# PRODUCTION PACKAGE OF PALISADE GRASS

## (*Brachiaria brizantha* (Hochst. ex A. Rich.) Stapf.)

*by*

**SHARU S. R.**
**(2013-21-104)**

**THESIS**

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# DECLARATION

I, hereby declare that this thesis entitled **'PRODUCTION PACKAGE OF PALISADE GRASS (*Brachiaria brizantha* (Hochst. ex A. Rich.) Stapf.)'** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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Certified that this thesis entitled **'PRODUCTION PACKAGE OF PALISADE GRASS (*Brachiaria brizantha* (Hochst. ex A. Rich.) Stapf.)'** is a record of research work done independently by **Ms. Sharu S. R.** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| % | - | per cent |
| °C | - | degree Celsius |
| ADF | - | acid detergent fibre |
| BCR | - | benefit cost ratio |
| Ca | - | Calcium |
| CD (0.05) | - | critical difference at 5% level |
| CGR | - | crop growth rate |
| cm | - | centimetre |
| cv. | - | cultivar |
| DMP | - | dry matter production |
| *et al.* | - | and co-workers/co-authors |
| Fig. | - | figure |
| FYM | - | farm yard manure |
| g | - | gram |
| g $g^{-1}$ | - | gram per gram |
| g $ha^{-1}$ | - | gram per hectare |
| ha | - | hectare |
| K | - | Potassium |
| KAU | - | Kerala Agricultural University |
| kg | - | kilogram |
| kg $ha^{-1}$ | - | kilogram per hectare |
| LAI | - | leaf area index |
| m | - | metre |
| mg | - | milligram |
| mg $g^{-1}$ | - | milligram per gram |
| mm | - | millimetre |
| $m^2$ | - | square metre |
| Mg | - | Magnesium |
| MOP | - | Muriate of potash |

| | | |
|---|---|---|
| N | - | Nitrogen |
| NAR | - | net assimilation rate |
| NS | - | non significant |
| P | - | Phosphorus |
| pH | - | negative logarithm of hydrogen ion concentration |
| POP | - | package of practices |
| q $ha^{-1}$ | - | quintals per hectare |
| RBD | - | randomized block design |
| RGR | - | relative growth rate |
| Rs $ha^{-1}$ $yr^{-1}$ | - | rupees per hectare per year |
| RWC | - | relative water content |
| SE | - | standard error |
| t $ha^{-1}$ | - | tonnes per hectare |
| *viz.* | - | namely |

# INTRODUCTION

# 1. INTRODUCTION

A major limitation of livestock production globally is the lack of fodder crops with year round green fodder production. This situation becomes severe in the areas constrained by low rainfall and acidic soils. In these areas, majority of livestock are reared or fed on crop residues with little supplementation of grains, bran, oil cakes etc. In general crop residues and their byproducts constitute major ingredients (40 %) in daily ration followed by green fodder (26 %), concentrates (3 %) and remaining comes through grazing.

Livestock requires feed and fodder round the year. The quantity and quality of feed supply remains the major limiting factor to improve livestock productivity. Inadequate nutrition affects the expression of full genetic potential. Balance feeding of livestock is also important to minimize green house gases (methane, $CO_2$ etc) and climate change. Hence there is a need to evaluate suitable forage species or cultivars to address the feed shortage challenge. The shortage of feed can be solved through the introduction and utilization of adaptable and high yielding cultivated forage crops with better nutritional values than the existing feed resources in the country.

India with only 2.29 per cent of the land area of the world is maintaining about 10.71 per cent of the livestock population of the world (DAHDF, 2013). But the area under fodder crop is estimated to be only 4.4 per cent of total cropped area. The fodder requirement is 1061.00 million tonnes, but the availability is only 395.20 million tonnes and the deficit is 665.80 million tonnes (Grover and Kumar, 2012). Moreover, the grazing lands are also diminishing at a faster rate.

The fodder requirement in Kerala is 232 lakh tonnes and the availability is 94.5 lakh tonnes with a deficit of 137.5 lakh tonnes. The fodder cultivating area in Kerala is only 4438 ha (FIB, 2014). In the present agricultural scenario expansion of area for fodder cultivation is not possible. In such a situation fodder production has to be intensified by raising fodder as an intercrop in the partial shaded conditions of coconut which is the predominant crop of Kerala. In addition the possibility of introducing newer crops and varieties has to be explored.

Among the different fodder grasses, *Brachiaria* is the most important genus for pastures in the tropics. Palisade grass also known as Signal grass (East Africa), St. Lucia grass (Queensland), Ceylon sheep grass (Sri Lanka), Upright *brachiaria* (Zimbabwe), Bread grass (South Africa) is a quick growing, high yielding fodder crop which is best suited to the tropical humid conditions. Palisade grass which belongs to the genus *Brachiaria* produces an excellent multipurpose and productive pasture that can withstand high stocking rates with good persistence under continuous or rotational grazing. It is a tufted perennial growing to a height of 60-150 cm. It can grow on a wide range of soils, light to heavy textures, with a wide range of soil nutrients and a pH of 4-8. It is reported to be more adaptable to acid soils than alkaline soils. Flood tolerance is generally poor. The crop is very aggressive, compete effectively with other species and cover the ground quickly. It is resistant to drought and can withstand dry seasons of three to six months during which the leaf may remain green. It will stand heavy grazing but will not tolerate fire. The grass is valuable for cut and carry feeding system.

Palisade grass is suitable for coastal regions where it can be grown with coconut palm. In Sri Lanka palisade grass has been reported to perform well under shades of coconut trees (Lagefoged, 1955). Trials conducted by All India Coordinated Research Project on Forage Crops at Vellayani revealed that palisade grass is suitable for cultivation under Kerala conditions. The reports of IGFRI revealed that the green fodder yield of the palisade grass variety Mulato was comparable to that of guinea grass (IGFRI, 2009). The grass is a nutrient responsive crop and recovers well from close cutting (Bogdan, 1977). Bhatt *et al.* (2002) noted that *Brachiaria mutica, Pennisetum polystachyon, Panicum maximum* and *Cenchrus ciliaris* produced higher green fodder yield under low light conditions indicating their adaptation to shade.

In order to optimize production, correct cutting management must be implemented since it affects the regrowth of herbage. The height at which a given perennial grass can be cut and still survive for extended periods is directly related to its ability to produce enough leaf surface to keep up photosynthetic production of food. Basically this ability is related to the type and habit of growth found in the grass. The correct cutting height is based on the structure of a grass species and each grass species has a minimum cutting height for better regrowth. Cutting below minimum height will weaken the grass and allow weed invasion. It is important that sufficient leaf blade length should be maintained to continue photosynthesis.

Proper nutrition is essential for satisfactory crop growth and production. All crops need a specific amount of the major nutrients, such as nitrogen, phosphorus and potassium along with micro nutrients for their normal growth and development. Once the nutrient doses exceed the optimum limit, the crop growth and yield are hindered.

Fodder yield is closely related to plant population. The number of plants per unit area is influenced by the distance between rows and the spacing between plants in a row. Selection of an optimal plant spacing that allows for ease of field operations, such as fertilizer application or weeding, minimizes competition among plants for light, water, and nutrients, and creates a favorable micro-climate in the canopy to reduce the risk for pest and diseases is essential for optimum crop production.

With this background the present study was undertaken with the following objectives.

- To standardise the nutrient requirement, spacing and cutting pattern of palisade grass under open and partial shaded condition.
- To work out the economics of cultivation.

# REVIEW OF LITERATURE

# 2. REVIEW OF LITERATURE

*Brachiaria brizantha,* commonly known as palisade grass which belongs to the genus of *Brachiaria* makes an excellent multipurpose and productive pasture that can withstand high stocking rates with good persistence under continuous or rotational grazing. Trials conducted by All India Coordinated Research Project on Forage Crops revealed that palisade grass is suitable for cultivation under Kerala conditions. The green fodder yield of the hybrid palisade grass, Mulato was comparable to that of guinea grass (IGFRI, 2009). The literature pertaining to different cutting pattern, plant spacing and nutrient management are reviewed in this chapter. Wherever sufficient literature on *Brachiaria* is not available, research information on related fodder crops are also reviewed.

## 2.1 EXPERIMENT- 1: STANDARDISING THE CUTTING PATTERN, N, P, K LEVELS AND SPACING IN PALISADE GRASS UNDER OPEN CONDITION

### 2.1.1 Effect of Cutting Pattern, Nutrient Levels and Spacing on Growth Parameters

#### *2.1.1.1 Plant Height*

Adams *et al.* (1991) observed that the ability of the grass to replenish leaf area, set seeds and store food reserves in their root is reduced under close cutting of grassland which reduces the growth of grass. In guinea grass, cutting height of 25 cm significantly reduced the stem elongation rate (SER) than cutting intensity of 50 cm (Dasilveira *et al.*, 2010). Nnadi *et al.* (2015) reported higher plant height with 15 cm cutting height when compared to 5 cm and 10 cm in guinea grass.

Application of N fertilizer enhanced plant height in fodder sorghum (Deesai and Deore, 1980; Mustafa and Majid, 1982). According to Soni *et al.* (1991) the plant height showed an increasing trend with increasing rates of nitrogen up to 120 kg ha$^{-1}$ in bajra napier hybrid. Application of N rates from 460 to 690 kg ha$^{-1}$

increased the plant height in dwarf napier hybrid (Hong and Hsu, 1993). According to Saeed *et al.* (1996) the height of mott grass increased with the nitrogen application over control. Sasireka *et al.* (1998) opined that the N application at the rate of 75 kg N $ha^{-1}$ increased the plant height (189.5 cm) in hybrid napier grass when compared to other lower doses. An increase in plant height was noticed with the addition of every 20 kg N $ha^{-1}$ in fodder oats (Tripathy, 1998). Singh *et al.* (2000a) reported that application of nitrogen up to 150 kg $ha^{-1}$ increased the plant height in hybrid napier grass. Nnadi *et al.* (2015) reported that the plant height showed an increasing trend with higher nutrient dose in guinea grass. The plant height was observed to be 99.8, 115.0 and 124.4 cm for control, 100 and 200 kg N $ha^{-1}$ treatments, respectively.

According to Yeh (1988) nitrogen rate was positively correlated with plant height in hybrid napier involving 4 levels of fertilizers nitrogen (250, 500, 750 and 1000 kg N $ha^{-1}$ $yr^{-1}$), one level of phosphorus (200 kg $P_2O_5$ $ha^{-1}$ $yr^{-1}$) and two levels of potassium (150 and 300 kg $ha^{-1}$ $yr^{-1}$). Application of highest dose of nitrogen (200 kg $ha^{-1}$) produced maximum plant height in signal grass (Sonia, 1999). Purushotham *et al.* (2001) stated that plant height increased significantly with nitrogen levels up to 150 kg $ha^{-1}$ in guinea grass. Soratto *et al.* (2004) opined that plant height of two *Panicum* cultivars were found to be enhanced with increased levels of nitrogen from 0 to 200 mg $L^{-1}$. Meena *et al.* (2012) observed that application of 120 kg N $ha^{-1}$ produced maximum plant height (276.9 cm) when compared to 40 and 80 kg N $ha^{-1}$ in fodder sorghum. Maximum plant height of 139 cm was recorded with the application of 90 kg N $ha^{-1}$ than other lower doses of nitrogen in fodder pearl millet (Singh *et al.*, 2012).

Ayub *et al.* (2000) noticed that the maximum plant height of 239.2 cm was recorded at 90 kg N $ha^{-1}$ when compared to lower doses of nitrogen levels (0, 30 and 60 kg respectively) in fodder maize. Bilal *et al.* (2000) pointed out that addition of N along with farm yard manure increased plant height over control at all stages of growth in all cuttings in napier grass. The crop fertilized with 300 kg N $ha^{-1}$ produced the tallest plants (157.3 cm) and was comparable with the crop fertilized with 200 kg N + 8 t FYM (146.4 cm). The nitrogen fertilization influenced the plant height in forage maize and it was 16 per cent higher at 400 kg N $ha^{-1}$ than at 0 kg N $ha^{-1}$ (Carpici *et al.*, 2010). Shahin *et al.* (2013) reported that maximum plant height of 127.5 cm was recorded with the application of 75 kg N $ha^{-1}$ than other levels of 60 (116.0) and 45 kg N $ha^{-1}$ (108.6 cm) respectively in fodder pearl millet.

Chandini (1980) reported that plant height of Guinea grass (*Panicum maximum* Jacq.), Setaria grass (*Setaria anceps* Stapf.) and Congo signal (*Brachiaria ruziziensis*), increased progressively with increase in phosphorus application up to 120 kg $P_2O_5$ $ha^{-1}$ and significant response to applied phosphorus was noticed only in the second harvest. Maximum plant height was obtained when 30 kg $P_2O_5$ $ha^{-1}$ was applied in *Cenchrus setigerus* (Bhatti and Singh, 1982). The plant height was greatly influenced by the application of varying levels of N and K along with a fixed dose of P in dwarf napier grass (Hong and Hsu, 1993). Purushotham *et al.* (1995) reported that plant height of Anjan grass (*Cenchrus ciliaris*) was significantly higher at 40 kg $P_2O_5$ $ha^{-1}$ compared to 20 kg $P_2O_5$ $ha^{-1}$. In contrary phosphorus application have no significant effects on plant height in Gamba grass (*Andropogon gayanus* Kunth) (Vineetha, 1995). Sonia (1999) reported that in *Brachiaria decumbens* plant height showed a positive response to K application only in the fourth harvest. According to Anita (2002) plant height was greatly influenced by K application in all the 5 harvests in guinea grass. In an experiment with bajra napier hybrid grass, Velayudham *et al.* (2011) reported that addition of higher dose of N P K (200: 70: 60 kg $ha^{-1}$) produced maximum plant height of 247.8 cm than other levels of 175: 60: 50 kg NPK $ha^{-1}$ (240.7 cm) and 150: 50: 40 kg NPK $ha^{-1}$ (227.5 cm) respectively.

The plant height was significantly increased with plant population in napier grass (Wijitphan *et al.*, 2009). In a spacing study conducted in napier grass closer spacing of 50 cm x 50 cm produced higher plant height when compared to a wider spacing of 60 cm x 60 cm and 70 cm x 70 cm (Bhatti *et al.*, 1985).

However there was no significant relation between plant density and plant height in sweet corn (Azam *et al.*, 2007) and in fodder maize (Yilmaz *et al.*, 2007).

### *2.1.1.2 Tillers Plant$^{-1}$*

Boonman (1972) found out that maximum basal tillering occurred during early vegetative growth stage and tiller density varied with different grasses. The highest number of tillers per $m^2$ was recorded at a cutting height of 20 cm (747.52) than 10 cm (651.22) in *Brachiaria brizantha* (Marcelino *et al.*, 2006). In guinea grass, cutting at 25 cm height significantly reduced stem elongation rate, length of leaf and number of leaves tiller$^{-1}$ relative to cutting at 50 cm height (Dasilveira *et al.*, 2010). Tiller density was maximum at a cutting height of 40 cm (702.36) when compared to 30, 20 and 10 cm in *Brachiaria hybrida* cv mulato I (Dutra *et al.*, 2014). An increased cutting height up to 20 cm increased the average tiller yield in napier grass (Jorgensen *et al.*, 2010). Dasilveira *et al.* (2010) observed that cutting at 25 cm produced lighter tiller than cutting at 50 cm, but produced more number of tiller plant$^{-1}$ in guinea grass. Carlassare and Karsten (2013) reported an increased tiller production with reduced cutting height in orchard grass (*Dactylis glomerata*).

A significant increase in the number of tillers plant$^{-1}$ was recorded with increasing levels of nitrogen from 30 to 90 kg ha$^{-1}$ in fodder pearl millet (Manohar *et al.*, 1992). Vineetha (1995) observed a progressive increase in tiller number with enhanced level of nitrogen in gamba grass. Nitrogen rates increased the number of tillers per pot at the first harvest of the palisade grass and the maximum number of tillers occurred at the nitrogen rate of 307 mg dm$^{-3}$ (Artur and Monteiro, 2014).

According to Deesai and Deore (1980) application of N fertilizer increased the number of tillers plant$^{-1}$ in hybrid napier grass. Agnihotri *et al.* (1985) reported that application of 20 kg N ha$^{-1}$ produced more number of tillers clump$^{-1}$ in *Eulaliopsis binata.* The number of tillers in fodder pearl millet was increased with increased application of nitrogen (Singh *et al.*, 1987). Tripathy (1998) concluded that the application of inorganic N fertilizer (20-60 kg ha$^{-1}$) increased the number of tiller up to fifth cutting in sabai grass.

Rathore *et al.* (1989) reported that maximum number of tillers was produced with N application up to 90 kg N ha$^{-1}$ in fodder pearl millet. Similar results were reported by Saeed *et al.* (1996) in mott dwarf elephant grass. Bilal *et al.* (2000) reported that application of N produced the maximum tillering at all the growth stages in all cuttings up to 300 kg N ha$^{-1}$ in napier grass.

The tiller number was increased up to 160 kg ha$^{-1}$ $P_2O_5$ in *Brachiaria ruziziensis* (Chandini, 1980). An increasing trend in the tiller number was noticed in *Cenchrus ciliaris* with P application up to 30 kg ha$^{-1}$ (Bhatti and Mathur, 1984). Krishnan (1993) commented that phosphatic fertilizers had no significant effect in tiller production in guinea grass. The tiller number was significantly influenced by the application of 75 kg of $K_2O$ ha$^{-1}$ in lemon grass (Chand and Rao, 1996). In contrast Sonia (1999) stated that application of three levels of K (50, 100 and 150 kg ha$^{-1}$) did not produce any effect on tiller number in *Brachiaria decumbens.* Ayub *et al.* (2000) reported that highest number of tillers per plant (31.7) was recorded with the addition of 90 kg N ha$^{-1}$ in fodder maize. According to Lekshmi (2004), maximum number of tillers was obtained on applying 300 kg N ha$^{-1}$ along with 75 kg P ha$^{-1}$ in guinea grass. Application of nitrogen at the rate of 75 kg ha$^{-1}$ produced more number of tillers m$^{-2}$ (181) than lower doses of N in fodder pearl millet (Shahin *et al.*, 2013).

Purushotham and Siddaraju (2003) observed that the number of tillers was significantly higher at a wider row spacing of 60 cm than 30 or 45 cm in guinea grass. Wijitphan *et al.* (2009) reported that the number of tillers was maximum for the lowest spacing of 50 x 40 cm (16) in napier grass. Adoption of 60 cm x 50 cm spacing enhanced the number of tillers per clump (24.3) than a spacing of 50 cm x 50 cm (23.4) in hybrid napier (Velayudham *et al.*, 2011). Manjunatha *et al.* (2013) obtained more number of tillers with a row spacing of 60 cm than 45 cm or 30 cm in perennial fodder sorghum.

### *2.1.1.3 Leaf : Stem Ratio*

Dasilveira *et al.* (2010) reported that cutting at 25 cm increased the leaf: stem ratio than cutting at 50 cm. Dutra *et al.* (2014) noticed highest leaf: stem ratio (2.14) with reduced height of cutting in *Brachiaria hybrida* cv. mulato I.

Chandini (1980) observed that leaf: stem ratio exhibited an increasing trend with increasing levels of P up to 160 kg $ha^{-1}$ in congo signal grass, guinea grass and setaria grass. Kothari and Saraf (1987) opined that there was an increase in the leaf: stem ratio with increased application of nitrogen in fodder sorghum. Yeh (1988) found out that leaf: stem ratio was significantly increased by nitrogen application in hybrid napier. Yadav and Sharma (1989) commented that leaf: stem ratio is not affected by potassium levels in dinanath grass. Yadav and Sharma (1989) also opined that leaf: stem ratio was influenced by nitrogen application in dinanath grass. Nitrogen application decreased the leaf to stem ratio in forage sorghum (Patel, 1994). Singh *et al.* (1996) studied a positive correlation of leaf: stem ratio and nitrogen levels. Jayakumar (1997) pointed out that the leaf: stem ratio was decreased with N application in hybrid napier. In an experiment in fodder soghum, application of 80 kg nitrogen $ha^{-1}$ increased the leaf: stem ratio (Barik *et al.*, 1998). The varying K levels and leaf: stem ratio depicted a negative correlation in congo signal grass (Sonia, 1999) and in guinea grass (Anita, 2002). Mahmud *et al.* (2003) observed an increasing trend of leaf: stem ratio with increasing fertilizer dose up to 100 kg N $ha^{-1}$ in fodder sorghum. According to Lekshmi (2004) under open condition the highest level of P (75 kg $ha^{-1}$) registered the highest leaf: stem ratio in all the 5 harvests in guinea grass. The leaf: stem ratio was greatly influenced by application of nitrogen in napier grass (Zewdu *et al.*, 2006). The leaf: stem ratio decreased with increasing nitrogen levels in fodder sorghum and sudan grass (Habib *et al.*, 2007). Carpici *et al.* (2010) indicated that leaf percentage was higher and increased as nitrogen rate was increased in forage maize. The leaf percentage was lowest (23 per cent) at 0 kg N $ha^{-1}$ and highest at 400 kg N $ha^{-1}$ (27.6 per cent). Shahin *et al.* (2013) commented that leaf: stem ratio was not affected by nitrogen application in pearl millet.

Velayudham *et al.* (2011) stated that adopting different spacing levels did not influence the leaf: stem ratio in hybrid napier. Mounika *et al.* (2015) reported highest leaf: stem ratio with a spacing of 45 x 45 cm (2.51) when compared with 60 x 30 cm (2.34) and 60 x 45 cm (2.39).

#### *2.1.1.4 Regeneration Percentage*

Davidson and Birch (1972) noticed that under grazing, *Brachiaria ruziziensis* formed a dense mat and withstood grazing well. According to Davidson and Birch (1972) frequent and close defoliation of *Trifolium subterraneum* produced a dense network of photosynthetic stolons. The tropical pasture grasses recover well from close cutting (Bogdan, 1977). The recovery from defoliation depends not only on the inherent capacity of the plant and defoliation characteristics but also on the biotic and abiotic environment of the plant (Richard, 1993).

### 2.1.2 Effect of Cutting Pattern, Nutrient Levels and Spacing on Yield Parameters

#### *2.1.2.1 Green Fodder Yield*

Generally, plants which branch freely at ground level yield best at low cutting heights (Clapp *et al.*, 1965). However Murphy *et al.* (1977) stated that cutting intensity had no effect on yield in pasture grass. For guinea grass a fairly low cut at 10 cm height is preferable to cut at 25 cm height and the extent of grass cover was increased when the cutting height was increased from 5 to 15 cm (Onyeonagu and Ugwuanyi, 2012).

Application of enhanced rate of nitrogen produced substantial yield increase in fodder and other fodder crops Muldoon (1985). Highest green fodder yield was obtained with highest dose of N application in signal grass (200 kg N ha$^{-1}$) (Sonia, 1999). The application of higher level of nutrients produced more herbage yield in hybrid napier (Jayanthi, 2007; Pathan and Bhilare, 2008). Vinayraj and Palled (2014) reported that significantly higher average green fodder (7.59 kg per clump) was registered in 300 kg nitrogen $ha^{-1}$ compared to 180 kg and 240 kg nitrogen $ha^{-1}$ in hybrid napier.

According to Sharma and Singh (1984) application of 120 kg N $ha^{-1}$ produced higher green fodder yield than 40 and 80 kg N $ha^{-1}$ in fodder maize. However, there was no significant increase in green fodder yield beyond 60 kg N $ha^{-1}$ in maize (Shanmughasundaram and Govindasamy, 1984). The highest dose of nitrogen (120 kg N $ha^{-1}$) produced maximum green fodder yield in maize (Sawant and Khanvilkar, 1987). Singh *et al.* (2000a) reported that increasing the nitrogen levels increased the forage production and digestibility up to 100 kg N $ha^{-1}$ in napier bajra hybrids.

Deshmukh *et al.* (1989) reported that the highest N dose of 180 kg N $ha^{-1}$ recorded maximum green fodder yield as compared to other lower doses in forage maize. Hunshal *et al.* (1989) indicated that application of N @ 200 kg N $ha^{-1}$ increased the fodder yield (60.6 t $ha^{-1}$) when compared to 100 kg N $ha^{-1}$ (57.0 t $ha^{-1}$) and 50 kg N $ha^{-1}$ (53.1 t $ha^{-1}$) in South African maize. Increasing the N fertilizer rate increased the fodder yield in hybrid Napier grass (Var. BH 18) (Gowda *et al.*, 1989). Jayaraman (1989) concluded that application of N showed a positive correlation with the green fodder yield up to 80 kg $ha^{-1}$ in BN 2 variety of bajra napier hybrid .

Shukla and Mennilal (1990) observed an increased forage yield in pearl millet with application of 90 kg N $ha^{-1}$. Pisal *et al.* (1991) obtained an increased forge production with nitrogen fertilization in multicut forage crops. Thaware *et al.* (1991) indicated that the green fodder yield of maize increased with an increase in N level up to 200 kg $ha^{-1}$. When hybrid Napier grass was fertilized with 75 kg and 112.5 kg N $ha^{-1}$ the average fodder yield increased up to 14 cuts (Purushotham *et al.*, 1992). Meerabai and Pillai (1993) found that there was an increasing trend in fodder yields of *Brachiaria ruziziensis* with the application of 100 kg N $ha^{-1}$ than 50 kg N $ha^{-1}$.

Pamo and Pieper (1989) showed that nitrogen application in combination with phosphorus and potassium increased the productivity of ruzi grass and recommended a fertilizer rate of 60 to 90 kg nitrogen $ha^{-1}$ after each harvest. In hybrid napier, application of N was found to be effective in increasing the green fodder yield up to 120 kg N $ha^{-1}$ (Channakesava *et al.*, 1992). Manohar *et al.* (1992) concluded that application of 50 kg $P_2O_5$ $ha^{-1}$ had no effect on green fodder yield in pearl millet. Application of 75 and 150 kg inorganic fertilizers $ha^{-1}$ increased the green fodder yield in fodder sorghum (Niranjan and Arya, 1995). Phillips and Kee (1998) reported that forage yield of *Cynodon dactylon* was enhanced by K application. Sasireka *et al.* (1998) obtained highest green fodder yield in hybrid napier grass with application of inorganic N fertilizer @ 75 kg $ha^{-1}$. Tripathy (1998) found a yield increase of sabai grass for every 20 kg N $ha^{-1}$. The fodder yield of rye grass was increased by 69, 92 and 121 per cent with the addition of 90, 120 and 180 kg $K_2O$ $ha^{-1}$ respectively.

Chhilar and Tomar (1970) opined that a spacing of 60 cm x 30 cm recorded higher fodder yield in hybrid napier than 60 cm x 50 cm spacing. Tiwana *et al.* (1975) stated that hybrid napier when grown at a spacing of 60 cm x 30 cm gave higher yield than 90 cm x 40 cm and 60 cm x 60 cm. Among the different row spacing levels of 50, 75, 100 and 125 cm with an intra row spacing of 50 cm napier grass planted at a spacing of 50 cm x 50 cm recorded highest green fodder yield (Miyagi, 1980). Munigowda *et al.* (1989) observed that BH-18 variety of hybrid napier produced highest yield at closer spacing of 60 cm x 30 cm. Graybill *et al.* (1991) reported a low plant density with wider plant spacing in forage maize. Saeed *et al.* (1996) revealed an increased green fodder yield with decreased plant spacing in mott grass. Maximum green fodder yield of 407.9 t $ha^{-1}$ was recorded at a narrow spacing of 45 cm x 45 cm than 75 cm x 75 cm in mott elephant grass as reported by (Yasin *et al.*, 2003). Thavaprakash and Velayudham (2007) observed that crop geometry produced a substantial green fodder yield of baby corn and found out that baby corn grown at 60 cm x 20 cm produced higher yield than 45 cm x 25 cm spacing. According to Sharma (2013) the closest spacing of 25 cm recorded higher fodder yield (153.7 q $ha^{-1}$) over 75 cm spacing sewan grass.

### *2.1.2.2 Dry Fodder Yield*

In general dry fodder yield increases linearly with successive increments of nitrogenous fertilizer. According to Chaparro *et al.* (1995) lower dry matter yields were produced with low cutting height in mott elephant grass.

Pamo (1991) concluded that there was significant increase in dry matter yield with increased levels of nitrogen in congo signal grass. Carvalho *et al.* (1992) opined that dry fodder yield showed an increasing trend with increased nitrogen levels in *Brachiaria* spp. Andrade *et al.* (1996) noticed enhanced nitrogen levels increased the dry fodder yield by 31.9 per cent in congo signal grass. Ezenwa *et al.* (1996) reported that dry matter yield was more for plots with no nitrogen fertilizer than the fertilized plots in the same crop. According to Rocha *et al.* (2002) dry fodder yield was increased by increased nitrogen levels in *Cynodon* spp. Application of 150 per cent RDF to Bajra Napier Hybrid recorded significantly maximum total dry matter yield (55.09 t $ha^{-1}$) over 100 per cent and 125 per cent RDF (150: 60: 60 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$ (Pathan *et al.*, 2012).

Malarvizhi and Fazhullah (1998) concluded that optimum N dose for higher dry fodder yield for irrigated Bajra Napier Hybrid grass (CO 3) was 100 kg N $ha^{-1}$. Singh *et al.* (2000a) stated that the N application @ 75 kg $ha^{-1}$ gave maximum dry fodder yields in hybrid napier grass. Ayub *et al.* (2007) reported that addition of 100 kg N $ha^{-1}$ gave significantly higher dry fodder yield than 50 and 150 kg N $ha^{-1}$ in forage pearl millet.

Ayub *et al.* (2009) reported that dry matter yield was greatly influenced by the application of nitrogen fertilizer in pearl millet. The dry matter production increased significantly with increase in nitrogen application up to 100 kg N $ha^{-1}$ in pearl millet (Bhilare *et al.*, 2010). Application of 90 kg N $ha^{-1}$ produced 53.2, 25.9 and 11.9 per cent higher dry matter yield over 0, 30 and 60 kg N ha$^{-1}$ respectively in fodder pearl millet (Singh *et al.*, 2012).

There was a progressive increase in the dry fodder production by 6.97, 7.47 and 8.85 per cent during first, second and third years respectively with the application of 0, 40 and 80 kg N ha$^{-1}$ in guinea grass (Ram and Trivedi, 2012). Pathan *et al.* (2012) found that application of 150 per cent recommended dose of fertilizers (RDF) recorded higher total dry matter yield (55.1 t ha$^{-1}$) over 100 per cent and 125 per cent RDF in hybrid napier grass. Saini (2012) revealed that application of 125 per cent recommended doses of N registered 88 per cent more dry matter production than 75 per cent recommended dose in fodder sorghum.

Shahin *et al.* (2013) reported that addition of nitrogen fertilizer up to 75 kg N ha$^{-1}$ caused an increased dry forage yield of 10.7 t fed$^{-1}$ in *Pennisetum glaucum*. Vinayraj and Palled (2014) showed that application of 300 kg N ha$^{-1}$ resulted in an increased total dry matter yield of 35.8 t ha$^{-1}$ compared to other nitrogen levels in hybrid napier.

According to Meerabai *et al.* (1993) a linear increase in dry fodder yield was noticed with enhanced application of K up to 90 kg ha$^{-1}$ in *Brachiaria ruziziensis*. In contrast, dry fodder yield was not influenced by K levels in rhodes grass (Prakash *et al.*, 1994) and signal grass (Sonia, 1999). The greatest plant height was recorded at the highest level of fertilizer (60: 26, N: P kg ha$^{-1}$) in *Cenchrus ciliaris* as observed by (Kumar *et al.*, 2005). In a study conducted in sweet sorghum with different levels of N, application of N @ 120 kg ha$^{-1}$ registered positively higher dry fodder yield of 9.7 t ha$^{-1}$ as compared to 60 kg N ha$^{-1}$ (8.2 t ha$^{-1}$) (Singh *et al.*, 2013). The dry fodder yields (18.2 t ha$^{-1}$) of multicut fodder sorghum increased significantly up to 60 kg N ha$^{-1}$ application (Somashekar *et al.*, 2014).

Bhatti *et al.* (1985) reported that dry fodder yield of elephant grass was more under closer spacing of 50 cm x 50 cm (18.7 t ha$^{-1}$) when compared to 60 cm x 60 cm (14.6 t $ha^{-1}$) and 70 cm x 70 cm (11.5 t $ha^{-1}$). The total dry fodder yield increased from 6 to 40 per cent when there was an enhancement in the plant density from 55,000 to 88,000 plants per ha in fodder maize (Karlen *et al.,* 1985). Bhagat *et al.* (1992) recorded highest dry matter yield at a row spacing of 1 m in hybrid napier (28 t $ha^{-1}$). Roth (1996) stated that there was 9 per cent dry fodder yield increase at 38 cm row spacing than 76 cm in fodder maize. Iptas and Acar (2006) found out that dry fodder yield was decreased from 27.2 t $ha^{-1}$ to 6.6 t $ha^{-1}$ as the row spacing was increased in fodder maize. Highest dry matter yield (7.7 t $ha^{-1}$) was recorded at 75 cm row spacing in the second year and was significantly greater than 7.3 t $ha^{-1}$ at 60 cm and 6.4 t $ha^{-1}$ at 40 cm row spacing in *Cenchrus ciliaris* as reported by ( Kumar *et al.*, 2005). Wijitphan *et al.* (2009) opined that highest total dry matter yield of 70.84 t $ha^{-1}$ was obtained from 50 x 40 cm plant spacing when compared to 50 x 60 cm, 50 x 80 cm and 50 x 100 cm in napier grass. According to Manjunatha *et al.* (2013) row spacing of 45 cm recorded higher dry fodder yield of 36.3 t $ha^{-1}$ when compared to 30 cm row spacing of 31.7 t $ha^{-1}$ in fodder sorghum.

### 2.1.3 Effect of Cutting Pattern, Nutrient Levels and Spacing on Physiological Parameters

#### *2.1.3.1 Dry Matter Production*

In a study of *Eragrostis curvula*, cutting height below 10 cm reduced dry matter production. All napier grass cultivars, Common Napier, Merkeron, Dwarf Napier, Taiwan A25, and Tangashima exhibited reduced dry matter production with 0 cm cutting height compared with 30 cm cutting height (Jorgensen *et al.*, 2010). Dutra *et al.* (2014) noticed an enhanced dry matter production of 9.63 t $ha^{-1}$ with 40 cm cutting height when compared to 30, 20 and 10 cm in *Brachiaria hybrida* cv. mulato I.

The increased level of K produced a significant impact on the dry matter production (Haby *et al.*, 1988) in rye grass whereas the dry biomass yield showed a negative response with potash application in teosinte. According to Filho *et al.*

(1989) dry matter production was increased with $P_2O_5$ levels up to 100 kg $ha^{-1}$ in *Brachiaria brizantha.* At Gualaca, Panama, ruzi grass produced 11,000 kg dry matter per ha without fertilizer and 27,000 kg dry matter per ha when fertilized with 600 kg N $ha^{-1}$ $year^{-1}$ in a rain fall area of 3997 mm per year (Skerman and Riveros, 1990). Pamo (1991) showed that dry matter yield of ruzi grass increased greatly with increasing nitrogen rate up to 80 k g N $ha^{-1}$ in all years.

Cox (1996) obtained a higher dry matter yield at narrow spacing in mott grass. Yasin *et al.* (2003) recorded highest dry matter yield at 45 x 45 cm spacing in mott elephant grass. The planting geometry of 75 x 20 cm produced more dry herbage yield (81.5 g $plant^{-1}$) than 45 x 20 cm and 60 x 20 cm in sweet corn cv. Sumadhur (Kunjir *et al.*, 2009). Higher quantity of dry matter yield (6.9 t $ha^{-1}$) was obtained with a spacing of 60 x 50 cm than other spacing levels in hybrid napier grass (Velayudham *et al.*, 2011).

### *2.1.3.2 Leaf Area Index*

Chaparro *et al.* (1995) found out that higher leaf percentage was observed with 46 cm cutting height compared to 10 cm cutting height, although cutting frequency affected leaf percentage more than cutting height in mott elephant grass. *Cenchrus ciliaris* developed a high residual leaf area after defoliation, which subsequently contributed to higher leaf area and shoot weight production as reported by (Hodgkinson *et al.*, 1989).

Leaf area is an important part of the plant, responsible for interception and conversion of solar energy. Leaf area has a direct influence on photosynthetic efficiency of crop plants in addition to increase in biomass of forage crops. As the level of nitrogen was increased LAI also increased progressively in fodder maize and cowpea (Ofori and Stern, 1987). Chapman and Lemaire (1993) pointed out that nitrogen supply affects the leaf elongation, resulting in larger leaf area. Chapman and Lemaire (1993) pointed out that nitrogen supply affects the leaf elongation, resulting in larger leaf area. Sonia (1999) reported that leaf area index was found to be increased with increase in the nitrogen level from 100 to

200 kg $ha^{-1}$ in *Brachiaria decumbens.* According to Illavska *et al.* (2001) with the application of 90 kg N $ha^{-1}$ and 180 kg N $ha^{-1}$ there was 52.9 and 64.3 per cent increase in leaf area index (LAI) respectively. Nitrogen fertilization promotes direct increase in photosynthetic leaf area (Nabinger, 2001). Leaf area is responsible for sunlight capture in a way that a larger leaf area allows higher exposure to sunlight. Singh *et al.* (2002) reported that leaf area index was found to be increasing with increased level of nitrogen up to 150 kg N $ha^{-1}$ in hybrid napier. According to Wadi *et al.* (2003) LAI was found to be increased as N, P and K fertilizers were increased in napier grass and king grass.

Application of N increased the leaf area in forage hybrid sorghum (Patel, 1985) and (Malik *et al.*, 1992). N application @ 120 kg $ha^{-1}$ promoted higher LAI than 0 and 40 kg $ha^{-1}$ in multicut fodder sorghum (Wanjan *et al.*, 1996). Kumar and Singh (2002) found out that an increase in the LAI at 30, 60 and 90 DAS was promoted in maize with phosphorus application up to 80 kg $P_2O$ $ha^{-1}$. Martuscello *et al.* (2005) found out that increases of even 130 per cent in leaf area of palisade grass (*Brachiaria brizantha* cv. Xaraés) was noticed on applying a nitrogen rate of 120 mg $dm^{-3}$ when compared with no nitrogen supply. Shahin *et al.* (2013) reported that maximum LAI (4.42 to 6.16) in fodder pearl millet was obtained with application of 60 kg N $ha^{-1}$.

Miyagi (1980) reported that among the different row spacing of 50, 75, 100 and 125 cm with an intra row spacing of 50 cm, napier grass planted at 50 x 50 cm recorded the highest leaf area index. Thavaprakash *et al.* (2005) stated that wider spacing of 60 cm x 19 cm positively contributed to enhanced leaf area index in baby corn than a closer spacing of 45 cm x 15 cm.

#### *2.1.3.3 Relative Growth Rate*

Gaborcik and Javorkova (1990) reported that RGR was enhanced by 15 per cent up to 300 kg N $ha^{-1}$ in Anthoxantho-Agrostietum grassland with 5 cuts. According to Kumar and Singh (2002) RGR of Maize hybrid Ganga-5 was improved with increased level of nitrogen up to 160 kg $ha^{-1}$. The highest RGR

(0.08 g g day$^{-1}$) and CGR (31.2 g g m$^{-2}$ day$^{-1}$) were obtained with application of 520 kg urea ha$^{-1}$, respectively in maize (Valdabadi and Farahani, 2012).

#### *2.1.3.4 Crop Growth Rate*

P application significantly increased the CGR in stylosanthes and a negative response was resulted in grasses (Pillai, 1986). Gaborcik and Javorkova (1990) found out that CGR was increased when nitrogen level was increased up to 300 kg ha$^{-1}$ with 3 cuts per year in Anthoxantho-Agrostietum grassland. The crop growth rate was greatly influenced by addition of P upto 200 kg $P_2O$ ha$^{-1}$ in *Brachiaria decumbens* and *Brachiaria brizantha* (Kanno *et al.*, 1999). According to Wadi *et al.* (2003) CGR of napier grass and king grass increased with the application of N, P and K fertilizers.

#### *2.1.3.5 Net Assimilation Rate*

According to Kanno *et al.* (1999) P application produced less effect in NAR in *Brachiaria decumbens* and *Brachiaria brizantha.* Shivay *et al.* (2002) opined that NAR was increased with the application of N at the rate of 80 and 120 kg Na$^{-1}$ in maize. The NAR was found to be the maximum at the highest dose of nitrogen in guinea grass (Lekshmi, 2004).

### 2.1.4 Effect of Cutting Pattern, Nutrient Levels and Spacing on Quality Studies

Crude protein and crude fibre content along with mineral nutrients like calcium, magnesium, phosphorus and potassium are the important quality parameters of fodder. These quality characters are altered to some extent by application of nitrogen. Moreover, the presence of toxic constituents such as nitrate N is considered as one of the important anti-nutritional factor that also decides the quality of fodder crops.

#### *2.1.4.1 Crude Protein Content*

Forage quality is paramount to palatability and animal intake. The proportion of leaf fraction is positively correlated to the content of plant crude protein and digestible energy which in turn determines the intake and performance of animals (Islam *et al.*, 2003).

In a study conducted in three *Brachiaria brizantha* cultivars (Marandu palisade grass, Xaraes palisade grass, and Piata palisade grass) with three cutting intensities of 10, 20 and 30 cm, cutting height of 30 cm recorded the highest crude protein content of 12.08 per cent, 12.50 per cent and 13.38 per cent respectively (Costa *et al.*, 2014).

Sharer *et al.* (1988) revealed a progressive increase in crude protein content in pearl millet and fodder sorghum with the application of each successive dose of nitrogen from 0 to 60 kg N ha$^{-1}$. Nitrogen fractions form the basis for crude protein content. The nitrogen application was found to increase the crude protein yield of *Brachiaria ruziziensis* (Andrade *et al.*, 1996). Nazir *et al.* (1997) reported a linear increase in crude protein content with an increasing rate of nitrogen from 100-20-0 kg ha$^{-1}$ in multicut hybrid sorgum. Pathan *et al.* (2012) opined that application of 150 per cent of RDF (150: 60: 60 kg N, $P_2O_5$, $K_2O$ ha$^{-1}$) recorded significantly higher average crude protein content (6.84 per cent) and total crude protein yield (37.78 q ha$^{-1}$) over 100 per cent and 125 per cent RDF (6.38 per cent and 6.61 per cent, respectively) in hybrid napier grass.

Dwivedi *et al.* (1980) recorded the highest crude protein content of 5.99 per cent with application of 90 kg N ha$^{-1}$ in *Chrysopogon fulvus*. In a study of Anjan grass, Ravikumar *et al.* (1980) observed 153 per cent higher crude protein content over control on applying 90 kg N ha$^{-1}$. However, no significant increase in crude protein content was observed in fodder maize when 120 kg N ha$^{-1}$ was applied (Thind and Sandhu, 1980).

There was an increase in the mean crude protein content from 7.95 to 9.18 per cent with the application of 60 to 90 kg N ha$^{-1}$ in fodder maize (Shanmughasundaram and Govindasamy, 1984). In hybrid napier grass the crude protein content was increased from 8.4 to 9.9 per cent in with application of 150 kg N $ha^{-1}$ (Govindasamy and Manickam, 1988). Application of 75 kg N $ha^{-1}$ revealed its superiority in increasing the crude protein content of hybrid napier grass (Sasireka *et al.*, 1998).

Malarvizhi and Fazhullah (1998) found out that in hybrid Napier grass crude protein content was increased with each increment of nitrogen. Singh *et al.* (2000b) noticed that application of N (75 kg $ha^{-1}$) achieved higher crude protein yields than lower nitrogen levels in fodder oats. Ayub *et al.* (2009) reported that there was a progressive increase in the crude protein contents from 6.5 per cent to 8.7 per cent when the N application was enhanced from 60 to 180 kg $ha^{-1}$ in pearl millet.

Agarwal *et al.* (2001) reported that in an experiment involving split application of nitrogen, 75 per cent N applied just after each cut and remaining 25 per cent on 20 days before next cut registered highest crude protein content than application of 100 per cent N just after harvest in perennial grasses. Kumar and Singh (2001) observed a significant increase in crude protein yield from 0.39 to 0.83 MT $ha^{-1}$ as the level of N fertilizer increased from 0 to 160 kg $ha^{-1}$ in forage maize.

Higher dose of N (300 kg $ha^{-1}$) and P (75 kg $ha^{-1}$) resulted in higher total crude protein content of 25.7 and 25.4 per cent respectively in guinea grass (Lekshmi, 2004). Pathan *et al.* (2012) reported that application of 150 per cent recommended dose of fertilizer (RDF) recorded higher crude protein content (6.8 per cent), total crude protein yield (37.8 q $ha^{-1}$) over 125 per cent RDF (6.6 per cent and 33.3 q $ha^{-1}$) and 100 per cent RDF (6.4 per cent and 28.4 q $ha^{-1}$) respectively in bajra napier hybrid. Singh *et al.* (2012) reported that application of 90 kg N $ha^{-1}$ in forage pearl millet registered the highest crude protein (12.1 per cent) and crude protein yield (13.1 q $ha^{-1}$) than other lower levels. Singh *et al.* (2013) found that application of N (180 kg $ha^{-1}$) recorded higher crude protein yield of 481.6 kg $ha^{-1}$ than other lower levels in sweet sorghum. Vinayraj and Palled (2014) reported that there was a significant increase in crude protein yield

(2921.38 kg $ha^{-1}$) when 300 kg N $ha^{-1}$ was applied in hybrid napier. In a field trial conducted in perennial rye grass involving 2 levels of N (60 kg $ha^{-1}$ and 120 kg $ha^{-1}$) along with P (60 kg $ha^{-1}$) and K (80 kg $ha^{-1}$) the crude protein content is increased by 0.14 and 2.66 per cent and the crude protein yield per hectare by 98 and 226 per cent respectively (Bumane, 2010).

Jacob (1999) reported that potassium had no effect on crude protein content in Congo signal grass. Rashid and Iqbal (2012) reported that crude protein content improved with the application of 57 kg P $ha^{-1}$ in sorghum. The effect of phosphorus fertilization on CP yield of Jumbo grass was non-significant (Hazary *et al.*, 2015).

Singh *et al.* (2008) revealed that higher protein content was recorded under the crop geometry of 60 x 20 cm and 60 x 15 cm as compared to 45 x 20, 45 x15, 30 x 20 and 30 x 15 cm in forage maize. The crude protein content (13.9 per cent) at 50 x 60 cm spacing was found to be on par with 50 x 80 cm plant spacing in napier grass (Wijitphan *et al.*, 2009). Different spacing levels did not influence the crude protein content in CO (CN) 4 variety of bajra napier hybrid grass (Velayudham *et al.*, 2011). Sharma (2013) reported that closer row spacing of 25 cm recorded highest crude protein content of 9.0 per cent over 75 cm in sewan grass. Ahmad *et al.* (2014) found out that baby corn sown at 60 x 20 cm spacing recorded higher crude protein content than other closer spacing.

#### *2.1.4.2 Crude Fibre Content*

When analyzing cutting intensities (10 cm, 20 cm and 30 cm) with three *Brachiaria brizantha* cultivar (Marandu palisade grass, Xaraes palisade grass, and Piata palisade grass) the NDF and ADF contents were found influenced by sward height. The highest contents of NDF- 75.82 per cent, 76.43 per cent and 70.67 respectively and ADF- 36.41 per cent, 36.6 per cent and 33.70 per cent respectively were observed at a height of 10 cm for all cultivars (Costa *et al.*, 2014).

Fibre content such as cellulose and hemicelluloses in forage vary with the fertilizer application. Shinde *et al.* (1989) reported that the minimum crude fibre content was obtained with 120 kg N $ha^{-1}$ application. However Mohammad *et al.* (1988) observed that nitrogen fertilizer application did not influence crude fibre content in napier grass up to 120 kg $ha^{-1}$. Vineetha (1995) observed that crude fibre content was significantly reduced by application of $P_2O_5$ up to highest level (100 kg $P_2O_5$ $ha^{-1}$) in gamba grass. Pathan *et al.* (2012) reported that the crude fibre content decreased with increase in recommended dose of fertilizer 150: 60: 60 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$ in hybrid napier. Application of 150 per cent RDF recorded significantly lowest average crude fibre content (29.02 per cent) over 100 per cent and 125 per cent RDF and the maximum crude fibre content (33.8 per cent) was observed with 100 per cent RDF in hybrid napier (Pathan *et al.*, 2012).

Khaddar *et al.* (1983) reported that crude fibre percentage significantly increased by application of nitrogen from 75 to 150 kg $ha^{-1}$ in fodder sorghum. In contrast, Patel (1994) stated that crude fibre content of sorghum was successively decreased by increasing level of nitrogen. In guinea grass the crude fibre content remained unaltered by potassium application (Anita, 2002). Ayub *et al.* (2009) stated that the crude fibre content was not influenced by nitrogen application but there was a decreasing trend at enhanced nitrogen application in pearl millet. Application of 150 per cent RDF recorded the lowest average crude fibre content (29.0 per cent), neutral detergent fibre (62.3 per cent) and acid detergent fibre (36.6 per cent) over 100 per cent and 125 per cent RDF.

According to Graybill *et al.* (1991) acid detergent fibre and neutral detergent fibre contents were not affected by increased plant densities in forage maize. Cusicanqui and Lauer (1999) reported that NDF content enhanced from 20-35 g $kg^{-1}$ and ADF content increased from 19-29 g $kg^{-1}$ with increasing plant densities in forage corn. Iptas and Acar (2006) stated that as row spacing was increased, ADF and NDF content increased from 214-227 g $kg^{-1}$ and from 420-451 g $kg^{-1}$ respectively in forage maize.

### *2.1.4.3 Nitrate Content*

Nitrate concentration is expressed as mg $g^{-1}$ fresh weight of leaves. In general excess application of nitrogenous fertilizers leads to nitrate accumulation in plants. Singh *et al.* (2000b) stated that the concentration of nitrate nitrogen was higher with two splits of N application compared to three splits in each level of nitrogen application in fodder oats and observed that most of the nitrate accumulate in stem followed by leaves and very little in grains. Higher nitrate content was found with 240 kg N $ha^{-1}$ than control in fodder oats as reported by (Tiwana *et al.,* 2002). According to Amandeep (2009) nitrate content in fodder pearl millet increased with nitrogen application up to 150 kg N $ha^{-1}$ both under irrigated and rainfed conditions. Nitrate accumulation was more in fodder oats at increased quantity of N application Mishra (2011). Tiwana *et al.* (2012) opined that nitrate content of fodder pearl millet was greatly influenced by nitrogen application and higher nitrogen level of 150 kg N $ha^{-1}$ resulted the nitrate content up to 894 and 1026 ppm as compared to other lower nitrogen levels under irrigated and rain fed conditions. According to Damame *et al.* (2013) addition of 100 kg N $ha^{-1}$ recorded more nitrate content (817.3 ppm) over 75 and 50 kg N $ha^{-1}$ (234.9 and 143.0 ppm respectively) in fodder pearl millet.

## 2.1.5 Effect of Cutting Pattern, Nutrient Levels and Spacing on Nutrient Uptake

### *2.1.5.1 Uptake of Nitrogen*

Muthaiah and Ramanathan (1983) revealed that highest N uptake was recorded when 90 kg N $ha^{-1}$ was applied in fodder sorghum. Patel (1985) opined that when N application was increased to 120 kg N $ha^{-1}$ the N uptake was also increased in fodder sorghum. Sumner and Farina (1986) reported that nitrogen and potassium at higher concentration resulted in growth stimulation and enhanced uptake of both the nutrients. Application of N had a beneficial effect on N uptake in fodder sorghum (Duraiswamy *et al.*, 1990). The uptake of N had a positive correlation with the applied nitrogen in sweet corn (Kar *et al.,* 2006). Bindhani *et al.* (2007) found out that when N level was increased, there was an enhancement in the N content of Baby corn. Somashekar *et al.* (2014) opined that maximum N uptake was noticed with the application of 60 kg N $ha^{-1}$ than 30 and 15 kg N $ha^{-1}$.

Vineetha (1995) observed that nitrogen content remained unaltered with the varying levels of P in gamba grass. The potash application @ 150 kg $ha^{-1}$ decreased the N content to 1.18 per cent in *Brachiaria decumbens* (Sonia, 1999). The uptake of N was increased to 294.36 kg $ha^{-1}$ by the application of 150 kg of K $ha^{-1}$ in guinea grass (Anita, 2002). When 75 kg $ha^{-1}$ of P was applied the N content in guinea grass was enhanced to 1.36 per cent (Lekshmi, 2004).

***2.1.5.2 Uptake of Phosphorus***

Nitrogen application decreased the P uptake (Kalra and Khokhar, 1979). According to Khaddar *et al.* (1983) phosphorus per cent in plant decreased from 0.17-0.14 by the enhanced application of nitrogen from 75-150 kg $ha^{-1}$. Ramanathan (1983) reported that P uptake was highest at higher levels of nitrogen and P uptake increased with increasing nitrogen doses in fodder sorghum. According to Roy and Wright (1984) nitrogen had a favourable effect on the uptake of phosphorus in fodder sorghum.

According to Awan and Abbasi (2000) with increasing levels of P fertilizer, the phosphorus uptake was increased in maize. Phosphorus fertilization had a significant positive effect on P concentration of Jumbo grass (Hazary *et al.*, 2015). The results revealed that over the control (0 kg P $ha^{-1}$), 10 and 20 kg P $ha^{-1}$ increased phosphorus concentration significantly to 0.25 kg $ha^{-1}$, 0.34 kg $ha^{-1}$ and 0.37 kg $ha^{-1}$ respectively.

The P content was reduced with K application in forage crops as reported by (Andrade *et al.*, 1996). However in Congo signal grass the P content was observed to be increased with K application (Jacob, 1999). According to Sonia (1999) the P content of signal grass was not affected by potassium application.

*2.1.5.3 Uptake of Potassium*

Khaddar *et al.* (1983) reported that there was no significant difference in potassium content due to applications of nitrogen from 95 to 150 kg $ha^{-1}$ in fodder sorghum. It was observed that the potassium uptake was the maximum at plant maturity stage and increased with increasing doses of N in fodder sorghum (Ramanathan, 1983). Duraiswamy *et al.* (1990) concluded that application of nitrogen had a beneficial effect on the uptake of K in fodder sorghum.

In general, a crop of common napier grass removes 463 kg of nitrogen, 96 kg of phosphorus and 594 kg of potassium $ha^{-1}$ $year^{-1}$ (Walmsley *et al.*, 1978). On an average, one tonne of dry perennial grass removes 9.4 kg N, 1.45 kg P, 1.4 kg K, 4.61 kg Ca, 2.65 kg Mg and 1.85 kg S (Bose and Balakrishnan, 2001).

*2.1.5.4 Uptake of Calcium and Magnesium*

According to Dwivedi *et al.* (1980), the Ca content was found to be increased with increased application of N in *Chrysopogon fulvus.* The Ca content remained unaltered with N application in *Brachiaria brizantha* and *Brachiaria humidicola* (Botrel *et al.*, 1990). In contrast Ca concentration decreased with the application of nitrogen and potassium in *Brachiaria ruziziensis* (Andrade *et al.*, 1996). According to Dampney (1992) the Mg concentration was diminished with K application in grasses.

*2.1.5.5 K : (Ca + Mg) Ratio*

According to (Mayland *et al.*, 1975) Ca and Mg content in forages was increased when nitrogen application was improved. Thill and George (1975) reported that the critical value of K: (Ca + Mg) ratio is 2 : 2.

**2.1.6 Effect of Cutting Pattern, Nutrient Levels and Spacing on Organic Carbon and NPK Status of Soil**

Chandini (1980) reported that in a field trial involving *Panicum maximum*, *Setaria anceps* and *Brachiaria ruziziensis*, significant increase in the nitrogen and phosphorus content of the soil was observed with the application of 120 kg $P_2O_5$ ha$^{-1}$. However varying levels of P had no significant influence in the available K content of the soil. Pillai (1986) in his field trial with Guinea grass (*Panicum maximum*) and Setaria grass (*Setaria sphacelata*) observed that when 60 kg ha$^{-1}$ of P was applied there was significant reduction in soil N and an enhancement of both P and K content of soil. Hazra and Tripathi (1989) observed that in sweet clover when the P level was increased from 30 to 90 kg $P_2O_5$ ha$^{-1}$, the available N and P content of the soil was also found to be increased. According to Silva *et al.* (1997) *Brachiaria ruziziensis* contribute more to the soil organic carbon than *Cajanus cajan*, *Crotalaria juncea* and *Muccuna aterrima*. Sonia (1999) pointed out that when the N level was increased from 100 to 200 kg N ha$^{-1}$, the available N content was increased from 150.53 to 176.40 kg N ha$^{-1}$ but the available P and K status was found to be reduced in signal grass. Also when the K level was increased from 50 to 150 kg K ha$^{-1}$ the N and P content of the soil exhibited a decreasing trend.

### 2.1.7 Effect of Cutting Pattern, Nutrient Levels and Spacing on Economics

Luikhan *et al.* (2012) revealed that the highest net return (42,853.74 Rs ha$^{-1}$) and benefit: cost ratio (3.2: 1) were obtained with 80 kg N ha$^{-1}$ as compared to 40 and 0 kg N ha$^{-1}$ in *Avena sativa*. Meena *et al.* (2012) reported that in fodder sorghum application of 120 kg N ha$^{-1}$ registered maximum net return of 32,070 Rs ha$^{-1}$ and B: C ratio of 2.6 as compared to other lower nitrogen levels. In a field study conducted in fodder sorghum involving varying levels of nitrogen application of N @ 300 kg ha$^{-1}$ registered higher gross return (1,07,781 Rs ha$^{-1}$), net returns (77,997 Rs ha$^{-1}$) and benefit: cost ratio (3.62) when compared to other lower levels of N application. Meena *et al.* (2012) pointed out that application of 120 kg N ha$^{-1}$ recorded 23.6, 9.1 and 13.9, 4.8 per cent higher net returns and B: C ratio than 40 and 80 kg N ha$^{-1}$ respectively in *Sorghum bicolor*. Vinayraj and Palled (2014) observed that CO 3 variety of hybrid Napier realized maximum net return (1,02,522 Rs ha$^{-1}$) and benefit: cost ratio (3.22) on applying 300 kg N ha$^{-1}$ than 240 and 180 kg ha$^{-1}$. Somashekar *et al.* (2014) reported that application of 60 kg N $ha^{-1}$ produced higher net return (32,550 Rs $ha^{-1}$) followed by 30 and 45 kg N $ha^{-1}$ (31,285 and 30,896 Rs $ha^{-1}$ respectively) in fodder sorghum.

Bhagat *et al.* (1992) observed that hybrid napier grown at a wider row spacing of 1.0 m fetched higher net return of 12,047 Rs $ha^{-1}$ $yr^{-1}$ than narrow spacing. Manjunatha *et al.* (2013) while studying different row spacing in perennial fodder sorghum pointed out that row spacing of 45 cm recorded the highest gross return (92,393 Rs $ha^{-1}$), net return (63,705 Rs $ha^{-1}$) and B: C ratio (3.21) compared to 30 cm row spacing.

## 2.2 EXPERIMENT - 2: STANDARDISING THE CUTTING PATTERN, N, P, K LEVELS AND SPACING IN PALISADE GRASS UNDER PARTIAL SHADED CONDITION

### 2.2.1 Effect of Cutting Pattern, Nutrient Levels and Spacing on Growth Parameters

The level of shade is the most significant factor determining the output from pastures grown in plantations. Decreasing irradiance reduces the growth of pasture species (Smith and Whiteman, 1983).

#### *2.2.1.1 Plant Height*

The height of the grass should be used as a guide for pasture management, coupled with the criterion of interrupting the regrowth process. More pronounced stem growth is a normal tendency in plants cultivated under shade condition and is a strategy to compensate for the reduction in light (Paciullo *et al.*, 2008).

Photosynthetic light response was compared for tropical forage grasses *viz. Brachiaria brizantha* cv. Marandu and *Brachiaria humidicola* grown outdoors on natural soil in pots, in full sunlight and shaded to 30 per cent of full sunlight over a 30 day period. The study revealed that both species exhibited the ability to adjust their photosynthetic behavior in response to shade (Dias-Filho, 2002).

Gobbi *et al.* (2009) observed that the lower incidence of PAR contributed to increased average canopy height and the length of petioles, stems and leaf blades in all cuttings in the canopy of the *Brachiaria decumbents* cultivar Basilisk. Onyeonagu and Ugwuanyi (2012) reported increased plant height of *Panicum maximum* with increased cutting height. The plant height increased progressively with increase in height of cut. The highest plant height was obtained at the 15 cm cutting when 400 kg N ha$^{-1}$ was applied in *Panicum maximum*.

Sward height increased significantly with decreasing light intensity and N fertilization in *Brachiaria brizantha, B. miliifirmis, Digitaria decumbens, Panicum maximum, Pennisetum clandestinum,* and *P. purpureum* as reported by (Eriksen and Whitney, 1981). An increase in plant height due to higher potassium application was recorded in guinea grass (Mullakoya, 1982).

Mohammad *et al.* (1985) observed that taller plants were produced at a narrow spacing than wider spacing in elephant grass. Karigoudar and Angadi (2005) reported that interaction effects of seed rate, row spacing and fertility level were found significant for plant height (159.70 cm) at 30 cm row spacing and 125 kg seed rate in fodder field bean.

### *2.2.1.2 Tillers Plant$^{-1}$*

Kipinis *et al.* (1977) observed that young stem of *Chloris gayana* showed reduction in tillering potential as the cutting height was increased suggesting that the stimulus of defoliation is negatively related to the distance between tiller base and the height of cut. Carlassare and Karsten (2013) reported increase in grass tiller population with reduction in cutting height in orchad grass (*Dactylis glomerata*). Difante *et al.* (2011) reported that cutting height is important to ensure that solar radiation reaches the leaves closer to the ground, with good amount and quality, activating dormant buds and favoring the emergence of new tillers. Moreover the use of fixed height for cutting lead to dramatic heights or heights lenient enough to compromise the amount of solar radiation along the crop canopy. Folkard (2011) revealed that mean pine grass tiller counts were reduced by 50 per cent under full shade without clipping, and 75 per cent under full shade with clipping while orchard grass tiller reductions were slightly less at 56 per cent and 66 per cent respectively.

Jacob (1999) reported more number of tillers with higher fertilizer dose than lower doses in congo signal grass under partial shaded condition. Jacob (1999) reported that more number of tillers was obtained in plots treated with fertilizer dose of 150: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ than the lower dose in congo signal under partial shaded condition. Paciullo *et al.* (2011) reported that tiller density varied with shading and nitrogen dose interaction in *Brachiaria* species. Under full sunlight conditions, the response was linear, whereas for 36 per cent and 54 per cent shading, the responses were found to be quadratic indicating that shade condition limited the plant response to the applied nitrogen, in terms of the appearance of new tillers. This result reinforces the importance of light in the production of new tillers in grass pasture.

Plants grown in the wider spacing had a slightly higher number of tillers indicating that individual plants perform better at wider spacing (Jimba and Adedeji, 2003). Diseko (2005) observed that the highest number of tillers was produced at 20 × 20 cm spacing than at a narrow spacing of 10 × 20 cm in *Pennisetum typhoides.* Gaya and Daraja (2013) reported that there was no significant difference in the tiller number produced due to intra row spacing in millet.

***2.2.1.3 Leaf : Stem Ratio***

The leaf: stem ratio of the forage grasses under shading was enhanced from 1.1 at 100 per cent sunlight to 1.8 at 18 per cent sunlight and the highest leaf: stem ratio of 2.8 was recorded in MARDI digit (*Digitaria setivalva* Stent.) (Wong *et al.*, 1985). Wilson *et al.* (1990) reported that the proportion of green leaf of *Paspalum notatum* pasture raised under tree was more than the open pasture. The leaf: stem ratio of shade tolerant plants was more than plants grown under open conditions (Wong, 1991). The leaf: stem ratio was significantly reduced with increasing shade levels and various K levels did not influence the leaf: stem ratio in guinea grass (Anita, 2002). According to Lekshmi (2004) there was a linear increase in leaf: stem ratio in guinea grass with the application of N and P fertilizers and under 50 per cent shade condition 300 kg N $ha^{-1}$ along with 75 kg $P_2O_5$ $ha^{-1}$ recorded the highest leaf: stem ratio (2.34) in the third harvest. The leaf: stem ratio was more at a cutting height of 25 cm (6.59) than 50 cm (5.47) in guinea grass (Dasilveira *et al.*, 2010).

#### *2.2.1.4 Regeneration Percentage*

Close cutting resulted in the development of new shoots from both lateral and terminal bud in *Cynodon dactylon* (Clapp *et al.,* 1965). Regrowth after harvesting was observed to be slower in the shaded plots in forage grasses (Eriksen and Whitney, 1981). It has been proposed that stoloniferous-decumbent grasses, such as *B. decumbens* and *B. dictyoneura* should be better suited to defoliation under shade than caespitose grasses, like *B. brizantha* because the former conserve more residual foliage and are less dependent on reserves (in roots and crown) for regrowth (Cruz *et al.*, 1999). In general, plants subjected to higher defoliation intensities have less remaining foliar area, a characteristic directly related to plant recovery after defoliation (Barbosa, 2004). Close cutting of grass lands above ground level was shown to reduce the ability of the grasses to interfere with growing points, weaken the rooting system and reduce stored food reserves in their roots, thereby reducing grass growth (Orodho, 2006). In guinea grass no significant difference was noticed in the regrowth periods for the 2 cutting heights of 25 cm and 50 cm (Dasilveira *et al.,* 2010).

### 2.2.2 Effect of Cutting Pattern, Nutrient Levels and Spacing on Yield Parameters

#### *2.2.2.1 Green Fodder Yield*

In Sri Lanka palisade grass has been reported to perform well under shades of coconut trees (Lagefoged, 1955). Generally, herbage yield of tropical grasses decreases with increasing shade (Wong *et al.*, 1985). In Australia, buffalo grass

(*Stenotaphrum secundatum*), carpet grass (*Axonopus compressus*), and kikuyu grass (*Pennisetum clandestinum*), grown in pots, had higher yields under shade cloth than in full sun (Samarakoon *et al*., 1990). Wilson *et al.* (1990) reported a 35 per cent greater growth of bahia grass *(Paspalum notalum)* under 55 per cent light transmission within a plantation of *Eucalyptus firandis* trees than obtained from the same grass in full sun outside the plantation. Under 50 per cent shade, yields of warm season grasses were reduced by 35 per cent or more, while yields of cool season grasses, including Kentucky bluegrass (*Poa pratensis*), orchard grass (*Dactylis glomerata*), and tall fescue (*Festuca arundinacea*), were not affected (Lin *et al*., 1999). Tudsri *et al*. (2002) reported decreased forage yield of napier grass under reduced cutting height. In an experiment involving 3 *Brachiaria* spp., *viz. B. brizantha, B. decumbens* and *B. dictyoneura* shade alone reduced biomass linearly by 60-75 per cent as irradiance decreased from 100 per cent to 40 per cent (Baruch and Guenni, 2007). Folkard (2011) stated that rough fescue appeared to be slightly more productive than pine grass under continuous clipping. Buffalo and mat grass had increased yields up to 68 per cent shading whereas kikuyu grass produced increased yield only up to 42 per cent shading.

According to Blackman and Templeman (1938) shading to 61 per cent and 44 per cent of daylight did not affect the yield of *Agrostis tenuis* and *Festuca rubra* at low level of nitrogen fertilization. When nitrogen fertilizer was added, the yield increased dramatically in normal daylight conditions, but not in shade. Lowry *et al*. (1988) recorded a 250 per cent higher yield of guinea grass *(Panicum maximum)* under the shade of the canopy of *Albizia lebbek* trees than in the full sunlight. Meerabai *et al.* (1993) stated that *Brachiaria ruziziensis* and *Panicum maximum* grown in coconut plantations produced a green fodder yield of 100 t $ha^{-1}$ and 108 t $ha^{-1}$ respectively. Productivity was also found to be increased with fertilizer application under shade condition. Durr and Rangel (2000) confirmed that there was no shade effect on the forage yield of *Panicum maximum* when grown in pots with low soil fertility conditions. Bhatt *et al.* (2002) found out that *Brachiaria mutica, Cenchrus ciliaris*, *Pennisetum* *polystachyon and Panicum maximum* produced higher fodder yield under low light intensity indicating their shade adaptations. At 57 per cent sunlight, total plant biomass in *B. brizantha* and *B. decumbens* was similar to that at full light conditions, when no N was added to the soil (Guenni *et al.,* 2008). Kusvurani and Tansiz (2011) concluded that low row spacing was most suitable for maximum herbage yield in annual rye grass.

Increased green fodder yield with higher level of phosphorus application was reported in thin napier grass by (Dwivedi *et al.,* 1991), with higher potassium application in guinea grass by Anita (2002) and higher nitrogen application in *Brachiaria mutica* by (Rumokoy and Toar, 2014).

#### *2.2.2.2 Dry Fodder Yield*

The dry weights of stems and shoots reduced significantly with increase in shade levels in three *Brachiaria* spp., *viz. B. brizantha, B. decumbens* and B. *dictyoneura* in all the harvests (Guenni *et al*., 2008). Mimenza *et al*. (2013) also recorded a significant reduction in dry fodder yield of *B. brizantha* when growth underneath the tree crown of six tree species, *viz. Acrocomia aculeate, Cordia alliodora, Guazum aulmifolia, Tabebuia rosea, Enterolobium cyclocarpum* and *Samanea saman.*

According to Eriksen and Whitney (1981) when no N fertilizer was added maximum dry fodder yields were obtained in *B. milliformis* (9.2 t $ha^{-1}$ $yr^{-1}$) at 27 per cent daylight; *D. decumbens*, *P. maximum*, and *B. brizantha*, (18.5 to 15.0 t $ha^{-1}$ $yr^{-1}$) at 45 per cent daylight; and *P. clandestinum*, (9.2 t $ha^{-1}$ $yr^{-1}$) at 70 per cent daylight.

### 2.2.3 Effect of Cutting Pattern, Nutrient Levels and Spacing on Physiological Parameters

#### *2.2.3.1 Dry Matter Production*

Wilson *et al*. (1990) found a 35 per cent increase in accumulated dry matter of bahia grass (*Paspalum notatum*) pasture under trees compared with open pasture in south Queensland. The percentage of DMP in all the six forage grasses *Brachiaria brizantha, B. miliifirmis, Digitaria decumbens, Panicum maximum, Pennisetum clandestinum,* and *P. purpureum* were significantly reduced by decreasing light intensity and by N fertilization (Eriksen and Whitney, 1981). In a study conducted to estimate the photosynthetically active radiation of tropical forage grasses, Silva *et al.* (2012) confirmed that there is a positive association between photosynthetically active radiation and dry matter production in forage grasses, *viz. Brachiaria decumbens* grass (*Brachiaria decumbens* cultivar Basilisk), Marandu grass (*Brachiaria brizantha* cultivar Marandu), Xaraes grass (*Brachiaria brizantha,* cultivar Xaraes), Mombaça grass (*Panicum maximum* cultivar Mombaça), Tanzania grass (*Panicum maximum,* cultivar Tanzania) and Tifton 85 grass (*Cynodon* spp. cultivar Tifton 85) and the grasses with the best productive performance were *Brachiaria decumbens* cultivar Basilisk and *Brachiaria brizantha* cultivar Xaraes. The dry matter production increased with decreasing levels of shade and the highest dry matter production of 2684.76 g $cm^{-2}$ was obtained when para grass was grown under the coconut trees of age 50 years and fertilized with 225 kg N $ha^{-1}$ (Rumokoy and Toar, 2014).

When a cutting height of 5 cm was adopted palisade grass produced highest dry matter content under full sunlight condition (31.37 per cent) than 62 per cent (17.26 per cent) and 34 per cent (18.69) light intensities (Senanayake, 1999).

Deinum (1966) reported that with the deficiency of nitrogen, dry matter yields were higher at reduced light intensities (100 cal. $cm^{-2}$ $day^{-1}$) in grasses.

#### *2.2.3.2 Leaf Area Index*

Photosynthetically active tissues, mainly green leaves, are the major component of forage growth and development. The amount of these tissues in a forage plant is influenced directly by cutting height. According to Janerson *et al.* (2014) among ten tropical grasses, *viz. Brachiaria decumbens*, *Brachiaria* hybrid cv. Mulato II, *Brachiaria brizantha* cv. Xaraés, *Brachiaria brizantha* cv.

Marandu, *Panicum maximum* cv. Tanzânia, *Panicum* hybrid cv. Massai, *Sorghum vulgare, Sorghum bicolor, Pennisetum purpureum* Common and *Pennisetum purpureum* cv. Roxo., LAI and light interception were significantly correlated for all species except *Brachiaria brizantha* cv. Xaraés, *Brachiaria brizantha* cv. Marandu and *Brachiaria* hybrid cv. Mulato II.

Guenni *et al.* (2008) pointed out that among the 3 *Brachiaria* species studied, *B. dictyoneura* have the lowest capacity to adjust to shade conditions being unable to produce adequate leaf area whereas *B. brizantha* and *B. decumbens* exhibited a better tolerance to shade. Lower levels of shade and higher doses of potassium significantly increased the leaf area index in the first (3.83 and 4.73), second (3.88 and 4.91) and fifth harvests (3.72 and 4.63) of guinea grass respectively (Anita and Lakshmi, 2014). Babaji *et al.* (2012) conducted a study on maize and observed no significant difference in leaf production in plants spaced at 25 cm than plants spaced at 50 cm. Leaf area of the two pearl millet landraces *viz.* Serere 6 A and Tswana was significantly higher in the wider plant spacing (35 × 75 cm) compared to narrow spacing (25 x 75 cm and 15 x 75 cm (Legwaila *et al.*, 2014).

#### *2.2.3.3 Relative Growth Rate*

The RGR of *B. brizantha* cv Marandu and *B. humidicola* are low in 30 per cent shade than open condition (Dias-Filho, 2000). The plants grown in 50 per cent shade condition registered lowest RGR of 7.71 mg $g^{-1}$ $day^{-1}$ in guinea grass. The RGR was found to be increasing with increase in nitrogen and phosphorus levels in guinea grass (Lekshmi, 2004).

#### *2.2.3.4 Crop Growth Rate*

A decrease in CGR was observed in rice cultivars at 50 per cent shade condition (Viji, 1995). According to Bhatt *et al.* (2002) *Brachiaria mutica, Panicum maximum, Pennisetum polystachyon, Cenchrus ciliaris and Setaria sphacelata* exhibited enhanced CGR under low light intensity.

*2.2.3.5 Net Assimilation Rate*

According to Viji (1995), NAR was found reduced in rice cultivars at 50 per cent shade condition. Lekshmi (2004) stated that under shaded condition NAR was lowest than open condition. At the highest level of nitrogen NAR remained the same for both the shade and open conditions for guinea grass.

**2.2.4 Effect of Cutting Pattern, Nutrient Levels and Spacing on Quality Studies**

Radiation levels on forage crops have an impact on nutrient quality.

*2.2.4.1 Crude Protein Content*

The quality parameters of the forage such as crude protein were significantly improved as shade progresses. Protein concentrations can be increased under shade as reported by (Kephart and Buxton, 1993). There is a linear increase in crude protein content of the fodder sorghum with an increasing rate of nitrogen from 100 to 200 kg ha$^{-1}$ (Nazir *et al*., 1997). Higher levels of nitrogen increased the crude protein content but increase in the P content exhibited a decreasing trend under 50 per cent shade conditions in guinea grass (Lekshmi, 2004). The photosynthetically active radiation (PAR) indirectly affects crude protein content of forage grasses (Silva *et al.,* 2012). Mimenza *et al*. (2013) noticed that crude protein content of *B. brizantha* increased significantly under all tree species, *viz. Acrocomia aculeate, Cordia alliodora, Guazuma ulmifolia, Tabebuia rosea, Enterolobium cyclocarpum* and *Samanea saman* compared to the open pasture.

In an experiment with different Brachiaria species (*B. brizantha* cv. Marandu, *B. brizantha* cv. MG 4, *B. brizantha* cv. Xaraes, *B. brizantha* cv. Pista, *B. decumbens and B. ruziziensis) B. brizantha* cv. Xaraes produced highest crude protein content of 15.19 in the first cut whereas in the remaining 5 cuts *B. brizantha* cv. Pista recorded the highest crude protein content of 14.17 per cent, 14.95 per cent, 10.19 per cent, 14.83 per cent and 14.60 per cent respectively (Maia *et al*., 2014).

*2.2.4.2 Crude Fibre Content*

Senanayake (1999) reported that when 62 per cent light intensity was imposed in palisade grass cut at 5 cm height highest ADF (38.71 per cent) and NDF (62.14 per cent) was obtained followed by 34 per cent light intensity ADF (35.83 per cent), NDF (60.94 per cent) and least for full sunlight conditions ADF (31.27 per cent), NDF (52.37 per cent) respectively. Highest level of N (300 kg N $ha^{-1}$) and P (75 kg $P_2O_5$ $ha^{-1}$) produced lowest crude fibre content (30.63 per cent) in guinea grass under shaded conditions (Lekshmi, 2004). The average production of crude fibre increased as the nitrogen fertilization increased, up to 225 kg $ha^{-1}$ in para grass and lowest crude fibre was obtained when the crop was grown under coconut trees of 20 years.

In an experiment with different Brachiaria species (*B. brizantha* cv. Marandu, *B. brizantha* cv. MG 4, *B. brizantha* cv. Xaraes, *B. brizantha* cv. Pista, *B. decumbens and B. ruziziensis) B. brizantha* cv. Xaraes produced lowest ADF was registered by *B. brizantha* cv. Pista (36.68 per cent) in the first cut and highest ADF was observed in *B. brizantha* cv. Xaraes (42.64 per cent) in the fourth cut (Maia *et al.*, 2014).

*2.2.4.3 Nitrate Content*

Plants containing more than 1.76 per cent nitrate is dangerous. Potassium is one of the essential mineral elements for plant growth and development and plays a key role both in the uptake of nitrate and at various steps during N assimilation and metabolism, as well as in numerous other biochemical and physiological processes (Marschner, 2012). Potassium stimulates N assimilation so that increased K fertilization can depress nitrate accumulation (Nurzynska-Wierdak *et al.*, 2012). Pathmasiri *et al.* (2014) reported that hybrid napier and wild guinea grass samples taken from three cuttings revealed significantly higher nitrate contents in both leaves and stems at first cutting compared to 2 and 3 cuttings.

Taute *et al.*(2002) in a trial conducted in *P. maximum* cv. Gatton involving seven levels of N fertilization (0, 25, 50, 75, 100, 125 and 150 kg N $ha^{-1}$)

concluded that nitrogen application rate between 75 and 100 kg N $ha^{-1}$ during autumn resulted in the optimum qualitative and quantitative characteristics. A disadvantage of high application levels of N is that it increased the $NO_3$-N concentration of plants.

### 2.2.5 Effect of Cutting Pattern, Nutrient Levels and Spacing on Nutrient Uptake

#### *2.2.5.1 Uptake of Nitrogen*

The percentage of N increased with decreasing light intensity (from 1.0 to 1.6 per cent) in the N fertilized plots and from 1.2 to 1.9 per cent in the no N treatments (Eriksen and Whitney, 1981). Wong *et al*. (1985) reported that the percentage of nitrogen in the dried forages of the six tropical grasses, Common guinea, Kazungula setaria, Carpet grass, Green panic, Signal grass and Tee Grass increased significantly with increasing shade intensity and green panic produced the lowest nitrogen content. In Australia, shade increased N concentrations in warm season grasses (Samarakoon *et al*., 1990). The uptake of N was increased to 34.5 kg $ha^{-1}$ by the application of 50 kg of K $ha^{-1}$ in *Brachiaria decumbens* (Jacob, 1999). Pasture quality measured as per cent green leaf and per cent of N in herbage of green panic (*Panicum maximum* var. *trichoglume*) was found to be higher in the tree plots, especially under *Eucalyptus argophloia,* than in the open pasture (Wilson, 1998). Carvalho *et al.* (2002) pointed out that the nitrogen content in the leaves of *Brachiaria brizantha* cultivar Marandu increased significantly under shade of *Andenanthera macrocarpa* tree when compared to the full sunlight condition. Baruch and Guenni (2007) reported that leaf N content increased at intermediate shade but decreased under severe shade to levels similar to full sunlight in both *Brachiaria decumbens* and *Brachiaria brizantha* while *B. dictyoneura* showed no response. Guenni *et al.* (2008) observed that the increase in leaf N with shading was lower than the increase in K, and was significant for *B. brizantha* and *B. decumbens* at both soil N levels (with and without N).

*2.2.5.2 Uptake of Phosphorus*

Jacob (1999) recorded a phosphorous uptake of 4.76 kg $ha^{-1}$ in congo signal grass (*B. ruziziensis*) when grown under coconut tree shade. In an experiment with shade tolerance of several forage species, Addison (2003) reported an increase in leaf phosphorous with shading in *C. pubescens, Desmondium uncinatum, Flemingia congesta Neonotonia wightii,* while other species, *viz. Calopogonium mucunoids, D. intortum* and *D. heterophyllum* were found to have the greatest concentrations of leaf P under full sunlight. Application of nitrogen and phosphorus significantly increased the content and uptake of phosphorus in guinea grass (Lekshmi, 2004). For *B. decumbens,* P concentration increased significantly as light intensity declined at both N levels (with and without N) as reported by (Guenni *et al.*, 2008). The nutrient content of plant showed a significant increase with increasing levels of shade while the nutrient uptake showed a significant increase with lower levels of shade.

*2.2.5.3 Uptake of Potassium*

Potassium values increased linearly with decreasing light intensity, increasing by as much as 25 to 100 per cent and concentrations of K tended to be higher in shaded forage, higher in N-fertilized forage (Eriksen and Whitney, 1981).

Watson *et al.* (1984) also found that the potassium content of marshall rye grass (*L. multiflorum*) grown under shade increased as shade intensity increased. The potassium content was 1.6 per cent under full sunlight whereas the potassium content was 2.1 per cent and 2.7 per cent under 50 per cent and 75 per cent shade respectively.

George (1996) reported that the potassium uptake was 131 kg $ha^{-1}$ for guinea grass (*P. maximum*) grown under partially shaded conditions. According to Mullen and Shelton (1996), the potassium concentration of buffalo grass (*S. secundatum*) was 2.47 per cent at 34 per cent light transmission, whereas at full sunlight, it was reduced to 1.55 per cent. Congo signal grass (*B. ruziziensis*) when grown under coconut tree shade recorded a potassium uptake of 28.4 kg $ha^{-1}$ (Jacob, 1999).

*2.2.5.4 Uptake of Calcium and Magnesium*

Lewis *et al.* (1983) pointed out that calcium content was doubled when planted under slash pines. Moderate shading may play a role in improving nutrient uptake, including minerals, especially P and Ca (Wilson *et al.*, 1990; Myers and Robbins, 1991). According to Belsky (1992) reported that total calcium content was found to increase from open grass land to tree under storey in forages. Mullen and Shelton (1996) reported that in buffalo grass calcium and magnesium content was more at 34 per cent light intensity than full sunlight conditions. According to Burner and Brauer (2003) calcium content showed a decreasing trend with increasing population density of loblolly pine in forages whereas magnesium showed no response to density treatments. In pine grass, orchard grass and rough fescue calcium and magnesium did not respond to shading (Folkard, 2011).

*2.2.5.5 K: (Ca + Mg) Ratio*

Increased nitrogen application was found to be decreasing the K: (Ca + Mg) ratio in grasses (Khan and Ali, 1969). Jacob (1999) reported that application of 100 per cent and 50 per cent of RDF produced no significant effect on K: (Ca + Mg) ratio in *Brachiaria ruziziensis.*

**2.2.6 Effect of Cutting Pattern, Nutrient Levels and Spacing on Organic Carbon and NPK Status of Soil**

Pillai (1986) in his field trial with guinea grass (*Panicum maximum*) and setaria grass (*Setaria sphacelata*) concluded that the effect of P application on K content of the soil was not significant in partial shade. Hazra and Tripathi (1989) reported that in sweet clover cultivation, the available N status of soil was greatly improved with P application and such increases were in the order of 2.5, 19.0 and 22.0 kg N $ha^{-1}$ under tree canopy with the application of 30, 60 and 90 kg $P_2O_5$ $ha^{-1}$ respectively. Shading of N deficient soils appears to stimulate mineralization of N from organic N reserves (Wilson *et al.*, 1990). Jacob (1999) reported that there was no significant difference in organic carbon content of the soil on applying 50 per cent and a 100 per cent of the RDF in congo signal grass. He has also reported that available NPK content of the soil cropped with congo signal grass was found to be 207, 51 and 99 kg $ha^{-1}$ respectively under partially shaded condition. According to Lekshmi (2004) there was significant increase in available phosphorus and a decrease in available potassium content of the soil with increase in shade levels. Application of nitrogen significantly increased the nitrogen content of the soil while reduced phosphorus and potassium content of the soil after the experiment. Phosphorus levels also significantly increased the nitrogen and phosphorus content but potassium content of the soil after the experiment showed a parabolic type of response.

### 2.2.7 Effect of Cutting Pattern, Nutrient Levels and Spacing on Economics

Anita (2002) reported that shade levels and potassium had significant influence on the net returns. The highest net returns and benefit: cost ratio was obtained with zero per cent shade level which was significantly superior to all other shade levels. Similarly the highest dose of $K_2O$ fetched maximum net returns and benefit: cost ratio in guinea grass. Lekshmi (2004) reported that in guinea grass lower levels of shade combined with higher dose of nitrogen and phosphorus registered highest net returns and benefit: cost ratio. But economic yield was obtained in shade intensity up to 50 per cent.

# MATERIALS AND METHODS

# 3. MATERIALS AND METHODS

The present investigation entitled "Production Package of Palisade Grass (*Brachiaria brizantha* (Hochst. ex A. Rich) Stapf.)" was carried out during July 2014 to April 2016 to standardise the nutrient requirement, spacing and cutting pattern of palisade grass under open and partial shaded condition and to work out the economics of cultivation. The experimental site, season, weather conditions, materials used and methods adopted for the study are detailed below.

## 3.1 EXPERIMENTAL SITE

The experiment was laid out in the Instructional Farm attached to the College of Agriculture, Vellayani, Thiruvananthapuram. The farm is located at 8.5° N latitude and 76.9° E longitude and at an altitude of 29 m above mean sea level.

## 3.2 SEASON AND WEATHER CONDITIONS

The field experiment was conducted during the period from July 2014 to April 2016. The data on weather parameters (monthly rainfall, number of rainy days per month, maximum temperature, minimum temperature, relative humidity, evaporation and sunshine hours) during the cropping period are given in the Appendix I and II and graphically presented in Figure 1 and 2.

## 3.3 SOIL

The soil of the experimental site was sandy clay loam which belongs to the order oxisols, Vellayani series. The composite soil samples were drawn from 0 - 15 cm depth from both open and partially shaded conditions before conducting the experiment and analysed for chemical properties. The data obtained is presented in Table 1 and 2.

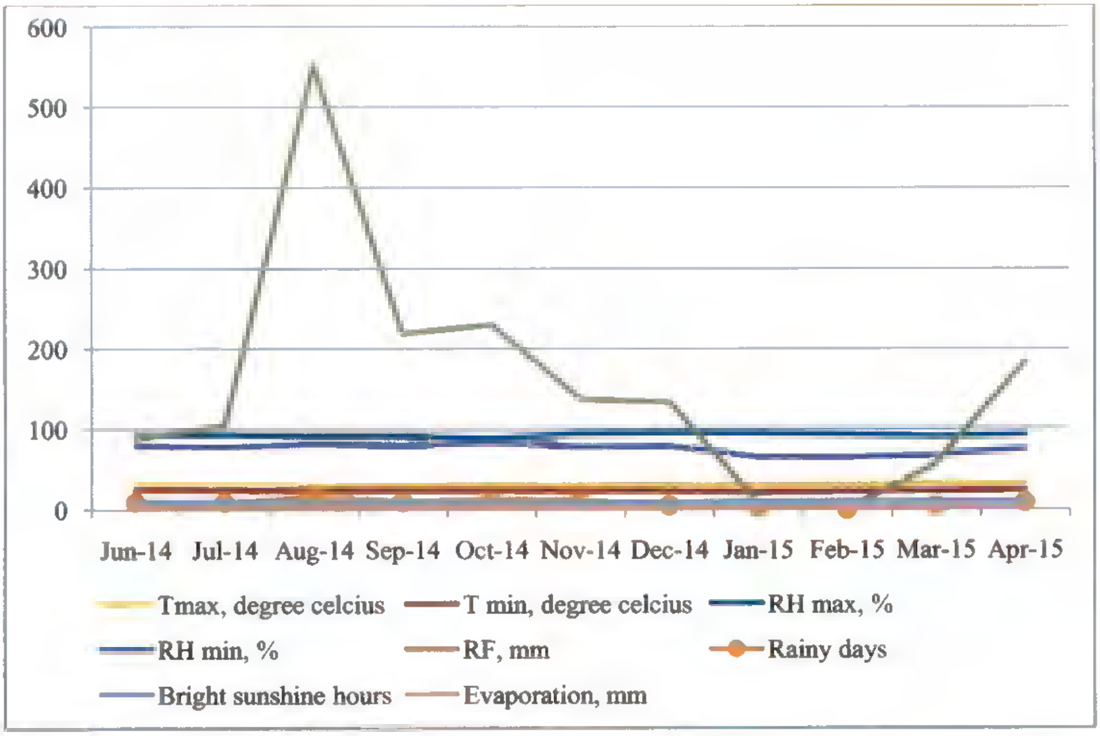


Fig. 1. Weather parameters during first year (2014-15)

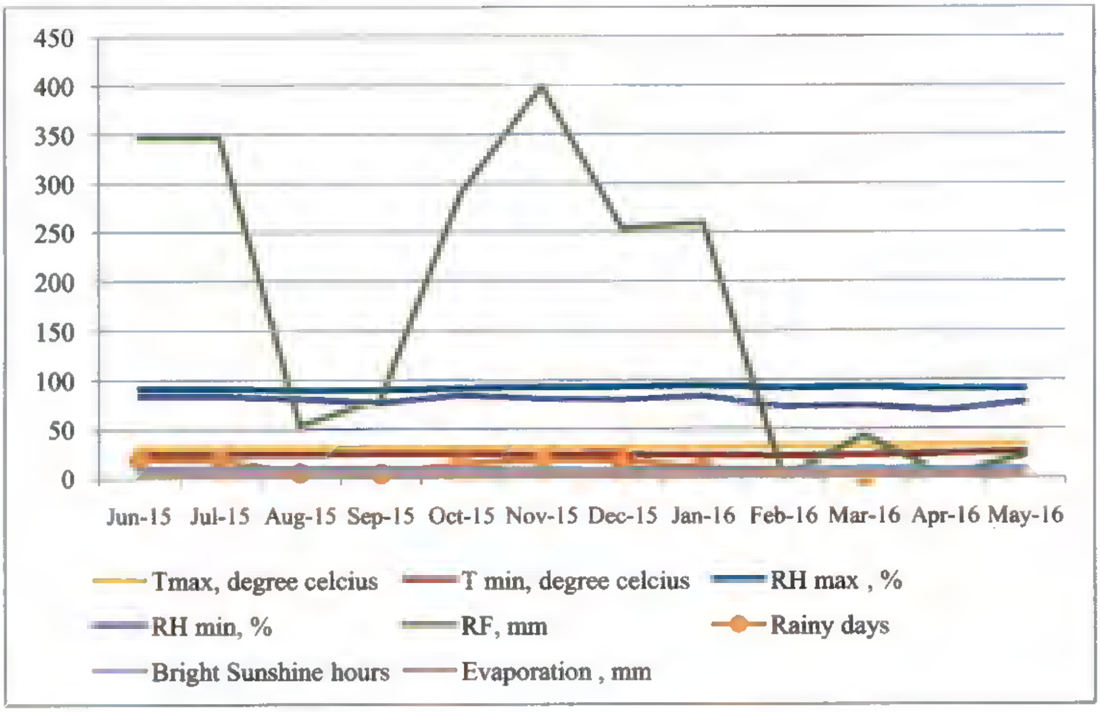


Fig. 2. Weather parameters during second year (2015-16)

Table 1. Soil physico-chemical properties of the experimental site (open condition)

| Particulars | Mean value | Method used |
|---|---|---|
| **A. Physical properties** | | |
| 1. Mechanical composition | | |
| Coarse sand (per cent) | 16.50 | International pipette method (Piper, 1967) |
| Fine sand (per cent) | 31.00 | |
| Silt (per cent) | 25.80 | |
| Clay (per cent) | 26.40 | |
| 2. Bulk density (g $cc^{-1}$) | 1.375 | Core method (Gupta and Dakshinamoorthi, 1980) |
| 3. Water holding capacity (per cent) | 21.40 | Core method (Gupta and Dakshinamoorthi, 1980) |
| 4. Porosity (per cent) | 32.00 | Core method (Gupta and Dakshinamoorthi, 1980) |
| **B. Chemical properties** | | |
| 1. Soil reaction (pH) | 5.20 | pH meter with glass electrode (Jackson, 1973) |
| 2. Organic C (%) | 0.52 | Walkley and Black rapid titration method (Jackson, 1973) |
| 3. Available N (kg $ha^{-1}$) | 290.05 | Alkaline $KMnO_4$ method (Subbiah and Asija, 1956) |
| 4. Available P (kg $ha^{-1}$) | 48.62 | Bray's colorimetric method (Jackson, 1973) |
| 5. Available K (kg $ha^{-1}$) | 85.50 | Neutral normal ammonium acetate method (Jackson, 1973) |

Table 2. Soil physico-chemical properties of the experimental site (partial shade condition)

| Particulars | Mean value | Method used |
|---|---|---|
| **A. Physical properties** | | |
| 1. Mechanical composition | | |
| Coarse sand (per cent) | 16.70 | International pipette method (Piper, 1967) |
| Fine sand (per cent) | 31.30 | |
| Silt (per cent) | 25.50 | |
| Clay (per cent) | 26.50 | |
| 2. Bulk density (g $cc^{-1}$) | 1.375 | Core method (Gupta and Dakshinamoorthi, 1980) |
| 3. Water holding capacity (per cent) | 21.50 | Core method (Gupta and Dakshinamoorthi, 1980) |
| 4. Porosity (per cent) | 32.00 | Core method (Gupta and Dakshinamoorthi, 1980) |
| **B. Chemical properties** | | |
| 1. Soil reaction (pH) | 5.20 | pH meter with glass electrode (Jackson, 1973) |
| 2. Organic C (%) | 0.55 | Walkley and Black rapid titration method (Jackson, 1973) |
| 3. Available N (kg $ha^{-1}$) | 300.23 | Alkaline $KMnO_4$ method (Subbiah and Asija, 1956) |
| 4. Available P (kg $ha^{-1}$) | 46.00 | Bray's colorimetric method (Jackson, 1973) |
| 5. Available K (kg $ha^{-1}$) | 71.00 | Neutral normal ammonium acetate method (Jackson, 1973) |

## 3.4 CROPPING HISTORY OF THE EXPERIMENTAL SITE

The experimental site (experiment-1) was previously planted with guinea grass and (experiment-2) was a partially shaded coconut garden having 65 years old palms permitting 60 per cent of the solar radiation to filter through the canopy. The interspaces of plantations were lying fallow during the previous years.

The light intensity was measured using lux meter HI 97500 according to the procedure suggested by Thavaprakash and Velayudham (2008). The incident light above the canopy was measured by holding the sensor above the canopy and the light transmitted through the canopy was measured by holding the sensor below the row and across the row and mean values were taken. The percentage of light intercepted by the crop canopy was calculated by the formula:

$$PLI = \frac{LI - LT}{LI} \times 100$$

where, PLI- percentage of light intercepted,

LI- light incident above the crop canopy,

LT- light transmitted below the crop canopy.

## 3.5 PLANTING MATERIAL

The slips for planting were obtained from All India Coordinated Research Project on Forage Crops at Vellayani Centre, Thiruvananthapuram, Kerala. The slips were multiplied in nursery and planted in the main field. The variety used was Mulato. Mulato is the first hybrid in Brachiaria genus and results from crossing *Brachiaria ruziziensis* (clone 44-6) and *Brachiaria brizantha* (CIAT 6297). It is a variety released from International Centre for Tropical Agriculture, Columbia in 2001.

## 3.6 EXPERIMENTAL DESIGN AND LAYOUT

### 3.6.1 Experiment - 1: Standardising the N, P, K Levels and Spacing in Palisade Grass under Open Condition

#### *3.6.1 .1 Experiment - 1a: Cutting at Ground Level*

Design : Randomised Block Design

Replication : 3

Gross plot size : 4 m x 5 m

**Treatments**

**Factor A. Nutrient levels (N) - 3**

$N_1$ - 200: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

$N_2$ - 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{1}$

$N_3$ - 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

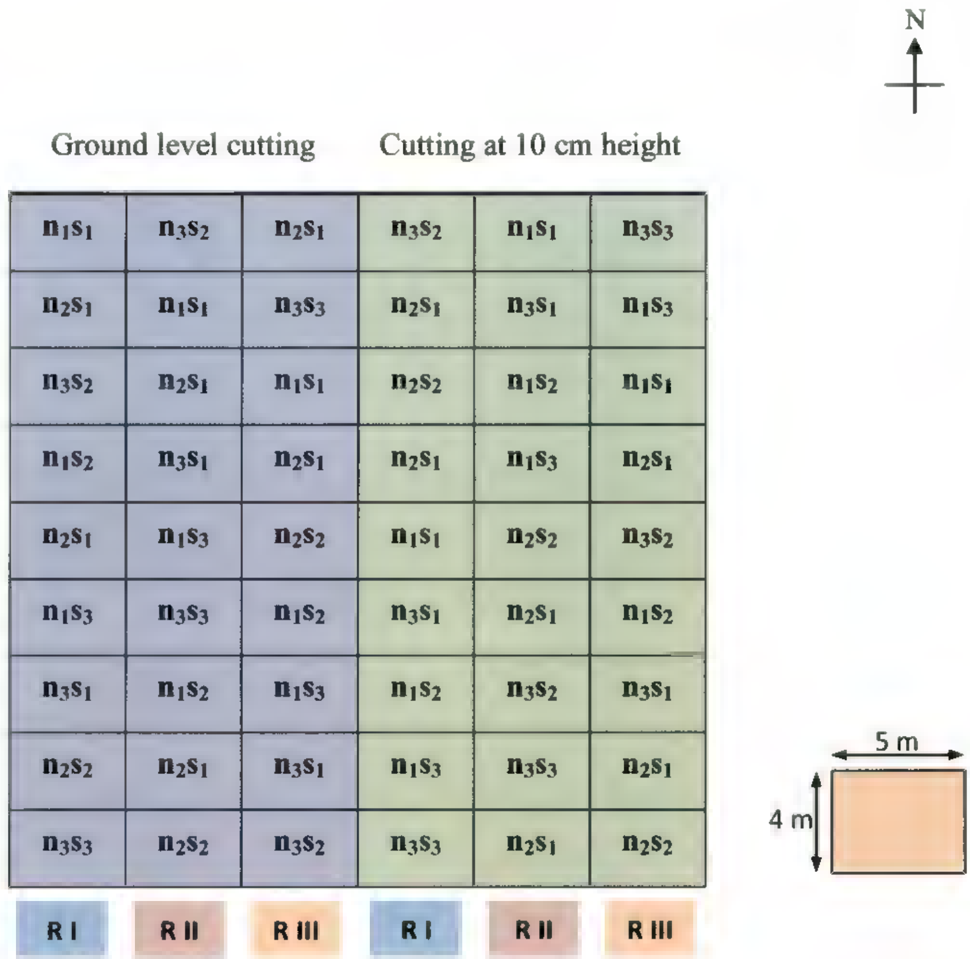


Fig. 3. Layout of the experiment (Open condition)

Plate 1. General view of the experimental field - Open condition

<u>Factor B</u>. **Spacing (S) - 3**

$S_1$ - 60 cm x 30 cm

$S_2$ - 60 cm x 40 cm

$S_3$ - 60 cm x 60 cm

### *3.6.1 .2 Experiment - 1b: Cutting at 10 cm height from Ground Level*

Design : Randomised Block Design

Replication : 3

Gross plot size : 4 m x 5 m

**Treatments**

<u>Factor A</u>. **Nutrient levels (N) - 3**

$N_1$- 200: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

$N_2$-250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{1}$

$N_3$- 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

<u>Factor B.</u> **Spacing (S) - 3**

$S_1$- 60 cm x 30 cm

$S_2$- 60 cm x 40 cm

$S_3$- 60 cm x 60 cm

## 3.6.2 Experiment - 2: Standardizing the N, P, K levels and Spacing of Palisade Grass under Partial Shaded Condition in Coconut Garden

### *3.6.2.1 Experiment - 2a: Cutting at Ground Level*

Design : Randomised Block Design

Replication : 3

Gross plot size : 4 m x 5 m

**Treatments**

<u>Factor A</u>. **Nutrient levels (N) - 3**

$N_1$ - 150: 37.5: 37.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

$N_2$ - 200: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

$N_3$ - 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

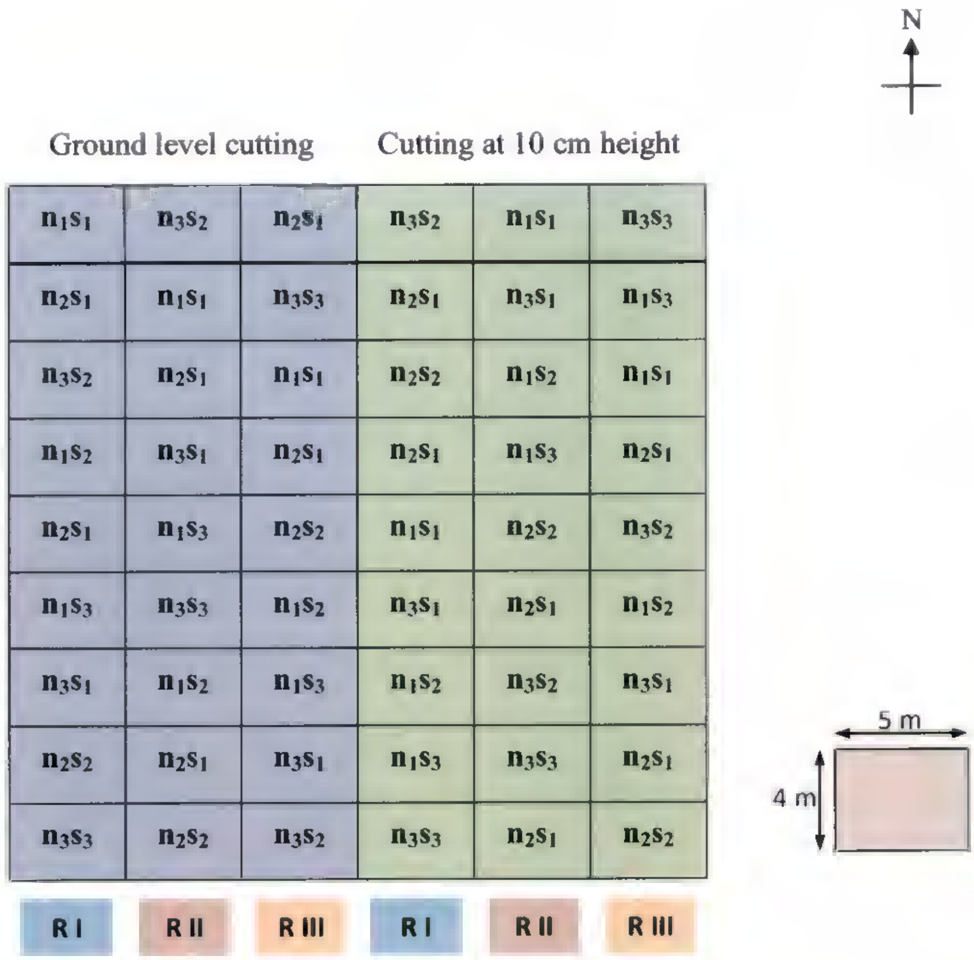


Fig. 4. Layout of the experiment (Shade condition)


Plate 2. General view of the experimental field – Partial shade conditions

**Factor B.** **Spacing (S) - 3**

$S_1$ - 60 cm x 20 cm

$S_2$ - 60 cm x 30 cm

$S_3$ - 60 cm x 40 cm

*3.6.2.2 Experiment - 2b: Cutting at 10 cm height from Ground Level*

| | |
|---|---|
| Design | : Randomised Block Design |
| Replication | : 3 |
| Gross plot size | : 4 m x 5 m |

**Treatments**

**Factor A.** **Nutrient levels (N) - 3**

$N_1$ - 150: 37.5: 37.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

$N_2$ - 200: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

$N_3$ - 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$

**Factor B.** **Spacing (S) - 3**

$S_1$ - 60 cm x 20 cm

$S_2$ - 60 cm x 30 cm

$S_3$ - 60 cm x 40 cm

## 3.7 DETAILS OF CULTIVATION

### 3.7.1 Field Preparation

The experimental area was cleared off weeds. The field was ploughed twice and laid out in to blocks and plots. The plots were dug and properly levelled.

### 3.7.2 Manuring and Fertilizer Application

Farmyard manure at the rate of 10 t $ha^{-1}$ was uniformly applied to all plots. Nitrogen, phosphorus and potassium were applied in the form of urea, mussoriephos and muriate of potash. Entire dose of phosphorus and potassium was applied as basal, nitrogen was top dressed in 5 equal splits after every harvest.

### 3.7.3 Planting

The planting of healthy slips of palisade grass was done on 15th July 2014 as per the treatments. The variety used was Mulato.

### 3.7.4 After Care

Gap filling was done twenty days after planting. Weeding and N application was done after every harvest. The crop was given sprinkler irrigation.

### 3.7.5 Harvest

The first harvest was taken 90 days after planting and subsequent harvests at an interval of 45 days.

## 3.8 OBSERVATIONS RECORDED

### 3.8.1 Biometric Observations

Five sample plants were randomly selected from the net plot for recording the biometric observations. There were six harvests in the first year and seven harvests in the second year.

#### *3.8.1.1 Plant Height*

The height of the sample plants were measured from the base of the plant to the tip of the longest leaf. The mean height plant$^{-1}$ was worked out at each harvest and expressed in cm.

#### *3.8.1.2 Tillers Plant$^{-1}$*

The number of tillers in the sample plants was counted and the average was worked out and recorded as number of tillers plant$^{-1}$ at each harvest.

#### *3.8.1.3 Leaf : Stem Ratio*

The sample plants collected at each harvest were separated into stem and leaf. The leaf and stem were separately oven dried to a constant weight and leaf: stem ratio was calculated as follows.

$$\text{Leaf: stem ratio} = \frac{\text{Dry weight of leaf}}{\text{Dry weight of stem}}$$

### *3.8.1.4 Regeneration Percentage*

The number of plants that regenerated after each harvest was counted and recorded. The regeneration percentage was calculated as follows.

$$\text{Regeneration percentage} = \frac{\text{Number of plants regenerated}}{\text{Total number of plants}} \times 100$$

## 3.8.2 Yield Parameters

### *3.8.2.1 Green Fodder Yield*

The green fodder yield from the net plot area was recorded at each harvest and expressed in t $ha^{-1}$.

### *3.8.2.2 Dry Fodder Yield*

The fresh weight of sample plants collected from each plot were recorded and then the sample plants were sun dried and later oven dried at a temperature of $70 \pm 5$ °C to a constant weight. The dry fodder yield was computed for each harvest as follows and expressed as t $ha^{-1}$.

$$\text{Dry fodder yield} = \frac{\text{Dry weight of sample plants}}{\text{Fresh weight of sample plants}} \times \text{Green fodder yield}$$

### *3.8.2.3 Total Green Fodder Yield*

The sum of the green fodder yield recorded in the net plot for six harvests in the first year was taken to obtain the total green fodder yield per ha in the first year. Similarly the total green fodder yield per ha of the second year was obtained from the sum of the green fodder yield recorded in the net plot for seven harvests and expressed in t $ha^{-1}$.

*3.8.2.4 Total Dry Fodder Yield*

The total dry fodder yield was computed by summing the dry fodder yield per net plot recorded for six harvests in first year and for seven harvests in second year and expressed in t $ha^{-1}$.

**3.8.3 Physiological Observations**

*3.8.3.1 Dry Matter Production Plant$^{-1}$ (at each harvest)*

The sample plants uprooted from the net plot were washed, dried under sun and then oven dried at 70 ± 5 °C to constant weight which was recorded as dry matter production $plant^{-1}$.

*3.8.3.2 Leaf Area Index (at each harvest)*

Leaf area index was worked out using the length width method suggested by Gomez (1972) and averages were worked out.

Leaf area = Leaf length x Leaf breadth x Number of leaves per plant x 0.75

$$LAI = \frac{\text{Leaf area}}{\text{Area occupied by the plant}}$$

*3.8.3.3 Relative Growth Rate (RGR)*

RGR was determined based on the formula of Williams (1946) and expressed in g $g^{-1}$ $day^{-1}$. It was calculated for the period between two consecutive harvests.

$$RGR = \frac{\log_e w_2 - \log_e w_1}{t_2 - t_1}$$

where, $w_1$ and $w_2$ are plant dry weight at time $t_1$ and $t_2$ respectively,

$t_2 - t_1$ - time interval in days.

*3.8.3.4 Crop Growth Rate (CGR)*

CGR was determined based on the formula of Watson (1958) and expressed in g $m^{-2}$ $day^{-1}$. It was calculated for the period between two consecutive harvests.

$$\text{CGR} = \frac{w_2 - w_1}{P\,(t_2 - t_1)}$$

where, $w_1$ and $w_2$ are plant dry weight at time $t_1$ and $t_2$ respectively,

$t_2 - t_1$ - time interval in days,

P - ground area on which $w_1$ and $w_2$ has been estimated.

### *3.8.3.5 Net Assimilation Rate (NAR)*

The method proposed by Gregory (1917) and modified by Williams (1946) was employed for calculating the NAR on leaf dry weight basis and the values were expressed as g $m^{-2}$ $day^{-1}$. It was calculated for the period between two consecutive harvests.

$$\text{NAR} = \frac{w_2 - w_1}{t_2 - t_1} \times \frac{\log_e L_2 - \log_e L_1}{L_2 - L_1}$$

where, $w_1$ and $w_2$ are plant dry weight at time $t_1$ and $t_2$ respectively,

$L_1$ and $L_2$ - leaf area at $t_1$ and $t_2$ respectively,

$t_2 - t_1$ - time interval in days.

### *3.8.3.6 Per Day Productivity*

Per day productivity was worked out for each harvest from the green fodder yield recorded per ha using the following relationship and the mean per day productivity was worked out and expressed in t $ha^{-1}day^{-1}$.

$$\text{Per day productivity} = \frac{\text{Green fodder yield per hectare}}{\text{Number of days in between two harvests}}$$

## 3.8.4 Quality Studies

### *3.8.4.1 Crude Protein Content*

Crude protein content at each harvest was calculated by multiplying the nitrogen content of plant by the factor 6.25 (Simpson *et al.*, 1965).

### *3.8.4.2 Crude Fibre Content*

Crude fibre content at final harvest was determined by A.O.A.C. method (A.O.A.C., 1975).

### *3.8.4.3 Nitrate Content at Each Harvest*

The nitrate content in plant samples at each harvest was estimated by rapid colorimetric method (Cataldo *et al*., 1975).

## 3.8.5 Plant Analysis

### *3.8.5.1 Uptake of Nitrogen*

The nitrogen content in plants was estimated by modified micro Kjeldal method (Jackson, 1973) and based on the nitrogen content and the dry matter produced the uptake of nitrogen was calculated and expressed in kg $ha^{-1}$.

### *3.8.5.2 Uptake of Phosphorus*

The phosphorus content was estimated by Vanedo-molybdate yellow colour method using spectrophotometer (Jackson, 1973) and uptake of phosphorus was calculated from the phosphorus content and dry matter produced and expressed in kg $ha^{-1}$.

### *3.8.5.3 Uptake of Potassium*

The potassium content was estimated using Flame photometer (Jackson, 1973). The uptake of potassium was calculated from the potassium content and dry matter produced and expressed in kg $ha^{-1}$.

### *3.8.5.4 Uptake of Calcium and Magnesium*

The calcium and magnesium content in plant samples were estimated using Atomic absorption spectrophotometry. Based on the nutrient contents and dry matter production the nutrient uptake was calculated and expressed in kg $ha^{-1}$.

### *3.8.5.5 K: (Ca + Mg) Ratio*

The K: (Ca + Mg) ratio was worked out from the values of K, Ca and Mg content obtained through the analysis of plant samples.

### 3.8.6 Soil Analysis Before and After the Experiment

The soil samples were collected before and after first and second year from individual plots of the experimental area. The composite samples drawn from the individual plots were air dried in shade, powdered, sieved through 2 mm sieve and analyzed for available nitrogen, available phosphorus, available potassium and organic carbon content. The available nitrogen content was estimated by alkaline potassium permanganate method (Subbiah and Asija, 1956), the available phosphorus content was estimated by Bray's colorimetric method (Jackson, 1973), available potassium by neutral normal ammonium acetate method (Jackson, 1973) and organic carbon content by Walkley and Black rapid titration method (Jackson, 1973).

### 3.8.7 Incidence of Pests and Diseases

The crop was observed at weekly intervals for incidence of pests and diseases.

### 3.8.8 Economic Analysis

The economics of cultivation was worked out based on the cost of cultivation and prevailing market price of the fodder crop.

#### *3.8.8.1 Net Income*

The net income was calculated by subtracting cost of cultivation from gross income and expressed in Rs ha$^{-1}$.

#### *3.8.8.2 B: C Ratio*

B: C ratio was worked out as the ratio of gross income to cost of cultivation.

$$\text{B: C ratio} = \frac{\text{Gross income}}{\text{Cost of cultivation}}$$

### 3.8.9 Statistical Analysis

The data pertaining to each observation was analysed statistically by applying the analysis of variance technique (ANOVA) as suggested by Panse and Sukhatme, 1985.

# RESULTS

# 4. RESULTS

The present experiment was conducted in the Instructional Farm attached to the College of Agriculture, Vellayani during July 2014 to April 2016, to standardise the nutrient requirement, spacing and cutting pattern of palisade grass under open and partial shaded condition and to work out the economics of cultivation. The experimental data collected were analysed statistically and the results are presented below.

## 4.1 EXPERIMENT- 1: STANDARDISING THE CUTTING PATTERN, N, P, K LEVELS AND SPACING IN PALISADE GRASS UNDER OPEN CONDITION

### 4.1.1 Biometric Observations

#### *4.1.1.1 Plant Height*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) regarding plant height of palisade grass under open condition during the first year are presented in Table 3a, 3b and 3c.

The result revealed that the treatments had significant impact on plant height during first year. The effect of cutting pattern on plant height was significant on the third, fifth and sixth harvest. Significantly higher plant height was recorded by the $C_2$ (cutting at 10 cm height from ground level) in the third (89.76 cm), fifth (95.90 cm) and sixth harvest (92.37 cm). Significant effect of nutrient levels on plant height was observed in all the harvests. The highest plant height was recorded by $N_3$ (300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) in all the harvests and it was on par with $N_2$ (250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) at third, fourth, fifth and sixth harvest. The effect of plant spacing was observed to be significant in the second, third and sixth harvest where the increased plant spacing decreased the plant height except in third harvest and the highest plant height was registered by the treatment involving narrow spacing (60 cm x 30 cm) in all the harvests. In the third harvest, $S_1$ (90.66 cm) was found to be on a par

Table 3a. Effect of cutting pattern, nutrient levels and spacing on plant height under open condition during first year, cm

| Treatments | Plant height | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 75.79 | 82.92 | 83.13 | 88.13 | 89.51 | 87.34 |
| $C_2$ | 75.75 | 88.07 | 89.76 | 88.94 | 95.90 | 92.37 |
| SEm (±) | 1.159 | 1.831 | 1.439 | 2.041 | 2.159 | 1.740 |
| CD (0.05) | NS | NS | 4.145 | NS | 6.218 | 5.011 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 70.81 | 80.11 | 83.18 | 82.37 | 86.01 | 85.96 |
| $N_2$ | 74.48 | 84.01 | 86.51 | 89.30 | 94.63 | 88.88 |
| $N_3$ | 82.02 | 92.38 | 89.64 | 93.93 | 97.46 | 94.73 |
| SEm (±) | 1.420 | 2.242 | 1.766 | 2.500 | 2.646 | 2.135 |
| CD (0.05) | 4.082 | 6.445 | 5.076 | 7.185 | 7.618 | 6.137 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 77.74 | 90.66 | 92.32 | 92.89 | 96.86 | 95.23 |
| $S_2$ | 75.69 | 85.56 | 83.07 | 87.44 | 92.34 | 87.42 |
| $S_3$ | 73.88 | 80.28 | 83.9 | 85.26 | 88.90 | 86.92 |
| SEm (±) | 1.420 | 2.242 | 1.766 | 2.500 | 2.646 | 2.135 |
| CD (0.05) | NS | 6.445 | 5.076 | NS | NS | 6.137 |

NS- Not significant

Table 3b. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under open condition during first year, cm

| Treatments | Plant height | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 71.12 | 76.32 | 78.34 | 83.03 | 82.77 | 81.60 |
| $c_1n_2$ | 73.99 | 81.46 | 83.94 | 87.14 | 92.78 | 85.16 |
| $c_1n_3$ | 82.26 | 90.98 | 87.11 | 94.20 | 92.96 | 95.28 |
| $c_2n_1$ | 70.49 | 83.89 | 88.01 | 81.71 | 89.25 | 90.32 |
| $c_2n_2$ | 74.98 | 86.56 | 89.08 | 91.46 | 96.47 | 92.60 |
| $c_2n_3$ | 81.79 | 93.78 | 92.18 | 93.66 | 101.96 | 94.18 |
| SEm (±) | 2.000 | 3.171 | 2.498 | 3.535 | 3.240 | 3.020 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 77.79 | 87.96 | 91.41 | 94.39 | 95.75 | 94.24 |
| $c_1s_2$ | 75.87 | 81.57 | 78.40 | 84.83 | 86.82 | 85.34 |
| $c_1s_3$ | 73.71 | 79.23 | 79.59 | 85.16 | 85.95 | 82.44 |
| $c_2s_1$ | 77.70 | 93.36 | 93.23 | 91.40 | 97.97 | 96.21 |
| $c_2s_2$ | 75.51 | 89.54 | 87.73 | 90.06 | 97.86 | 89.49 |
| $c_2s_3$ | 74.04 | 81.32 | 88.30 | 85.37 | 91.85 | 91.40 |
| SEm (±) | 2.000 | 3.171 | 2.498 | 3.535 | 3.240 | 3.020 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 72.38 | 84.10 | 90.22 | 88.72 | 91.25 | 88.93 |
| $n_1s_2$ | 71.75 | 81.95 | 80.22 | 82.05 | 86.93 | 87.47 |
| $n_1s_3$ | 68.28 | 74.27 | 79.10 | 76.35 | 79.86 | 81.48 |
| $n_2s_1$ | 75.30 | 89.90 | 88.63 | 91.88 | 94.65 | 91.07 |
| $n_2s_2$ | 75.10 | 80.97 | 84.50 | 89.10 | 97.08 | 85.08 |
| $n_2s_3$ | 73.05 | 81.15 | 86.40 | 86.92 | 92.16 | 90.48 |
| $n_3s_1$ | 85.55 | 97.97 | 98.12 | 98.08 | 104.70 | 105.68 |
| $n_3s_2$ | 80.22 | 93.75 | 84.89 | 91.18 | 93.01 | 89.70 |
| $n_3s_3$ | 80.30 | 85.42 | 86.33 | 92.52 | 94.68 | 88.80 |
| SEm (±) | 2.460 | 3.880 | 3.059 | 4.330 | 4.420 | 3.698 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 3c. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under open condition during first year, cm

| Treatments | Plant height | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 73.77 | 81.87 | 87.93 | 92.60 | 88.90 | 89.16 |
| $c_1n_1s_2$ | 72.77 | 75.13 | 74.53 | 81.37 | 81.26 | 81.53 |
| $c_1n_1s_3$ | 66.83 | 71.97 | 72.57 | 75.13 | 78.16 | 74.10 |
| $c_1n_2s_1$ | 74.00 | 85.80 | 86.90 | 90.87 | 93.30 | 84.20 |
| $c_1n_2s_2$ | 74.50 | 76.73 | 81.53 | 83.00 | 91.60 | 87.93 |
| $c_1n_2s_3$ | 73.47 | 81.83 | 83.40 | 87.57 | 93.46 | 83.33 |
| $c_1n_3s_1$ | 85.60 | 96.20 | 99.40 | 99.70 | 105.06 | 109.36 |
| $c_1n_3s_2$ | 80.33 | 92.83 | 79.13 | 90.13 | 87.60 | 86.56 |
| $c_1n_3s_3$ | 80.83 | 83.90 | 82.80 | 92.77 | 86.23 | 89.90 |
| $c_2n_1s_1$ | 71.00 | 86.33 | 92.50 | 84.83 | 93.60 | 88.70 |
| $c_2n_1s_2$ | 70.73 | 88.77 | 85.90 | 82.73 | 92.60 | 93.40 |
| $c_2n_1s_3$ | 69.73 | 76.57 | 85.63 | 77.56 | 81.56 | 88.86 |
| $c_2n_2s_1$ | 76.60 | 94.00 | 90.37 | 92.90 | 96.00 | 97.93 |
| $c_2n_2s_2$ | 75.70 | 85.20 | 87.47 | 95.20 | 102.56 | 82.23 |
| $c_2n_2s_3$ | 72.63 | 80.47 | 89.40 | 86.26 | 90.86 | 97.63 |
| $c_2n_3s_1$ | 85.50 | 99.73 | 96.83 | 96.46 | 104.33 | 102.00 |
| $c_2n_3s_2$ | 80.10 | 94.67 | 89.83 | 92.23 | 98.43 | 92.83 |
| $c_2n_3s_3$ | 79.77 | 86.93 | 89.87 | 92.26 | 103.13 | 87.70 |
| SEm (±) | 3.479 | 5.493 | 4.326 | 6.124 | 5.360 | 5.231 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

with $S_2$ (85.56 cm) whereas in the third and sixth harvest $S_3$ (92.32 and 95.23 cm) was found superior to $N_2$ (83.07 and 87.42 cm).

The interaction between cutting pattern and nutrients levels, cutting pattern and spacing and nutrient level and spacing was found non significant in all the harvests during the first year. The combined interaction was also found to be non significant.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) regarding plant height of palisade grass under open condition in the second year are presented in Table 4a, 4b and 4c.

The significant effect of cutting pattern on plant height was noticed on third, sixth and seventh harvests. Plant height was significantly increased by increasing the cutting height ($C_2$) to 10 cm in the third (92.82 cm), sixth (92.10 cm) and seventh (92.84 cm) harvest. In the third, sixth and seventh harvest $C_2$ was found superior to $C_1$. Significant effect of nutrients on plant height was observed in all the harvests except third harvest. The plant height was significantly influenced by increasing the nutrient levels up to 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ in all the harvests except third. In the first, second, fourth, sixth and seventh harvests $N_3$ was found to be on a par with $N_2$ whereas, in the fifth harvest $N_3$ (95.80 cm) was found superior to $N_2$ (91.14 cm). The effect of plant spacing on plant height was observed only on third, fourth and seventh harvests. In the third harvest $S_1$ (94.22cm) and $S_2$ (92.26 cm) was on a par whereas in the fourth and seventh harvests $S_1$ was found significantly superior to $S_2$ and $S_3$.

In the first and sixth harvest significant interaction was observed between cutting height and nutrient levels. In both the harvests highest plant height was observed in the treatment involving 10 cm cutting height and a nutrient level of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ (92.86 and 94.64 cm respectively). Also $c_2n_2$ and $c_2n_3$ was on a par in the first and sixth harvest. Combined interaction was found to be non significant.

Table 4a. Effect of cutting pattern, nutrient levels and spacing on plant height under open condition during second year, cm

| Treatments | Plant height | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 87.97 | 91.06 | 88.57 | 92.64 | 91.14 | 83.31 | 88.54 |
| $C_2$ | 90.25 | 92.15 | 92.82 | 94.74 | 92.42 | 92.10 | 92.84 |
| SEm (±) | 0.804 | 1.229 | 1.172 | 1.664 | 1.246 | 0.791 | 1.087 |
| CD (0.05) | NS | NS | 3.375 | NS | NS | 2.28 | 3.132 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 86.62 | 87.06 | 89.30 | 89.02 | 88.41 | 85.69 | 86.52 |
| $N_2$ | 89.84 | 92.13 | 90.08 | 93.77 | 91.14 | 88.08 | 90.95 |
| $N_3$ | 90.87 | 95.63 | 92.69 | 98.28 | 95.80 | 89.35 | 94.60 |
| SEm (±) | 0.989 | 1.505 | 1.435 | 2.040 | 1.327 | 0.970 | 1.332 |
| CD (0.05) | 2.849 | 4.335 | NS | 5.875 | 3.822 | 2.793 | 3.836 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 91.12 | 93.86 | 94.22 | 98.20 | 91.79 | 88.92 | 95.22 |
| $S_2$ | 88.11 | 92.18 | 92.26 | 90.57 | 93.45 | 88.36 | 89.05 |
| $S_3$ | 88.11 | 88.79 | 85.58 | 92.31 | 90.11 | 85.84 | 87.80 |
| SEm (±) | 0.989 | 1.505 | 1.435 | 2.040 | 1.327 | 0.970 | 1.332 |
| CD (0.05) | NS | NS | 4.133 | 5.875 | NS | NS | 3.836 |

NS- Not significant

Table 4b. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under open condition during second year, cm

| Treatments | Plant height | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 87.88 | 86.10 | 88.43 | 88.03 | 86.10 | 83.34 | 84.50 |
| $c_1n_2$ | 86.83 | 90.24 | 87.66 | 93.13 | 92.34 | 81.53 | 88.31 |
| $c_1n_3$ | 89.18 | 96.83 | 89.60 | 96.75 | 94.98 | 85.06 | 92.81 |
| $c_2n_1$ | 85.34 | 88.01 | 90.16 | 90.02 | 90.72 | 88.04 | 88.55 |
| $c_2n_2$ | 92.86 | 94.01 | 92.48 | 94.41 | 89.94 | 94.63 | 93.58 |
| $c_2n_3$ | 92.56 | 94.42 | 95.78 | 99.81 | 96.62 | 93.64 | 96.38 |
| SEm (±) | 1.394 | 2.129 | 2.030 | 2.886 | 1.775 | 1.371 | 2.176 |
| CD (0.05) | 4.016 | NS | NS | NS | NS | 3.949 | NS |
| $c_1s_1$ | 89.74 | 92.37 | 91.16 | 96.95 | 90.82 | 84.74 | 93.14 |
| $c_1s_2$ | 86.46 | 93.08 | 88.62 | 91.03 | 91.87 | 82.33 | 87.11 |
| $c_1s_3$ | 87.70 | 87.71 | 85.91 | 89.93 | 90.73 | 82.86 | 85.36 |
| $c_2s_1$ | 92.50 | 95.33 | 97.26 | 99.44 | 92.76 | 93.10 | 97.30 |
| $c_2s_2$ | 89.75 | 91.25 | 95.92 | 90.11 | 95.03 | 94.40 | 91.00 |
| $c_2s_3$ | 88.51 | 89.85 | 85.26 | 94.68 | 89.48 | 88.82 | 90.23 |
| SEm (±) | 1.394 | 2.129 | 2.030 | 2.886 | 1.775 | 1.371 | 2.176 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 89.48 | 89.71 | 91.50 | 94.13 | 89.08 | 85.85 | 91.30 |
| $n_1s_2$ | 85.16 | 88.53 | 91.75 | 85.08 | 88.88 | 87.60 | 84.01 |
| $n_1s_3$ | 85.20 | 82.91 | 84.65 | 87.86 | 87.26 | 83.63 | 84.26 |
| $n_2s_1$ | 90.36 | 94.03 | 92.92 | 98.23 | 88.31 | 89.83 | 95.60 |
| $n_2s_2$ | 89.61 | 91.63 | 92.45 | 90.90 | 94.33 | 88.80 | 89.08 |
| $n_2s_3$ | 89.55 | 90.71 | 84.86 | 92.18 | 90.78 | 85.61 | 88.16 |
| $n_3s_1$ | 93.51 | 97.81 | 98.23 | 102.23 | 97.98 | 91.08 | 98.76 |
| $n_3s_2$ | 89.55 | 96.30 | 92.60 | 95.73 | 97.15 | 88.70 | 94.06 |
| $n_3s_3$ | 89.56 | 92.71 | 87.25 | 96.88 | 92.28 | 88.28 | 90.96 |
| SEm (±) | 2.307 | 2.608 | 2.486 | 3.534 | 2.174 | 1.680 | 3.168 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 4c. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under open condition during second year, cm

| Treatments | Plant height | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 88.56 | 86.63 | 88.96 | 91.46 | 86.00 | 82.93 | 89.60 |
| $c_1n_1s_2$ | 86.93 | 88.70 | 88.70 | 84.40 | 83.83 | 85.00 | 82.10 |
| $c_1n_1s_3$ | 88.16 | 82.96 | 87.63 | 88.23 | 88.46 | 82.10 | 81.80 |
| $c_1n_2s_1$ | 87.30 | 94.63 | 91.73 | 100.86 | 91.86 | 82.93 | 93.83 |
| $c_1n_2s_2$ | 86.26 | 89.43 | 86.96 | 91.83 | 92.26 | 79.86 | 84.10 |
| $c_1n_2s_3$ | 86.93 | 86.66 | 84.30 | 86.70 | 92.90 | 81.80 | 87.00 |
| $c_1n_3s_1$ | 93.36 | 95.86 | 92.80 | 98.53 | 94.60 | 88.36 | 96.00 |
| $c_1n_3s_2$ | 86.20 | 101.13 | 90.20 | 96.86 | 99.53 | 82.13 | 95.13 |
| $c_1n_3s_3$ | 88.00 | 93.50 | 85.80 | 94.86 | 90.83 | 84.70 | 87.30 |
| $c_2n_1s_1$ | 90.40 | 92.80 | 94.03 | 96.80 | 92.16 | 88.77 | 93.00 |
| $c_2n_1s_2$ | 83.40 | 88.36 | 94.80 | 85.76 | 93.93 | 90.20 | 85.93 |
| $c_2n_1s_3$ | 82.23 | 82.86 | 81.66 | 87.50 | 86.06 | 85.16 | 86.73 |
| $c_2n_2s_1$ | 93.43 | 93.43 | 94.10 | 95.60 | 84.76 | 96.73 | 97.36 |
| $c_2n_2s_2$ | 92.96 | 93.83 | 97.93 | 89.96 | 96.40 | 97.73 | 94.06 |
| $c_2n_2s_3$ | 92.16 | 94.76 | 85.43 | 97.66 | 88.66 | 89.43 | 89.33 |
| $c_2n_3s_1$ | 93.66 | 99.76 | 103.66 | 105.93 | 101.36 | 93.80 | 101.53 |
| $c_2n_3s_2$ | 92.90 | 91.56 | 95.00 | 94.60 | 94.76 | 95.26 | 93.00 |
| $c_2n_3s_3$ | 91.13 | 91.93 | 88.70 | 98.90 | 93.73 | 91.86 | 94.63 |
| SEm (±) | 3.572 | 3.814 | 3.445 | 4.630 | 3.780 | 3.530 | 4.080 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

#### *4.1.1.2 Tillers Plant$^{-1}$*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to number of tillers plant$^{-1}$ of palisade grass under open condition in the first year are presented in Table 5a, 5b and 5c.

Significant effect of cutting pattern on number of tillers plant$^{-1}$ was noticed only on the first and fifth harvest. The number of tillers plant$^{-1}$ was increased by decreasing the cutting height from 10 cm to ground level both in the first (17.08) and fifth harvest (37.96). The tiller number plant$^{-1}$ was significantly increased by increasing the nutrient levels at all the harvests. Among the fertilizer treatments, the highest nutrient level of $N_3$ recorded the highest number of tillers plant$^{-1}$ in all the harvests. The effect of plant spacing on number of tillers plant$^{-1}$ was noticed in early harvests (first, second and third). Significantly higher number of tillers plant$^{-1}$ were produced in the wider spacing ($S_3$) in all the harvests.

None of the interactions were significant.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to tiller number plant$^{-1}$ of palisade grass under open condition in the second year are presented in Table 6a, 6b and 6c.

In all the harvests except first and seventh, cutting pattern produced a significant impact on number of tillers plant$^{-1}$ which was increased by decreasing the cutting height from 10 cm to ground level. The tiller number plant$^{-1}$ was significantly influenced by the nutrient levels in the third, fourth and fifth harvests where highest number of tillers plant$^{-1}$ (41.65) were produced by $N_3$ and it was on a par with $N_2$ (39.26) at fourth harvest. The effect of plant spacing on number of tillers plant$^{-1}$ recorded was noticed in all the harvests except first. Among the different spacing treatments, the highest tiller number was produced when wider spacing was adopted.

The interactions effects were non significant.

Table 5a. Effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under open condition during first year

| Treatments | Tiller plant$^{-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 17.08 | 33.26 | 35.62 | 43.47 | 37.96 | 38.05 |
| $C_2$ | 14.28 | 32.21 | 34.33 | 42.83 | 31.90 | 33.33 |
| SEm (±) | 0.350 | 0.520 | 0.699 | 1.638 | 1.398 | 1.906 |
| CD (0.05) | 1.022 | NS | NS | NS | 4.025 | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 13.33 | 30.91 | 33.22 | 38.80 | 31.12 | 28.67 |
| $N_2$ | 14.78 | 32.21 | 34.67 | 42.14 | 33.38 | 35.48 |
| $N_3$ | 17.43 | 35.08 | 37.03 | 48.51 | 40.27 | 42.91 |
| SEm (±) | 0.430 | 0.640 | 0.856 | 2.007 | 1.712 | 2.334 |
| CD (0.05) | 1.251 | 1.849 | 2.467 | 5.779 | 4.929 | 6.721 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 14.17 | 31.08 | 32.36 | 40.03 | 31.66 | 33.51 |
| $S_2$ | 14.88 | 32.11 | 34.79 | 43.85 | 35.62 | 35.36 |
| $S_3$ | 16.49 | 35.01 | 37.78 | 45.56 | 37.51 | 38.20 |
| SEm (±) | 0.430 | 0.640 | 0.856 | 2.007 | 1.712 | 2.334 |
| CD (0.05) | 1.251 | 1.849 | 2.467 | NS | NS | NS |

NS- Not significant

Table 5b. Interaction effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under open condition during first year

| Treatments | Tiller plant$^{-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1$ | 13.75 | 31.13 | 34.08 | 38.58 | 35.51 | 30.75 |
| $c_1n_2$ | 16.08 | 32.83 | 34.44 | 43.07 | 36.15 | 36.86 |
| $c_1n_3$ | 18.42 | 35.82 | 38.34 | 48.74 | 42.22 | 46.53 |
| $c_2n_1$ | 12.91 | 30.70 | 32.35 | 39.01 | 26.74 | 26.60 |
| $c_2n_2$ | 13.48 | 31.58 | 34.91 | 41.21 | 30.62 | 34.11 |
| $c_2n_3$ | 16.44 | 34.35 | 35.73 | 48.27 | 38.33 | 39.28 |
| SEm (±) | 0.612 | 0.905 | 0.632 | 0.861 | 0.688 | 0.652 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 14.81 | 31.11 | 33.00 | 40.02 | 34.34 | 35.15 |
| $c_1s_2$ | 15.73 | 32.40 | 34.72 | 44.55 | 39.16 | 37.95 |
| $c_1s_3$ | 17.72 | 36.27 | 39.15 | 45.83 | 40.37 | 41.04 |
| $c_2s_1$ | 13.53 | 31.05 | 31.72 | 40.05 | 28.97 | 31.86 |
| $c_2s_2$ | 14.04 | 31.83 | 34.86 | 43.14 | 32.07 | 32.77 |
| $c_2s_3$ | 15.26 | 33.75 | 36.41 | 45.30 | 34.64 | 35.35 |
| SEm (±) | 0.614 | 0.903 | 0.632 | 0.865 | 0.688 | 0.650 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 12.46 | 29.11 | 32.06 | 36.71 | 28.53 | 25.16 |
| $n_1s_2$ | 12.85 | 30.73 | 32.56 | 39.61 | 31.55 | 29.63 |
| $n_1s_3$ | 14.68 | 32.90 | 35.03 | 40.06 | 33.30 | 31.23 |
| $n_2s_1$ | 13.40 | 30.58 | 31.26 | 38.26 | 30.38 | 33.36 |
| $n_2s_2$ | 14.58 | 31.50 | 35.05 | 42.45 | 33.38 | 33.56 |
| $n_2s_3$ | 16.38 | 34.55 | 37.71 | 45.71 | 36.40 | 39.53 |
| $n_3s_1$ | 16.65 | 33.55 | 33.75 | 45.13 | 36.06 | 42.00 |
| $n_3s_2$ | 17.23 | 34.11 | 36.76 | 49.48 | 41.93 | 42.90 |
| $n_3s_3$ | 18.41 | 37.60 | 40.60 | 50.91 | 42.83 | 43.83 |
| SEm (±) | 0.75 6 | 1.113 | 0.975 | 0.932 | 0.943 | 0.887 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 5c. Interaction effect of cutting pattern, nutrient levels and spacing on tillers $plant^{-1}$ under open condition during first year

| Treatments | Tiller $plant^{-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 13.16 | 29.06 | 32.53 | 35.66 | 31.93 | 25.20 |
| $c_1n_1s_2$ | 13.00 | 30.26 | 32.73 | 39.73 | 37.06 | 32.00 |
| $c_1n_1s_3$ | 15.10 | 34.06 | 37.00 | 40.36 | 37.53 | 35.06 |
| $c_1n_2s_1$ | 13.73 | 30.66 | 32.13 | 40.46 | 31.36 | 35.66 |
| $c_1n_2s_2$ | 15.90 | 32.20 | 33.16 | 43.23 | 37.43 | 35.40 |
| $c_1n_2s_3$ | 18.63 | 35.63 | 38.03 | 45.53 | 39.66 | 39.53 |
| $c_1n_3s_1$ | 17.53 | 33.60 | 34.33 | 43.93 | 39.73 | 44.60 |
| $c_1n_3s_2$ | 18.30 | 34.73 | 38.26 | 50.70 | 43.00 | 46.46 |
| $c_1n_3s_3$ | 19.43 | 39.13 | 42.43 | 51.60 | 43.93 | 48.53 |
| $c_2n_1s_1$ | 11.76 | 29.16 | 31.60 | 37.76 | 25.13 | 25.13 |
| $c_2n_1s_2$ | 12.70 | 31.20 | 32.40 | 39.50 | 26.03 | 27.26 |
| $c_2n_1s_3$ | 14.26 | 31.73 | 33.06 | 39.76 | 29.07 | 27.40 |
| $c_2n_2s_1$ | 13.06 | 30.50 | 30.40 | 36.06 | 29.40 | 31.06 |
| $c_2n_2s_2$ | 13.26 | 30.80 | 36.93 | 41.66 | 29.33 | 31.73 |
| $c_2n_2s_3$ | 14.13 | 33.46 | 37.40 | 45.90 | 33.13 | 39.53 |
| $c_2n_3s_1$ | 15.76 | 33.50 | 33.16 | 46.33 | 32.40 | 39.40 |
| $c_2n_3s_2$ | 16.16 | 33.50 | 35.26 | 48.26 | 40.86 | 39.33 |
| $c_2n_3s_3$ | 17.40 | 36.06 | 38.76 | 50.23 | 41.73 | 39.13 |
| SEm (±) | 1.06 3 | 1.57 5 | 1.844 | 1.857 | 1.763 | 1.647 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 6a. Effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under open condition during second year

| Treatments | Tiller plant$^{-1}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 37.61 | 38.94 | 40.00 | 40.95 | 32.80 | 34.04 | 27.16 |
| $C_2$ | 34.55 | 34.58 | 36.83 | 36.29 | 29.98 | 31.45 | 25.22 |
| SEm (±) | 1.027 | 0.883 | 0.809 | 1.104 | 0.804 | 0.750 | 0.800 |
| CD (0.05) | NS | 2.545 | 2.330 | 3.179 | 2.317 | 2.162 | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 34.94 | 34.97 | 36.29 | 34.95 | 29.75 | 31.46 | 24.38 |
| $N_2$ | 36.69 | 36.31 | 36.56 | 39.26 | 30.54 | 32.19 | 26.00 |
| $N_3$ | 36.61 | 38.99 | 42.40 | 41.65 | 33.87 | 34.58 | 28.18 |
| SEm (±) | 1.258 | 1.082 | 0.991 | 1.352 | 0.985 | 0.919 | 0.980 |
| CD (0.05) | NS | NS | 2.854 | 3.894 | 2.838 | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 34.52 | 34.53 | 33.07 | 35.05 | 30.63 | 30.51 | 24.17 |
| $S_2$ | 35.26 | 36.07 | 39.59 | 38.95 | 29.33 | 33.34 | 24.12 |
| $S_3$ | 38.45 | 39.67 | 42.58 | 41.86 | 34.21 | 34.38 | 30.27 |
| SEm (±) | 1.258 | 1.082 | 0.991 | 1.352 | 0.985 | 0.919 | 0.980 |
| CD (0.05) | NS | 3.117 | 2.854 | 3.894 | 2.838 | 2.647 | 2.822 |

NS- Not significant

Table 6b. Interaction effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under open condition during second year

| Treatments | Tiller plant$^{-1}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 36.38 | 36.32 | 37.45 | 38.55 | 32.80 | 32.16 | 25.80 |
| $c_1n_2$ | 38.22 | 37.32 | 38.34 | 39.87 | 31.68 | 33.35 | 27.26 |
| $c_1n_3$ | 38.23 | 43.17 | 44.21 | 44.42 | 33.91 | 36.60 | 28.42 |
| $c_2n_1$ | 33.50 | 33.62 | 35.13 | 31.35 | 26.71 | 30.75 | 22.96 |
| $c_2n_2$ | 35.16 | 35.31 | 34.77 | 38.64 | 29.40 | 31.03 | 24.74 |
| $c_2n_3$ | 34.98 | 34.81 | 40.60 | 38.88 | 33.84 | 32.56 | 27.95 |
| SEm (±) | 2.322 | 1.865 | 2.835 | 3.128 | 4.251 | 3.970 | 3.982 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 37.50 | 36.17 | 34.13 | 37.94 | 31.93 | 32.27 | 24.48 |
| $c_1s_2$ | 35.82 | 39.05 | 39.70 | 40.71 | 31.04 | 33.57 | 24.71 |
| $c_1s_3$ | 39.52 | 41.58 | 46.17 | 44.20 | 35.42 | 36.26 | 32.28 |
| $c_2s_1$ | 31.55 | 32.88 | 32.02 | 32.15 | 29.33 | 28.74 | 23.86 |
| $c_2s_2$ | 34.71 | 33.08 | 39.48 | 37.20 | 27.62 | 33.11 | 23.53 |
| $c_2s_3$ | 37.38 | 37.76 | 39.00 | 39.53 | 33.00 | 32.50 | 28.26 |
| SEm (±) | 2.322 | 1.865 | 2.835 | 3.128 | 4.251 | 3.970 | 3.982 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 32.95 | 31.40 | 31.53 | 32.86 | 27.90 | 28.88 | 21.46 |
| $n_1s_2$ | 35.20 | 36.53 | 36.51 | 32.13 | 29.03 | 32.06 | 22.98 |
| $n_1s_3$ | 36.68 | 36.98 | 40.83 | 39.86 | 32.33 | 33.43 | 28.70 |
| $n_2s_1$ | 34.85 | 33.90 | 32.73 | 35.81 | 30.46 | 29.78 | 25.08 |
| $n_2s_2$ | 34.93 | 35.88 | 37.60 | 41.60 | 26.60 | 32.50 | 23.60 |
| $n_2s_3$ | 40.30 | 39.16 | 39.35 | 40.36 | 34.56 | 34.30 | 29.33 |
| $n_3s_1$ | 35.78 | 38.30 | 34.96 | 36.46 | 33.53 | 32.86 | 25.98 |
| $n_3s_2$ | 35.66 | 35.80 | 44.66 | 43.13 | 32.36 | 35.46 | 25.78 |
| $n_3s_3$ | 38.38 | 42.88 | 47.58 | 45.36 | 35.73 | 35.41 | 32.80 |
| SEm (±) | 2.527 | 2.894 | 3.750 | 3.768 | 4.780 | 3.554 | 4.978 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 6c. Interaction effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under open condition during second year

| Treatments | Tiller plant$^{-1}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1s_1$ | 35.40 | 34.53 | 30.80 | 35.86 | 32.33 | 28.10 | 22.86 |
| $c_1n_1s_2$ | 34.46 | 35.60 | 37.10 | 35.40 | 31.33 | 31.93 | 24.00 |
| $c_1n_1s_3$ | 39.30 | 38.83 | 44.46 | 44.40 | 34.73 | 36.46 | 30.53 |
| $c_1n_2s_1$ | 37.20 | 32.06 | 34.20 | 40.30 | 31.46 | 33.46 | 23.80 |
| $c_1n_2s_2$ | 37.80 | 39.90 | 36.60 | 41.86 | 27.80 | 32.60 | 25.00 |
| $c_1n_2s_3$ | 39.66 | 40.00 | 44.23 | 37.46 | 35.80 | 34.00 | 33.00 |
| $c_1n_3s_1$ | 39.90 | 41.93 | 37.40 | 37.66 | 32.00 | 35.26 | 26.80 |
| $c_1n_3s_2$ | 35.20 | 41.66 | 45.40 | 44.86 | 34.00 | 36.20 | 25.13 |
| $c_1n_3s_3$ | 39.60 | 45.93 | 49.83 | 50.73 | 35.73 | 38.33 | 33.33 |
| $c_2n_1s_1$ | 30.50 | 28.26 | 32.26 | 29.86 | 23.46 | 29.66 | 20.06 |
| $c_2n_1s_2$ | 35.93 | 37.46 | 35.93 | 28.86 | 26.73 | 32.20 | 21.96 |
| $c_2n_1s_3$ | 34.06 | 35.13 | 37.20 | 35.33 | 29.93 | 30.40 | 26.86 |
| $c_2n_2s_1$ | 32.50 | 35.73 | 31.26 | 31.33 | 29.46 | 26.10 | 26.36 |
| $c_2n_2s_2$ | 32.06 | 31.86 | 38.60 | 41.33 | 25.40 | 32.40 | 22.20 |
| $c_2n_2s_3$ | 40.93 | 38.33 | 34.46 | 43.26 | 33.33 | 34.60 | 25.66 |
| $c_2n_3s_1$ | 31.66 | 34.66 | 32.53 | 35.26 | 35.06 | 30.46 | 25.16 |
| $c_2n_3s_2$ | 36.13 | 29.93 | 43.93 | 41.40 | 30.73 | 34.73 | 26.43 |
| $c_2n_3s_3$ | 37.16 | 39.83 | 45.33 | 40.00 | 35.73 | 32.50 | 32.26 |
| SEm (±) | 4.563 | 5.892 | 6.876 | 4.789 | 5.325 | 6.320 | 5.443 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

#### *4.1.1.3 Leaf: Stem Ratio*

The data presented in Table 7a, 7b and 7c shows the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to leaf: stem ratio of palisade grass under open condition in the first year.

Significant effect of cutting pattern on leaf: stem ratio was observed only on the third, fourth and sixth harvests. The leaf: stem ratio was increased by increasing the cutting height from ground level to 10 cm in the third (1.28), fourth (1.11) and sixth harvests (1.45). The leaf: stem ratio was significantly increased by increasing the nutrient levels at all the harvests except initial harvest. Significant effect of plant spacing on leaf: stem ratio was noticed on third and fourth harvests. In the third harvest, highest leaf: stem ratio (1.25) was obtained with a spacing of 60 cm x 40 cm whereas, in the fourth harvest leaf: stem ratio (1.13) was more with 60 cm x 30 cm spacing.

Significant interaction was observed between cutting height and nutrient levels in the sixth harvest. Maximum leaf: stem ratio (1.50) was recorded when ground level cutting was followed along with application of 300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ of fertilizer. All other interactions were found non significant.

The data presented in Table 8a, 8b and 8c shows the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to leaf: stem ratio of palisade grass under open condition in the second year.

The cutting pattern produced a significant impact on leaf: stem ratio in fifth (1.52) and seventh (1.26) harvest. In both the harvests highest leaf: stem ratio was noticed with 10 cm cutting height. The leaf: stem ratio was significantly increased by the nutrient levels in all the harvests except third harvest where highest leaf: stem ratio was produced by $N_2$ (1.48) and it was on a par with $N_3$ (1.46). Significant effect of plant spacing on leaf: stem ratio was noticed in all the harvests except first. Among the different spacing treatments, the highest leaf: stem ratio was produced when narrow spacing (60 cm x 30 cm) was adopted.

The interactions effects were non significant.

Table 7a. Effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under open condition during first year

| Treatments | Leaf: stem ratio | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 0.78 | 1.02 | 1.18 | 1.07 | 1.63 | 1.41 |
| $C_2$ | 0.80 | 1.02 | 1.28 | 1.11 | 1.64 | 1.45 |
| SEm (±) | 0.021 | 0.002 | 0.034 | 0.014 | 0.009 | 0.006 |
| CD (0.05) | NS | NS | 0.011 | 0.042 | NS | 0.019 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 0.77 | 1.00 | 1.14 | 1.03 | 1.58 | 1.41 |
| $N_2$ | 0.81 | 1.01 | 1.20 | 1.07 | 1.60 | 1.42 |
| $N_3$ | 0.80 | 1.04 | 1.35 | 1.16 | 1.72 | 1.46 |
| SEm (±) | 0.026 | 0.002 | 0.014 | 0.017 | 0.011 | 0.008 |
| CD (0.05) | NS | 0.007 | 0.042 | 0.051 | 0.034 | 0.024 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 0.80 | 1.02 | 1.24 | 1.13 | 1.64 | 1.43 |
| $S_2$ | 0.76 | 1.07 | 1.25 | 1.07 | 1.63 | 1.44 |
| $S_3$ | 0.81 | 1.02 | 1.20 | 1.07 | 1.62 | 1.42 |
| SEm (±) | 0.026 | 0.007 | 0.014 | 0.017 | 0.011 | 0.008 |
| CD (0.05) | NS | NS | 0.042 | 0.051 | NS | NS |

NS- Not significant

Table 7b. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under open condition during first year

| Treatments | Leaf: stem ratio | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1$ | 0.73 | 1.04 | 1.30 | 1.16 | 1.72 | 1.43 |
| $c_1n_2$ | 0.81 | 1.02 | 1.17 | 1.04 | 1.59 | 1.40 |
| $c_1n_3$ | 0.80 | 1.00 | 1.07 | 1.01 | 1.57 | 1.41 |
| $c_2n_1$ | 0.81 | 1.04 | 1.40 | 1.17 | 1.71 | 1.50 |
| $c_2n_2$ | 0.81 | 1.01 | 1.22 | 1.11 | 1.61 | 1.44 |
| $c_2n_3$ | 0.80 | 1.00 | 1.21 | 1.05 | 1.59 | 1.41 |
| SEm (±) | 0.037 | 0.003 | 0.020 | 0.025 | 0.016 | 0.011 |
| CD (0.05) | NS | NS | NS | NS | NS | 0.034 |
| $c_1s_1$ | 0.81 | 1.02 | 1.20 | 1.08 | 1.64 | 1.42 |
| $c_1s_2$ | 0.72 | 1.02 | 1.20 | 1.05 | 1.62 | 1.41 |
| $c_1s_3$ | 0.81 | 1.02 | 1.15 | 1.07 | 1.62 | 1.40 |
| $c_2s_1$ | 0.81 | 1.01 | 1.28 | 1.18 | 1.65 | 1.44 |
| $c_2s_2$ | 0.81 | 1.02 | 1.31 | 1.08 | 1.64 | 1.48 |
| $c_2s_3$ | 0.80 | 1.02 | 1.24 | 1.077 | 1.63 | 1.43 |
| SEm (±) | 0.037 | 0.003 | 0.020 | 0.025 | 0.016 | 0.011 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 0.82 | 1.04 | 1.38 | 1.17 | 1.73 | 1.46 |
| $n_1s_2$ | 0.68 | 1.04 | 1.36 | 1.16 | 1.72 | 1.46 |
| $n_1s_3$ | 0.81 | 1.04 | 1.31 | 1.16 | 1.72 | 1.46 |
| $n_2s_1$ | 0.81 | 1.01 | 1.19 | 1.15 | 1.62 | 1.42 |
| $n_2s_2$ | 0.81 | 1.02 | 1.21 | 1.05 | 1.59 | 1.46 |
| $n_2s_3$ | 0.81 | 1.01 | 1.19 | 1.03 | 1.58 | 1.39 |
| $n_3s_1$ | 0.80 | 1.00 | 1.15 | 1.07 | 1.59 | 1.41 |
| $n_3s_2$ | 0.80 | 1.00 | 1.19 | 0.99 | 1.58 | 1.42 |
| $n_3s_3$ | 0.80 | 1.00 | 1.09 | 1.03 | 1.57 | 1.40 |
| SEm (±) | 0.045 | 0.004 | 0.025 | 0.030 | 0.020 | 0.014 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 7c. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under open condition during first year

| Treatments | Leaf: stem ratio | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 0.81 | 1.04 | 1.33 | 1.16 | 1.72 | 1.43 |
| $c_1n_1s_2$ | 0.55 | 1.04 | 1.33 | 1.18 | 1.72 | 1.42 |
| $c_1n_1s_3$ | 0.82 | 1.04 | 1.26 | 1.13 | 1.72 | 1.43 |
| $c_1n_2s_1$ | 0.81 | 1.02 | 1.16 | 1.10 | 1.62 | 1.41 |
| $c_1n_2s_2$ | 0.81 | 1.01 | 1.16 | 1.00 | 1.58 | 1.41 |
| $c_1n_2s_3$ | 0.81 | 1.02 | 1.19 | 1.03 | 1.57 | 1.38 |
| $c_1n_3s_1$ | 0.80 | 1.00 | 1.10 | 0.99 | 1.57 | 1.42 |
| $c_1n_3s_2$ | 0.81 | 1.00 | 1.11 | 0.99 | 1.57 | 1.40 |
| $c_1n_3s_3$ | 0.80 | 1.00 | 1.01 | 1.06 | 1.56 | 1.40 |
| $c_2n_1s_1$ | 0.82 | 1.04 | 1.44 | 1.18 | 1.74 | 1.50 |
| $c_2n_1s_2$ | 0.82 | 1.05 | 1.40 | 1.15 | 1.72 | 1.50 |
| $c_2n_1s_3$ | 0.80 | 1.05 | 1.37 | 1.19 | 1.71 | 1.50 |
| $c_2n_2s_1$ | 0.81 | 1.01 | 1.21 | 1.20 | 1.62 | 1.43 |
| $c_2n_2s_2$ | 0.81 | 1.02 | 1.26 | 1.10 | 1.61 | 1.50 |
| $c_2n_2s_3$ | 0.81 | 1.01 | 1.20 | 1.03 | 1.60 | 1.40 |
| $c_2n_3s_1$ | 0.80 | 1.00 | 1.20 | 1.16 | 1.60 | 1.40 |
| $c_2n_3s_2$ | 0.80 | 1.00 | 1.26 | 1.00 | 1.60 | 1.44 |
| $c_2n_3s_3$ | 0.80 | 1.01 | 1.17 | 1.00 | 1.58 | 1.41 |
| SEm (±) | 0.064 | 0.006 | 0.035 | 0.043 | 0.054 | 0.020 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 8a. Effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under open condition during second year

| Treatments | Leaf: stem ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 1.23 | 1.38 | 1.43 | 1.66 | 1.44 | 1.41 | 1.22 |
| $C_2$ | 1.24 | 1.34 | 1.40 | 1.62 | 1.52 | 1.43 | 1.26 |
| SEm (±) | 0.090 | 0.034 | 0.024 | 0.040 | 0.033 | 0.031 | 0.023 |
| CD (0.05) | NS | NS | NS | NS | 0.063 | NS | 0.044 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 1.18 | 1.30 | 1.31 | 1.47 | 1.35 | 1.34 | 1.15 |
| $N_2$ | 1.20 | 1.36 | 1.48 | 1.68 | 1.50 | 1.43 | 1.20 |
| $N_3$ | 1.32 | 1.43 | 1.46 | 1.77 | 1.61 | 1.50 | 1.38 |
| SEm (±) | 0.011 | 0.042 | 0.029 | 0.050 | 0.041 | 0.038 | 0.028 |
| CD (0.05) | 0.034 | 0.080 | 0.056 | 0.095 | 0.078 | 0.072 | 0.054 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 1.25 | 1.44 | 1.49 | 1.76 | 1.63 | 1.51 | 1.33 |
| $S_2$ | 1.24 | 1.37 | 1.43 | 1.63 | 1.56 | 1.47 | 1.26 |
| $S_3$ | 1.23 | 1.28 | 1.34 | 1.53 | 1.27 | 1.30 | 1.15 |
| SEm (±) | 0.011 | 0.042 | 0.029 | 0.050 | 0.041 | 0.038 | 0.028 |
| CD (0.05) | NS | 0.080 | 0.056 | 0.095 | 0.078 | 0.072 | 0.054 |

NS- Not significant

Table 8b. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under open condition during second year

| Treatments | Leaf: stem ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 1.32 | 1.42 | 1.46 | 1.84 | 1.64 | 1.52 | 1.39 |
| $c_1n_2$ | 1.21 | 1.41 | 1.51 | 1.71 | 1.50 | 1.40 | 1.21 |
| $c_1n_3$ | 1.19 | 1.29 | 1.32 | 1.43 | 1.44 | 1.38 | 1.20 |
| $c_2n_1$ | 1.32 | 1.42 | 1.47 | 1.71 | 1.58 | 1.48 | 1.37 |
| $c_2n_2$ | 1.19 | 1.29 | 1.43 | 1.63 | 1.50 | 1.45 | 1.18 |
| $c_2n_3$ | 1.17 | 1.30 | 1.30 | 1.51 | 1.26 | 1.31 | 1.11 |
| SEm (±) | 0.016 | 0.060 | 0.042 | 0.071 | 0.058 | 0.054 | 0.040 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 1.25 | 1.44 | 1.50 | 1.75 | 1.64 | 1.53 | 1.38 |
| $c_1s_2$ | 1.24 | 1.39 | 1.45 | 1.64 | 1.65 | 1.47 | 1.24 |
| $c_1s_3$ | 1.23 | 1.30 | 1.33 | 1.58 | 1.29 | 1.30 | 1.17 |
| $c_2s_1$ | 1.24 | 1.42 | 1.48 | 1.76 | 1.62 | 1.49 | 1.27 |
| $c_2s_2$ | 1.22 | 1.33 | 1.40 | 1.61 | 1.47 | 1.46 | 1.27 |
| $c_2s_3$ | 1.22 | 1.26 | 1.33 | 1.48 | 1.24 | 1.29 | 1.11 |
| SEm (±) | 0.016 | 0.060 | 0.042 | 0.071 | 0.058 | 0.054 | 0.040 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 1.33 | 1.55 | 1.57 | 1.90 | 1.78 | 1.56 | 1.48 |
| $n_1s_2$ | 1.32 | 1.44 | 1.48 | 1.75 | 1.70 | 1.58 | 1.41 |
| $n_1s_3$ | 1.32 | 1.28 | 1.34 | 1.68 | 1.35 | 1.35 | 1.24 |
| $n_2s_1$ | 1.22 | 1.40 | 1.55 | 1.80 | 1.65 | 1.50 | 1.29 |
| $n_2s_2$ | 1.19 | 1.34 | 1.45 | 1.68 | 1.56 | 1.45 | 1.21 |
| $n_2s_3$ | 1.18 | 1.32 | 1.42 | 1.53 | 1.28 | 1.33 | 1.10 |
| $n_3s_1$ | 1.19 | 1.34 | 1.36 | 1.58 | 1.46 | 1.46 | 1.21 |
| $n_3s_2$ | 1.18 | 1.32 | 1.35 | 1.45 | 1.40 | 1.36 | 1.15 |
| $n_3s_3$ | 1.17 | 1.23 | 1.24 | 1.38 | 1.17 | 1.20 | 1.10 |
| SEm (±) | 0.020 | 0.073 | 0.052 | 0.08 | 0.071 | 0.066 | 0.049 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 8c. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under open condition during second year

| Treatments | Leaf: stem ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1s_1$ | 1.34 | 1.52 | 1.58 | 1.94 | 1.76 | 1.57 | 1.54 |
| $c_1n_1s_2$ | 1.32 | 1.48 | 1.46 | 1.80 | 1.80 | 1.62 | 1.40 |
| $c_1n_1s_3$ | 1.31 | 1.27 | 1.33 | 1.78 | 1.36 | 1.36 | 1.23 |
| $c_1n_2s_1$ | 1.22 | 1.45 | 1.60 | 1.82 | 1.63 | 1.52 | 1.31 |
| $c_1n_2s_2$ | 1.21 | 1.41 | 1.50 | 1.74 | 1.56 | 1.43 | 1.20 |
| $c_1n_2s_3$ | 1.20 | 1.39 | 1.43 | 1.59 | 1.30 | 1.26 | 1.13 |
| $c_1n_3s_1$ | 1.20 | 1.35 | 1.33 | 1.51 | 1.53 | 1.50 | 1.30 |
| $c_1n_3s_2$ | 1.20 | 1.30 | 1.40 | 1.40 | 1.58 | 1.36 | 1.13 |
| $c_1n_3s_3$ | 1.18 | 1.23 | 1.25 | 1.37 | 1.21 | 1.28 | 1.16 |
| $c_2n_1s_1$ | 1.32 | 1.59 | 1.56 | 1.87 | 1.80 | 1.55 | 1.43 |
| $c_2n_1s_2$ | 1.32 | 1.40 | 1.50 | 1.70 | 1.61 | 1.54 | 1.43 |
| $c_2n_1s_3$ | 1.32 | 1.29 | 1.36 | 1.58 | 1.33 | 1.35 | 1.24 |
| $c_2n_2s_1$ | 1.22 | 1.35 | 1.50 | 1.79 | 1.66 | 1.48 | 1.26 |
| $c_2n_2s_2$ | 1.18 | 1.27 | 1.40 | 1.63 | 1.56 | 1.48 | 1.23 |
| $c_2n_2s_3$ | 1.17 | 1.26 | 1.41 | 1.47 | 1.26 | 1.40 | 1.06 |
| $c_2n_3s_1$ | 1.17 | 1.33 | 1.39 | 1.64 | 1.40 | 1.43 | 1.13 |
| $c_2n_3s_2$ | 1.17 | 1.33 | 1.30 | 1.50 | 1.23 | 1.36 | 1.17 |
| $c_2n_3s_3$ | 1.16 | 1.24 | 1.23 | 1.40 | 1.14 | 1.13 | 1.03 |
| SEm (±) | 0.029 | 0.103 | 0.073 | 0.123 | 0.101 | 0.094 | 0.070 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

#### *4.1.1.4 Regeneration Percentage*

The effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to regeneration percentage of palisade grass under open condition in the first year are presented in Table 9a, 9b and 9c.

There was no significant effect of cutting pattern on regeneration percentage on all harvests. The regeneration percentage was not significantly influenced by increasing the nutrient levels at all the harvests. Significant effect of plant spacing on regeneration percentage was noticed on all harvests. In all harvests highest regeneration percentage was obtained with a spacing of 60 cm x 60 cm and was significantly superior to 60 cm x 40 cm and 60 cm x 30 cm.

Significant interaction was observed between nutrient levels and spacing in the fourth and fifth harvest. In both harvests maximum regeneration percentage was observed in $n_2s_3$ and $n_3s_3$. All other interactions were found non significant.

The effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to regeneration percentage of palisade grass under open condition in the second year are presented in Table 10a, 10b and 10c.

There was no significant effect of cutting pattern on regeneration percentage on all harvests. The regeneration percentage was not significantly influenced by increasing the nutrient levels at all the harvests. Significant effect of plant spacing on regeneration percentage was noticed on all harvests except third harvest. In all harvests highest regeneration percentage was obtained with a spacing of 60 cm x 60 cm.

The interactions effects were non significant.

### 4.1.2 Yield Parameters

#### *4.1.2.1 Green Fodder Yield*

The influence of cutting pattern, nutrient levels and plant spacing on green fodder yield of palisade grass under open condition in the first year are presented in Table 11a, 11b and 11c.

Table 9a. Effect of cutting pattern, nutrient levels and spacing on regeneration percentage under open condition during first year, per cent

| Treatments | Regeneration percentage | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 99.28 | 98.79 | 98.55 | 98.47 | 98.19 | 98.11 |
| $C_2$ | 99.69 | 99.08 | 99.02 | 98.85 | 98.73 | 98.50 |
| SEm (±) | 0.183 | 0.274 | 0.286 | 0.250 | 0.249 | 0.259 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 99.57 | 99.20 | 98.83 | 98.72 | 98.30 | 98.01 |
| $N_2$ | 99.14 | 98.70 | 98.70 | 98.61 | 98.43 | 98.26 |
| $N_3$ | 99.73 | 98.91 | 98.82 | 98.65 | 98.65 | 98.65 |
| SEm (±) | 0.224 | 0.336 | 0.351 | 0.306 | 0.306 | 0.317 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | 99.30 | 98.43 | 98.17 | 97.91 | 97.48 | 97.13 |
| $S_2$ | 99.16 | 98.38 | 98.38 | 98.27 | 98.10 | 97.98 |
| $S_3$ | 100.00 | 100.00 | 99.81 | 99.81 | 99.81 | 99.81 |
| SEm (±) | 0.224 | 0.336 | 0.351 | 0.306 | 0.306 | 0.317 |
| CD (0.05) | 0.645 | 0.969 | 1.012 | 0.883 | 0.881 | 0.915 |

NS- Not significant

Table 9b. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under open condition during first year, per cent

| Treatments | Regeneration percentage | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 99.55 | 99.15 | 98.60 | 98.37 | 97.86 | 97.64 |
| $c_1n_2$ | 98.81 | 98.36 | 98.36 | 98.36 | 98.02 | 98.02 |
| $c_1n_3$ | 99.47 | 98.85 | 98.68 | 98.68 | 98.68 | 98.68 |
| $c_2n_1$ | 99.60 | 99.25 | 99.07 | 99.07 | 98.73 | 98.38 |
| $c_2n_2$ | 99.47 | 99.03 | 99.03 | 98.85 | 98.85 | 98.51 |
| $c_2n_3$ | 100.00 | 98.96 | 98.96 | 98.62 | 98.62 | 98.62 |
| SEm (±) | 0.317 | 0.476 | 0.497 | 0.433 | 0.432 | 0.449 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 98.95 | 98.60 | 98.25 | 98.25 | 97.40 | 97.40 |
| $c_1s_2$ | 98.88 | 97.77 | 97.77 | 97.55 | 97.55 | 97.33 |
| $c_1s_3$ | 100.00 | 100.00 | 99.62 | 99.62 | 99.62 | 99.62 |
| $c_2s_1$ | 99.64 | 98.26 | 98.08 | 97.56 | 97.56 | 96.87 |
| $c_2s_2$ | 99.43 | 98.98 | 98.98 | 98.98 | 98.64 | 98.64 |
| $c_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.317 | 0.476 | 0.497 | 0.433 | 0.432 | 0.449 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 99.73 | 98.95 | 98.41 | 98.41 | 97.65 | 97.13 |
| $n_1s_2$ | 99.00 | 98.66 | 98.66 | 98.33 | 97.81 | 97.48 |
| $n_1s_3$ | 100.00 | 100.00 | 99.43 | 99.43 | 99.43 | 99.43 |
| $n_2s_1$ | 98.95 | 98.95 | 98.95 | 98.68 | 98.16 | 97.65 |
| $n_2s_2$ | 98.48 | 97.15 | 97.15 | 97.10 | 97.15 | 97.15 |
| $n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $n_3s_1$ | 99.21 | 97.40 | 97.15 | 96.63 | 96.63 | 96.63 |
| $n_3s_2$ | 100.00 | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 |
| $n_3s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.388 | 0.583 | 0.608 | 0.531 | 1.153 | 0.778 |
| CD (0.05) | NS | NS | NS | 1.530 | 3.320 | NS |

NS- Not significant

Table 9c. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under open condition during first year, per cent

| Treatments | Regeneration percentage | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 100.00 | 99.46 | 98.93 | 98.93 | 97.40 | 97.40 |
| $c_1n_1s_2$ | 98.66 | 98.00 | 98.00 | 97.33 | 97.33 | 96.66 |
| $c_1n_1s_3$ | 100.00 | 100.00 | 98.86 | 98.86 | 98.86 | 98.86 |
| $c_1n_2s_1$ | 98.43 | 98.43 | 98.43 | 98.43 | 97.40 | 97.40 |
| $c_1n_2s_2$ | 98.00 | 96.66 | 96.66 | 96.66 | 96.66 | 96.66 |
| $c_1n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_1n_3s_1$ | 98.43 | 97.90 | 97.40 | 97.40 | 97.40 | 97.40 |
| $c_1n_3s_2$ | 100.00 | 98.66 | 98.66 | 98.66 | 98.66 | 98.66 |
| $c_1n_3s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_1s_1$ | 99.46 | 98.43 | 97.90 | 97.90 | 97.90 | 96.86 |
| $c_2n_1s_2$ | 99.33 | 99.33 | 99.33 | 99.33 | 98.30 | 98.30 |
| $c_2n_1s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_2s_1$ | 99.46 | 99.46 | 99.46 | 98.93 | 98.93 | 97.90 |
| $c_2n_2s_2$ | 98.96 | 97.63 | 97.63 | 97.63 | 97.63 | 97.63 |
| $c_2n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_3s_1$ | 100.00 | 96.90 | 96.90 | 95.86 | 95.86 | 95.86 |
| $c_2n_3s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_3s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.549 | 0.824 | 0.861 | 0.751 | 0.749 | 0.778 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 10a. Effect of cutting pattern, nutrient levels and spacing on regeneration percentage under open condition during second year, per cent

| Treatments | Regeneration percentage | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 99.63 | 99.63 | 99.63 | 99.57 | 99.51 | 99.519 | 99.27 |
| $C_2$ | 99.94 | 99.88 | 99.73 | 99.61 | 99.55 | 99.10 | 98.98 |
| SEm (±) | 0.108 | 0.116 | 0.155 | 0.177 | 0.167 | 0.253 | 0.234 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 99.62 | 99.53 | 99.53 | 99.53 | 99.36 | 99.01 | 99.01 |
| $N_2$ | 99.73 | 99.73 | 99.51 | 99.25 | 99.25 | 99.25 | 99.14 |
| $N_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 99.65 | 99.21 |
| SEm (±) | 0.132 | 0.142 | 0.189 | 0.216 | 0.204 | 0.310 | 0.287 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 99.47 | 99.38 | 99.38 | 99.12 | 98.95 | 98.26 | 97.71 |
| $S_2$ | 99.88 | 99.88 | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 |
| $S_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.132 | 0.142 | 0.189 | 0.216 | 0.204 | 0.310 | 0.287 |
| CD (0.05) | 0.382 | 0.410 | NS | 0.624 | 0.590 | 0.893 | 0.828 |

NS- Not significant

Table 10b. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under open condition during second year, per cent

| Treatments | Regeneration percentage | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1$ | 99.25 | 99.25 | 99.25 | 99.25 | 99.07 | 99.07 | 99.07 |
| $c_1n_2$ | 99.64 | 99.64 | 99.64 | 99.47 | 99.47 | 99.47 | 99.25 |
| $c_1n_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 99.47 |
| $c_2n_1$ | 100.00 | 99.82 | 99.82 | 99.82 | 99.64 | 98.95 | 98.95 |
| $c_2n_2$ | 99.82 | 99.82 | 99.37 | 99.03 | 99.03 | 99.03 | 99.03 |
| $c_2n_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 99.31 | 98.95 |
| SEm (±) | 0.187 | 0.201 | 0.268 | 0.306 | 0.290 | 0.438 | 0.406 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 99.12 | 99.12 | 99.12 | 98.95 | 98.77 | 98.77 | 98.03 |
| $c_1s_2$ | 99.77 | 99.77 | 99.77 | 99.77 | 99.77 | 99.77 | 99.77 |
| $c_1s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2s_1$ | 99.82 | 99.64 | 99.64 | 99.30 | 99.12 | 97.74 | 97.38 |
| $c_2s_2$ | 100.0 | 100.00 | 99.55 | 99.55 | 99.55 | 99.55 | 99.55 |
| $c_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.187 | 0.201 | 0.268 | 0.306 | 0.290 | 0.438 | 0.406 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 99.21 | 98.95 | 98.95 | 98.95 | 98.41 | 97.38 | 97.38 |
| $n_1s_2$ | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 |
| $n_1s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $n_2s_1$ | 99.20 | 99.20 | 99.20 | 98.43 | 98.43 | 98.43 | 98.10 |
| $n_2s_2$ | 100.00 | 100.00 | 99.333 | 99.33 | 99.33 | 99.33 | 99.33 |
| $n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $n_3s_1$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 98.96 | 97.65 |
| $n_3s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $n_3s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.229 | 0.246 | 0.328 | 0.375 | 0.354 | 0.537 | 0.498 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 10c. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under open condition during second year, per cent

| Treatments | Regeneration percentage | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 98.43 | 98.43 | 98.43 | 98.43 | 97.90 | 97.90 | 97.90 |
| $c_1n_1s_2$ | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 |
| $c_1n_1s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_1n_2s_1$ | 98.93 | 98.93 | 98.93 | 98.43 | 98.43 | 98.43 | 97.76 |
| $c_1n_2s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_1n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_1n_3s_1$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 98.43 |
| $c_1n_3s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_1n_3s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_1s_1$ | 100.00 | 99.46 | 99.46 | 99.46 | 98.93 | 96.86 | 96.86 |
| $c_2n_1s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_1s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_2s_1$ | 99.46 | 99.46 | 99.46 | 98.43 | 98.43 | 98.43 | 98.43 |
| $c_2n_2s_2$ | 100.00 | 100.00 | 98.66 | 98.66 | 98.66 | 98.66 | 98.66 |
| $c_2n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_3s_1$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 97.93 | 96.86 |
| $c_2n_3s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_3s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.325 | 0.349 | 0.465 | 0.531 | 0.502 | 0.759 | 0.704 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 11a. Effect of cutting pattern, nutrient levels and spacing on GFY under open condition during first year, t $ha^{-1}$

| Treatments | Green fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 12.94 | 17.69 | 16.99 | 19.61 | 19.16 | 18.89 | 105.29 |
| $C_2$ | 13.78 | 17.78 | 18.87 | 22.55 | 21.40 | 20.59 | 114.98 |
| SEm (±) | 0.466 | 0.942 | 0.983 | 1.519 | 1.222 | 1.005 | 2.448 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | 7.050 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 12.95 | 16.08 | 14.68 | 16.30 | 16.25 | 17.66 | 93.94 |
| $N_2$ | 13.57 | 18.10 | 19.35 | 21.37 | 20.66 | 20.27 | 113.32 |
| $N_3$ | 13.57 | 19.03 | 19.76 | 25.57 | 23.93 | 21.28 | 123.15 |
| SEm (±) | 0.571 | 1.153 | 1.201 | 1.858 | 1.497 | 1.231 | 3.004 |
| CD (0.05) | NS | NS | 3.460 | 5.350 | 4.310 | NS | 8.650 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 14.16 | 19.47 | 17.77 | 27.00 | 20.17 | 20.26 | 118.85`` |
| $S_2$ | 12.50 | 16.78 | 19.53 | 18.82 | 22.62 | 20.60 | 110.86 |
| $S_3$ | 13.43 | 16.95 | 16.50 | 17.42 | 18.04 | 18.34 | 100.70 |
| SEm (±) | 0.571 | 1.153 | 1.201 | 1.858 | 1.497 | 1.231 | 3.004 |
| CD (0.05) | NS | NS | NS | 5.350 | 4.310 | NS | 8.650 |

NS- Not significant

Table 11b. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under open condition during first year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Total yield** |
| $c_1n_1$ | 12.52 | 16.43 | 13.88 | 15.64 | 16.84 | 16.43 | 91.76 |
| $c_1n_2$ | 13.02 | 17.36 | 17.72 | 19.33 | 17.94 | 21.21 | 106.60 |
| $c_1n_3$ | 13.30 | 19.27 | 19.37 | 23.85 | 22.68 | 19.02 | 117.52 |
| $c_2n_1$ | 13.38 | 15.74 | 15.47 | 16.96 | 15.65 | 18.87 | 96.11 |
| $c_2n_2$ | 14.13 | 18.83 | 20.98 | 23.40 | 23.36 | 19.32 | 120.04 |
| $c_2n_3$ | 13.84 | 18.78 | 20.15 | 27.27 | 25.16 | 23.54 | 128.77 |
| SEm (±) | 0.673 | 1.238 | 1.678 | 0.853 | 0.889 | 0.698 | 9.873 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 14.01 | 19.31 | 18.25 | 23.85 | 20.21 | 19.37 | 115.02 |
| $c_1s_2$ | 11.53 | 17.13 | 17.11 | 18.97 | 19.95 | 19.16 | 103.87 |
| $c_1s_3$ | 13.30 | 16.63 | 15.62 | 16.00 | 17.31 | 18.12 | 96.98 |
| $c_2s_1$ | 14.31 | 19.64 | 17.28 | 30.15 | 20.13 | 21.14 | 122.67 |
| $c_2s_2$ | 13.47 | 16.44 | 21.95 | 18.65 | 25.27 | 22.03 | 117.84 |
| $c_2s_3$ | 13.57 | 17.27 | 17.37 | 18.83 | 18.77 | 18.56 | 104.41 |
| SEm (±) | 0.673 | 1.236 | 1.678 | 0.856 | 0.889 | 0.698 | 9.873 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 14.36 | 18.06 | 13.38 | 21.35 | 13.63 | 18.03 | 98.83 |
| $n_1s_2$ | 10.65 | 14.45 | 17.26 | 14.63 | 19.76 | 18.58 | 95.35 |
| $n_1s_3$ | 13.85 | 15.75 | 13.40 | 12.93 | 15.35 | 16.35 | 87.63 |
| $n_2s_1$ | 14.26 | 18.43 | 21.08 | 26.78 | 18.86 | 20.88 | 120.31 |
| $n_2s_2$ | 13.71 | 18.60 | 21.21 | 19.06 | 22.15 | 20.23 | 114.98 |
| $n_2s_3$ | 12.75 | 17.26 | 15.76 | 18.25 | 20.95 | 19.68 | 104.66 |
| $n_3s_1$ | 13.85 | 21.93 | 18.85 | 32.88 | 28.01 | 21.86 | 137.40 |
| $n_3s_2$ | 13.15 | 17.31 | 20.11 | 22.75 | 25.93 | 22.98 | 122.25 |
| $n_3s_3$ | 13.71 | 17.85 | 20.33 | 21.06 | 17.83 | 19.00 | 109.80 |
| SEm (±) | 0.783 | 1.984 | 1.786 | 0.978 | 1.412 | 0.765 | 10.132 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 11c. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under open condition during first year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Total yield** |
| $c_1n_1s_1$ | 13.76 | 18.66 | 15.40 | 17.20 | 17.10 | 14.70 | 96.83 |
| $c_1n_1s_2$ | 9.66 | 14.56 | 15.26 | 16.53 | 18.83 | 18.50 | 93.36 |
| $c_1n_1s_3$ | 14.13 | 16.06 | 11.00 | 13.20 | 14.60 | 16.10 | 85.10 |
| $c_1n_2s_1$ | 15.80 | 17.20 | 20.80 | 25.80 | 15.53 | 21.23 | 116.36 |
| $c_1n_2s_2$ | 12.46 | 19.10 | 17.76 | 14.56 | 18.86 | 21.06 | 103.83 |
| $c_1n_2s_3$ | 10.80 | 15.80 | 14.60 | 17.63 | 19.43 | 21.33 | 99.60 |
| $c_1n_3s_1$ | 12.46 | 22.06 | 18.56 | 28.56 | 28.00 | 22.20 | 131.86 |
| $c_1n_3s_2$ | 12.46 | 17.73 | 18.30 | 25.83 | 22.16 | 17.93 | 114.43 |
| $c_1n_3s_3$ | 14.96 | 18.03 | 21.26 | 17.16 | 17.90 | 16.93 | 106.26 |
| $c_2n_1s_1$ | 14.96 | 17.46 | 11.36 | 25.50 | 10.16 | 21.36 | 100.83 |
| $c_2n_1s_2$ | 11.63 | 14.33 | 19.26 | 12.73 | 20.70 | 18.66 | 97.33 |
| $c_2n_1s_3$ | 13.56 | 15.43 | 15.80 | 12.60 | 16.10 | 16.60 | 90.16 |
| $c_2n_2s_1$ | 12.73 | 19.66 | 21.36 | 27.76 | 22.20 | 20.53 | 124.26 |
| $c_2n_2s_2$ | 14.96 | 18.10 | 24.66 | 23.56 | 25.43 | 19.40 | 126.13 |
| $c_2n_2s_3$ | 14.70 | 18.73 | 16.93 | 18.86 | 22.46 | 18.03 | 109.73 |
| $c_2n_3s_1$ | 15.23 | 21.80 | 19.13 | 37.20 | 28.03 | 21.53 | 142.93 |
| $c_2n_3s_2$ | 13.83 | 16.90 | 21.93 | 19.66 | 29.70 | 28.03 | 130.06 |
| $c_2n_3s_3$ | 12.46 | 17.66 | 19.40 | 24.96 | 17.76 | 21.06 | 113.33 |
| SEm (±) | 1.324 | 1.567 | 1.765 | 2.113 | 1.987 | 0.980 | 12.987 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

The results revealed that the effect of cutting pattern on green fodder yield was non significant in all the harvests whereas the total green fodder yield was significantly influenced by cutting height. The highest green fodder yield was obtained when cutting at 10 cm height from the ground level was followed (114.98 t $ha^{-1}$). The effect of nutrients on green fodder yield was observed in all the harvests except first, second and sixth harvests. The green fodder yield was significantly influenced by increasing the fertilizer levels. With respect to total yield application of 300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ ($N_3$) recorded maximum yield (123.15 t $ha^{-1}$) which was significantly superior to other nutrient levels. The result indicated that spacing treatments was found significant only in the fourth harvest. As the spacing was increased the green fodder yield was found to exhibit a decreasing trend and the higher green fodder yield was recorded by the treatment involving narrow spacing. The total green fodder yield showed significant difference among the spacing treatments and highest yield was recorded by $S_1$ (60 cm x 30 cm) spacing (118.85 t $ha^{-1}$) which was on a par with $S_2$ (60 cm x 40 cm) spacing (110.86 t $ha^{-1}$).

No significant interaction between cutting pattern, nutrient levels and plant spacing was observed.

The influence of cutting pattern, nutrient levels and plant spacing on green fodder yield of palisade grass under open condition in the second year are presented in Table 12a, 12b and 12c.

The result showed that the cutting pattern had significant impact on green fodder yield in third and fourth harvests. In the third and fourth harvest ground level cutting produced maximum green fodder yield of 17.59 and 16.86 t $ha^{-1}$ respectively. The total green fodder yield was not significantly influenced by cutting height. The fertilizer treatments had significant effect on green fodder yield in third, fourth, sixth and seventh harvests. In the third and fourth harvest $N_3$ and $N_2$ was on a par whereas in the sixth and seventh harvests $N_3$ was significantly superior to $N_2$. The total fodder yield was significantly influenced

Table 12a. Effect of cutting pattern, nutrient levels and spacing on GFY under open condition during second year, t $ha^{-1}$

| Treatments | Green fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| **Cutting pattern (C)** | | | | | | | | |
| $C_1$ | 15.61 | 14.32 | 17.58 | 16.86 | 12.39 | 14.77 | 15.57 | 104.98 |
| $C_2$ | 15.78 | 13.71 | 15.24 | 14.71 | 12.55 | 15.53 | 15.54 | 105.24 |
| SEm (±) | 0.403 | 0.619 | 0.645 | 0.555 | 0.479 | 0.458 | 0.480 | 1.257 |
| CD (0.05) | NS | NS | 1.858 | 1.600 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | | | |
| $N_1$ | 14.72 | 12.87 | 14.67 | 14.17 | 11.63 | 14.12 | 14.00 | 96.21 |
| $N_2$ | 16.00 | 14.19 | 17.55 | 16.13 | 13.21 | 14.66 | 14.98 | 106.73 |
| $N_3$ | 16.37 | 14.98 | 17.02 | 17.06 | 12.58 | 16.66 | 17.68 | 112.38 |
| SEm (±) | 0.493 | 0.758 | 0.790 | 0.680 | 0.587 | 0.561 | 0.588 | 1.539 |
| CD (0.05) | NS | NS | 2.276 | 1.959 | NS | 1.617 | 1.693 | 4.432 |
| **Spacing (S)** | | | | | | | | |
| $S_1$ | 15.25 | 14.20 | 17.43 | 17.20 | 12.63 | 16.57 | 16.37 | 109.68 |
| $S_2$ | 16.40 | 14.17 | 16.12 | 15.37 | 12.50 | 14.96 | 15.72 | 105.27 |
| $S_3$ | 15.43 | 13.67 | 15.68 | 14.79 | 12.28 | 13.92 | 14.56 | 100.37 |
| SEm (±) | 0.493 | 0.758 | 0.790 | 0.680 | 0.587 | 0.561 | 0.588 | 1.539 |
| CD (0.05) | NS | NS | NS | 1.959 | NS | 1.617 | 1.693 | 4.432 |

NS- Not significant

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Table 12b. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under open condition during second year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| $c_1n_1$ | 13.08 | 13.23 | 15.22 | 15.33 | 11.72 | 13.83 | 15.10 | 97.53 |
| $c_1n_2$ | 15.73 | 14.20 | 19.91 | 16.63 | 12.01 | 14.68 | 14.54 | 105.96 |
| $c_1n_3$ | 15.32 | 15.53 | 17.63 | 14.87 | 13.45 | 15.80 | 17.06 | 111.44 |
| $c_2n_1$ | 15.25 | 12.51 | 14.13 | 14.11 | 11.54 | 14.42 | 12.91 | 94.88 |
| $c_2n_2$ | 16.53 | 14.18 | 15.18 | 17.12 | 14.41 | 14.64 | 15.42 | 107.51 |
| $c_2n_3$ | 18.80 | 14.44 | 16.41 | 16.12 | 11.72 | 17.52 | 18.30 | 113.32 |
| SEm (±) | 0.962 | 1.073 | 1.118 | 0.698 | 0.830 | 0.794 | 0.831 | 2.177 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 16.15 | 14.42 | 19.02 | 17.76 | 11.93 | 15.81 | 16.13 | 107.53 |
| $c_1s_2$ | 13.98 | 14.33 | 17.12 | 15.03 | 13.23 | 15.11 | 15.40 | 106.94 |
| $c_1s_3$ | 14.00 | 14.21 | 16.62 | 14.05 | 12.02 | 13.40 | 15.17 | 100.46 |
| $c_2s_1$ | 18.24 | 13.98 | 15.84 | 16.45 | 13.34 | 17.33 | 16.62 | 111.83 |
| $c_2s_2$ | 16.75 | 14.01 | 15.13 | 15.05 | 11.77 | 14.81 | 16.05 | 103.60 |
| $c_2s_3$ | 15.58 | 13.14 | 14.75 | 15.84 | 12.55 | 14.44 | 13.95 | 100.2 |
| SEm (±) | 0.962 | 1.073 | 1.118 | 0.698 | 0.830 | 0.794 | 0.831 | 2.177 |
| CD (0.05) | NS | NS | NS | 2.011 | NS | NS | NS | NS |
| $n_1s_1$ | 16.11 | 13.08 | 14.51 | 15.30 | 12.06 | 15.66 | 15.51 | 100.78 |
| $n_1s_2$ | 13.50 | 11.26 | 14.55 | 15.05 | 10.58 | 13.10 | 13.63 | 91.93 |
| $n_1s_3$ | 12.90 | 14.26 | 14.96 | 13.81 | 12.25 | 13.61 | 12.86 | 95.91 |
| $n_2s_1$ | 17.50 | 12.83 | 19.70 | 16.06 | 14.45 | 15.36 | 15.50 | 111.41 |
| $n_2s_2$ | 15.58 | 16.01 | 17.06 | 15.95 | 13.31 | 14.78 | 15.45 | 108.16 |
| $n_2s_3$ | 15.31 | 13.73 | 15.88 | 15.98 | 11.86 | 13.85 | 14.00 | 100.63 |
| $n_3s_1$ | 17.98 | 16.70 | 18.08 | 17.96 | 11.40 | 18.68 | 18.11 | 116.85 |
| $n_3s_2$ | 17.03 | 15.23 | 16.76 | 15.88 | 13.61 | 17.00 | 18.10 | 115.71 |
| $n_3s_3$ | 16.16 | 13.03 | 16.21 | 15.28 | 12.75 | 14.30 | 16.83 | 104.58 |
| SEm (±) | 1.178 | 1.314 | 1.369 | 0.855 | 2.879 | 0.972 | 1.018 | 2.666 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 12c. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under open condition during second year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| $c_1n_1s_1$ | 14.03 | 13.66 | 16.36 | 16.70 | 10.90 | 14.70 | 15.70 | 98.36 |
| $c_1n_1s_2$ | 13.16 | 11.70 | 15.43 | 16.30 | 11.26 | 14.27 | 15.40 | 97.93 |
| $c_1n_1s_3$ | 12.06 | 14.33 | 13.86 | 13.00 | 13.00 | 12.53 | 14.20 | 96.30 |
| $c_1n_2s_1$ | 16.96 | 11.83 | 22.86 | 16.56 | 12.86 | 14.77 | 15.00 | 108.46 |
| $c_1n_2s_2$ | 14.46 | 15.73 | 19.13 | 14.16 | 12.70 | 15.27 | 14.36 | 108.23 |
| $c_1n_2s_3$ | 15.76 | 15.03 | 17.73 | 13.90 | 10.46 | 14.03 | 14.26 | 101.20 |
| $c_1n_3s_1$ | 17.46 | 17.76 | 17.83 | 20.00 | 12.03 | 17.97 | 17.70 | 115.76 |
| $c_1n_3s_2$ | 14.33 | 15.56 | 16.80 | 15.00 | 15.73 | 15.80 | 16.43 | 114.66 |
| $c_1n_3s_3$ | 14.16 | 13.26 | 18.26 | 14.90 | 12.60 | 13.63 | 17.06 | 103.90 |
| $c_2n_1s_1$ | 18.20 | 12.50 | 12.66 | 14.63 | 13.23 | 16.63 | 15.33 | 103.20 |
| $c_2n_1s_2$ | 13.83 | 10.83 | 13.66 | 13.90 | 9.90 | 11.93 | 11.86 | 85.93 |
| $c_2n_1s_3$ | 13.73 | 14.20 | 16.06 | 13.80 | 11.50 | 14.70 | 11.53 | 95.53 |
| $c_2n_2s_1$ | 18.03 | 13.83 | 16.53 | 17.96 | 16.03 | 15.97 | 16.00 | 114.36 |
| $c_2n_2s_2$ | 16.70 | 16.30 | 15.00 | 15.33 | 13.93 | 14.30 | 16.53 | 108.10 |
| $c_2n_2s_3$ | 14.86 | 12.43 | 14.03 | 18.06 | 13.26 | 13.67 | 13.73 | 100.06 |
| $c_2n_3s_1$ | 18.50 | 15.63 | 18.33 | 16.76 | 10.76 | 19.40 | 18.53 | 117.93 |
| $c_2n_3s_2$ | 19.73 | 14.90 | 16.73 | 15.93 | 11.50 | 18.20 | 19.76 | 116.76 |
| $c_2n_3s_3$ | 18.16 | 12.80 | 14.16 | 15.66 | 12.90 | 14.97 | 16.60 | 105.26 |
| SEm (±) | 2.543 | 2.786 | 3.111 | 2.987 | 3.234 | 2.897 | 2.543 | 3.865 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

by all the fertilizer treatments. The maximum green fodder yield was recorded by highest fertilizer level of $N_3$ (112.38 t $ha^{-1}$) which was superior to the application of 200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ (96.21 t $ha^{-1}$) and 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$(106.73 t $ha^{-1}$). The significant effect of plant spacing was noticed on fourth, sixth and seventh harvests and also total yield. The narrow plant spacing of 60 cm x 30 cm recorded maximum total yield of 109.68 t $ha^{-1}$ which was on a par with 60 cm x 40 cm spacing (105.27 t $ha^{-1}$) and significantly superior to 60 cm x 60 cm spacing (100.37 t $ha^{-1}$).

Significant interaction was observed between cutting height and spacing in the fourth harvest. Maximum green fodder yield was recorded when ground level cutting and 60 cm x 30 cm spacing was followed (17.76 t $ha^{-1}$) which was on a par with $c_2s_1$ (16.45 t $ha^{-1)}$) and $c_2s_3$ (15.84 t $ha^{-1}$). All other interactions was found non significant.

#### *4.1.2.2 Dry Fodder Yield*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with regard to dry fodder yield of palisade grass under open condition in the first year are presented in Table 13a, 13b and 13c.

The results revealed that the effect of cutting pattern on dry fodder yield was non significant in all the harvests whereas the total dry fodder yield was significantly influenced by cutting height. The maximum dry fodder yield was obtained when cutting at 10 cm height from the ground level was followed (31.35 t $ha^{-1}$). The effect of nutrients on dry fodder yield was observed in all the harvests except first. In the second harvest dry fodder yield was significantly influenced by nutrient levels whereas in all other harvests $N_2$ and $N_3$ was found to be on a par. With respect to total yield application of 300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ recorded maximum yield (33.62 t $ha^{-1}$) which was significantly superior to other nutrient levels. The result indicated that spacing treatments was found significant in all the harvests except first and third. In the second and fourth harvests $S_1$ (60 cm x 30 cm) recorded highest dry fodder yield of 5.13 and 7.28 t $ha^{-1}$

Table 13a. Effect of cutting pattern, nutrient levels and spacing on DFY under open condition during first year, t $ha^{-1}$

| Treatments | Dry fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 3.78 | 4.54 | 4.96 | 5.46 | 5.20 | 4.99 | 28.76 |
| $C_2$ | 3.92 | 4.43 | 5.31 | 6.20 | 5.83 | 5.60 | 31.35 |
| SEm (±) | 0.123 | 0.176 | 0.271 | 0.417 | 0.315 | 0.235 | 0.585 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | 1.687 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 3.69 | 3.74 | 4.21 | 4.57 | 4.71 | 4.39 | 25.33 |
| $N_2$ | 3.92 | 4.52 | 5.45 | 5.94 | 5.70 | 5.66 | 31.22 |
| $N_3$ | 3.93 | 5.20 | 5.73 | 6.99 | 6.13 | 5.83 | 33.62 |
| SEm (±) | 0.150 | 0.213 | 0.332 | 0.510 | 0.386 | 0.288 | 0.715 |
| CD (0.05) | NS | 0.614 | 0.956 | 1.471 | 1.114 | 0.832 | 2.061 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 3.88 | 5.13 | 5.09 | 7.28 | 5.32 | 5.59 | 32.09 |
| $S_2$ | 3.69 | 4.15 | 5.51 | 5.31 | 6.43 | 5.63 | 30.74 |
| $S_3$ | 3.97 | 4.18 | 4.79 | 4.90 | 4.80 | 4.66 | 27.33 |
| SEm (±) | 0.150 | 0.213 | 0.332 | 0.510 | 0.386 | 0.288 | 0.715 |
| CD (0.05) | NS | 0.614 | NS | 1.471 | 1.114 | 0.832 | 2.061 |

NS- Not significant

Table 13b. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under open condition during first year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| $c_1n_1$ | 3.55 | 3.94 | 3.90 | 4.43 | 4.67 | 4.06 | 24.58 |
| $c_1n_2$ | 3.76 | 4.48 | 5.19 | 5.42 | 5.03 | 5.63 | 29.54 |
| $c_1n_3$ | 4.02 | 5.20 | 5.78 | 6.54 | 5.89 | 5.27 | 32.16 |
| $c_2n_1$ | 3.84 | 3.53 | 4.51 | 4.70 | 4.76 | 4.72 | 26.07 |
| $c_2n_2$ | 4.08 | 4.56 | 5.72 | 6.46 | 6.38 | 5.68 | 32.91 |
| $c_2n_3$ | 3.85 | 5.20 | 5.69 | 7.43 | 6.37 | 6.40 | 35.07 |
| SEm (±) | 0.213 | 0.304 | 0.469 | 0.722 | 0.547 | 0.408 | 1.011 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 3.87 | 5.07 | 5.26 | 6.51 | 5.27 | 5.23 | 30.67 |
| $c_1s_2$ | 3.51 | 4.57 | 4.95 | 5.49 | 5.79 | 5.25 | 29.59 |
| $c_1s_3$ | 3.95 | 3.99 | 4.65 | 4.39 | 4.54 | 4.48 | 26.02 |
| $c_2s_1$ | 3.90 | 5.19 | 4.92 | 8.06 | 5.37 | 5.95 | 33.52 |
| $c_2s_2$ | 3.87 | 3.72 | 6.07 | 5.13 | 7.07 | 6.00 | 31.89 |
| $c_2s_3$ | 4.00 | 4.37 | 4.93 | 5.41 | 5.06 | 4.85 | 28.64 |
| SEm (±) | 0.213 | 0.304 | 0.469 | 0.722 | 0.547 | 0.408 | 1.011 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 3.77 | 4.25 | 3.66 | 5.94 | 3.74 | 4.70 | 26.08 |
| $n_1s_2$ | 3.23 | 3.28 | 4.92 | 4.10 | 5.95 | 4.76 | 26.26 |
| $n_1s_3$ | 4.09 | 3.68 | 4.04 | 3.66 | 4.44 | 3.71 | 23.64 |
| $n_2s_1$ | 4.09 | 4.70 | 6.02 | 7.27 | 5.29 | 6.19 | 33.57 |
| $n_2s_2$ | 3.86 | 4.59 | 5.88 | 5.41 | 6.17 | 5.43 | 31.36 |
| $n_2s_3$ | 3.82 | 4.28 | 4.47 | 5.13 | 5.66 | 5.36 | 28.74 |
| $n_3s_1$ | 3.79 | 6.46 | 5.59 | 8.64 | 6.93 | 5.88 | 36.64 |
| $n_3s_2$ | 4.00 | 4.56 | 5.74 | 6.42 | 7.165 | 6.69 | 34.60 |
| $n_3s_3$ | 4.02 | 4.58 | 5.87 | 5.90 | 4.30 | 4.93 | 29.61 |
| SEm (±) | 0.263 | 0.372 | 0.575 | 0.885 | 0.670 | 0.499 | 1.242 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 13c. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under open condition during first year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| $c_1n_1s_1$ | 3.71 | 4.42 | 4.14 | 5.07 | 4.50 | 3.68 | 25.54 |
| $c_1n_1s_2$ | 2.91 | 3.66 | 4.24 | 4.47 | 5.23 | 4.58 | 25.11 |
| $c_1n_1s_3$ | 4.04 | 3.76 | 3.33 | 3.75 | 4.28 | 3.92 | 23.09 |
| $c_1n_2s_1$ | 4.34 | 4.39 | 6.07 | 6.99 | 4.17 | 5.82 | 31.79 |
| $c_1n_2s_2$ | 3.68 | 5.09 | 5.21 | 4.39 | 5.56 | 6.00 | 29.94 |
| $c_1n_2s_3$ | 3.28 | 3.97 | 4.29 | 4.88 | 5.37 | 5.08 | 26.88 |
| $c_1n_3s_1$ | 3.57 | 6.41 | 5.57 | 7.47 | 7.14 | 6.19 | 34.70 |
| $c_1n_3s_2$ | 3.94 | 4.97 | 5.42 | 7.62 | 6.57 | 5.18 | 33.71 |
| $c_1n_3s_3$ | 4.55 | 4.23 | 6.35 | 4.53 | 3.97 | 4.44 | 28.09 |
| $c_2n_1s_1$ | 3.83 | 4.07 | 3.19 | 6.81 | 2.98 | 5.73 | 26.63 |
| $c_2n_1s_2$ | 3.54 | 2.91 | 5.60 | 3.72 | 6.68 | 4.93 | 27.41 |
| $c_2n_1s_3$ | 4.14 | 3.61 | 4.75 | 3.57 | 4.61 | 3.50 | 24.19 |
| $c_2n_2s_1$ | 3.84 | 5.00 | 5.97 | 7.56 | 6.40 | 6.56 | 35.34 |
| $c_2n_2s_2$ | 4.03 | 4.10 | 6.55 | 6.43 | 6.79 | 4.86 | 32.79 |
| $c_2n_2s_3$ | 4.37 | 4.58 | 4.65 | 5.39 | 5.95 | 5.63 | 30.59 |
| $c_2n_3s_1$ | 4.02 | 6.51 | 5.61 | 9.81 | 6.72 | 5.56 | 38.58 |
| $c_2n_3s_2$ | 4.05 | 4.16 | 6.07 | 5.23 | 7.75 | 8.21 | 35.49 |
| $c_2n_3s_3$ | 3.49 | 4.93 | 5.40 | 7.26 | 4.63 | 5.42 | 31.14 |
| SEm (±) | 0.369 | 0.527 | 0.813 | 1.251 | 0.947 | 0.705 | 1.754 |
| CD (0.05) | NS | NS | NS | NS | NS | 2.032 | NS |

NS- Not significant

respectively. In the fifth and sixth harvests $S_1$ and $S_2$ was found to be on a par. Regarding total yield also $S_1$ (60 cm x 30 cm) was observed to be on a par with $S_2$ (60 cm x 40 cm) .

Significant interaction between cutting pattern, nutrient levels and plant spacing was noticed in the sixth harvest. The highest dry fodder yield of 8.21 t $ha^{-1}$ was recorded by the treatment $c_2n_3s_2$ and it was on a par with $c_2n_2s_1$ (6.5 t $ha^{-1}$) and $c_1n_3s_1$ (6.1 t $ha^{-1}$) respectively.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to dry fodder yield of palisade grass under open condition in the second year are presented in Table 14a, 14b and 14c.

The result showed that the cutting pattern had significant impact on dry fodder yield in third, fourth and sixth harvests. In the third harvest ground level cutting produced maximum dry fodder yield of 4.97 t $ha^{-1}$ whereas in the fourth and sixth harvests maximum dry fodder yield was recorded when cutting height of 10 cm was followed. The total dry fodder yield was not significantly influenced by cutting height. The fertilizer treatments had significant effect on green fodder yield in all harvests except sixth. In the seventh harvest highest level of nutrients produced maximum dry fodder yield. In all other harvests $N_2$ and $N_3$ was found to be on a par. The total dry fodder yield was significantly influenced by all the fertilizer treatments. The maximum dry fodder yield was recorded by highest fertilizer level ($N_3$) (31.57 t $ha^{-1}$) which was superior to the application of 200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ and 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$. The significant effect of plant spacing was noticed on first, fourth and sixth harvests and also total yield. In all these harvests narrow plant spacing of 60 cm x 30 cm was on a par with 60 cm x 40 cm spacing.

Significant interaction was observed between cutting height and spacing in the fourth harvest. The highest dry fodder yield was recorded by $c_2s_1$ (5.05 t $ha^{-1}$) which was on a par with $c_1s_2$ (4.91 t $ha^{-1}$). All other interactions were found non significant.

Table 14a. Effect of cutting pattern, nutrient levels and spacing on DFY under open condition during second year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| **Cutting pattern (C)** | | | | | | | | |
| $C_1$ | 4.20 | 4.01 | 4.97 | 4.21 | 3.49 | 4.01 | 4.33 | 29.10 |
| $C_2$ | 4.58 | 3.92 | 4.36 | 4.56 | 3.50 | 4.50 | 4.23 | 29.68 |
| SEm (±) | 0.158 | 0.133 | 0.135 | 0.101 | 0.106 | 0.162 | 0.166 | 0.138 |
| CD (0.05) | NS | NS | 0.390 | 0.291 | NS | 0.467 | NS | NS |
| **Nutrient levels (N)** | | | | | | | | |
| $N_1$ | 3.95 | 3.41 | 4.05 | 4.01 | 3.27 | 3.94 | 3.96 | 26.62 |
| $N_2$ | 4.52 | 4.04 | 4.79 | 4.45 | 3.83 | 4.28 | 4.04 | 29.98 |
| $N_3$ | 4.70 | 4.46 | 5.16 | 4.68 | 3.37 | 4.55 | 4.85 | 31.57 |
| SEm (±) | 0.194 | 0.208 | 0.166 | 0.128 | 0.158 | 0.198 | 0.177 | 0.429 |
| CD (0.05) | 0.560 | 0.599 | 0.480 | 0.369 | 0.455 | NS | 0.511 | 1.237 |
| **Spacing (S)** | | | | | | | | |
| $S_1$ | 4.78 | 4.03 | 4.86 | 4.46 | 3.51 | 4.68 | 4.51 | 30.86 |
| $S_2$ | 4.31 | 4.13 | 4.63 | 4.61 | 3.48 | 4.20 | 4.30 | 29.57 |
| $S_3$ | 4.08 | 3.74 | 4.51 | 4.08 | 3.49 | 3.88 | 4.03 | 27.73 |
| SEm (±) | 0.194 | 0.208 | 0.166 | 0.128 | 0.158 | 0.198 | 0.177 | 0.429 |
| CD (0.05) | 0.560 | NS | NS | 0.369 | NS | 0.572 | NS | 1.237 |

NS- Not significant

Table 14b. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under open condition during second year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| $c_1n_1$ | 3.71 | 3.61 | 4.28 | 4.04 | 3.24 | 3.73 | 4.34 | 26.98 |
| $c_1n_2$ | 4.57 | 3.95 | 5.26 | 4.03 | 3.61 | 4.28 | 3.97 | 29.70 |
| $c_1n_3$ | 4.32 | 4.48 | 5.38 | 4.55 | 3.60 | 4.03 | 4.68 | 30.61 |
| $c_2n_1$ | 4.18 | 3.22 | 3.83 | 3.98 | 3.30 | 4.15 | 3.57 | 26.26 |
| $c_2n_2$ | 4.48 | 4.12 | 4.32 | 4.88 | 4.05 | 4.27 | 4.11 | 30.26 |
| $c_2n_3$ | 5.08 | 4.44 | 4.94 | 4.81 | 3.14 | 5.06 | 5.02 | 32.52 |
| SEm (±) | 0.275 | 0.288 | 0.239 | 0.179 | 0.223 | 0.281 | 0.251 | 0.608 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 4.66 | 4.09 | 5.14 | 3.86 | 3.46 | 4.23 | 4.53 | 30.01 |
| $c_1s_2$ | 3.98 | 4.15 | 4.99 | 4.91 | 3.64 | 4.11 | 4.33 | 29.90 |
| $c_1s_3$ | 3.96 | 3.80 | 4.79 | 3.84 | 3.35 | 3.69 | 4.14 | 27.38 |
| $c_2s_1$ | 4.90 | 3.97 | 4.58 | 5.05 | 3.56 | 5.13 | 4.49 | 31.71 |
| $c_2s_2$ | 4.65 | 4.11 | 4.27 | 4.31 | 3.32 | 4.29 | 4.28 | 29.25 |
| $c_2s_3$ | 4.20 | 3.69 | 4.23 | 4.31 | 3.62 | 4.07 | 3.93 | 28.08 |
| SEm (±) | 0.275 | 0.288 | 0.239 | 0.179 | 0.223 | 0.281 | 0.251 | 0.608 |
| CD (0.05) | NS | NS | NS | 0.516 | NS | NS | NS | NS |
| $n_1s_1$ | 4.52 | 3.49 | 4.02 | 3.706 | 3.32 | 4.29 | 4.47 | 27.85 |
| $n_1s_2$ | 3.77 | 3.17 | 4.21 | 4.31 | 2.87 | 3.81 | 3.75 | 25.92 |
| $n_1s_3$ | 3.55 | 3.57 | 3.93 | 4.02 | 3.63 | 3.72 | 3.64 | 26.08 |
| $n_2s_1$ | 4.92 | 3.80 | 5.18 | 4.76 | 4.18 | 4.54 | 4.20 | 31.61 |
| $n_2s_2$ | 4.47 | 4.59 | 4.56 | 4.46 | 3.85 | 4.21 | 4.13 | 30.28 |
| $n_2s_3$ | 4.19 | 3.72 | 4.64 | 4.15 | 3.47 | 4.07 | 3.79 | 28.06 |
| $n_3s_1$ | 4.90 | 4.80 | 5.39 | 4.91 | 3.03 | 5.21 | 4.86 | 33.12 |
| $n_3s_2$ | 4.70 | 4.63 | 5.12 | 5.07 | 3.70 | 4.58 | 5.03 | 32.52 |
| $n_3s_3$ | 4.50 | 3.94 | 4.97 | 4.06 | 3.37 | 3.85 | 4.67 | 29.05 |
| SEm (±) | 0.336 | 0.354 | 0.292 | 0.219 | 0.282 | 0.344 | 0.307 | 0.744 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 14c. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under open condition during second year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| $c_1n_1s_1$ | 4.13 | 3.81 | 4.54 | 3.29 | 2.94 | 3.82 | 4.59 | 27.14 |
| $c_1n_1s_2$ | 3.56 | 3.33 | 4.63 | 4.85 | 2.95 | 3.96 | 4.46 | 27.76 |
| $c_1n_1s_3$ | 3.44 | 3.69 | 3.67 | 3.97 | 3.84 | 3.41 | 3.99 | 26.03 |
| $c_1n_2s_1$ | 4.99 | 3.48 | 5.71 | 3.90 | 4.13 | 4.32 | 4.23 | 30.78 |
| $c_1n_2s_2$ | 4.26 | 4.48 | 4.99 | 4.53 | 3.79 | 4.38 | 3.91 | 30.33 |
| $c_1n_2s_3$ | 4.46 | 3.91 | 5.09 | 3.68 | 2.93 | 4.15 | 3.77 | 28.01 |
| $c_1n_3s_1$ | 4.86 | 4.98 | 5.18 | 4.40 | 3.33 | 4.57 | 4.77 | 32.11 |
| $c_1n_3s_2$ | 4.12 | 4.64 | 5.34 | 5.36 | 4.17 | 3.99 | 4.62 | 31.61 |
| $c_1n_3s_3$ | 3.98 | 3.81 | 5.62 | 3.89 | 3.30 | 3.52 | 4.66 | 28.12 |
| $c_2n_1s_1$ | 4.91 | 3.18 | 3.50 | 4.11 | 3.70 | 4.77 | 4.36 | 28.55 |
| $c_2n_1s_2$ | 3.99 | 3.02 | 3.79 | 3.76 | 2.79 | 3.66 | 3.05 | 24.08 |
| $c_2n_1s_3$ | 3.66 | 3.46 | 4.19 | 4.07 | 3.41 | 4.03 | 3.30 | 26.14 |
| $c_2n_2s_1$ | 4.86 | 4.13 | 4.66 | 5.62 | 4.23 | 4.77 | 4.16 | 32.44 |
| $c_2n_2s_2$ | 4.67 | 4.70 | 4.13 | 4.39 | 3.92 | 4.05 | 4.35 | 30.23 |
| $c_2n_2s_3$ | 3.91 | 3.53 | 4.19 | 4.63 | 4.01 | 4.00 | 3.82 | 28.11 |
| $c_2n_3s_1$ | 4.94 | 4.61 | 5.60 | 5.43 | 2.74 | 5.84 | 4.95 | 34.14 |
| $c_2n_3s_2$ | 5.28 | 4.62 | 4.89 | 4.78 | 3.24 | 5.16 | 5.44 | 33.44 |
| $c_2n_3s_3$ | 5.03 | 4.07 | 4.33 | 4.24 | 3.44 | 4.18 | 4.68 | 29.99 |
| SEm (±) | 0.639 | 0.503 | 0.410 | 0.310 | 0.387 | 0.486 | 0.434 | 1.055 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

### 4.1.3 Physiological Observations

#### *4.1.3.1 Dry Matter Production*

The dry matter production was significantly influenced by cutting pattern, nutrient levels and plant spacing under open condition in the first year (Table 15a, 15b and 15c).

The result showed that the cutting pattern had significant impact on dry matter production only in sixth harvest. In the sixth harvest, $C_2$ recorded highest DMP of 216.70 g plant$^{-1}$. The DMP was significantly influenced by the chemical fertilizer treatments in all the harvests except initial harvest. In sixth harvest, highest DMP was noticed with $N_3$ (224.67 g plant$^{-1}$) whereas in all other harvests $N_3$ and $N_2$ was on a par. The significant effect of plant spacing was noticed on all harvests except second and third harvests. $S_3$ registered highest DMP of 183.53, 226.08, 245.77 and 258.52 g plant$^{-1}$ in first, fourth, fifth and sixth harvests respectively.

Significant interaction was observed between cutting height and spacing in the sixth harvest. The treatment combination $c_2s_3$ recorded highest DMP of 304.55 g plant$^{-1}$ in the sixth harvest. Significant interaction was observed between nutrient levels and spacing in the sixth harvest. The treatment combination $n_3s_3$ recorded highest DMP of 311.10 g plant$^{-1}$ in the sixth harvest. Significant interaction was observed cutting pattern, nutrient levels and plant spacing in first and sixth harvest. In first harvest, $c_1n_3s_3$ registered maximum DMP of 216.93 g plant$^{-1}$ and was on a par with $c_2n_2s_3$, $c_2n_1s_3$ and $c_1n_1s_3$. In sixth harvest, maximum DMP was noticed with $c_2n_3s_3$ (363.13 g plant$^{-1}$) and was on a par with $c_2n_2s_3$ (327.06 g plant$^{-1}$).

The dry matter production was significantly influenced by cutting pattern, nutrient levels and plant spacing under open condition in the second year (Table 16a, 16b and 16c).

Table 15a. Effect of cutting pattern, nutrient levels and spacing on DMP under open condition during first year, g $plant^{-1}$

| Treatments | Dry matter production | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 119.39 | 116.12 | 111.03 | 174.43 | 172.95 | 170.99 |
| $C_2$ | 124.65 | 121.10 | 124.20 | 196.42 | 207.87 | 216.70 |
| SEm (±) | 4.961 | 6.301 | 6.901 | 15.391 | 12.967 | 6.318 |
| CD (0.05) | NS | NS | NS | NS | NS | 18.192 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 117.71 | 101.58 | 90.91 | 139.02 | 158.29 | 161.92 |
| $N_2$ | 122.81 | 123.67 | 130.01 | 194.73 | 196.00 | 194.93 |
| $N_3$ | 125.53 | 130.57 | 131.92 | 222.52 | 216.93 | 224.67 |
| SEm (±) | 6.076 | 7.715 | 8.452 | 18.850 | 15.884 | 7.741 |
| CD (0.05) | NS | 22.213 | 24.335 | 54.272 | 45.732 | 22.287 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 82.23 | 120.96 | 114.64 | 173.50 | 126.34 | 137.31 |
| $S_2$ | 100.29 | 116.37 | 126.01 | 156.69 | 199.12 | 185.70 |
| $S_3$ | 183.53 | 118.50 | 112.19 | 226.08 | 245.77 | 258.52 |
| SEm (±) | 6.076 | 7.715 | 8.452 | 18.850 | 15.884 | 7.741 |
| CD (0.05) | 17.494 | NS | NS | 54.272 | 45.732 | 22.287 |

NS- Not significant

Table 15b. Interaction effect of cutting pattern, nutrient levels and spacing on DMP under open condition during first year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 112.54 | 103.36 | 82.70 | 137.33 | 151.22 | 147.35 |
| $c_1n_2$ | 112.41 | 119.31 | 117.27 | 175.43 | 173.21 | 176.85 |
| $c_1n_3$ | 133.21 | 125.68 | 133.12 | 210.53 | 194.42 | 188.77 |
| $c_2n_1$ | 122.88 | 99.81 | 99.11 | 140.71 | 165.37 | 176.50 |
| $c_2n_2$ | 133.22 | 128.04 | 142.76 | 214.04 | 218.79 | 213.01 |
| $c_2n_3$ | 117.85 | 135.46 | 130.72 | 234.50 | 239.45 | 260.58 |
| SEm (±) | 8.579 | 10.914 | 11.953 | 26.659 | 22.465 | 10.947 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 81.88 | 122.11 | 119.24 | 152.67 | 122.77 | 122.52 |
| $c_1s_2$ | 93.97 | 110.09 | 110.97 | 163.06 | 176.66 | 177.96 |
| $c_1s_3$ | 182.31 | 116.14 | 102.89 | 207.55 | 219.42 | 212.48 |
| $c_2s_1$ | 82.58 | 119.80 | 110.05 | 194.33 | 129.90 | 152.10 |
| $c_2s_2$ | 106.61 | 122.65 | 141.06 | 150.32 | 221.57 | 193.44 |
| $c_2s_3$ | 184.75 | 120.86 | 121.49 | 244.61 | 272.13 | 304.55 |
| SEm (±) | 8.579 | 10.914 | 11.953 | 26.659 | 22.465 | 10.947 |
| CD (0.05) | NS | NS | NS | NS | NS | 31.517 |
| $n_1s_1$ | 79.20 | 108.33 | 76.33 | 137.44 | 85.09 | 112.33 |
| $n_1s_2$ | 84.00 | 92.73 | 110.09 | 114.36 | 179.20 | 171.45 |
| $n_1s_3$ | 189.93 | 103.69 | 86.30 | 165.26 | 210.60 | 202.00 |
| $n_2s_1$ | 87.75 | 121.99 | 139.53 | 173.23 | 119.90 | 156.25 |
| $n_2s_2$ | 106.04 | 133.60 | 135.84 | 160.12 | 186.84 | 166.08 |
| $n_2s_3$ | 174.66 | 115.43 | 114.66 | 250.86 | 281.26 | 262.46 |
| $n_3s_1$ | 79.75 | 132.55 | 128.06 | 209.84 | 174.03 | 143.36 |
| $n_3s_2$ | 110.84 | 122.78 | 132.12 | 195.60 | 231.32 | 219.57 |
| $n_3s_3$ | 186.00 | 136.38 | 135.59 | 262.11 | 245.46 | 311.10 |
| SEm (±) | 10.524 | 13.366 | 14.640 | 32.651 | 27.512 | 13.407 |
| CD (0.05) | NS | NS | NS | NS | NS | 38.599 |

NS- Not significant

Table 15c. Interaction effect of cutting pattern, nutrient levels and spacing on DMP under open condition during first year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 77.60 | 113.60 | 89.16 | 114.02 | 98.83 | 79.50 |
| $c_1n_1s_2$ | 72.96 | 93.10 | 91.75 | 127.44 | 153.92 | 182.02 |
| $c_1n_1s_3$ | 187.06 | 103.38 | 67.20 | 170.53 | 200.93 | 180.53 |
| $c_1n_2s_1$ | 94.39 | 115.50 | 140.92 | 165.60 | 89.96 | 152.06 |
| $c_1n_2s_2$ | 99.92 | 127.94 | 117.78 | 124.56 | 165.28 | 180.64 |
| $c_1n_2s_3$ | 142.93 | 114.50 | 93.10 | 236.13 | 264.40 | 197.86 |
| $c_1n_3s_1$ | 73.66 | 137.24 | 127.63 | 178.39 | 179.54 | 136.02 |
| $c_1n_3s_2$ | 109.04 | 109.24 | 123.38 | 237.20 | 210.80 | 171.22 |
| $c_1n_3s_3$ | 216.93 | 130.56 | 148.36 | 216.00 | 192.93 | 259.06 |
| $c_2n_1s_1$ | 80.80 | 103.07 | 63.51 | 160.86 | 71.36 | 145.17 |
| $c_2n_1s_2$ | 95.04 | 92.37 | 128.43 | 101.28 | 204.48 | 160.88 |
| $c_2n_1s_3$ | 192.80 | 104.00 | 105.41 | 160.00 | 220.26 | 223.46 |
| $c_2n_2s_1$ | 81.10 | 128.49 | 138.15 | 180.86 | 149.84 | 160.44 |
| $c_2n_2s_2$ | 112.16 | 139.26 | 153.90 | 195.68 | 208.40 | 151.52 |
| $c_2n_2s_3$ | 206.40 | 116.36 | 136.22 | 265.60 | 298.13 | 327.06 |
| $c_2n_3s_1$ | 85.84 | 127.86 | 128.49 | 241.29 | 168.52 | 150.70 |
| $c_2n_3s_2$ | 112.64 | 136.32 | 140.86 | 154.00 | 251.84 | 267.92 |
| $c_2n_3s_3$ | 155.06 | 142.21 | 122.83 | 308.23 | 298.00 | 363.13 |
| SEm (±) | 14.883 | 18.904 | 20.704 | 46.175 | 38.906 | 18.960 |
| CD (0.05) | 42.851 | NS | NS | NS | NS | 54.586 |

NS- Not significant

Table 16a. Effect of cutting pattern, nutrient levels and spacing on DMP under open condition during second year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 131.97 | 126.97 | 163.71 | 148.06 | 105.58 | 124.49 | 138.34 |
| $C_2$ | 146.56 | 123.75 | 140.04 | 146.52 | 107.86 | 141.93 | 133.39 |
| SEm (±) | 6.847 | 7.072 | 7.451 | 5.967 | 5.544 | 6.314 | 5.725 |
| CD (0.05) | NS | NS | 21.452 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 120.34 | 115.74 | 137.56 | 138.44 | 100.65 | 122.02 | 121.55 |
| $N_2$ | 144.39 | 126.76 | 158.46 | 149.28 | 116.73 | 135.83 | 126.29 |
| $N_3$ | 153.06 | 133.57 | 159.60 | 154.15 | 102.77 | 141.79 | 159.75 |
| SEm (±) | 8.386 | 8.661 | 9.125 | 7.308 | 6.790 | 7.733 | 7.012 |
| CD (0.05) | 24.146 | NS | NS | NS | NS | NS | 20.189 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 106.33 | 84.97 | 108.84 | 94.37 | 72.24 | 103.66 | 99.04 |
| $S_2$ | 121.96 | 115.09 | 132.30 | 135.02 | 92.74 | 117.96 | 121.58 |
| $S_3$ | 189.51 | 176.02 | 214.48 | 212.48 | 155.17 | 178.02 | 186.97 |
| SEm (±) | 8.386 | 8.661 | 9.125 | 7.308 | 6.790 | 7.733 | 7.012 |
| CD (0.05) | 24.146 | 24.937 | 26.273 | 21.041 | 19.551 | 22.264 | 20.189 |

NS- Not significant

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Table 16b. Interaction effect of cutting pattern, nutrient levels and spacing on DMP under open condition during second year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1$ | 112.23 | 116.54 | 143.24 | 151.17 | 102.30 | 113.50 | 137.39 |
| $c_1n_2$ | 147.92 | 126.21 | 178.77 | 135.24 | 105.01 | 137.08 | 123.60 |
| $c_1n_3$ | 135.77 | 138.16 | 169.10 | 157.77 | 109.43 | 122.90 | 154.02 |
| $c_2n_1$ | 128.45 | 114.95 | 131.88 | 125.72 | 99.01 | 130.53 | 105.71 |
| $c_2n_2$ | 140.87 | 127.31 | 138.16 | 163.31 | 128.45 | 134.57 | 128.99 |
| $c_2n_3$ | 170.36 | 128.98 | 150.09 | 150.53 | 96.11 | 160.67 | 165.49 |
| SEm (±) | 11.861 | 12.249 | 12.905 | 10.335 | 9.604 | 10.936 | 9.916 |
| CD (0.05) | NS | NS | NS | 29.757 | NS | NS | NS |
| $c_1s_1$ | 103.11 | 83.87 | 116.61 | 86.19 | 71.01 | 91.69 | 99.54 |
| $c_1s_2$ | 110.32 | 116.42 | 144.16 | 147.86 | 98.32 | 114.82 | 122.45 |
| $c_1s_3$ | 182.48 | 180.62 | 230.35 | 210.13 | 147.42 | 166.97 | 193.02 |
| $c_2s_1$ | 109.55 | 86.07 | 101.06 | 102.54 | 73.47 | 115.63 | 98.54 |
| $c_2s_2$ | 133.60 | 113.76 | 120.45 | 122.18 | 87.17 | 121.09 | 120.72 |
| $c_2s_3$ | 196.53 | 171.42 | 198.62 | 214.84 | 162.93 | 189.06 | 180.93 |
| SEm (±) | 11.861 | 12.249 | 12.905 | 10.335 | 9.604 | 10.936 | 9.916 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 99.32 | 76.50 | 91.26 | 77.81 | 67.13 | 93.16 | 98.06 |
| $n_1s_2$ | 103.04 | 89.08 | 124.24 | 126.20 | 71.64 | 104.36 | 102.40 |
| $n_1s_3$ | 158.66 | 181.66 | 197.20 | 211.33 | 163.20 | 168.53 | 164.20 |
| $n_2s_1$ | 110.18 | 80.09 | 117.14 | 105.26 | 90.15 | 100.00 | 90.58 |
| $n_2s_2$ | 127.28 | 131.48 | 136.00 | 126.52 | 105.92 | 118.36 | 115.44 |
| $n_2s_3$ | 195.73 | 168.73 | 222.26 | 216.06 | 154.13 | 189.13 | 172.86 |
| $n_3s_1$ | 109.50 | 98.33 | 118.12 | 100.03 | 59.44 | 117.81 | 108.49 |
| $n_3s_2$ | 135.56 | 124.72 | 136.68 | 152.36 | 100.68 | 131.16 | 146.92 |
| $n_3s_3$ | 214.13 | 177.66 | 224.00 | 210.06 | 148.20 | 176.40 | 223.86 |
| SEm (±) | 14.526 | 15.002 | 15.806 | 12.658 | 11.754 | 13.394 | 12.145 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 16c. Interaction effect of cutting pattern, nutrient levels and spacing on DMP under open condition during second year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 88.92 | 113.60 | 89.16 | 98.83 | 114.02 | 80.43 | 101.17 |
| $c_1n_1s_2$ | 95.52 | 93.10 | 91.75 | 153.92 | 127.44 | 109.68 | 126.88 |
| $c_1n_1s_3$ | 152.26 | 103.38 | 67.20 | 200.93 | 170.53 | 150.40 | 184.13 |
| $c_1n_2s_1$ | 112.00 | 115.50 | 140.92 | 89.96 | 165.60 | 93.84 | 91.44 |
| $c_1n_2s_2$ | 120.16 | 127.94 | 117.78 | 165.28 | 124.56 | 124.08 | 107.76 |
| $c_1n_2s_3$ | 211.60 | 114.50 | 93.10 | 264.40 | 236.13 | 193.33 | 171.60 |
| $c_1n_3s_1$ | 108.43 | 137.24 | 127.63 | 179.54 | 178.39 | 100.80 | 106.03 |
| $c_1n_3s_2$ | 115.28 | 109.24 | 123.38 | 210.80 | 237.20 | 110.72 | 132.72 |
| $c_1n_3s_3$ | 183.60 | 130.56 | 148.36 | 192.93 | 216.00 | 157.20 | 223.33 |
| $c_2n_1s_1$ | 109.72 | 103.07 | 63.51 | 71.36 | 160.86 | 105.90 | 94.95 |
| $c_2n_1s_2$ | 110.56 | 92.37 | 128.40 | 204.48 | 101.28 | 99.04 | 77.92 |
| $c_2n_1s_3$ | 165.06 | 104.00 | 105.41 | 220.26 | 160.00 | 186.66 | 144.26 |
| $c_2n_2s_1$ | 108.36 | 128.49 | 138.15 | 149.84 | 180.86 | 106.15 | 89.72 |
| $c_2n_2s_2$ | 134.40 | 139.26 | 153.90 | 208.40 | 195.68 | 112.64 | 123.12 |
| $c_2n_2s_3$ | 179.86 | 116.36 | 136.22 | 298.13 | 265.60 | 184.93 | 174.13 |
| $c_2n_3s_1$ | 110.58 | 127.86 | 128.49 | 168.52 | 241.29 | 134.83 | 110.95 |
| $c_2n_3s_2$ | 155.84 | 136.32 | 140.86 | 251.84 | 154.00 | 151.60 | 161.12 |
| $c_2n_3s_3$ | 244.66 | 142.21 | 122.83 | 298.00 | 308.23 | 195.60 | 224.40 |
| SEm (±) | 20.543 | 21.217 | 22.353 | 17.902 | 16.634 | 18.942 | 17.176 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

The result showed that the cutting pattern had significant impact on dry matter production only in third harvest. In the third harvest, $C_1$ recorded highest DMP of 163.71 g plant$^{-1}$. The DMP was significantly influenced by the chemical fertilizer treatments only in first and seventh harvests. In first harvest, maximum DMP was noticed with $N_3$ (224.67 g plant$^{-1}$) and on a par with $N_2$. In seventh harvest, highest DMP was noticed with $N_3$ (159.75 g plant$^{-1}$). The significant effect of plant spacing was noticed on all harvests. $S_3$ registered highest DMP of 189.51, 176.02, 214.48, 212.48, 155.17, 178.02 and 186.97 g plant$^{-1}$ in first, second, third, fourth, fifth and sixth harvest respectively.

Significant interaction was observed between cutting height and nutrient levels in the fourth harvest. The treatment combination $c_2n_2$ recorded maximum DMP of 163.31 g plant$^{-1}$ in the fourth harvest and was on a par with $c_2n_3$, $c_1n_3$, $c_1n_2$ and $c_1n_1$.

### *4.1.3.2 Leaf Area Index*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to LAI of palisade grass under open condition in the first year are presented in Table 17a, 17b and 17c.

Significant effect of cutting height on leaf area index was noticed only on first and fifth harvests. The ground level cutting treatments produced highest leaf area index of 1.59 and 3.75 in the first and fifth harvests respectively. The leaf area index was significantly influenced by the chemical fertilizer treatments in all the harvests. $N_3$ was observed to be significantly superior to $N_2$ in all the harvests. The different spacing treatments showed significant effect on leaf area index in all the harvests. Among the different spacing treatments $S_1$ and $S_2$ was found to be on a par in all the harvests.

None of the interactions was found to have significant influence on leaf area index.

Table 17a. Effect of cutting pattern, nutrient levels and spacing on LAI under open condition during first year

| Treatments | Leaf area index | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 1.59 | 3.28 | 3.51 | 4.30 | 3.75 | 3.76 |
| $C_2$ | 1.41 | 3.21 | 3.40 | 4.25 | 3.22 | 3.31 |
| SEm (±) | 0.039 | 0.046 | 0.065 | 0.178 | 0.147 | 0.182 |
| CD (0.05) | 0.114 | NS | NS | NS | 0.426 | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 1.31 | 3.07 | 3.31 | 3.87 | 3.19 | 2.81 |
| $N_2$ | 1.45 | 3.19 | 3.41 | 4.16 | 3.29 | 3.50 |
| $N_3$ | 1.73 | 3.48 | 3.65 | 4.82 | 3.97 | 4.29 |
| SEm (±) | 0.048 | 0.056 | 0.079 | 0.218 | 0.180 | 0.223 |
| CD (0.05) | 0.140 | 0.163 | 0.230 | 0.630 | 0.521 | 0.644 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 1.90 | 4.17 | 4.34 | 5.37 | 4.35 | 4.49 |
| $S_2$ | 1.49 | 3.23 | 3.50 | 4.41 | 3.58 | 3.55 |
| $S_3$ | 1.10 | 2.34 | 2.53 | 3.05 | 2.51 | 2.56 |
| SEm (±) | 0.048 | 0.056 | 0.079 | 0.218 | 0.180 | 0.223 |
| CD (0.05) | 0.140 | 0.163 | 0.230 | 0.630 | 0.521 | 0.644 |

NS- Not significant

Table 17b. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under open condition during first year

| Treatments | Leaf area index | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 1.36 | 3.07 | 3.38 | 3.83 | 3.51 | 2.90 |
| $c_1n_2$ | 1.56 | 3.24 | 3.40 | 4.27 | 3.54 | 3.66 |
| $c_1n_3$ | 1.83 | 3.54 | 3.76 | 4.82 | 4.20 | 4.63 |
| $c_2n_1$ | 1.27 | 3.06 | 3.24 | 3.90 | 2.87 | 2.65 |
| $c_2n_2$ | 1.34 | 3.14 | 3.43 | 4.03 | 3.04 | 3.33 |
| $c_2n_3$ | 1.63 | 3.42 | 3.53 | 4.81 | 3.74 | 3.95 |
| SEm (±) | 0.068 | 0.080 | 0.112 | 0.309 | 0.255 | 0.316 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 1.98 | 4.17 | 4.42 | 5.37 | 4.60 | 4.71 |
| $c_1s_2$ | 1.58 | 3.26 | 3.49 | 4.48 | 3.94 | 3.82 |
| $c_1s_3$ | 1.18 | 2.43 | 2.62 | 3.07 | 2.70 | 2.75 |
| $c_2s_1$ | 1.81 | 4.16 | 4.25 | 5.37 | 4.10 | 4.27 |
| $c_2s_2$ | 1.41 | 3.20 | 3.50 | 4.34 | 3.22 | 3.29 |
| $c_2s_3$ | 1.02 | 2.26 | 2.44 | 3.03 | 2.32 | 2.37 |
| SEm (±) | 0.068 | 0.080 | 0.112 | 0.309 | 0.255 | 0.316 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 1.67 | 3.90 | 4.30 | 4.92 | 4.16 | 3.37 |
| $n_1s_2$ | 1.29 | 3.09 | 3.27 | 3.98 | 3.17 | 2.98 |
| $n_1s_3$ | 0.98 | 2.20 | 2.35 | 2.68 | 2.23 | 2.09 |
| $n_2s_1$ | 1.79 | 4.10 | 4.19 | 5.13 | 4.07 | 4.47 |
| $n_2s_2$ | 1.46 | 3.17 | 3.52 | 4.27 | 3.36 | 3.37 |
| $n_2s_3$ | 1.09 | 2.31 | 2.53 | 3.06 | 2.44 | 2.65 |
| $n_3s_1$ | 2.23 | 4.50 | 4.52 | 6.05 | 4.83 | 5.63 |
| $n_3s_2$ | 1.73 | 3.43 | 3.69 | 4.98 | 4.21 | 4.31 |
| $n_3s_3$ | 1.23 | 2.52 | 2.72 | 3.41 | 2.87 | 2.94 |
| SEm (±) | 0.084 | 0.098 | 0.138 | 0.378 | 0.313 | 0.387 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 17c. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under open condition during first year

| Treatments | Leaf area index | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 1.76 | 3.90 | 4.36 | 4.78 | 4.28 | 3.38 |
| $c_1n_1s_2$ | 1.31 | 3.04 | 3.29 | 3.99 | 3.73 | 3.22 |
| $c_1n_1s_3$ | 1.01 | 2.28 | 2.48 | 2.70 | 2.51 | 2.35 |
| $c_1n_2s_1$ | 1.84 | 4.11 | 4.31 | 5.43 | 4.20 | 4.78 |
| $c_1n_2s_2$ | 1.60 | 3.24 | 3.34 | 4.35 | 3.77 | 3.56 |
| $c_1n_2s_3$ | 1.25 | 2.38 | 2.55 | 3.05 | 2.66 | 2.65 |
| $c_1n_3s_1$ | 2.35 | 4.51 | 4.60 | 5.89 | 5.33 | 5.98 |
| $c_1n_3s_2$ | 1.84 | 3.49 | 3.85 | 5.10 | 4.32 | 4.67 |
| $c_1n_3s_3$ | 1.30 | 2.62 | 2.84 | 3.46 | 2.94 | 3.25 |
| $c_2n_1s_1$ | 1.58 | 3.91 | 4.24 | 5.06 | 4.04 | 3.37 |
| $c_2n_1s_2$ | 1.28 | 3.14 | 3.26 | 3.97 | 2.62 | 2.74 |
| $c_2n_1s_3$ | 0.95 | 2.13 | 2.22 | 2.66 | 1.95 | 1.83 |
| $c_2n_2s_1$ | 1.75 | 4.09 | 4.08 | 4.84 | 3.94 | 4.16 |
| $c_2n_2s_2$ | 1.33 | 3.10 | 3.71 | 4.19 | 2.95 | 3.19 |
| $c_2n_2s_3$ | 0.94 | 2.24 | 2.50 | 3.08 | 2.22 | 2.65 |
| $c_2n_3s_1$ | 2.11 | 4.49 | 4.45 | 6.21 | 4.33 | 5.28 |
| $c_2n_3s_2$ | 1.62 | 3.37 | 3.54 | 4.85 | 4.11 | 3.95 |
| $c_2n_3s_3$ | 1.17 | 2.42 | 2.60 | 3.37 | 2.80 | 2.62 |
| SEm (±) | 0.119 | 0.138 | 0.195 | 0.535 | 0.443 | 0.547 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to LAI of palisade grass under open condition in the second year are presented in Table 18a, 18b and 18c.

A significant response was noticed by the treatments with cutting height on leaf area index up to sixth harvest. Among the two cutting patterns cutting at ground level was significantly superior to cutting at 10 cm from the ground level. However, the seventh harvest remained to be non significant. Regarding fertilizer treatments significant response was indicated in third, fourth and fifth harvests. In the third harvest the maximum leaf area index of 4.13 was obtained with a fertilizer dose of 300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ followed by $N_2$ (3.60). In the fourth and fifth harvests $N_3$ and $N_2$ was found to be on a par. There was a significant influence of plant spacing treatments on the LAI at all harvests. Among the different spacing treatments the highest LAI was observed in the 60 cm x 30 cm (4.70) spacing followed by 60 cm x 40 cm (3.92) and 60 cm x 60 cm (2.80).

No significant interaction effects was noticed on the leaf area index.

#### *4.1.3.3 Relative Growth Rate*

Data on relative growth rate as influenced by cutting pattern, nutrient levels and plant spacing under open condition in the first year are presented in Table 19a, 19b and 19c.

A significant response was noticed by the treatments with cutting height on RGR only between fifth and sixth harvest. Among the two cutting patterns cutting at 10 cm from ground level recorded highest RGR of 2.25 g $g^{-1}$ $day^{-1}$. Regarding fertilizer treatments significant response was indicated between all harvests. Maximum RGR was registered with a fertilizer dose of 300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ followed in all harvests. There was a significant influence of plant spacing treatments on RGR between third and fourth harvest, fourth and fifth harvest and fifth and sixth harvest. Among the different spacing treatments the highest RGR of 2.26 g $g^{-1}$ $day^{-1}$, 2.31 g $g^{-1}$ $day^{-1}$, and 2.34 g $g^{-1}$ $day^{-1}$ were

Table 18a. Effect of cutting pattern, nutrient levels and spacing on LAI under open condition during second year

| Treatments | Leaf area index | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 3.76 | 3.85 | 3.89 | 4.05 | 3.26 | 3.38 | 2.65 |
| $C_2$ | 3.41 | 3.42 | 3.62 | 3.57 | 2.97 | 3.12 | 2.48 |
| SEm (±) | 0.109 | 0.095 | 0.088 | 0.117 | 0.085 | 0.086 | 0.087 |
| CD (0.05) | 0.315 | 0.276 | 0.256 | 0.339 | 0.245 | 0.249 | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 3.47 | 3.45 | 3.54 | 3.44 | 2.94 | 3.11 | 2.37 |
| $N_2$ | 3.63 | 3.59 | 3.60 | 3.89 | 3.02 | 3.18 | 2.57 |
| $N_3$ | 3.65 | 3.87 | 4.13 | 4.09 | 3.38 | 3.45 | 2.76 |
| SEm (±) | 0.134 | 0.117 | 0.109 | 0.144 | 0.104 | 0.106 | 0.107 |
| CD (0.05) | NS | NS | 0.314 | 0.415 | 0.300 | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 4.63 | 4.63 | 4.43 | 4.70 | 4.10 | 4.09 | 3.24 |
| $S_2$ | 3.54 | 3.63 | 3.98 | 3.92 | 2.95 | 3.35 | 2.42 |
| $S_3$ | 2.57 | 2.66 | 2.85 | 2.80 | 2.29 | 2.30 | 2.03 |
| SEm (±) | 0.134 | 0.117 | 0.109 | 0.144 | 0.104 | 0.106 | 0.107 |
| CD (0.05) | 0.386 | 0.338 | 0.314 | 0.415 | 0.300 | 0.306 | 0.310 |

NS- Not significant

Table 18b. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under open condition during second year

| Treatments | Leaf area index | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1$ | 3.61 | 3.60 | 3.61 | 3.78 | 3.27 | 3.14 | 2.51 |
| $c_1n_2$ | 3.81 | 3.66 | 3.74 | 4.04 | 3.14 | 3.35 | 2.65 |
| $c_1n_3$ | 3.85 | 4.30 | 4.31 | 4.32 | 3.37 | 3.64 | 2.78 |
| $c_2n_1$ | 3.33 | 3.30 | 3.48 | 3.09 | 2.61 | 3.08 | 2.23 |
| $c_2n_2$ | 3.44 | 3.52 | 3.46 | 3.75 | 2.91 | 3.02 | 2.49 |
| $c_2n_3$ | 3.45 | 3.44 | 3.94 | 3.86 | 3.39 | 3.25 | 2.73 |
| SEm (±) | 0.189 | 0.166 | 0.154 | 0.203 | 0.147 | 0.150 | 0.152 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 5.03 | 4.85 | 4.58 | 5.09 | 4.28 | 4.33 | 3.29 |
| $c_1s_2$ | 3.60 | 3.92 | 3.99 | 4.09 | 3.12 | 3.37 | 2.48 |
| $c_1s_3$ | 2.65 | 2.78 | 3.10 | 2.96 | 2.37 | 2.43 | 2.16 |
| $c_2s_1$ | 4.23 | 4.41 | 4.29 | 4.31 | 3.93 | 3.85 | 3.20 |
| $c_2s_2$ | 3.49 | 3.33 | 3.97 | 3.74 | 2.78 | 3.33 | 2.36 |
| $c_2s_3$ | 2.50 | 2.53 | 2.61 | 2.65 | 2.21 | 2.18 | 1.89 |
| SEm (±) | 0.189 | 0.166 | 0.154 | 0.203 | 0.147 | 0.150 | 0.152 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 4.42 | 4.21 | 4.23 | 4.41 | 3.74 | 3.87 | 2.88 |
| $n_1s_2$ | 3.54 | 3.67 | 3.67 | 3.23 | 2.92 | 3.22 | 2.31 |
| $n_1s_3$ | 2.45 | 2.48 | 2.74 | 2.67 | 2.16 | 2.24 | 1.92 |
| $n_2s_1$ | 4.67 | 4.55 | 4.39 | 4.80 | 4.08 | 3.99 | 3.37 |
| $n_2s_2$ | 3.51 | 3.61 | 3.78 | 4.18 | 2.68 | 3.27 | 2.37 |
| $n_2s_3$ | 2.70 | 2.62 | 2.64 | 2.70 | 2.32 | 2.30 | 1.96 |
| $n_3s_1$ | 4.80 | 5.138 | 4.69 | 4.89 | 4.50 | 4.41 | 3.48 |
| $n_3s_2$ | 3.58 | 3.60 | 4.49 | 4.34 | 3.25 | 3.56 | 2.59 |
| $n_3s_3$ | 2.57 | 2.87 | 3.19 | 3.04 | 2.39 | 2.37 | 2.20 |
| SEm (±) | 0.232 | 0.203 | 0.188 | 0.249 | 0.180 | 0.183 | 0.186 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 18c. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under open condition during second year

| Treatments | Leaf area index | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1s_1$ | 4.75 | 4.63 | 4.13 | 4.81 | 4.34 | 3.77 | 3.07 |
| $c_1n_1s_2$ | 3.46 | 3.58 | 3.73 | 3.56 | 3.15 | 3.21 | 2.41 |
| $c_1n_1s_3$ | 2.63 | 2.60 | 2.98 | 2.97 | 2.33 | 2.44 | 2.04 |
| $c_1n_2s_1$ | 4.99 | 4.30 | 4.58 | 5.40 | 4.22 | 4.49 | 3.22 |
| $c_1n_2s_2$ | 3.80 | 4.01 | 3.68 | 4.21 | 2.80 | 3.28 | 2.52 |
| $c_1n_2s_3$ | 2.66 | 2.68 | 2.97 | 2.51 | 2.40 | 2.28 | 2.21 |
| $c_1n_3s_1$ | 5.35 | 5.62 | 5.02 | 5.05 | 4.29 | 4.73 | 3.59 |
| $c_1n_3s_2$ | 3.54 | 4.19 | 4.56 | 4.51 | 3.42 | 3.64 | 2.53 |
| $c_1n_3s_3$ | 2.65 | 3.08 | 3.34 | 3.40 | 2.39 | 2.57 | 2.23 |
| $c_2n_1s_1$ | 4.09 | 3.79 | 4.33 | 4.01 | 3.14 | 3.98 | 2.69 |
| $c_2n_1s_2$ | 3.61 | 3.77 | 3.61 | 2.90 | 2.69 | 3.24 | 2.21 |
| $c_2n_1s_3$ | 2.28 | 2.35 | 2.49 | 2.37 | 2.00 | 2.04 | 1.80 |
| $c_2n_2s_1$ | 4.35 | 4.79 | 4.19 | 4.20 | 3.94 | 3.50 | 3.53 |
| $c_2n_2s_2$ | 3.22 | 3.21 | 3.88 | 4.16 | 2.56 | 3.26 | 2.23 |
| $c_2n_2s_3$ | 2.74 | 2.57 | 2.31 | 2.90 | 2.23 | 2.32 | 1.72 |
| $c_2n_3s_1$ | 4.24 | 4.65 | 4.36 | 4.73 | 4.70 | 4.08 | 3.37 |
| $c_2n_3s_2$ | 3.63 | 3.01 | 4.42 | 4.16 | 3.09 | 3.49 | 2.66 |
| $c_2n_3s_3$ | 2.49 | 2.67 | 3.04 | 2.68 | 2.39 | 2.18 | 2.16 |
| SEm (±) | 0.328 | 0.287 | 0.267 | 0.353 | 0.254 | 0.259 | 0.263 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 19a. Effect of cutting pattern, nutrient levels and spacing on RGR under open condition during first year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 2.00 | 1.97 | 2.14 | 2.15 | 2.16 |
| $C_2$ | 2.02 | 2.02 | 2.20 | 2.22 | 2.25 |
| SEm (±) | 0.022 | 0.026 | 0.047 | 0.025 | 0.014 |
| CD (0.05) | NS | NS | NS | NS | 0.042 |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 1.94 | 1.88 | 2.06 | 2.10 | 2.13 |
| $N_2$ | 2.04 | 2.05 | 2.21 | 2.19 | 2.21 |
| $N_3$ | 2.05 | 2.05 | 2.24 | 2.26 | 2.26 |
| SEm (±) | 0.028 | 0.032 | 0.043 | 0.031 | 0.018 |
| CD (0.05) | 0.081 | 0.094 | 0.125 | 0.091 | 0.052 |
| **Spacing (S)** | | | | | |
| $S_1$ | 2.02 | 1.98 | 2.16 | 2.02 | 2.07 |
| $S_2$ | 2.00 | 2.03 | 2.08 | 2.23 | 2.20 |
| $S_3$ | 2.01 | 1.97 | 2.26 | 2.31 | 2.34 |
| SEm (±) | 0.028 | 0.032 | 0.043 | 0.031 | 0.018 |
| CD (0.05) | NS | NS | 0.125 | 0.091 | 0.052 |

NS- Not significant

Table 19b. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under open condition during first year, g g$^{-1}$ day$^{-1}$

| Treatments | RGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 1.95 | 1.85 | 2.06 | 2.10 | 2.09 |
| $c_1n_2$ | 2.02 | 2.00 | 2.16 | 2.12 | 2.18 |
| $c_1n_3$ | 2.04 | 2.06 | 2.20 | 2.22 | 2.20 |
| $c_2n_1$ | 1.93 | 1.91 | 2.06 | 2.10 | 2.18 |
| $c_2n_2$ | 2.05 | 2.10 | 2.26 | 2.25 | 2.20 |
| $c_2n_3$ | 2.07 | 2.04 | 2.28 | 2.30 | 2.33 |
| SEm (±) | 0.039 | 0.046 | 0.082 | 0.044 | 0.025 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 2.02 | 2.01 | 2.10 | 2.01 | 2.01 |
| $c_1s_2$ | 1.99 | 1.97 | 2.10 | 2.18 | 2.19 |
| $c_1s_3$ | 2.00 | 1.93 | 2.23 | 2.26 | 2.26 |
| $c_2s_1$ | 2.03 | 1.94 | 2.23 | 2.02 | 2.13 |
| $c_2s_2$ | 2.01 | 2.09 | 2.07 | 2.27 | 2.21 |
| $c_2s_3$ | 2.01 | 2.01 | 2.30 | 2.35 | 2.41 |
| SEm (±) | 0.039 | 0.046 | 0.082 | 0.044 | 0.025 |
| CD (0.05) | NS | NS | NS | NS | 0.07 |
| $n_1s_1$ | 1.98 | 1.82 | 2.06 | 1.86 | 1.99 |
| $n_1s_2$ | 1.90 | 1.97 | 1.95 | 2.18 | 2.18 |
| $n_1s_3$ | 1.94 | 1.85 | 2.17 | 2.26 | 2.24 |
| $n_2s_1$ | 2.03 | 2.09 | 2.17 | 2.01 | 2.13 |
| $n_2s_2$ | 2.07 | 2.06 | 2.13 | 2.20 | 2.16 |
| $n_2s_3$ | 2.01 | 2.00 | 2.33 | 2.35 | 2.35 |
| $n_3s_1$ | 2.06 | 2.03 | 2.25 | 2.18 | 2.09 |
| $n_3s_2$ | 2.02 | 2.05 | 2.18 | 2.30 | 2.27 |
| $n_3s_3$ | 2.08 | 2.07 | 2.30 | 2.31 | 2.43 |
| SEm (±) | 0.048 | 0.218 | 0.101 | 0.054 | 0.030 |
| CD (0.05) | NS | NS | NS | NS | 0.089 |

NS- Not significant

Table 19c. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under open condition during first year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1s_1$ | 1.99 | 1.89 | 1.97 | 1.94 | 1.86 |
| $c_1n_1s_2$ | 1.92 | 1.89 | 2.03 | 2.13 | 2.21 |
| $c_1n_1s_3$ | 1.94 | 1.77 | 2.18 | 2.25 | 2.20 |
| $c_1n_2s_1$ | 2.00 | 2.10 | 2.15 | 1.90 | 2.11 |
| $c_1n_2s_2$ | 2.06 | 2.00 | 2.03 | 2.16 | 2.20 |
| $c_1n_2s_3$ | 2.00 | 1.92 | 2.31 | 2.32 | 2.24 |
| $c_1n_3s_1$ | 2.07 | 2.05 | 2.17 | 2.19 | 2.07 |
| $c_1n_3s_2$ | 1.99 | 2.02 | 2.24 | 2.27 | 2.18 |
| $c_1n_3s_3$ | 2.06 | 2.11 | 2.21 | 2.20 | 2.36 |
| $c_2n_1s_1$ | 1.97 | 1.75 | 2.15 | 1.79 | 2.11 |
| $c_2n_1s_2$ | 1.89 | 2.06 | 1.88 | 2.24 | 2.15 |
| $c_2n_1s_3$ | 1.94 | 1.93 | 2.15 | 2.27 | 2.28 |
| $c_2n_2s_1$ | 2.06 | 2.08 | 2.20 | 2.12 | 2.15 |
| $c_2n_2s_2$ | 2.09 | 2.13 | 2.23 | 2.25 | 2.12 |
| $c_2n_2s_3$ | 2.01 | 2.08 | 2.35 | 2.38 | 2.46 |
| $c_2n_3s_1$ | 2.06 | 2.00 | 2.33 | 2.16 | 2.12 |
| $c_2n_3s_2$ | 2.05 | 2.09 | 2.12 | 2.33 | 2.37 |
| $c_2n_3s_3$ | 2.10 | 2.03 | 2.39 | 2.41 | 2.50 |
| SEm (±) | 0.068 | 0.079 | 0.142 | 0.077 | 0.044 |
| CD (0.05) | NS | NS | NS | NS | 0.127 |

NS- Not significant

obtained between third and fourth harvest, fourth and fifth harvest and fifth and sixth harvest respectively in the wider spacing of 60 cm x 60 cm.

Significant interaction was observed between cutting height and spacing between fifth and sixth harvest. The treatment combination $c_2s_3$ recorded highest RGR of 2.41 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between nutrient level and spacing between fifth and sixth harvest. The treatment combination $n_3s_3$ recorded highest RGR of 2.43 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between cutting height, nutrient level and spacing between fifth and sixth harvest. The treatment combination $c_2n_3s_3$ recorded highest RGR of 2.50 g $g^{-1}$ $day^{-1}$.

Data on relative growth rate as influenced by cutting pattern, nutrient levels and plant spacing under open condition under open condition in the second year are presented in Table 20a, 20b and 20c.

A significant response was noticed by the treatments with cutting height on RGR only between second and third harvest. Among the two cutting patterns cutting at ground level recorded highest RGR of 2.13 g $g^{-1}$ $day^{-1}$. Regarding fertilizer treatments significant response was indicated only between sixth and seventh harvest. Maximum RGR was registered with a fertilizer dose of 300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ between second and third harvest. There was a significant influence of plant spacing treatments on RGR between all harvests. Among the different spacing treatments the highest RGR was observed in the 60 cm x 60 cm spacing treatment.

Significant interaction was observed between cutting height and nutrient levels between third and fourth harvest. The treatment combination $c_2n_2$ recorded highest RGR of 2.13 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between cutting height and spacing between third and fourth harvest. The treatment combination $c_2s_3$ recorded highest RGR of 2.27 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between cutting height and nutrient level between sixth

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Table 20a. Effect of cutting pattern, nutrient levels and spacing on RGR under open condition during second year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 2.02 | 2.13 | 2.08 | 1.94 | 2.03 | 2.05 |
| $C_2$ | 2.00 | 2.07 | 2.08 | 1.94 | 2.08 | 2.05 |
| SEm (±) | 0.023 | 0.020 | 0.015 | 0.020 | 0.019 | 0.018 |
| CD (0.05) | NS | 0.058 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 1.97 | 2.06 | 2.05 | 1.90 | 2.01 | 2.00 |
| $N_2$ | 2.02 | 2.12 | 2.09 | 1.99 | 2.06 | 2.02 |
| $N_3$ | 2.046 | 2.12 | 2.11 | 1.92 | 2.09 | 2.11 |
| SEm (±) | 0.028 | 0.024 | 0.015 | 0.025 | 0.023 | 0.021 |
| CD (0.05) | NS | NS | NS | NS | NS | 0.063 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 1.86 | 1.98 | 1.92 | 1.80 | 1.96 | 1.93 |
| $S_2$ | 1.99 | 2.06 | 2.07 | 1.89 | 2.01 | 2.01 |
| $S_3$ | 2.17 | 2.27 | 2.26 | 2.12 | 2.19 | 2.205 |
| SEm (±) | 0.028 | 0.024 | 0.015 | 0.025 | 0.023 | 0.021 |
| CD (0.05) | 0.082 | 0.071 | 0.044 | 0.074 | 0.069 | 0.063 |

NS- Not significant

Table 20b. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under open condition during second year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1$ | 1.98 | 2.09 | 2.08 | 1.90 | 1.99 | 2.05 |
| $c_1n_2$ | 2.02 | 2.17 | 2.05 | 1.96 | 2.06 | 2.01 |
| $c_1n_3$ | 2.06 | 2.14 | 2.12 | 1.96 | 2.03 | 2.09 |
| $c_2n_1$ | 1.96 | 2.03 | 2.02 | 1.91 | 2.03 | 1.96 |
| $c_2n_2$ | 2.02 | 2.06 | 2.13 | 2.02 | 2.05 | 2.04 |
| $c_2n_3$ | 2.02 | 2.11 | 2.10 | 1.88 | 2.15 | 2.14 |
| SEm (±) | 0.040 | 0.035 | 0.026 | 0.036 | 0.340 | 0.031 |
| CD (0.05) | NS | NS | 0.075 | NS | NS | 0.090 |
| $c_1s_1$ | 1.86 | 2.01 | 1.88 | 1.79 | 1.91 | 1.92 |
| $c_1s_2$ | 2.00 | 2.09 | 2.11 | 1.92 | 2.01 | 2.02 |
| $c_1s_3$ | 2.19 | 2.29 | 2.26 | 2.10 | 2.16 | 2.21 |
| $c_2s_1$ | 1.86 | 1.94 | 1.95 | 1.80 | 2.00 | 1.93 |
| $c_2s_2$ | 1.98 | 2.02 | 2.03 | 1.87 | 2.01 | 2.01 |
| $c_2s_3$ | 2.16 | 2.24 | 2.27 | 2.14 | 2.21 | 2.19 |
| SEm (±) | 0.040 | 0.035 | 0.026 | 0.036 | 0.340 | 0.031 |
| CD (0.05) | NS | NS | 0.075 | NS | NS | NS |
| $n_1s_1$ | 1.82 | 1.90 | 1.84 | 1.77 | 1.91 | 1.93 |
| $n_1s_2$ | 1.89 | 2.04 | 2.04 | 1.79 | 1.96 | 1.94 |
| $n_1s_3$ | 2.19 | 2.24 | 2.26 | 2.15 | 2.16 | 2.14 |
| $n_2s_1$ | 1.83 | 2.01 | 1.96 | 1.90 | 1.94 | 1.90 |
| $n_2s_2$ | 2.06 | 2.06 | 2.05 | 1.96 | 2.01 | 2.00 |
| $n_2s_3$ | 2.16 | 2.28 | 2.26 | 2.10 | 2.22 | 2.17 |
| $n_3s_1$ | 1.93 | 2.02 | 1.95 | 1.72 | 2.02 | 1.95 |
| $n_3s_2$ | 2.02 | 2.07 | 2.12 | 1.93 | 2.06 | 2.11 |
| $n_3s_3$ | 2.17 | 2.28 | 2.26 | 2.11 | 2.18 | 2.29 |
| SEm (±) | 0.049 | 0.042 | 0.031 | 0.044 | 0.041 | 0.038 |
| CD (0.05) | NS | NS | NS | 0.128 | NS | NS |

NS- Not significant

Table 20c. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under open condition during second year, g g$^{-1}$ day$^{-1}$

| Treatments | RGR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 1.83 | 1.97 | 1.82 | 1.71 | 1.86 | 1.94 |
| $c_1n_1s_2$ | 1.93 | 2.08 | 2.09 | 1.79 | 1.99 | 2.03 |
| $c_1n_1s_3$ | 2.19 | 2.21 | 2.32 | 2.19 | 2.12 | 2.19 |
| $c_1n_2s_1$ | 1.80 | 2.06 | 1.89 | 1.90 | 1.92 | 1.90 |
| $c_1n_2s_2$ | 2.05 | 2.12 | 2.08 | 1.96 | 2.04 | 1.96 |
| $c_1n_2s_3$ | 2.20 | 2.33 | 2.19 | 2.02 | 2.23 | 2.16 |
| $c_1n_3s_1$ | 1.96 | 2.00 | 1.93 | 1.77 | 1.95 | 1.91 |
| $c_1n_3s_2$ | 2.04 | 2.08 | 2.17 | 2.00 | 1.99 | 2.06 |
| $c_1n_3s_3$ | 2.19 | 2.34 | 2.26 | 2.10 | 2.14 | 2.29 |
| $c_2n_1s_1$ | 1.82 | 1.83 | 1.86 | 1.84 | 1.96 | 1.93 |
| $c_2n_1s_2$ | 1.85 | 1.99 | 1.99 | 1.79 | 1.93 | 1.84 |
| $c_2n_1s_3$ | 2.20 | 2.26 | 2.21 | 2.12 | 2.20 | 2.10 |
| $c_2n_2s_1$ | 1.86 | 1.96 | 2.04 | 1.90 | 1.90 | 1.89 |
| $c_2n_2s_2$ | 2.07 | 2.00 | 2.02 | 1.96 | 1.99 | 2.04 |
| $c_2n_2s_3$ | 2.13 | 2.24 | 2.33 | 2.19 | 2.21 | 2.18 |
| $c_2n_3s_1$ | 1.90 | 2.04 | 1.97 | 1.66 | 2.08 | 1.99 |
| $c_2n_3s_2$ | 2.01 | 2.06 | 2.07 | 1.87 | 2.13 | 2.15 |
| $c_2n_3s_3$ | 2.15 | 2.22 | 2.27 | 2.12 | 2.23 | 2.29 |
| SEm (±) | 0.069 | 0.060 | 0.045 | 0.062 | 0.059 | 0.053 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

and seventh harvest. The treatment combination $c_2n_3$ recorded highest RGR of 2.14 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between nutrient levels and spacing between fourth and fifth harvest. $n_1s_3$ recorded highest RGR of 2.15 g $g^{-1}$ $day^{-1}$.

#### *4.1.3.4 Crop Growth Rate*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to CGR of palisade grass under open condition in the first year are presented in Table 21a, 21b and 21c.

A significant response was not noticed by the cutting treatments on CGR. Also no significant variation was observed by the treatments involving chemical fertilizer. But there was a significant influence of plant spacing treatments on CGR between first and second harvest and between fourth and fifth harvest. Among the different spacing treatments the highest CGR of 4.78 g $m^{-2}$ $day^{-1}$ was observed by $S_1$ between first and second harvest and 3.92 g $m^{-2}$ $day^{-1}$ by $S_2$ between fourth and fifth harvest.

Significant interaction was observed between nutrient levels and spacing between fifth and sixth harvest. $n_2s_1$ recorded highest CGR of 4.48 g $m^{-2}$ $day^{-1}$. Significant interaction was observed between cutting height, nutrient level and spacing between fifth and sixth harvest. The treatment combination $c_1n_2s_1$ recorded highest CGR of 7.66 g $m^{-2}$ $day^{-1}$

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to CGR of palisade grass under open condition in the second year are presented in Table 22a, 22b and 22c.

A significant response was noticed by the treatments with cutting height on CGR only between second and third harvest. Among the two cutting patterns cutting at ground level recorded highest CGR of 3.22 g $m^{-2}$ $day^{-1}$. Regarding fertilizer treatments significant response was indicated only between fourth and fifth harvest. Maximum CGR was registered with a fertilizer dose of 250: 62.5: 62.5

Table 21a. Effect of cutting pattern, nutrient levels and spacing on CGR under open condition during first year, g $m^{-2}$ $day^{-1}$

| Treatments | CGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 0.79 | -0.36 | 5.13 | -0.56 | -0.09 |
| $C_2$ | 0.71 | 0.19 | 6.89 | 0.11 | 0.71 |
| SEm (±) | 0.668 | 0.854 | 1,715 | 1.478 | 0.990 |
| CD (0.05) | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | -0.30 | -1.13 | 4.27 | 0.77 | 0.73 |
| $N_2$ | 1.04 | 0.78 | 4.93 | -0.74 | 0.46 |
| $N_3$ | 1.52 | 0.09 | 8.83 | -0.71 | -0.27 |
| SEm (±) | 0.817 | 1.045 | 2.098 | 1.812 | 1.218 |
| CD (0.05) | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | |
| $S_1$ | 4.78 | -0.78 | 7.26 | -5.82 | 1.38 |
| $S_2$ | 1.49 | 0.89 | 2.84 | 3.92 | -1.24 |
| $S_3$ | -4.01 | -0.39 | 7.93 | 1.21 | 0.78 |
| SEm (±) | 0.817 | 1.045 | 2.098 | 1.812 | 1.218 |
| CD (0.05) | 2.353 | NS | NS | 5.218 | NS |

NS- Not significant

Table 21b. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under open condition during first year, g m$^{-2}$ day$^{-1}$

| Treatments | CGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 0.38 | -1.79 | 4.25 | 0.81 | -0.28 |
| $c_1n_2$ | 1.14 | 0.29 | 4.16 | -1.27 | 1.66 |
| $c_1n_3$ | 0.84 | 0.40 | 6.99 | -1.24 | -1.65 |
| $c_2n_1$ | -0.99 | -0.48 | 4.29 | 0.74 | 1.75 |
| $c_2n_2$ | 0.93 | 1.26 | 5.70 | -0.21 | -0.72 |
| $c_2n_3$ | 2.19 | -0.23 | 10.68 | -0.18 | 1.10 |
| SEm (±) | 1.153 | 1.481 | 2.972 | 2.560 | 1.720 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 4.96 | -0.35 | 4.12 | -3.69 | 0.03 |
| $c_1s_2$ | 1.49 | 0.08 | 4.82 | 1.25 | 0.11 |
| $c_1s_3$ | -4.08 | -0.81 | 6.46 | 0.73 | -0.42 |
| $c_2s_1$ | 4.59 | -1.20 | 10.40 | -7.95 | 2.73 |
| $c_2s_2$ | 1.48 | 1.70 | 0.85 | 6.59 | -2.60 |
| $c_2s_3$ | -3.94 | 0.03 | 9.417 | 1.70 | 2.00 |
| SEm (±) | 1.153 | 1.481 | 2.972 | 2.560 | 1.720 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 3.59 | -3.95 | 7.54 | -6.46 | 3.46 |
| $n_1s_2$ | 0.81 | 1.60 | 0.39 | 6.00 | -0.71 |
| $n_1s_3$ | -5.32 | -1.07 | 4.87 | 2.79 | -0.53 |
| $n_2s_1$ | 4.22 | 2.16 | 4.15 | -6.58 | 4.48 |
| $n_2s_2$ | 2.55 | 0.20 | 2.25 | 2.47 | -1.92 |
| $n_2s_3$ | -3.65 | -0.04 | 8.40 | 1.87 | -1.16 |
| $n_3s_1$ | 6.51 | -0.55 | 10.09 | -4.42 | -3.78 |
| $n_3s_2$ | 1.10 | 0.86 | 5.87 | 3.30 | -1.08 |
| $n_3s_3$ | -3.06 | -0.04 | 10.53 | -1.02 | 4.05 |
| SEm (±) | 1.414 | 1.815 | 3.638 | 3.136 | 2.105 |
| CD (0.05) | NS | NS | NS | NS | 6.062 |

NS- Not significant

Table 21c. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under open condition during first year, g m$^{-2}$ day$^{-1}$

| Treatments | CGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 4.44 | -3.01 | 3.07 | -1.87 | -2.18 |
| $c_1n_1s_2$ | 1.86 | -0.12 | 3.30 | 2.45 | 2.60 |
| $c_1n_1s_3$ | 5.16 | -2.23 | 6.37 | 1.87 | -1.26 |
| $c_1n_2s_1$ | 2.60 | 3.13 | 3.04 | -9.33 | 7.66 |
| $c_1n_2s_2$ | 2.59 | -0.94 | 0.63 | 3.77 | 1.42 |
| $c_1n_2s_3$ | -1.75 | -1.32 | 8.82 | 1.74 | -4.10 |
| $c_1n_3s_1$ | 7.84 | -1.18 | 6.26 | 0.14 | -5.37 |
| $c_1n_3s_2$ | 0.02 | 1.31 | 10.54 | -2.44 | -3.66 |
| $c_1n_3s_3$ | -5.33 | 1.10 | 4.17 | -1.42 | 4.08 |
| $c_2n_1s_1$ | 2.75 | -4.88 | 12.02 | -11.05 | 9.11 |
| $c_2n_1s_2$ | -0.24 | 3.34 | -2.51 | 9.55 | -4.03 |
| $c_2n_1s_3$ | -5.48 | 0.08 | 3.37 | 3.72 | 0.19 |
| $c_2n_2s_1$ | 5.85 | 1.19 | 5.27 | -3.83 | 1.31 |
| $c_2n_2s_2$ | 2.51 | 1.35 | 3.87 | 1.18 | -5.26 |
| $c_2n_2s_3$ | -5.55 | 1.22 | 7.98 | 2.01 | 1.78 |
| $c_2n_3s_1$ | 5.19 | 0.08 | 13.92 | -8.98 | -2.20 |
| $c_2n_3s_2$ | 2.19 | 0.42 | 1.21 | 9.06 | 1.49 |
| $c_2n_3s_3$ | -0.79 | -1.19 | 16.89 | -0.63 | 4.02 |
| SEm (±) | 2.002 | 2.563 | 5.145 | 4.435 | 2.978 |
| CD (0.05) | NS | NS | NS | NS | 8.575 |

NS- Not significant

Table 22a. Effect of cutting pattern, nutrient levels and spacing on CGR under open condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | CGR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | -0.64 | 3.22 | -1.55 | -3.44 | 1.76 | 1.09 |
| $C_2$ | -2.09 | 1.35 | 0.44 | -3.34 | 3.31 | -0.88 |
| SEm (±) | 0.805 | 0.576 | 0.862 | 0.429 | 0.714 | 0.704 |
| CD (0.05) | NS | 1.659 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | -0.89 | 2.01 | -0.20 | -3.11 | 2.19 | 0.05 |
| $N_2$ | -1.66 | 2.72 | -0.91 | -2.53 | 1.50 | -0.81 |
| $N_3$ | -1.54 | 2.13 | -0.54 | -4.53 | 3.92 | 1.08 |
| SEm (±) | 0.986 | 0.703 | 1.056 | 0.524 | 0.874 | 0.861 |
| CD (0.05) | NS | NS | NS | 1.510 | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | -2.63 | 2.94 | -1.78 | -2.73 | 3.8 | -0.57 |
| $S_2$ | -0.63 | 1.59 | 0.25 | -3.91 | 2.33 | 0.33 |
| $S_3$ | -0.83 | 2.32 | -0.12 | -3.53 | 1.41 | 0.55 |
| SEm (±) | 0.986 | 0.703 | 1.056 | 0.524 | 0.874 | 0.861 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 22b. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under open condition during second year, g m$^{-2}$ day$^{-1}$

| Treatments | CGR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 0.03 | 2.68 | -0.12 | -4.05 | 1.53 | 2.07 |
| $c_1n_2$ | -2.10 | 4.77 | -3.80 | -2.16 | 2.29 | -1.05 |
| $c_1n_3$ | 0.17 | 2.22 | -0.73 | -4.12 | 1.45 | 2.25 |
| $c_2n_1$ | -1.79 | 1.34 | -0.27 | -2.17 | 2.84 | -1.97 |
| $c_2n_2$ | -1.22 | 0.66 | 1.98 | -2.90 | 0.72 | -0.57 |
| $c_2n_3$ | -3.26 | 2.05 | -0.36 | -4.95 | 6.38 | -0.09 |
| SEm (±) | 1.394 | 0.993 | 1.493 | 0.742 | 1.237 | 1.218 |
| CD (0.05) | NS | NS | NS | NS | 3.56 | NS |
| $c_1s_1$ | -2.37 | 4.04 | -3.75 | -1.87 | 2.55 | 0.97 |
| $c_1s_2$ | 0.56 | 2.56 | 0.34 | -4.58 | 1.52 | 0.70 |
| $c_1s_3$ | -0.11 | 3.06 | -1.24 | -3.87 | 1.20 | 1.60 |
| $c_2s_1$ | -2.89 | 1.85 | 0.18 | -3.58 | 5.20 | -2.11 |
| $c_2s_2$ | -1.83 | 0.62 | 0.16 | -3.24 | 3.14 | -0.03 |
| $c_2s_3$ | -1.55 | 1.58 | 1.00 | -3.20 | 1.61 | -0.50 |
| SEm (±) | 1.394 | 0.993 | 1.493 | 0.742 | 1.237 | 1.218 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | -2.81 | 1.82 | -1.66 | -1.32 | 3.21 | 0.60 |
| $n_1s_2$ | -1.29 | 3.25 | 0.18 | -5.05 | 3.03 | -0.18 |
| $n_1s_3$ | 1.42 | 0.95 | 0.87 | -2.97 | 0.33 | -0.26 |
| $n_2s_1$ | -3.71 | 4.57 | -1.46 | -1.86 | 1.21 | -1.16 |
| $n_2s_2$ | 0.39 | 0.42 | -0.88 | -1.90 | 1.15 | -0.27 |
| $n_2s_3$ | -1.67 | 3.16 | -0.38 | -3.82 | 2.16 | -1.00 |
| $n_3s_1$ | -1.37 | 2.44 | -2.23 | -5.01 | 7.20 | -1.15 |
| $n_3s_2$ | -1.00 | 1.10 | 1.45 | -4.78 | 2.82 | 1.46 |
| $n_3s_3$ | -2.25 | 2.86 | -0.86 | -3.81 | 1.74 | 2.93 |
| SEm (±) | 1.706 | 1.217 | 1,831 | 0.907 | 1.517 | 1.491 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 22c. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under open condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | CGR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | -1.51 | 3.53 | -3.79 | -2.17 | 2.90 | 2.56 |
| $c_1n_1s_2$ | -0.09 | 4.01 | 0.16 | -6.03 | 3.26 | 1.59 |
| $c_1n_1s_3$ | 1.62 | 0.50 | 3.26 | -3.94 | -1.55 | 2.08 |
| $c_1n_2s_1$ | -5.02 | 7.39 | -5.33 | 0.09 | 0.61 | -0.29 |
| $c_1n_2s_2$ | 0.69 | 2.66 | -2.07 | -2.82 | 1.90 | -1.51 |
| $c_1n_2s_3$ | -1.97 | 4.25 | -4.01 | -3.76 | 4.36 | -1.34 |
| $c_1n_3s_1$ | -0.58 | 1.19 | -2.13 | -3.55 | 4.14 | 0.64 |
| $c_1n_3s_2$ | 1.10 | 1.02 | 2.93 | -4.89 | -0.58 | 2.03 |
| $c_1n_3s_3$ | 0.03 | 4.45 | -2.98 | -3.91 | 0.81 | 4.08 |
| $c_2n_1s_1$ | -4.11 | 0.11 | 0.47 | -0.47 | 3.52 | -1.35 |
| $c_2n_1s_2$ | -2.49 | 2.49 | 0.20 | -4.06 | 2.79 | -1.93 |
| $c_2n_1s_3$ | 1.21 | 1.41 | -1.51 | -2.00 | 2.21 | -2.61 |
| $c_2n_2s_1$ | -2.40 | 1.75 | 2.40 | -3.83 | 1.81 | -2.03 |
| $c_2n_2s_2$ | 0.09 | -1.82 | 0.31 | -0.98 | 0.40 | 0.97 |
| $c_2n_2s_3$ | -1.37 | 2.08 | 3.25 | -3.88 | -0.04 | -0.66 |
| $c_2n_3s_1$ | -2.17 | 3.69 | -2.33 | -6.46 | 10.27 | -2.94 |
| $c_2n_3s_2$ | -3.11 | 1.19 | -0.03 | -4.67 | 6.22 | 0.88 |
| $c_2n_3s_3$ | -4.50 | 1.26 | 1.26 | -3.72 | 2.66 | 1.77 |
| SEm (±) | 2.416 | 1.72 | 2.593 | 1.286 | 2.143 | 2.109 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ between fourth and fifth harvest. There was no significant influence of plant spacing treatments on CGR between all harvests.

Significant interaction was observed between cutting height and nutrient level between fifth and sixth harvest. The treatment combination $c_2n_3$ recorded highest CGR of 6.38 g $m^{-2}$ $day^{-1}$.

### *4.1.3.5 Net Assimilation Rate*

Data on net assimilation rate as influenced by cutting pattern, nutrient levels and plant spacing under open condition in the first year are presented in Table 23a, 23b and 23c.

A significant response was not noticed by the cutting treatments on NAR. Also no significant variation was observed by the treatments involving chemical fertilizer. But there was a significant influence of plant spacing treatments on NAR between first and second harvest and between fourth and fifth harvest. Among the different spacing treatments the highest NAR of 0.007 g $m^{-2}$ $day^{-1}$ was observed by $S_1$ between first and second harvest and 0.005 g $m^{-2}$ $day^{-1}$ by $S_2$ between fourth and fifth harvest.

None of the interactions was found to have significant influence on NAR.

Data on net assimilation rate as influenced by cutting pattern, nutrient levels and plant spacing under open condition in the second year are presented in Table 24a, 24b and 24c.

A significant response was noticed by the treatments with cutting height on NAR only between second and third harvest. Among the two cutting patterns cutting at ground level recorded highest NAR of 0.004 g $m^{-2}$ $day^{-1}$. Regarding fertilizer treatments no significant response was indicated between all harvests. There was no significant influence of plant spacing treatments on NAR between all harvests.

None of the interactions was found to have significant influence on NAR.

Table 23a. Effect of cutting pattern, nutrient levels and spacing on NAR under open condition during first year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | |
| $C_1$ | -0.001 | -0.001 | -0.006 | -0.001 | 0.001 |
| $C_2$ | -0.001 | 0.001 | -0.007 | 0.001 | 0.001 |
| SEm (±) | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 |
| CD (0.05) | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | -0.003 | -0.002 | -0.005 | 0.002 | 0.001 |
| $N_2$ | 0.001 | 0.001 | -0.007 | -0.001 | 0.000 |
| $N_3$ | 0.001 | 0.001 | -0.009 | -0.001 | 0.001 |
| SEm (±) | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 |
| CD (0.05) | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | |
| $S_1$ | 0.007 | -0.001 | -0.006 | -0.006 | 0.002 |
| $S_2$ | 0.003 | 0.001 | -0.003 | 0.005 | -0.002 |
| $S_3$ | -0.011 | -0.001 | -0.011 | 0.002 | 0.002 |
| SEm (±) | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 |
| CD (0.05) | 0.005 | NS | NS | 0.006 | NS |

NS- Not significant

Table 23b. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under open condition during first year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1$ | -0.001 | -0.003 | -0.006 | 0.002 | -0.001 |
| $c_1n_2$ | 0.002 | -0.002 | -0.006 | -0.001 | 0.001 |
| $c_1n_3$ | -0.001 | 0.001 | -0.007 | -0.001 | -0.001 |
| $c_2n_1$ | -0.004 | -0.001 | -0.005 | 0.003 | 0.002 |
| $c_2n_2$ | -0.001 | 0.002 | -0.007 | 0.001 | -0.001 |
| $c_2n_3$ | 0.003 | -0.001 | -0.010 | 0.001 | 0.002 |
| SEm (±) | 0.002 | 0.001 | 0.003 | 0.003 | 0.002 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 0.007 | -0.001 | -0.003 | -0.004 | 0.001 |
| $c_1s_2$ | 0.003 | -0.002 | -0.005 | 0.001 | 0.001 |
| $c_1s_3$ | -0.010 | -0.002 | -0.010 | 0.001 | -0.001 |
| $c_2s_1$ | 0.007 | -0.001 | -0.009 | -0.008 | 0.004 |
| $c_2s_2$ | 0.003 | 0.002 | -0.001 | 0.008 | -0.005 |
| $c_2s_3$ | -0.012 | 0.001 | -0.012 | 0.003 | 0.004 |
| SEm (±) | 0.002 | 0.001 | 0.003 | 0.003 | 0.002 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 0.006 | -0.004 | -0.007 | -0.007 | 0.005 |
| $n_1s_2$ | 0.002 | 0.002 | -0.006 | 0.009 | -0.002 |
| $n_1s_3$ | -0.015 | -0.003 | -0.008 | 0.005 | -0.001 |
| $n_2s_1$ | 0.007 | 0.002 | -0.004 | -0.007 | 0.004 |
| $n_2s_2$ | 0.005 | 0.002 | -0.003 | 0.002 | -0.003 |
| $n_2s_3$ | -0.010 | 0.002 | -0.013 | 0.003 | -0.001 |
| $n_3s_1$ | 0.009 | -0.001 | -0.008 | -0.004 | -0.003 |
| $n_3s_2$ | 0.002 | 0.001 | -0.006 | 0.003 | -0.001 |
| $n_3s_3$ | -0.008 | -0.001 | -0.011 | -0.001 | 0.007 |
| SEm (±) | 0.002 | 0.002 | 0.003 | 0.003 | 0.003 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 23c. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under open condition during first year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1s_1$ | 0.007 | -0.003 | -0.003 | -0.001 | -0.003 |
| $c_1n_1s_2$ | 0.004 | -0.003 | -0.004 | 0.003 | 0.005 |
| $c_1n_1s_3$ | -0.014 | -0.006 | -0.011 | 0.003 | -0.002 |
| $c_1n_2s_1$ | 0.005 | 0.003 | -0.003 | -0.010 | 0.008 |
| $c_1n_2s_2$ | 0.005 | -0.001 | -0.001 | 0.004 | 0.002 |
| $c_1n_2s_3$ | -0.004 | -0.002 | -0.014 | 0.002 | -0.006 |
| $c_1n_3s_1$ | 0.010 | -0.001 | -0.004 | 0.001 | -0.004 |
| $c_1n_3s_2$ | 0.001 | 0.002 | -0.011 | -0.002 | -0.003 |
| $c_1n_3s_3$ | -0.013 | 0.002 | -0.006 | -0.002 | 0.007 |
| $c_2n_1s_1$ | 0.005 | -0.005 | -0.011 | -0.012 | 0.012 |
| $c_2n_1s_2$ | -0.005 | 0.005 | 0.004 | 0.015 | -0.008 |
| $c_2n_1s_3$ | -0.016 | 0.001 | -0.006 | 0.006 | 0.001 |
| $c_2n_2s_1$ | 0.009 | 0.001 | -0.004 | -0.003 | 0.001 |
| $c_2n_2s_2$ | 0.005 | 0.002 | -0.005 | 0.001 | -0.007 |
| $c_2n_2s_3$ | -0.016 | 0.002 | -0.013 | 0.004 | 0.005 |
| $c_2n_3s_1$ | 0.007 | -0.002 | -0.012 | -0.008 | -0.002 |
| $c_2n_3s_2$ | 0.004 | 0.001 | -0.001 | 0.009 | 0.001 |
| $c_2n_3s_3$ | -0.003 | -0.002 | -0.017 | -0.001 | 0.007 |
| SEm (±) | 0.003 | 0.002 | 0.005 | 0.005 | 0.004 |
| CD (0.05) | NS | NS | NS | NS | 8.575 |

NS- Not significant

Table 24a. Effect of cutting pattern, nutrient levels and spacing on NAR under open condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | -0.001 | 0.004 | -0.002 | -0.004 | 0.002 | 0.002 |
| $C_2$ | -0.003 | 0.001 | 0.001 | -0.004 | 0.004 | -0.001 |
| SEm (±) | 0.001 | 0.0006 | 0.0010 | 0.0006 | 0.0010 | 0.0010 |
| CD (0.05) | NS | 0.002 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | -0.001 | 0.002 | -0.001 | -0.003 | 0.003 | -0.001 |
| $N_2$ | -0.002 | 0.003 | -0.001 | -0.004 | 0.002 | -0.001 |
| $N_3$ | -0.002 | 0.002 | -0.001 | -0.005 | 0.004 | 0.002 |
| SEm (±) | 0.0013 | 0.0010 | 0.0013 | 0.0010 | 0.0013 | 0.0013 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | -0.003 | 0.003 | -0.002 | -0.003 | 0.003 | -0.001 |
| $S_2$ | -0.001 | 0.002 | 0.001 | -0.005 | 0.003 | 0.001 |
| $S_3$ | -0.001 | 0.003 | -0.001 | -0.005 | 0.003 | 0.001 |
| SEm (±) | 0.0013 | 0.0010 | 0.0013 | 0.0010 | 0.0013 | 0.0013 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 24b. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under open condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 0.001 | 0.003 | 0.001 | -0.004 | 0.002 | 0.003 |
| $c_1n_2$ | -0.002 | 0.005 | -0.004 | -0.003 | 0.003 | -0.002 |
| $c_1n_3$ | 0.001 | 0.003 | -0.001 | -0.005 | 0.002 | 0.004 |
| $c_2n_1$ | -0.002 | 0.002 | -0.001 | -0.003 | 0.004 | -0.004 |
| $c_2n_2$ | -0.002 | 0.001 | 0.003 | -0.004 | 0.001 | -0.001 |
| $c_2n_3$ | -0.005 | 0.001 | 0.001 | -0.006 | 0.006 | 0.001 |
| SEm (±) | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | -0.002 | 0.004 | -0.003 | -0.002 | 0.002 | 0.001 |
| $c_1s_2$ | 0.001 | 0.003 | 0.001 | -0.006 | 0.002 | 0.001 |
| $c_1s_3$ | 0.001 | 0.004 | -0.002 | -0.005 | 0.002 | 0.003 |
| $c_2s_1$ | -0.003 | 0.002 | 0.001 | -0.004 | 0.004 | -0.003 |
| $c_2s_2$ | -0.002 | 0.002 | 0.001 | -0.004 | 0.004 | 0.001 |
| $c_2s_3$ | -0.003 | 0.001 | 0.001 | -0.006 | 0.003 | -0.001 |
| SEm (±) | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | -0.003 | 0.002 | -0.002 | -0.001 | 0.004 | 0.001 |
| $n_1s_2$ | -0.002 | 0.004 | -0.001 | -0.006 | 0.004 | -0.001 |
| $n_1s_3$ | 0.003 | 0.002 | 0.001 | -0.003 | 0.001 | -0.001 |
| $n_2s_1$ | -0.004 | 0.004 | -0.001 | -0.002 | 0.001 | -0.002 |
| $n_2s_2$ | 0.003 | 0.001 | -0.001 | -0.003 | 0.001 | -0.001 |
| $n_2s_3$ | -0.003 | 0.005 | -0.001 | -0.007 | 0.004 | -0.002 |
| $n_3s_1$ | -0.001 | 0.002 | -0.002 | -0.005 | 0.005 | -0.002 |
| $n_3s_2$ | -0.001 | 0.001 | 0.002 | -0.005 | 0.004 | 0.002 |
| $n_3s_3$ | -0.004 | 0.002 | -0.001 | -0.006 | 0.003 | 0.005 |
| SEm (±) | 0.002 | 0.001 | 0.002 | 0.001 | 0.002 | 0.002 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 24c. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under open condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1s_1$ | -0.001 | 0.004 | -0.004 | -0.002 | 0.003 | 0.003 |
| $c_1n_1s_2$ | -0.001 | 0.005 | 0.001 | -0.008 | 0.005 | 0.002 |
| $c_1n_1s_3$ | 0.004 | 0.001 | 0.005 | -0.002 | -0.003 | 0.004 |
| $c_1n_2s_1$ | -0.005 | 0.007 | -0.004 | 0.001 | -0.003 | -0.001 |
| $c_1n_2s_2$ | 0.003 | 0.003 | -0.002 | -0.003 | 0.001 | -0.002 |
| $c_1n_2s_3$ | -0.003 | 0.006 | -0.006 | -0.007 | 0.007 | -0.003 |
| $c_1n_3s_1$ | -0.001 | 0.001 | -0.002 | -0.003 | 0.004 | 0.001 |
| $c_1n_3s_2$ | 0.002 | 0.001 | 0.003 | -0.006 | 0.001 | 0.003 |
| $c_1n_3s_3$ | 0.002 | 0.006 | -0.004 | -0.006 | 0.001 | 0.007 |
| $c_2n_1s_1$ | -0.005 | 0.006 | 0.001 | -0.001 | 0.004 | -0.002 |
| $c_2n_1s_2$ | -0.003 | 0.003 | -0.001 | -0.004 | 0.004 | -0.003 |
| $c_2n_1s_3$ | 0.002 | 0.003 | -0.003 | -0.004 | 0.005 | -0.006 |
| $c_2n_2s_1$ | -0.002 | 0.002 | 0.002 | -0.004 | 0.002 | -0.003 |
| $c_2n_2s_2$ | -0.002 | -0.003 | 0.001 | -0.002 | 0.001 | 0.002 |
| $c_2n_2s_3$ | -0.002 | 0.004 | 0.005 | -0.007 | -0.005 | -0.001 |
| $c_2n_3s_1$ | -0.002 | 0.004 | -0.002 | -0.006 | 0.005 | -0.004 |
| $c_2n_3s_2$ | -0.004 | 0.001 | 0.001 | -0.005 | 0.008 | 0.001 |
| $c_2n_3s_3$ | -0.007 | -0.003 | 0.002 | -0.006 | 0.005 | 0.004 |
| SEm (±) | 0.003 | 0.002 | 0.003 | 0.002 | 0.003 | 0.003 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

### *4.1.3.6 Per Day Productivity*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to per day productivity of palisade grass under open condition in the first and second year are presented in Table 25a, 25b and 25c.

The different treatments involving cutting height showed significant effect on per day productivity in the first year whereas no significance was noticed in the second year. The cutting treatments of 10 cm from ground level produced maximum per day productivity of 0.4 t $ha^{-1}$ $day^{-1.}$ The per day productivity was significantly influenced by the chemical fertilizer treatments in both the years. $N_3$ (0.43 t $ha^{-1}$ $day^{-1}$ and 0.35 t $ha^{-1}$ $day^{-1}$) was observed to be significantly superior to $N_2$ (0.39 t $ha^{-1}$ $day^{-1}$ and 0.33 t $ha^{-1}$ $day^{-1}$) and $N_1$ (0.32 t $ha^{-1}$ $day^{-1}$ and 0.30 t $ha^{-1}$ $day^{-1}$) in first and second year respectively. The different spacing treatments showed significant effect on per day productivity in both the years. Among the different spacing treatments $S_1$, $S_2$ and $S_3$ was found to be significantly superior to each other in both the years.

None of the interactions was found to have significant influence on per day productivity.

## 4.1.4 Quality Studies

### *4.1.4.1 Crude Protein Content*

The cutting pattern and nutrient levels had a significant influence on crude protein content of palisade grass under open condition in the first year. The plant spacing was found to be non significant (Table 26a, 26b and 26c).

The effect of cutting pattern on crude protein content was noticed on all harvest except first. The crude protein content was increased by increasing the cutting height to 10 cm from ground level. The crude protein content was significantly influenced by increasing the nutrient levels at all the harvests. Among the fertilizer treatments, the highest nutrient level recorded the highest protein content in all the harvests. In first, third and fourth harvests $N_2$ and $N_3$

Table 25a. Effect of cutting pattern, nutrient levels and spacing on per day productivity under open condition, t $ha^{-1}$ $day^{-1}$

| Treatments | Per day productivity | |
|---|---|---|
| | First year | Second year |
| **Cutting pattern (C)** | | |
| $C_1$ | 0.36 | 0.33 |
| $C_2$ | 0.40 | 0.33 |
| SEm (±) | 0.009 | 0.003 |
| CD (0.05) | 0.027 | NS |
| **Nutrient levels (N)** | | |
| $N_1$ | 0.32 | 0.30 |
| $N_2$ | 0.39 | 0.33 |
| $N_3$ | 0.43 | 0.35 |
| SEm (±) | 0.011 | 0.004 |
| CD (0.05) | 0.033 | 0.014 |
| **Spacing (S)** | | |
| $S_1$ | 0.41 | 0.34 |
| $S_2$ | 0.38 | 0.33 |
| $S_3$ | 0.34 | 0.31 |
| SEm (±) | 0.011 | 0.004 |
| CD (0.05) | 0.033 | 0.014 |

NS- Not significant

Table 25b. Interaction effect of cutting pattern, nutrient levels and spacing on per day productivity under open condition, t ha$^{-1}$ day$^{-1}$

| Treatments | Per day productivity | |
|---|---|---|
| | **First year** | **Second year** |
| $c_1n_1$ | 0.31 | 0.30 |
| $c_1n_2$ | 0.37 | 0.33 |
| $c_1n_3$ | 0.41 | 0.35 |
| $c_2n_1$ | 0.33 | 0.30 |
| $c_2n_2$ | 0.41 | 0.34 |
| $c_2n_3$ | 0.45 | 0.36 |
| SEm (±) | 0.016 | 0.006 |
| CD (0.05) | NS | NS |
| $c_1s_1$ | 0.40 | 0.34 |
| $c_1s_2$ | 0.36 | 0.34 |
| $c_1s_3$ | 0.33 | 0.31 |
| $c_2s_1$ | 0.42 | 0.35 |
| $c_2s_2$ | 0.41 | 0.32 |
| $c_2s_3$ | 0.36 | 0.31 |
| SEm (±) | 0.016 | 0.006 |
| CD (0.05) | NS | NS |
| $n_1s_1$ | 0.34 | 0.31 |
| $n_1s_2$ | 0.33 | 0.29 |
| $n_1s_3$ | 0.29 | 0.30 |
| $n_2s_1$ | 0.41 | 0.35 |
| $n_2s_2$ | 0.40 | 0.34 |
| $n_2s_3$ | 0.36 | 0.31 |
| $n_3s_1$ | 0.48 | 0.37 |
| $n_3s_2$ | 0.42 | 0.36 |
| $n_3s_3$ | 0.38 | 0.33 |
| SEm (±) | 0.019 | 0.008 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 25c. Interaction effect of cutting pattern, nutrient levels and spacing on per day productivity under open condition, t ha$^{-1}$ day$^{-1}$

| Treatments | Per day productivity | |
|---|---|---|
| | First year | Second year |
| $c_1n_1s_1$ | 0.33 | 0.31 |
| $c_1n_1s_2$ | 0.33 | 0.31 |
| $c_1n_1s_3$ | 0.29 | 0.30 |
| $c_1n_2s_1$ | 0.40 | 0.34 |
| $c_1n_2s_2$ | 0.36 | 0.34 |
| $c_1n_2s_3$ | 0.35 | 0.32 |
| $c_1n_3s_1$ | 0.46 | 0.36 |
| $c_1n_3s_2$ | 0.40 | 0.36 |
| $c_1n_3s_3$ | 0.36 | 0.32 |
| $c_2n_1s_1$ | 0.34 | 0.32 |
| $c_2n_1s_2$ | 0.34 | 0.27 |
| $c_2n_1s_3$ | 0.30 | 0.30 |
| $c_2n_2s_1$ | 0.43 | 0.36 |
| $c_2n_2s_2$ | 0.44 | 0.34 |
| $c_2n_2s_3$ | 0.38 | 0.31 |
| $c_2n_3s_1$ | 0.50 | 0.37 |
| $c_2n_3s_2$ | 0.45 | 0.37 |
| $c_2n_3s_3$ | 0.39 | 0.33 |
| SEm (±) | 0.028 | 0.011 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 26a. Effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during first year, per cent

| Treatments | Crude protein content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 8.34 | 8.40 | 8.43 | 8.27 | 8.34 | 8.21 |
| $C_2$ | 8.40 | 8.67 | 8.66 | 8.54 | 8.51 | 8.57 |
| SEm (±) | 0.270 | 0.027 | 0.042 | 0.055 | 0.053 | 0.042 |
| CD (0.05) | NS | 0.078 | 0.121 | 0.159 | 0.155 | 0.123 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 8.11 | 8.25 | 8.29 | 8.19 | 8.28 | 8.28 |
| $N_2$ | 8.43 | 8.60 | 8.65 | 8.44 | 8.38 | 8.34 |
| $N_3$ | 8.57 | 8.76 | 8.69 | 8.59 | 8.62 | 8.55 |
| SEm (±) | 0.063 | 0.033 | 0.051 | 0.067 | 0.065 | 0.052 |
| CD (0.05) | 0.183 | 0.096 | 0.149 | 0.194 | 0.189 | 0.150 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 8.43 | 8.48 | 8.52 | 8.39 | 8.47 | 8.38 |
| $S_2$ | 8.37 | 8.55 | 8.60 | 8.38 | 8.43 | 8.43 |
| $S_3$ | 8.31 | 8.56 | 8.51 | 8.46 | 8.37 | 8.37 |
| SEm (±) | 0.063 | 0.033 | 0.051 | 0.067 | 0.065 | 0.052 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 26b. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during first year, per cent

| Treatments | Crude protein content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 8.05 | 8.12 | 8.22 | 8.09 | 8.13 | 8.06 |
| $c_1n_2$ | 8.42 | 8.44 | 8.43 | 8.27 | 8.27 | 8.12 |
| $c_1n_3$ | 8.56 | 8.64 | 8.64 | 8.46 | 8.61 | 8.46 |
| $c_2n_1$ | 8.17 | 8.38 | 8.36 | 8.29 | 8.42 | 8.50 |
| $c_2n_2$ | 8.44 | 8.75 | 8.87 | 8.61 | 8.49 | 8.57 |
| $c_2n_3$ | 8.58 | 8.87 | 8.74 | 8.72 | 8.63 | 8.65 |
| SEm (±) | 0.047 | 0.072 | 0.089 | 0.095 | 0.093 | 0.073 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 8.35 | 8.32 | 8.48 | 8.28 | 8.36 | 8.11 |
| $c_1s_2$ | 8.34 | 8.45 | 8.44 | 8.19 | 8.38 | 8.27 |
| $c_1s_3$ | 8.34 | 8.43 | 8.36 | 8.36 | 8.27 | 8.27 |
| $c_2s_1$ | 8.50 | 8.64 | 8.56 | 8.50 | 8.58 | 8.65 |
| $c_2s_2$ | 8.40 | 8.66 | 8.75 | 8.57 | 8.48 | 8.59 |
| $c_2s_3$ | 8.29 | 8.70 | 8.65 | 8.56 | 8.47 | 8.47 |
| SEm (±) | 0.047 | 0.072 | 0.089 | 0.095 | 0.093 | 0.073 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 8.20 | 8.21 | 8.10 | 8.37 | 8.39 | 8.32 |
| $n_1s_2$ | 8.02 | 8.26 | 8.42 | 8.03 | 8.27 | 8.31 |
| $n_1s_3$ | 8.12 | 8.28 | 8.35 | 8.16 | 8.17 | 8.22 |
| $n_2s_1$ | 8.45 | 8.53 | 8.70 | 8.18 | 8.38 | 8.31 |
| $n_2s_2$ | 8.43 | 8.61 | 8.72 | 8.51 | 8.34 | 8.37 |
| $n_2s_3$ | 8.42 | 8.65 | 8.53 | 8.6 | 8.42 | 8.35 |
| $n_3s_1$ | 8.63 | 8.70 | 8.76 | 8.62 | 8.65 | 8.52 |
| $n_3s_2$ | 8.67 | 8.79 | 8.65 | 8.60 | 8.68 | 8.61 |
| $n_3s_3$ | 8.41 | 8.77 | 8.65 | 8.57 | 8.53 | 8.54 |
| SEm (±) | 0.057 | 0.084 | 0.110 | 0.117 | 0.113 | 0.090 |
| CD (0.05) | NS | NS | NS | 0.337 | NS | NS |

NS- Not significant

Table 26c. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during first year, per cent

| Treatments | Crude protein content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 8.10 | 8.04 | 8.00 | 8.25 | 8.08 | 7.91 |
| $c_1n_1s_2$ | 7.96 | 8.12 | 8.29 | 7.85 | 8.25 | 8.16 |
| $c_1n_1s_3$ | 8.10 | 8.20 | 8.37 | 8.17 | 8.08 | 8.12 |
| $c_1n_2s_1$ | 8.37 | 8.39 | 8.62 | 8.12 | 8.35 | 8.04 |
| $c_1n_2s_2$ | 8.51 | 8.45 | 8.49 | 8.27 | 8.27 | 8.16 |
| $c_1n_2s_3$ | 8.39 | 8.49 | 8.18 | 8.44 | 8.18 | 8.16 |
| $c_1n_3s_1$ | 8.60 | 8.54 | 8.83 | 8.48 | 8.66 | 8.37 |
| $c_1n_3s_2$ | 8.56 | 8.78 | 8.56 | 8.45 | 8.62 | 8.47 |
| $c_1n_3s_3$ | 8.53 | 8.60 | 8.54 | 8.48 | 8.56 | 8.54 |
| $c_2n_1s_1$ | 8.31 | 8.39 | 8.20 | 8.49 | 8.70 | 8.72 |
| $c_2n_1s_2$ | 8.08 | 8.41 | 8.56 | 8.21 | 8.29 | 8.45 |
| $c_2n_1s_3$ | 8.14 | 8.35 | 8.33 | 8.17 | 8.27 | 8.33 |
| $c_2n_2s_1$ | 8.54 | 8.68 | 8.79 | 8.25 | 8.41 | 8.58 |
| $c_2n_2s_2$ | 8.35 | 8.76 | 8.95 | 8.75 | 8.41 | 8.58 |
| $c_2n_2s_3$ | 8.45 | 8.80 | 8.87 | 8.85 | 8.66 | 8.54 |
| $c_2n_3s_1$ | 8.66 | 8.87 | 8.70 | 8.77 | 8.64 | 8.66 |
| $c_2n_3s_2$ | 8.79 | 8.81 | 8.74 | 8.75 | 8.75 | 8.74 |
| $c_2n_3s_3$ | 8.28 | 8.95 | 8.76 | 8.67 | 8.50 | 8.54 |
| SEm (±) | 0.155 | 0.081 | 0.126 | 0.165 | 0.161 | 0.127 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

were found to be on a par whereas in the second, fifth and sixth harvests $N_3$ were found significantly superior to $N_2$ and $N_1$. An increase in plant spacing did not produce any increase in protein content at all harvests.

Interactions between nutrient levels and spacing were observed in the fourth harvest. The fertilizer dose of 250 along with wider spacing recorded highest crude protein content of 8.64 % and it was on a par with $n_1s_1$, $n_2s_2$, $n_3s_1$, $n_3s_2$ and $n_3s_3$.

The cutting pattern and nutrient levels had a significant influence on crude protein content of palisade grass under open condition in the second year. The plant spacing was found to be non significant (Table 27a, 27b and 27c).

In fourth, sixth and seventh harvests cutting pattern produced a significant impact on crude protein content and the crude protein content was increased by increasing the cutting height to 10 cm from ground level. The crude protein content was significantly influenced by the nutrient levels in all the harvests except second. In all the harvests $N_2$ and $N_3$ was found to be on a par. The effect of plant spacing on number of tillers plant$^{-1}$ was noticed on all the harvests except first. Among the different spacing treatments, no significant difference was observed.

The interactions effects were non significant.

#### *4.1.4.2 Crude Fibre Content*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) regarding crude fibre content of palisade grass under open condition in the first and second year are presented in Table 28a, 28b and 28c.

The different treatments involving cutting height showed significant effect on crude fibre content both in the first and second year. The ground level cutting treatments produced maximum crude fibre content of 28.23 % in the first year and 29.88 % in the second year. The crude fibre content was significantly

Table 27a. Effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during second year, per cent

| Treatments | Crude protein content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 8.20 | 8.12 | 8.33 | 7.92 | 8.20 | 7.89 | 8.19 |
| $C_2$ | 8.11 | 8.07 | 8.31 | 8.13 | 8.16 | 8.13 | 8.58 |
| SEm (±) | 0.063 | 0.085 | 0.040 | 0.056 | 0.040 | 0.060 | 0.073 |
| CD (0.05) | NS | NS | NS | 0.162 | NS | 0.174 | 0.212 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 7.93 | 7.97 | 8.20 | 7.73 | 7.93 | 7.65 | 8.13 |
| $N_2$ | 8.20 | 8.10 | 8.40 | 8.12 | 8.32 | 8.12 | 8.42 |
| $N_3$ | 8.33 | 8.21 | 8.36 | 8.23 | 8.29 | 8.26 | 8.60 |
| SEm (±) | 0.078 | 0.104 | 0.049 | 0.069 | 0.049 | 0.073 | 0.090 |
| CD (0.05) | 0.226 | NS | 0.142 | 0.199 | 0.143 | 0.213 | 0.260 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 8.13 | 8.11 | 8.29 | 8.06 | 8.14 | 7.98 | 8.43 |
| $S_2$ | 8.14 | 8.08 | 8.28 | 8.01 | 8.19 | 8.03 | 8.32 |
| $S_3$ | 8.20 | 8.08 | 8.39 | 8.01 | 8.21 | 8.02 | 8.40 |
| SEm (±) | 0.078 | 0.104 | 0.049 | 0.069 | 0.049 | 0.073 | 0.090 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 27b. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during second year, per cent

| Treatments | Crude protein content | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1$ | 8.11 | 8.06 | 8.18 | 7.71 | 8.01 | 7.49 | 7.81 |
| $c_1n_2$ | 8.17 | 8.15 | 8.34 | 7.99 | 8.25 | 7.98 | 8.26 |
| $c_1n_3$ | 8.32 | 8.13 | 8.47 | 8.07 | 8.34 | 8.20 | 8.48 |
| $c_2n_1$ | 7.76 | 7.87 | 8.22 | 7.76 | 7.86 | 7.81 | 8.44 |
| $c_2n_2$ | 8.24 | 8.05 | 8.46 | 8.24 | 8.38 | 8.26 | 8.58 |
| $c_2n_3$ | 8.34 | 8.29 | 8.26 | 8.40 | 8.23 | 8.32 | 8.72 |
| SEm (±) | 0.111 | 0.147 | 0.069 | 0.097 | 0.070 | 0.104 | 0.129 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 8.19 | 8.14 | 8.33 | 7.95 | 8.11 | 7.85 | 8.28 |
| $c_1s_2$ | 8.18 | 8.09 | 8.27 | 7.91 | 8.23 | 7.95 | 8.15 |
| $c_1s_3$ | 8.22 | 8.11 | 8.38 | 7.90 | 8.26 | 7.87 | 8.13 |
| $c_2s_1$ | 8.07 | 8.09 | 8.24 | 8.17 | 8.16 | 8.11 | 8.59 |
| $c_2s_2$ | 8.09 | 8.06 | 8.29 | 8.11 | 8.14 | 8.11 | 8.49 |
| $c_2s_3$ | 8.18 | 8.05 | 8.40 | 8.12 | 8.17 | 8.17 | 8.67 |
| SEm (±) | 0.111 | 0.147 | 0.069 | 0.097 | 0.070 | 0.104 | 0.129 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 7.92 | 7.98 | 8.11 | 7.79 | 7.95 | 7.63 | 8.27 |
| $n_1s_2$ | 7.93 | 7.94 | 8.10 | 7.77 | 7.91 | 7.66 | 8.00 |
| $n_1s_3$ | 7.96 | 7.97 | 8.38 | 7.64 | 7.93 | 7.66 | 8.12 |
| $n_2s_1$ | 8.14 | 8.12 | 8.37 | 8.16 | 8.25 | 8.04 | 8.47 |
| $n_2s_2$ | 8.18 | 8.13 | 8.36 | 8.03 | 8.35 | 8.15 | 8.44 |
| $n_2s_3$ | 8.29 | 8.06 | 8.47 | 8.16 | 8.36 | 8.17 | 8.36 |
| $n_3s_1$ | 8.34 | 8.24 | 8.38 | 8.24 | 8.21 | 8.28 | 8.57 |
| $n_3s_2$ | 8.30 | 8.16 | 8.38 | 8.24 | 8.30 | 8.27 | 8.53 |
| $n_3s_3$ | 8.35 | 8.22 | 8.33 | 8.23 | 8.35 | 8.23 | 8.71 |
| SEm (±) | 0.135 | 0.181 | 0.085 | 0.119 | 0.086 | 0.127 | 0.162 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 27c. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during second year, per cent

| Treatments | Crude protein content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 8.07 | 8.10 | 8.08 | 7.70 | 8.00 | 7.49 | 8.00 |
| $c_1n_1s_2$ | 8.12 | 8.02 | 8.08 | 7.77 | 8.00 | 7.46 | 7.70 |
| $c_1n_1s_3$ | 8.13 | 8.08 | 8.37 | 7.66 | 8.03 | 7.52 | 7.74 |
| $c_1n_2s_1$ | 8.14 | 8.16 | 8.39 | 8.10 | 8.17 | 7.83 | 8.44 |
| $c_1n_2s_2$ | 8.16 | 8.18 | 8.27 | 7.91 | 8.26 | 8.07 | 8.26 |
| $c_1n_2s_3$ | 8.21 | 8.12 | 8.37 | 7.97 | 8.33 | 8.04 | 8.10 |
| $c_1n_3s_1$ | 8.37 | 8.16 | 8.52 | 8.06 | 8.18 | 8.23 | 8.42 |
| $c_1n_3s_2$ | 8.27 | 8.08 | 8.47 | 8.06 | 8.44 | 8.31 | 8.48 |
| $c_1n_3s_3$ | 8.33 | 8.15 | 8.41 | 8.08 | 8.42 | 8.07 | 8.55 |
| $c_2n_1s_1$ | 7.77 | 7.86 | 8.14 | 7.88 | 7.91 | 7.76 | 8.54 |
| $c_2n_1s_2$ | 7.73 | 7.87 | 8.12 | 7.77 | 7.83 | 7.87 | 8.30 |
| $c_2n_1s_3$ | 7.79 | 7.87 | 8.39 | 7.62 | 7.83 | 7.80 | 8.50 |
| $c_2n_2s_1$ | 8.15 | 8.08 | 8.35 | 8.23 | 8.33 | 8.25 | 8.50 |
| $c_2n_2s_2$ | 8.20 | 8.07 | 8.45 | 8.15 | 8.44 | 8.23 | 8.61 |
| $c_2n_2s_3$ | 8.37 | 8.00 | 8.58 | 8.35 | 8.39 | 8.31 | 8.63 |
| $c_2n_3s_1$ | 8.31 | 8.33 | 8.25 | 8.41 | 8.25 | 8.33 | 8.72 |
| $c_2n_3s_2$ | 8.34 | 8.25 | 8.29 | 8.41 | 8.16 | 8.23 | 8.58 |
| $c_2n_3s_3$ | 8.37 | 8.29 | 8.24 | 8.37 | 8.29 | 8.40 | 8.87 |
| SEm (±) | 0.192 | 0.256 | 0.120 | 0.168 | 0.121 | 0.180 | 0.228 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 28a. Effect of cutting pattern, nutrient levels and spacing on crude fibre content under open condition, per cent

| Treatments | Crude fibre content | |
|---|---|---|
| | First year | Second year |
| **Cutting pattern (C)** | | |
| $C_1$ | 28.23 | 29.88 |
| $C_2$ | 27.40 | 28.41 |
| SEm (±) | 0.074 | 0.135 |
| CD (0.05) | 0.215 | 0.391 |
| **Nutrient levels (N)** | | |
| $N_1$ | 28.25 | 30.08 |
| $N_2$ | 27.76 | 28.82 |
| $N_3$ | 27.44 | 28.54 |
| SEm (±) | 0.091 | 0.166 |
| CD (0.05) | 0.263 | 0.479 |
| **Spacing (S)** | | |
| $S_1$ | 27.81 | 28.82 |
| $S_2$ | 27.85 | 29.19 |
| $S_3$ | 27.79 | 29.43 |
| SEm (±) | 0.091 | 0.166 |
| CD (0.05) | NS | 0.479 |

NS- Not significant

Table 28b. Interaction effect of cutting pattern, nutrient levels and spacing on crude fibre content under open condition, per cent

| Treatments | Crude fibre content | |
|---|---|---|
| | First year | Second year |
| $c_1n_1$ | 28.85 | 31.06 |
| $c_1n_2$ | 28.20 | 29.41 |
| $c_1n_3$ | 27.64 | 29.17 |
| $c_2n_1$ | 27.64 | 29.10 |
| $c_2n_2$ | 27.32 | 28.23 |
| $c_2n_3$ | 27.24 | 27.91 |
| SEm (±) | 0.125 | 0.202 |
| CD (0.05) | 0.362 | NS |
| $c_1s_1$ | 28.24 | 29.46 |
| $c_1s_2$ | 28.26 | 30.34 |
| $c_1s_3$ | 28.18 | 29.84 |
| $c_2s_1$ | 27.37 | 28.17 |
| $c_2s_2$ | 27.43 | 28.52 |
| $c_2s_3$ | 27.40 | 28.54 |
| SEm (±) | 0.125 | 0.202 |
| CD (0.05) | NS | NS |
| $n_1s_1$ | 28.28 | 30.21 |
| $n_1s_2$ | 28.30 | 30.13 |
| $n_1s_3$ | 28.16 | 29.90 |
| $n_2s_1$ | 27.78 | 28.36 |
| $n_2s_2$ | 27.78 | 28.93 |
| $n_2s_3$ | 27.71 | 29.16 |
| $n_3s_1$ | 27.36 | 27.88 |
| $n_3s_2$ | 27.46 | 29.23 |
| $n_3s_3$ | 27.50 | 28.51 |
| SEm (±) | 0.154 | 0.246 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 28c. Interaction effect of cutting pattern, nutrient levels and spacing on crude fibre content under open condition, per cent

| Treatments | Crude fibre content | |
|---|---|---|
| | First year | Second year |
| $c_1n_1s_1$ | 28.83 | 31.06 |
| $c_1n_1s_2$ | 28.93 | 31.00 |
| $c_1n_1s_3$ | 28.80 | 31.13 |
| $c_1n_2s_1$ | 28.26 | 28.73 |
| $c_1n_2s_2$ | 28.16 | 29.83 |
| $c_1n_2s_3$ | 28.16 | 29.66 |
| $c_1n_3s_1$ | 27.63 | 28.60 |
| $c_1n_3s_2$ | 27.70 | 30.20 |
| $c_1n_3s_3$ | 27.60 | 28.73 |
| $c_2n_1s_1$ | 27.73 | 29.36 |
| $c_2n_1s_2$ | 27.66 | 29.26 |
| $c_2n_1s_3$ | 27.53 | 28.66 |
| $c_2n_2s_1$ | 27.30 | 28.00 |
| $c_2n_2s_2$ | 27.40 | 28.03 |
| $c_2n_2s_3$ | 27.26 | 28.66 |
| $c_2n_3s_1$ | 27.10 | 27.16 |
| $c_2n_3s_2$ | 27.23 | 28.26 |
| $c_2n_3s_3$ | 27.40 | 28.30 |
| SEm (±) | 0.221 | 0.407 |
| CD (0.05) | NS | NS |

NS- Not significant

influenced by the chemical fertilizer treatments in both the years. $N_3$ was observed to be significantly superior to $N_2$ and $N_1$ in the first year whereas $N_3$ and $N_2$ was observed to be on a par in the second year. The different spacing treatments showed significant effect on crude fibre content only in the second year. Among the different spacing treatments highest crude fibre content was noticed in the wider spacing treatment ($S_3$) (29.19 %) and it was on a par with $S_2$ (29.43 %) and $S_1$ recorded least content of crude fibre (28.82 %).

In the first year significant interaction was noticed between cutting height and nutrient levels. The lowest crude fibre content was recorded by $c_2n_3$ and it was on a par with $c_2n_2$. No other interactions were found significant.

***4.1.4.3 Nitrate Content***

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to nitrate content of palisade grass under open condition in the first year are presented in Table 29a, 29b and 29c.

The effect of cutting pattern on nitrate content was noticed only on sixth harvest. The nitrate content was increased by increasing the cutting height to 10 cm from ground level. Among the fertilizer treatments, the highest nutrient level recorded the highest nitrate content only in third harvests. An increase in plant spacing decreased nitrate content in third harvest.

The interactions effects were non significant.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to nitrate content of palisade grass under open condition in the second year are presented in Table 30a, 30b and 30c.

The effect of cutting pattern on nitrate content was noticed only on fifth harvest. The nitrate content was increased by increasing the cutting height to 10 cm from ground level. Among the fertilizer treatments, the highest nutrient level recorded the highest nitrate content only in third harvest. Among the different

Table 29a. Effect of cutting pattern, nutrient levels and spacing on nitrate content under open condition during first year, per cent

| Treatments | Nitrate content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 0.08 | 0.09 | 0.04 | 0.08 | 0.07 | 0.06 |
| $C_2$ | 0.07 | 0.08 | 0.04 | 0.09 | 0.07 | 0.08 |
| SEm (±) | 0.003 | 0.004 | 0.004 | 0.005 | 0.004 | 0.005 |
| CD (0.05) | NS | NS | NS | NS | NS | 0.017 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 0.07 | 0.08 | 0.03 | 0.08 | 0.07 | 0.07 |
| $N_2$ | 0.07 | 0.08 | 0.05 | 0.09 | 0.07 | 0.06 |
| $N_3$ | 0.08 | 0.10 | 0.05 | 0.09 | 0.08 | 0.07 |
| SEm (±) | 0.004 | 0.005 | 0.005 | 0.006 | 0.005 | 0.007 |
| CD (0.05) | NS | NS | 0.015 | NS | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | 0.08 | 0.09 | 0.06 | 0.09 | 0.07 | 0.08 |
| $S_2$ | 0.08 | 0.08 | 0.04 | 0.09 | 0.07 | 0.06 |
| $S_3$ | 0.07 | 0.09 | 0.03 | 0.08 | 0.07 | 0.06 |
| SEm (±) | 0.004 | 0.005 | 0.005 | 0.006 | 0.005 | 0.007 |
| CD (0.05) | NS | NS | 0.015 | NS | 0.017 | NS |

NS- Not significant

Table 29b. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under open condition during first year, per cent

| Treatments | Nitrate content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 0.08 | 0.09 | 0.03 | 0.074 | 0.068 | 0.061 |
| $c_1n_2$ | 0.08 | 0.09 | 0.06 | 0.097 | 0.077 | 0.047 |
| $c_1n_3$ | 0.08 | 0.10 | 0.04 | 0.091 | 0.069 | 0.082 |
| $c_2n_1$ | 0.07 | 0.08 | 0.03 | 0.089 | 0.078 | 0.079 |
| $c_2n_2$ | 0.07 | 0.09 | 0.04 | 0.101 | 0.063 | 0.087 |
| $c_2n_3$ | 0.08 | 0.09 | 0.06 | 0.101 | 0.091 | 0.077 |
| SEm (±) | 0.005 | 0.01 | 0.007 | 0.009 | 0.008 | 0.010 |
| CD (0.05) | NS | NS | 0.021 | NS | NS | NS |
| $c_1s_1$ | 0.07 | 0.09 | 0.06 | 0.096 | 0.081 | 0.069 |
| $c_1s_2$ | 0.08 | 0.09 | 0.04 | 0.096 | 0.067 | 0.054 |
| $c_1s_3$ | 0.08 | 0.09 | 0.03 | 0.070 | 0.066 | 0.067 |
| $c_2s_1$ | 0.09 | 0.10 | 0.06 | 0.097 | 0.093 | 0.097 |
| $c_2s_2$ | 0.08 | 0.07 | 0.04 | 0.099 | 0.067 | 0.081 |
| $c_2s_3$ | 0.06 | 0.08 | 0.03 | 0.096 | 0.072 | 0.064 |
| SEm (±) | 0.005 | 0.008 | 0.007 | 0.009 | 0.008 | 0.010 |
| CD (0.05) | 0.017 | NS | NS | NS | NS | 0.029 |
| $n_1s_1$ | 0.08 | 0.08 | 0.03 | 0.063 | 0.068 | 0.055 |
| $n_1s_2$ | 0.07 | 0.07 | 0.03 | 0.085 | 0.065 | 0.072 |
| $n_1s_3$ | 0.08 | 0.11 | 0.03 | 0.097 | 0.085 | 0.083 |
| $n_2s_1$ | 0.08 | 0.10 | 0.06 | 0.100 | 0.095 | 0.088 |
| $n_2s_2$ | 0.09 | 0.08 | 0.05 | 0.113 | 0.067 | 0.057 |
| $n_2s_3$ | 0.06 | 0.07 | 0.04 | 0.083 | 0.048 | 0.055 |
| $n_3s_1$ | 0.09 | 0.11 | 0.08 | 0.125 | 0.098 | 0.105 |
| $n_3s_2$ | 0.08 | 0.10 | 0.05 | 0.095 | 0.068 | 0.075 |
| $n_3s_3$ | 0.08 | 0.08 | 0.03 | 0.068 | 0.073 | 0.058 |
| SEm (±) | 0.006 | 0.010 | 0.008 | 0.011 | 0.010 | 0.012 |
| CD (0.05) | NS | 0.030 | NS | 0.033 | NS | NS |

NS- Not significant

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Table 29c. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under open condition during first year, per cent

| Treatments | Nitrate content | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1s_1$ | 0.07 | 0.07 | 0.03 | 0.05 | 0.05 | 0.03 |
| $c_1n_1s_2$ | 0.07 | 0.08 | 0.03 | 0.08 | 0.05 | 0.05 |
| $c_1n_1s_3$ | 0.09 | 0.13 | 0.03 | 0.08 | 0.09 | 0.09 |
| $c_1n_2s_1$ | 0.08 | 0.10 | 0.06 | 0.11 | 0.09 | 0.07 |
| $c_1n_2s_2$ | 0.09 | 0.09 | 0.07 | 0.11 | 0.08 | 0.03 |
| $c_1n_2s_3$ | 0.07 | 0.07 | 0.05 | 0.06 | 0.04 | 0.03 |
| $c_1n_3s_1$ | 0.08 | 0.12 | 0.08 | 0.12 | 0.09 | 0.10 |
| $c_1n_3s_2$ | 0.09 | 0.11 | 0.03 | 0.08 | 0.05 | 0.07 |
| $c_1n_3s_3$ | 0.09 | 0.08 | 0.01 | 0.06 | 0.05 | 0.07 |
| $c_2n_1s_1$ | 0.09 | 0.09 | 0.04 | 0.07 | 0.08 | 0.07 |
| $c_2n_1s_2$ | 0.07 | 0.06 | 0.03 | 0.08 | 0.07 | 0.08 |
| $c_2n_1s_3$ | 0.07 | 0.08 | 0.03 | 0.10 | 0.07 | 0.07 |
| $c_2n_2s_1$ | 0.08 | 0.11 | 0.05 | 0.08 | 0.09 | 0.10 |
| $c_2n_2s_2$ | 0.09 | 0.07 | 0.03 | 0.11 | 0.04 | 0.08 |
| $c_2n_2s_3$ | 0.05 | 0.07 | 0.03 | 0.10 | 0.05 | 0.07 |
| $c_2n_3s_1$ | 0.10 | 0.10 | 0.08 | 0.12 | 0.10 | 0.11 |
| $c_2n_3s_2$ | 0.07 | 0.10 | 0.07 | 0.10 | 0.08 | 0.07 |
| $c_2n_3s_3$ | 0.07 | 0.08 | 0.04 | 0.07 | 0.09 | 0.04 |
| SEm (±) | 0.010 | 0.014 | 0.012 | 0.016 | 0.014 | 0.017 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 30a. Effect of cutting pattern, nutrient levels and spacing on nitrate content under open condition during second year, per cent

| Treatments | Nitrate content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 0.07 | 0.06 | 0.04 | 0.07 | 0.06 | 0.06 | 0.07 |
| $C_2$ | 0.06 | 0.07 | 0.04 | 0.06 | 0.07 | 0.05 | 0.08 |
| SEm (±) | 0.017 | 0.013 | 0.005 | 0.069 | 0.006 | 0.005 | 0.012 |
| CD (0.05) | NS | NS | NS | NS | 0.012 | NS | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 0.08 | 0.06 | 0.04 | 0.05 | 0.05 | 0.06 | 0.07 |
| $N_2$ | 0.05 | 0.05 | 0.04 | 0.06 | 0.06 | 0.05 | 0.07 |
| $N_3$ | 0.06 | 0.07 | 0.06 | 0.06 | 0.06 | 0.07 | 0.08 |
| SEm (±) | 0.025 | 0.014 | 0.004 | 0.005 | 0.007 | 0.006 | 0.011 |
| CD (0.05) | NS | NS | 0.009 | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 0.08 | 0.07 | 0.06 | 0.08 | 0.07 | 0.07 | 0.06 |
| $S_2$ | 0.06 | 0.06 | 0.04 | 0.06 | 0.06 | 0.05 | 0.08 |
| $S_3$ | 0.04 | 0.05 | 0.03 | 0.04 | 0.04 | 0.04 | 0.07 |
| SEm (±) | 0.025 | 0.014 | 0.004 | 0.005 | 0.007 | 0.006 | 0.011 |
| CD (0.05) | NS | NS | 0.009 | 0.011 | 0.014 | 0.013 | NS |

NS- Not significant

Table 30b. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under open condition during second year, per cent

| Treatments | Nitrate content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 0.115 | 0.066 | 0.034 | 0.047 | 0.053 | 0.064 | 0.073 |
| $c_1n_2$ | 0.055 | 0.056 | 0.055 | 0.072 | 0.046 | 0.058 | 0.071 |
| $c_1n_3$ | 0.054 | 0.073 | 0.046 | 0.062 | 0.070 | 0.062 | 0.078 |
| $c_2n_1$ | 0.051 | 0.060 | 0.033 | 0.058 | 0.065 | 0.043 | 0.066 |
| $c_2n_2$ | 0.054 | 0.045 | 0.041 | 0.051 | 0.073 | 0.056 | 0.068 |
| $c_2n_3$ | 0.071 | 0.075 | 0.058 | 0.066 | 0.064 | 0.065 | 0.084 |
| SEm (±) | 0.035 | 0.017 | 0.005 | 0.012 | 0.013 | 0.013 | 0.015 |
| CD (0.05) | NS | NS | 0.011 | NS | NS | NS | NS |
| $c_1s_1$ | 0.093 | 0.070 | 0.061 | 0.078 | 0.066 | 0.068 | 0.063 |
| $c_1s_2$ | 0.087 | 0.081 | 0.048 | 0.062 | 0.046 | 0.062 | 0.085 |
| $c_1s_3$ | 0.044 | 0.045 | 0.026 | 0.041 | 0.056 | 0.054 | 0.074 |
| $c_2s_1$ | 0.084 | 0.072 | 0.062 | 0.085 | 0.086 | 0.076 | 0.073 |
| $c_2s_2$ | 0.048 | 0.054 | 0.035 | 0.066 | 0.076 | 0.054 | 0.076 |
| $c_2s_3$ | 0.043 | 0.054 | 0.035 | 0.024 | 0.040 | 0.034 | 0.068 |
| SEm (±) | 0.035 | 0.017 | 0.005 | 0.012 | 0.013 | 0.013 | 0.015 |
| CD (0.05) | NS | NS | NS | NS | 0.026 | NS | NS |
| $n_1s_1$ | 0.106 | 0.073 | 0.043 | 0.063 | 0.053 | 0.055 | 0.055 |
| $n_1s_2$ | 0.106 | 0.076 | 0.033 | 0.065 | 0.066 | 0.043 | 0.076 |
| $n_1s_3$ | 0.046 | 0.045 | 0.025 | 0.026 | 0.063 | 0.053 | 0.083 |
| $n_2s_1$ | 0.075 | 0.053 | 0.060 | 0.083 | 0.083 | 0.078 | 0.063 |
| $n_2s_2$ | 0.046 | 0.055 | 0.056 | 0.063 | 0.056 | 0.063 | 0.076 |
| $n_2s_3$ | 0.043 | 0.046 | 0.033 | 0.033 | 0.040 | 0.036 | 0.070 |
| $n_3s_1$ | 0.085 | 0.086 | 0.086 | 0.090 | 0.093 | 0.090 | 0.086 |
| $n_3s_2$ | 0.066 | 0.076 | 0.046 | 0.065 | 0.066 | 0.063 | 0.095 |
| $n_3s_3$ | 0.046 | 0.065 | 0.035 | 0.033 | 0.046 | 0.033 | 0.063 |
| SEm (±) | 0.038 | 0.021 | 0.006 | 0.011 | 0.016 | 0.015 | 0.022 |
| CD (0.05) | NS | NS | NS | NS | 0.031 | NS | NS |

NS- Not significant

Table 30c. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under open condition during second year, per cent

| Treatments | Nitrate content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 0.023 | 0.073 | 0.043 | 0.050 | 0.033 | 0.053 | 0.040 |
| $c_1n_1s_2$ | 0.043 | 0.087 | 0.033 | 0.057 | 0.043 | 0.057 | 0.080 |
| $c_1n_1s_3$ | 0.040 | 0.040 | 0.027 | 0.037 | 0.083 | 0.083 | 0.100 |
| $c_1n_2s_1$ | 0.057 | 0.060 | 0.060 | 0.097 | 0.073 | 0.060 | 0.057 |
| $c_1n_2s_2$ | 0.047 | 0.070 | 0.070 | 0.080 | 0.033 | 0.080 | 0.080 |
| $c_1n_2s_3$ | 0.063 | 0.040 | 0.037 | 0.040 | 0.033 | 0.033 | 0.077 |
| $c_1n_3s_1$ | 0.080 | 0.077 | 0.080 | 0.090 | 0.093 | 0.090 | 0.093 |
| $c_1n_3s_2$ | 0.053 | 0.087 | 0.043 | 0.050 | 0.063 | 0.050 | 0.097 |
| $c_1n_3s_3$ | 0.030 | 0.057 | 0.017 | 0.047 | 0.053 | 0.047 | 0.047 |
| $c_2n_1s_1$ | 0.070 | 0.073 | 0.043 | 0.087 | 0.073 | 0.057 | 0.070 |
| $c_2n_1s_2$ | 0.040 | 0.057 | 0.033 | 0.073 | 0.080 | 0.040 | 0.063 |
| $c_2n_1s_3$ | 0.043 | 0.050 | 0.023 | 0.017 | 0.043 | 0.033 | 0.067 |
| $c_2n_2s_1$ | 0.093 | 0.057 | 0.060 | 0.080 | 0.093 | 0.083 | 0.070 |
| $c_2n_2s_2$ | 0.037 | 0.040 | 0.033 | 0.047 | 0.080 | 0.047 | 0.073 |
| $c_2n_2s_3$ | 0.033 | 0.052 | 0.030 | 0.027 | 0.047 | 0.040 | 0.063 |
| $c_2n_3s_1$ | 0.090 | 0.087 | 0.083 | 0.090 | 0.093 | 0.090 | 0.080 |
| $c_2n_3s_2$ | 0.070 | 0.067 | 0.040 | 0.080 | 0.070 | 0.077 | 0.093 |
| $c_2n_3s_3$ | 0.053 | 0.073 | 0.053 | 0.030 | 0.030 | 0.030 | 0.074 |
| SEm (±) | 0.012 | 0.017 | 0.008 | 0.012 | 0.011 | 0.014 | 0.022 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

spacing treatments significant difference was observed in third, fourth, fifth and sixth harvests. An increase in plant spacing decreased nitrate content in all harvest.

The interactions effects were non significant.

### 4.1.5 Plant Analysis

#### *4.1.5.1 N Uptake*

The effect of cutting pattern, nutrient levels and plant spacing on N uptake of palisade grass under open condition in the first year was significant (Table 31a, 31b and 31c).

The different treatments involving cutting height showed significant effect on N uptake. The cutting height of 10 cm from ground level produced highest N (305.18 kg $ha^{-1}$). The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of N (328.19 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of nutrients. Among the different spacing treatments $S_1$ recorded highest N (305.76 kg $ha^{-1}$) uptake.

None of the interactions was found to have significant influence on uptake of nitrogen.

The effect of cutting pattern, nutrient levels and plant spacing on N uptake of palisade grass under open condition in the second year was significant (Table 32a, 32b and 32c).

The different treatments involving cutting height showed significant effect only on N uptake. The cutting height of 10 cm from ground level produced highest N (337.93 kg $ha^{-1}$) uptake. The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of N (360.70 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of nutrients. Among the different spacing treatments $S_1$ recorded highest N (341.71 kg $ha^{-1}$) uptake.

Table 31a. Effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under open condition in the first year, kg $ha^{-1}$

| **Treatments** | **Uptake of Nitrogen** | **Uptake of Phosphorus** | **Uptake of Potassium** | **Uptake of Calcium** | **Uptake of Magnesium** |
|---|---|---|---|---|---|
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 265.69 | 30.41 | 247.52 | 109.30 | 76.75 |
| $C_2$ | 305.18 | 32.55 | 267.70 | 117.25 | 82.36 |
| SEm (±) | 5.511 | 0.677 | 4.885 | 2.219 | 1.664 |
| CD (0.05) | 15.869 | 1.951 | 14.065 | 6.390 | 4.791 |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 235.16 | 25.40 | 215.37 | 95.69 | 65.25 |
| $N_2$ | 292.96 | 32.47 | 266.66 | 117.57 | 81.62 |
| $N_3$ | 328.19 | 36.57 | 290.80 | 126.57 | 91.80 |
| SEm (±) | 6.750 | 0.830 | 5.982 | 2.718 | 2.037 |
| CD (0.05) | 19.435 | 2.390 | 17.225 | 7.826 | 5.867 |
| **Spacing (S)** | | | | | |
| $S_1$ | 305.76 | 33.77 | 276.60 | 121.06 | 85.93 |
| $S_2$ | 292.97 | 32.13 | 262.72 | 115.20 | 81.82 |
| $S_3$ | 257.58 | 28.53 | 233.52 | 103.57 | 70.92 |
| SEm (±) | 6.750 | 0.830 | 5.982 | 2.718 | 2.037 |
| CD (0.05) | 19.435 | 2.390 | 17.225 | 7.826 | 5.867 |

Table 31b. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under open condition in the first year, kg ha$^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1$ | 219.38 | 24.60 | 208.96 | 92.88 | 63.28 |
| $c_1n_2$ | 265.99 | 30.93 | 252.49 | 112.36 | 78.27 |
| $c_1n_3$ | 311.70 | 35.68 | 281.12 | 122.67 | 88.72 |
| $c_2n_1$ | 250.93 | 26.19 | 221.79 | 98.50 | 67.21 |
| $c_2n_2$ | 319.93 | 34.00 | 280.83 | 122.79 | 84.97 |
| $c_2n_3$ | 344.68 | 37.45 | 300.49 | 130.47 | 94.89 |
| SEm (±) | 9.546 | 1.174 | 8.461 | 3.844 | 2.882 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 281.59 | 33.15 | 267.4 | 117.39 | 81.83 |
| $c_1s_2$ | 274.27 | 31.09 | 253.01 | 111.44 | 80.07 |
| $c_1s_3$ | 241.22 | 26.98 | 222.15 | 99.08 | 68.36 |
| $c_2s_1$ | 329.94 | 34.39 | 285.80 | 124.74 | 90.02 |
| $c_2s_2$ | 311.67 | 33.18 | 272.42 | 118.96 | 83.57 |
| $c_2s_3$ | 273.94 | 30.07 | 244.88 | 108.06 | 73.48 |
| SEm (±) | 9.546 | 1.174 | 8.461 | 3.844 | 2.882 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 243.74 | 26.08 | 221.73 | 97.00 | 67.07 |
| $n_1s_2$ | 244.74 | 26.35 | 223.33 | 99.49 | 66.84 |
| $n_1s_3$ | 217.00 | 23.76 | 201.06 | 90.58 | 61.83 |
| $n_2s_1$ | 313.24 | 35.16 | 286.94 | 126.26 | 89.02 |
| $n_2s_2$ | 295.59 | 32.47 | 267.71 | 117.62 | 83.50 |
| $n_2s_3$ | 270.06 | 29.78 | 245.33 | 108.84 | 72.33 |
| $n_3s_1$ | 360.30 | 40.08 | 321.13 | 139.93 | 101.69 |
| $n_3s_2$ | 338.58 | 37.58 | 297.11 | 128.49 | 95.11 |
| $n_3s_3$ | 285.68 | 32.04 | 254.16 | 111.29 | 78.60 |
| SEm (±) | 11.692 | 1.437 | 10.362 | 4.708 | 3.529 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 31c. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under open condition in the first year, kg $ha^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1s_1$ | 222.19 | 25.54 | 217.09 | 94.46 | 64.78 |
| $c_1n_1s_2$ | 228.04 | 25.11 | 213.46 | 95.67 | 64.29 |
| $c_1n_1s_3$ | 207.93 | 23.17 | 196.34 | 88.51 | 60.77 |
| $c_1n_2s_1$ | 281.68 | 34.97 | 273.45 | 120.63 | 85.11 |
| $c_1n_2s_2$ | 272.06 | 30.94 | 255.49 | 114.16 | 81.51 |
| $c_1n_2s_3$ | 244.24 | 26.88 | 228.54 | 102.30 | 68.18 |
| $c_1n_3s_1$ | 340.90 | 38.95 | 311.70 | 137.08 | 95.61 |
| $c_1n_3s_2$ | 322.70 | 37.21 | 290.08 | 124.50 | 94.40 |
| $c_1n_3s_3$ | 271.49 | 30.90 | 241.57 | 106.44 | 76.14 |
| $c_2n_1s_1$ | 265.29 | 26.63 | 226.38 | 99.54 | 69.36 |
| $c_2n_1s_2$ | 261.44 | 27.60 | 233.20 | 103.32 | 69.38 |
| $c_2n_1s_3$ | 226.07 | 24.36 | 205.78 | 92.65 | 62.89 |
| $c_2n_2s_1$ | 344.81 | 35.34 | 300.44 | 131.90 | 92.93 |
| $c_2n_2s_2$ | 319.12 | 34.00 | 279.92 | 121.07 | 85.50 |
| $c_2n_2s_3$ | 295.87 | 32.67 | 262.12 | 115.39 | 76.48 |
| $c_2n_3s_1$ | 379.71 | 41.21 | 330.57 | 142.79 | 107.77 |
| $c_2n_3s_2$ | 354.45 | 37.96 | 304.14 | 132.48 | 95.82 |
| $c_2n_3s_3$ | 299.87 | 33.10 | 266.76 | 116.15 | 81.07 |
| SEm (±) | 16.535 | 2.033 | 14.655 | 6.658 | 4.992 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 32a. Effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under open condition in the second year, kg ha$^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 317.04 | 36.18 | 281.64 | 113.30 | 74.18 |
| $C_2$ | 337.93 | 35.89 | 282.24 | 112.44 | 73.68 |
| SEm (±) | 5.768 | 0.766 | 6.610 | 2.419 | 1.225 |
| CD (0.05) | 16.607 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 289.46 | 31.21 | 252.95 | 102.33 | 64.84 |
| $N_2$ | 332.31 | 36.80 | 288.70 | 115.91 | 74.84 |
| $N_3$ | 360.70 | 40.09 | 304.18 | 120.36 | 82.11 |
| SEm (±) | 7.064 | 0.663 | 4.890 | 2.158 | 1.479 |
| CD (0.05) | 20.339 | 1.910 | 14.080 | 6.214 | 4.259 |
| **Spacing (S)** | | | | | |
| $S_1$ | 341.71 | 37.69 | 294.73 | 117.23 | 77.81 |
| $S_2$ | 331.70 | 36.28 | 283.90 | 113.28 | 75.21 |
| $S_3$ | 309.06 | 34.13 | 267.21 | 108.09 | 68.77 |
| SEm (±) | 7.064 | 0.663 | 4.890 | 2.158 | 1.479 |
| CD (0.05) | 20.339 | 1.910 | 14.080 | 6.214 | 4.259 |

NS- Not significant

Table 32b. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under open condition in the second year, kg ha$^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1$ | 284.93 | 31.91 | 258.50 | 104.67 | 66.23 |
| $c_1n_2$ | 318.08 | 36.87 | 287.44 | 116.50 | 75.56 |
| $c_1n_3$ | 348.13 | 39.76 | 298.99 | 118.72 | 80.74 |
| $c_2n_1$ | 294.00 | 30.52 | 247.40 | 99.99 | 63.44 |
| $c_2n_2$ | 346.54 | 36.74 | 289.95 | 115.32 | 74.11 |
| $c_2n_3$ | 373.27 | 40.41 | 309.38 | 122.00 | 83.49 |
| SEm (±) | 9.990 | 0.938 | 6.916 | 3.052 | 2.092 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 317.79 | 37.41 | 288.18 | 104.67 | 74.74 |
| $c_1s_2$ | 329.57 | 37.23 | 290.11 | 116.50 | 78.16 |
| $c_1s_3$ | 303.77 | 33.90 | 266.64 | 118.72 | 69.64 |
| $c_2s_1$ | 365.62 | 37.97 | 301.28 | 99.99 | 80.88 |
| $c_2s_2$ | 333.84 | 35.34 | 277.68 | 115.32 | 72.26 |
| $c_2s_3$ | 314.34 | 34.36 | 267.77 | 122.00 | 67.90 |
| SEm (±) | 9.990 | 0.938 | 6.916 | 3.052 | 2.092 |
| CD (0.05) | NS | NS | NS | NS | 6.024 |
| $n_1s_1$ | 303.75 | 32.49 | 263.22 | 104.46 | 67.15 |
| $n_1s_2$ | 279.17 | 30.04 | 243.41 | 98.82 | 61.54 |
| $n_1s_3$ | 285.47 | 31.12 | 252.23 | 103.72 | 65.82 |
| $n_2s_1$ | 349.96 | 39.39 | 306.06 | 122.62 | 80.80 |
| $n_2s_2$ | 337.47 | 36.94 | 291.79 | 116.72 | 77.13 |
| $n_2s_3$ | 309.50 | 34.08 | 268.24 | 108.40 | 66.58 |
| $n_3s_1$ | 371.41 | 41.18 | 314.91 | 124.63 | 85.47 |
| $n_3s_2$ | 378.47 | 41.88 | 316.49 | 124.32 | 86.97 |
| $n_3s_3$ | 332.20 | 37.20 | 281.15 | 112.14 | 73.91 |
| SEm (±) | 12.236 | 1.149 | 8.470 | 3.738 | 2.562 |
| CD (0.05) | NS | NS | NS | NS | 7.378 |

NS- Not significant

Table 32c. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under open condition in the second year, kg ha$^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1s_1$ | 274.89 | 31.62 | 256.12 | 101.18 | 64.35 |
| $c_1n_1s_2$ | 294.47 | 32.43 | 262.71 | 107.18 | 66.90 |
| $c_1n_1s_3$ | 285.42 | 31.67 | 256.69 | 105.66 | 67.45 |
| $c_1n_2s_1$ | 324.86 | 40.32 | 300.61 | 120.92 | 79.58 |
| $c_1n_2s_2$ | 330.98 | 37.50 | 296.21 | 120.08 | 80.26 |
| $c_1n_2s_3$ | 298.40 | 32.78 | 265.52 | 108.50 | 66.84 |
| $c_1n_3s_1$ | 353.64 | 40.28 | 307.81 | 123.14 | 80.29 |
| $c_1n_3s_2$ | 363.25 | 41.76 | 311.42 | 121.38 | 87.31 |
| $c_1n_3s_3$ | 327.49 | 37.25 | 277.73 | 111.66 | 74.62 |
| $c_2n_1s_1$ | 332.62 | 33.37 | 270.32 | 107.73 | 69.96 |
| $c_2n_1s_2$ | 263.87 | 27.64 | 224.11 | 90.45 | 56.18 |
| $c_2n_1s_3$ | 285.51 | 30.56 | 247.77 | 101.79 | 64.18 |
| $c_2n_2s_1$ | 375.06 | 38.46 | 311.52 | 124.32 | 82.02 |
| $c_2n_2s_2$ | 343.96 | 36.38 | 287.36 | 113.36 | 73.99 |
| $c_2n_2s_3$ | 320.60 | 35.38 | 270.97 | 108.28 | 66.33 |
| $c_2n_3s_1$ | 389.19 | 42.08 | 322.01 | 126.11 | 90.65 |
| $c_2n_3s_2$ | 393.70 | 42.00 | 321.57 | 127.27 | 86.62 |
| $c_2n_3s_3$ | 336.91 | 37.16 | 284.57 | 112.63 | 73.20 |
| SEm (±) | 17.304 | 1.625 | 11.979 | 5.286 | 3.624 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

None of the interactions was found to have significant influence on uptake of nitrogen.

#### *4.1.5.2 P Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to P uptake of palisade grass under open condition in the first year are presented in Table 31a, 31b and 31c.

The different treatments involving cutting height showed significant effect on P uptake. The cutting height of 10 cm from ground level produced highest P (32.55 kg $ha^{-1}$). The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of P (36.57 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of nutrients. Among the different spacing treatments $S_1$ recorded highest N (33.77 kg $ha^{-1}$) uptake and it was on par with $S_2$ (32.13 kg $ha^{-1}$).

None of the interactions was found to have significant influence on uptake of P.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to N uptake of palisade grass under open condition in the second year are presented in Table 32a, 32b and 32c.

The different treatments involving cutting height showed no significant effect on P uptake. The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of P (40.09 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of nutrients. Among the different spacing treatments $S_1$ recorded highest N (37.69 kg $ha^{-1}$) uptake.

None of the interactions was found to have significant influence on uptake of phosphorus.

*4.1.5.3 K Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to K uptake of palisade grass under open condition in the first year are presented in Table 31a, 31b and 31c.

The different treatments involving cutting height showed significant effect on K uptake. The cutting height of 10 cm from ground level produced highest K (267.70 kg $ha^{-1}$). The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of P (290.80 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of nutrients. Among the different spacing treatments $S_1$ recorded highest K (276.60 kg $ha^{-1}$) uptake and it was on par with $S_2$ (262.72 kg $ha^{-1}$).

None of the interactions was found to have significant influence on uptake of K.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to K uptake of palisade grass under open condition in the second year are presented in Table 32a, 32b and 32c.

The different treatments involving cutting height showed no significant effect on K uptake. The K uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of K (304.18 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of K. Among the different spacing treatments $S_1$ recorded maximum K uptake of 294.74 kg $ha^{-1}$ and was on a par with $S_2$.

None of the interactions was found to have significant influence on uptake of K.

*4.1.5.4 Ca Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Ca uptake of palisade grass under open condition in the first year are presented in Table 31a, 31b and 31c.

The different treatments involving cutting height showed significant effect on Ca uptake. The cutting treatments of 10 cm from ground level produced highest Ca (117.25 kg $ha^{-1}$) uptake. The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Ca (126.57 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of Ca. Among the different spacing treatments $S_1$ recorded highest uptake of Ca (121.06 kg $ha^{-1}$).

None of the interactions was found to have significant influence on uptake of Ca.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Ca uptake of palisade grass under open condition in the second year are presented in Table 32a, 32b and 32c.

The different treatments involving cutting height showed no significant effect on Ca uptake. The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Ca (120.36 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of Ca. Among the different spacing treatments $S_1$ recorded highest uptake of Ca (117.23 kg $ha^{-1}$).

None of the interactions was found to have significant influence on uptake of Ca.

#### *4.1.5.5 Mg Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Mg uptake of palisade grass under open condition in the first year are presented in Table 31a, 31b and 31c.

The different treatments involving cutting height showed significant effect on Mg uptake. The cutting treatments of 10 cm from ground level produced highest Mg (82.36 kg $ha^{-1}$) uptake. The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Mg (91.80 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of Ca. Among the different spacing treatments $S_1$ recorded highest uptake of Mg (85.93 kg $ha^{-1}$).

None of the interactions was found to have significant influence on uptake of Mg.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Mg uptake of palisade grass under open condition in the second year are presented in Table 32a, 32b and 32c.

The different treatments involving cutting height showed no significant effect on Mg uptake. The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Mg (82.11 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of Mg. Among the different spacing treatments $S_1$ recorded maximum uptake of Mg (77.81 kg $ha^{-1}$) and was on a par with $S_2$ (75.21 kg $ha^{-1}$).

Significant interaction was noticed between cutting height and spacing treatments in Mg uptake. Highest Mg uptake was recorded by the treatment $c_2s_1$ (80.88 kg $ha^{-1}$). The interaction between nutrient levels and spacing treatments was also found to be significant with respect to uptake of Mg. Highest Mg uptake was recorded by the treatment $n_3s_2$ (86.97 kg $ha^{-1}$). No other interactions were found significant.

### *4.1.5.6 K: (Ca+ Mg) Ratio*

The results presented in Table 33a, 33b and 33c indicated that the treatments had no significant effect on K: (Ca + Mg) ratio in both first and second years.

The interaction effects were also found non significant.

Table 33a. Effect of cutting pattern, nutrient levels and spacing on K: (Ca + Mg) ratio under open condition

| **Treatments** | **K: (Ca + Mg) ratio** | |
|---|---|---|
| | **First year** | **Second year** |
| **Cutting pattern (C)** | | |
| $C_1$ | 1.33 | 1.50 |
| $C_2$ | 1.34 | 1.51 |
| SEm (±) | 0.003 | 0.008 |
| CD (0.05) | NS | NS |
| **Nutrient levels (N)** | | |
| $N_1$ | 1.33 | 1.51 |
| $N_2$ | 1.34 | 1.51 |
| $N_3$ | 1.33 | 1.50 |
| SEm (±) | 0.042 | 0.010 |
| CD (0.05) | NS | NS |
| **Spacing (S)** | | |
| $S_1$ | 1.33 | 1.51 |
| $S_2$ | 1.33 | 1.50 |
| $S_3$ | 1.33 | 1.51 |
| SEm (±) | 0.042 | 0.010 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 33b. Interaction effect of cutting pattern, nutrient levels and spacing on K: (Ca + Mg) ratio under open condition

| Treatments | K: (Ca +Mg) ratio | |
|---|---|---|
| | **First year** | **Second year** |
| $c_1n_1$ | 1.33 | 1.51 |
| $c_1n_2$ | 1.32 | 1.50 |
| $c_1n_3$ | 1.32 | 1.49 |
| $c_2n_1$ | 1.33 | 1.51 |
| $c_2n_2$ | 1.35 | 1.53 |
| $c_2n_3$ | 1.33 | 1.50 |
| SEm (±) | 0.010 | 0.014 |
| CD (0.05) | NS | NS |
| $c_1s_1$ | 1.34 | 1.5 |
| $c_1s_2$ | 1.32 | 1.49 |
| $c_1s_3$ | 1.32 | 1.49 |
| $c_2s_1$ | 1.33 | 1.50 |
| $c_2s_2$ | 1.34 | 1.52 |
| $c_2s_3$ | 1.35 | 1.52 |
| SEm (±) | 0.010 | 0.014 |
| CD (0.05) | NS | NS |
| $n_1s_1$ | 1.35 | 1.53 |
| $n_1s_2$ | 1.34 | 1.52 |
| $n_1s_3$ | 1.32 | 1.48 |
| $n_2s_1$ | 1.33 | 1.50 |
| $n_2s_2$ | 1.33 | 1.51 |
| $n_2s_3$ | 1.35 | 1.53 |
| $n_3s_1$ | 1.32 | 1.50 |
| $n_3s_2$ | 1.32 | 1.49 |
| $n_3s_3$ | 1.33 | 1.51 |
| SEm (±) | 0.012 | 0.017 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 33c. Interaction effect of cutting pattern, nutrient levels and spacing on K: (Ca + Mg) ratio under open condition

| **Treatments** | **K: (Ca +Mg) ratio** | |
|---|---|---|
| | **First year** | **Second year** |
| $c_1n_1s_1$ | 1.36 | 1.55 |
| $c_1n_1s_2$ | 1.33 | 1.51 |
| $c_1n_1s_3$ | 1.31 | 1.48 |
| $c_1n_2s_1$ | 1.32 | 1.50 |
| $c_1n_2s_2$ | 1.31 | 1.48 |
| $c_1n_2s_3$ | 1.34 | 1.52 |
| $c_1n_3s_1$ | 1.34 | 1.51 |
| $c_1n_3s_2$ | 1.32 | 1.49 |
| $c_1n_3s_3$ | 1.32 | 1.49 |
| $c_2n_1s_1$ | 1.34 | 1.52 |
| $c_2n_1s_2$ | 1.35 | 1.53 |
| $c_2n_1s_3$ | 1.32 | 1.49 |
| $c_2n_2s_1$ | 1.33 | 1.51 |
| $c_2n_2s_2$ | 1.35 | 1.53 |
| $c_2n_2s_3$ | 1.37 | 1.55 |
| $c_2n_3s_1$ | 1.31 | 1.48 |
| $c_2n_3s_2$ | 1.33 | 1.50 |
| $c_2n_3s_3$ | 1.35 | 1.53 |
| SEm (±) | 0.018 | 0.025 |
| CD (0.05) | NS | NS |

NS- Not significant

### 4.1.6 Soil Analysis

#### *4.1.6.1 Available N*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available nitrogen status of the soil after the experiment under open condition in the first year are presented in Table 34a, 34b and 34c.

The results revealed that treatments involving cutting height had no significant effect on available nitrogen status of the soil. The available nitrogen status of the soil was significantly increased by the chemical fertilizer treatments. $N_3$ registered maximum available nitrogen (239.73 kg $ha^{-1}$) and was on a par with $N_2$. The spacing treatments had no significant effect on available nitrogen status of the soil.

Interactions were non significant with respect to available nitrogen status of the soil.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available nitrogen, status of the soil after the experiment under open condition in the second year are presented in Table 35a, 35b and 35c.

The results indicated that treatments involving cutting height had significant effect on available nitrogen status of the soil. The ground level cutting registered highest available nitrogen (230.68 kg $ha^{-1}$). There was significant variation in available nitrogen, status of the soil between different fertilizer treatments. $N_3$ registered highest available nitrogen (232.51 kg $ha^{-1}$) and was significantly superior to $N_2$ and $N_1$. Among the different spacing treatments, there was no significant effect on available nitrogen status of the soil.

Interactions were found to be non significant with respect to available nitrogen, status of the soil.

Table 34a. Effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under open condition in the first year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| **Cutting pattern (C)** | | | | |
| $C_1$ | 236.69 | 39.39 | 79.52 | 0.54 |
| $C_2$ | 233.48 | 39.24 | 80.44 | 0.55 |
| SEm (±) | 1.584 | 0.786 | 0.729 | 0.004 |
| CD (0.05) | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | |
| $N_1$ | 231.33 | 35.48 | 73.77 | 0.56 |
| $N_2$ | 234.20 | 41.97 | 80.72 | 0.54 |
| $N_3$ | 239.73 | 40.50 | 85.45 | 0.54 |
| SEm (±) | 1.940 | 0.962 | 0.893 | 0.005 |
| CD (0.05) | 5.588 | 2.772 | 2.572 | NS |
| **Spacing (S)** | | | | |
| $S_1$ | 233.67 | 40.02 | 80.10 | 0.54 |
| $S_2$ | 234.08 | 38.88 | 80.76 | 0.55 |
| $S_3$ | 237.50 | 39.05 | 79.08 | 0.56 |
| SEm (±) | 1.940 | 0.962 | 0.893 | 0.005 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Table 34b. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under open condition in the first year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic carbon (per cent) |
|---|---|---|---|---|
| $c_1n_1$ | 233.40 | 34.81 | 73.04 | 0.55 |
| $c_1n_2$ | 235.24 | 42.04 | 80.07 | 0.54 |
| $c_1n_3$ | 241.43 | 41.33 | 85.44 | 0.54 |
| $c_2n_1$ | 229.26 | 36.15 | 74.51 | 0.57 |
| $c_2n_2$ | 233.15 | 41.90 | 81.36 | 0.55 |
| $c_2n_3$ | 238.04 | 39.67 | 85.45 | 0.54 |
| SEm (±) | 2.744 | 1.361 | 1.263 | 0.008 |
| CD (0.05) | NS | NS | NS | NS |
| $c_1s_1$ | 235.57 | 39.82 | 79.33 | 0.54 |
| $c_1s_2$ | 235.18 | 40.23 | 81.25 | 0.54 |
| $c_1s_3$ | 239.31 | 38.13 | 77.97 | 0.55 |
| $c_2s_1$ | 231.77 | 40.23 | 80.87 | 0.55 |
| $c_2s_2$ | 232.98 | 37.53 | 80.26 | 0.55 |
| $c_2s_3$ | 235.70 | 39.96 | 80.18 | 0.56 |
| SEm (±) | 2.744 | 1.361 | 1.263 | 0.008 |
| CD (0.05) | NS | NS | NS | NS |
| $n_1s_1$ | 229.58 | 34.13 | 72.58 | 0.55 |
| $n_1s_2$ | 229.23 | 36.31 | 75.66 | 0.56 |
| $n_1s_3$ | 235.18 | 36.00 | 73.08 | 0.56 |
| $n_2s_1$ | 233.36 | 44.25 | 80.83 | 0.55 |
| $n_2s_2$ | 235.90 | 40.28 | 81.68 | 0.53 |
| $n_2s_3$ | 233.33 | 41.38 | 79.65 | 0.56 |
| $n_3s_1$ | 238.08 | 41.70 | 86.90 | 0.53 |
| $n_3s_2$ | 237.13 | 40.05 | 84.93 | 0.55 |
| $n_3s_3$ | 244.00 | 39.76 | 84.51 | 0.55 |
| SEm (±) | 3.361 | 1.667 | 1.547 | 0.010 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Table 34c. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under open condition in the first year

| **Treatments** | **Available Nitrogen (kg ha$^{-1}$)** | **Available Phosphorus (kg ha$^{-1}$)** | **Available Potassium (kg ha$^{-1}$)** | **Organic Carbon (per cent)** |
|---|---|---|---|---|
| $c_1n_1s_1$ | 231.73 | 34.20 | 72.00 | 0.55 |
| $c_1n_1s_2$ | 228.86 | 35.96 | 75.73 | 0.55 |
| $c_1n_1s_3$ | 239.60 | 34.26 | 71.40 | 0.56 |
| $c_1n_2s_1$ | 234.16 | 43.23 | 80.66 | 0.54 |
| $c_1n_2s_2$ | 235.23 | 41.90 | 82.63 | 0.52 |
| $c_1n_2s_3$ | 236.33 | 41.00 | 76.93 | 0.56 |
| $c_1n_3s_1$ | 240.83 | 42.03 | 85.33 | 0.54 |
| $c_1n_3s_2$ | 241.46 | 42.83 | 85.40 | 0.55 |
| $c_1n_3s_3$ | 242.00 | 39.13 | 85.60 | 0.55 |
| $c_2n_1s_1$ | 227.43 | 34.06 | 73.16 | 0.56 |
| $c_2n_1s_2$ | 229.60 | 36.60 | 75.60 | 0.58 |
| $c_2n_1s_3$ | 230.76 | 37.73 | 74.76 | 0.57 |
| $c_2n_2s_1$ | 232.56 | 45.26 | 81.00 | 0.56 |
| $c_2n_2s_2$ | 236.56 | 38.66 | 80.73 | 0.54 |
| $c_2n_2s_3$ | 230.33 | 41.76 | 82.36 | 0.56 |
| $c_2n_3s_1$ | 235.33 | 41.36 | 88.46 | 0.52 |
| $c_2n_3s_2$ | 232.80 | 37.26 | 84.46 | 0.55 |
| $c_2n_3s_3$ | 246.00 | 40.40 | 83.43 | 0.55 |
| SEm (±) | 4.754 | 2.358 | 2.187 | 0.014 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Table 35a. Effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under open condition in the second year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| **Cutting pattern (C)** | | | | |
| $C_1$ | 230.68 | 39.36 | 81.77 | 0.56 |
| $C_2$ | 221.04 | 39.37 | 88.72 | 0.56 |
| SEm (±) | 1.597 | 0.743 | 0.727 | 0.004 |
| CD (0.05) | 4.598 | NS | 2.095 | NS |
| **Nutrient levels (N)** | | | | |
| $N_1$ | 218.34 | 26.23 | 81.77 | 0.55 |
| $N_2$ | 226.73 | 41.84 | 88.72 | 0.57 |
| $N_3$ | 232.51 | 50.03 | 93.43 | 0.57 |
| SEm (±) | 1.955 | 0.910 | 0.891 | 0.005 |
| CD (0.05) | 5.631 | 2.622 | 2.566 | NS |
| **Spacing (S)** | | | | |
| $S_1$ | 223.54 | 39.03 | 88.10 | 0.56 |
| $S_2$ | 226.12 | 38.72 | 88.76 | 0.56 |
| $S_3$ | 227.92 | 40.35 | 87.06 | 0.57 |
| SEm (±) | 1.955 | 0.910 | 0.891 | 0.005 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Table 35b. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under open condition in the second year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| $c_1n_1$ | 222.39 | 25.14 | 81.04 | 0.57 |
| $c_1n_2$ | 232.04 | 41.63 | 88.07 | 0.56 |
| $c_1n_3$ | 237.62 | 51.31 | 93.44 | 0.56 |
| $c_2n_1$ | 214.29 | 27.31 | 82.51 | 0.53 |
| $c_2n_2$ | 221.42 | 42.05 | 89.36 | 0.58 |
| $c_2n_3$ | 227.39 | 48.75 | 93.42 | 0.58 |
| SEm (±) | 2.765 | 1.287 | 1.260 | 0.007 |
| CD (0.05) | NS | NS | NS | 0.022 |
| $c_1s_1$ | 228.03 | 38.97 | 87.33 | 0.56 |
| $c_1s_2$ | 231.89 | 39.62 | 89.25 | 0.56 |
| $c_1s_3$ | 232.14 | 39.49 | 85.97 | 0.57 |
| $c_2s_1$ | 219.06 | 39.08 | 88.87 | 0.56 |
| $c_2s_2$ | 220.35 | 37.82 | 88.26 | 0.56 |
| $c_2s_3$ | 223.70 | 41.21 | 88.15 | 0.57 |
| SEm (±) | 2.765 | 1.287 | 1.260 | 0.007 |
| CD (0.05) | NS | NS | NS | NS |
| $n_1s_1$ | 220.58 | 24.14 | 80.58 | 0.53 |
| $n_1s_2$ | 220.63 | 27.46 | 83.66 | 0.56 |
| $n_1s_3$ | 213.83 | 27.08 | 81.08 | 0.58 |
| $n_2s_1$ | 220.59 | 42.80 | 88.83 | 0.57 |
| $n_2s_2$ | 228.31 | 40.00 | 89.68 | 0.56 |
| $n_2s_3$ | 231.29 | 42.73 | 87.65 | 0.57 |
| $n_3s_1$ | 229.46 | 50.13 | 94.90 | 0.59 |
| $n_3s_2$ | 229.42 | 48.71 | 92.93 | 0.56 |
| $n_3s_3$ | 238.64 | 51.25 | 92.46 | 0.57 |
| SEm (±) | 3.387 | 1.577 | 1.543 | 0.009 |
| CD (0.05) | NS | NS | NS | 0.027 |

NS- Not significant

Table 35c. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under open condition in the second year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| $c_1n_1s_1$ | 223.96 | 24.50 | 80.00 | 0.55 |
| $c_1n_1s_2$ | 222.47 | 25.72 | 83.73 | 0.58 |
| $c_1n_1s_3$ | 220.75 | 25.21 | 79.40 | 0.58 |
| $c_1n_2s_1$ | 224.27 | 41.03 | 88.66 | 0.56 |
| $c_1n_2s_2$ | 234.60 | 41.09 | 90.63 | 0.54 |
| $c_1n_2s_3$ | 237.25 | 42.79 | 84.93 | 0.57 |
| $c_1n_3s_1$ | 235.86 | 51.39 | 93.33 | 0.58 |
| $c_1n_3s_2$ | 238.60 | 52.06 | 93.40 | 0.55 |
| $c_1n_3s_3$ | 238.41 | 50.48 | 93.60 | 0.56 |
| $c_2n_1s_1$ | 217.20 | 23.79 | 81.16 | 0.51 |
| $c_2n_1s_2$ | 218.78 | 29.20 | 83.60 | 0.53 |
| $c_2n_1s_3$ | 206.90 | 28.95 | 82.76 | 0.53 |
| $c_2n_2s_1$ | 216.92 | 44.58 | 89.00 | 0.58 |
| $c_2n_2s_2$ | 222.03 | 38.92 | 88.73 | 0.59 |
| $c_2n_2s_3$ | 225.33 | 42.67 | 90.36 | 0.57 |
| $c_2n_3s_1$ | 223.07 | 48.88 | 96.46 | 0.59 |
| $c_2n_3s_2$ | 220.24 | 45.36 | 92.46 | 0.57 |
| $c_2n_3s_3$ | 238.86 | 52.01 | 91.33 | 0.58 |
| SEm (±) | 4.790 | 2.230 | 2.182 | 0.013 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

*4.1.6.2 Available P*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available P status of the soil after the experiment under open condition in the first year are presented in Table 34a, 34b and 34c.

The results revealed that treatments involving cutting height had no significant effect on available P status of the soil. There was significant variation in available P status of the soil between different fertilizer treatments. Among the different fertilizer treatments $N_2$ registered maximum available P (41.97 kg $ha^{-1}$) and was on a par with $N_3$ (40.50 kg $ha^{-1}$). Among the different spacing treatments no significant effect on available P status of the soil was observed.

Interactions were non significant with respect to available P status of the soil.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available P status of the soil after the experiment under open condition in the second year are presented in Table 35a, 35b and 35c.

The results indicated that treatments involving cutting height had no significant effect on available P status of the soil. There was significant variation in available P status of the soil between different fertilizer treatments. Among the different fertilizer treatments $N_3$ registered highest available P (50.03 kg $ha^{-1}$). Among the different spacing treatments no significant effect on available P status of the soil was observed.

Interactions were found to be non significant with respect to available P status of the soil.

*4.1.6.3 Available K*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available K status of the soil after the experiment under open condition in the first year are presented in Table 34a, 34b and 34c.

The results indicated that treatments involving cutting height had no significant effect on available K status of the soil. There was significant variation in available K status of the soil between different fertilizer treatments. Among the different fertilizer treatments $N_3$ registered highest available K (85.45 kg $ha^{-1}$). Among the different spacing treatments also no significant variation was noticed.

Interactions were non significant with respect to available K status of the soil.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available K status of the soil after the experiment under open condition in the second year are presented in Table 35a, 35b and 35c.

The results revealed that treatments involving cutting height had significant effect on available K status of the soil. The cutting treatments of 10 cm from ground level produced highest (88.72 kg $ha^{-1}$) available K. There was significant variation in available K status of the soil between different fertilizer treatments. $N_3$ registered highest available K (93.43 kg $ha^{-1}$) and was significantly superior to $N_2$ and $N_1$. Among the different spacing treatments no significant effect on available K status of the soil was observed.

Interactions were found to be non significant with respect to available K status of the soil.

#### *4.1.6.4 Organic Carbon*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to organic carbon status of the soil after the experiment under open condition in the first year are presented in Table 34a, 34b and 34c.

The results revealed that treatments involving cutting height had no significant effect on organic carbon status of the soil. There was no significant variation in organic carbon status of the soil between different fertilizer treatments. Among the different spacing treatments no significant variation was observed.

Interactions were non significant with respect to organic carbon content of the soil.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to organic carbon status of the soil after the experiment under open condition in the second year are presented in Table 35a, 35b and 35c.

The results indicated that treatments involving cutting height had no significant effect on organic carbon status of the soil. There was no significant variation in organic carbon status of the soil between different fertilizer treatments. Among the different spacing treatments also no significant variation was noticed.

Interactions were found to be non significant with respect to organic carbon status of the soil.

### 4.1.7 Incidence of Pests and Diseases

The incidence of pest and disease was not noticed throughout the crop period in both years.

### 4.1.8 Economic Analysis

#### *4.1.8.1 Net Income*

The effect of cutting pattern, nutrient levels and plant spacing on net income of palisade grass under open condition in the first and second year are presented in Table 36a, 36b and 36c.

The different treatments involving cutting height showed significant effect on net income in the first year whereas no significance was noticed in the second year. The cutting treatments of 10 cm from ground level produced maximum net income (72,650 Rs. $ha^{-1}$) in first year. The net income was significantly

Table 36a. Effect of cutting pattern, nutrient levels and spacing on net income and B: C ratio under open condition

| Treatments | Net income (Rs $ha^{-1}$) | | B: C ratio | |
|---|---|---|---|---|
| | First year | Second year | First year | Second year |
| **Cutting pattern (C)** | | | | |
| $C_1$ | 55067 | 57474 | 1.53 | 1.57 |
| $C_2$ | 72650 | 60923 | 1.72 | 1.62 |
| SEm (±) | 3677.823 | 1885.425 | 0.035 | 0.019 |
| CD (0.05) | 10588.455 | NS | 0.102 | NS |
| **Nutrient levels (N)** | | | | |
| $N_1$ | 41334 | 47621 | 1.42 | 1.49 |
| $N_2$ | 68631 | 61635 | 1.68 | 1.62 |
| $N_3$ | 81611 | 68341 | 1.79 | 1.68 |
| SEm (±) | 4504.395 | 2309.164 | 0.043 | 0.023 |
| CD (0.05) | 12968.156 | 6648.086 | 0.125 | 0.067 |
| **Spacing (S)** | | | | |
| $S_1$ | 69983 | 66057 | 1.64 | 1.67 |
| $S_2$ | 64250 | 59441 | 1.63 | 1.60 |
| $S_3$ | 57342 | 52099 | 1.61 | 1.53 |
| SEm (±) | 4504.395 | 2309.164 | 0.043 | 0.023 |
| CD (0.05) | NS | 6648.086 | NS | 0.067 |

NS- Not significant

Table 36b. Interaction effect of cutting pattern, nutrient levels and spacing on net income and B: C ratio under open condition

| Treatments | Net income (Rs ha$^{-1}$) | | B: C ratio | |
|---|---|---|---|---|
| | First year | Second year | First year | Second year |
| $c_1n_1$ | 36545 | 48075 | 1.36 | 1.49 |
| $c_1n_2$ | 57017 | 58947 | 1.55 | 1.59 |
| $c_1n_3$ | 71640 | 65402 | 1.68 | 1.64 |
| $c_2n_1$ | 46122 | 47168 | 1.47 | 1.49 |
| $c_2n_2$ | 80244 | 64323 | 1.80 | 1.66 |
| $c_2n_3$ | 91583 | 71279 | 1.89 | 1.72 |
| SEm (±) | 6370.178 | 3265.652 | 0.061 | 0.032 |
| CD (0.05) | NS | NS | NS | NS |
| $c_1s_1$ | 62712 | 61302 | 1.56 | 1.61 |
| $c_1s_2$ | 52245 | 60419 | 1.50 | 1.60 |
| $c_1s_3$ | 50246 | 50702 | 1.52 | 1.50 |
| $c_2s_1$ | 77255 | 70812 | 1.71 | 1.73 |
| $c_2s_2$ | 76255 | 58462 | 1.75 | 1.60 |
| $c_2s_3$ | 64439 | 53496 | 1.69 | 1.55 |
| SEm (±) | 6370.178 | 3265.652 | 0.061 | 0.032 |
| CD (0.05) | NS | NS | NS | NS |
| $n_1s_1$ | 41731 | 54480 | 1.39 | 1.56 |
| $n_1s_2$ | 42756 | 41205 | 1.42 | 1.42 |
| $n_1s_3$ | 39515 | 47180 | 1.43 | 1.49 |
| $n_2s_1$ | 72178 | 68652 | 1.66 | 1.69 |
| $n_2s_2$ | 70428 | 63777 | 1.69 | 1.64 |
| $n_2s_3$ | 63287 | 52477 | 1.67 | 1.53 |
| $n_3s_1$ | 96042 | 75041 | 1.87 | 1.75 |
| $n_3s_2$ | 79567 | 73341 | 1.77 | 1.73 |
| $n_3s_3$ | 69226 | 56641 | 1.72 | 1.56 |
| SEm (±) | 7801.843 | 3999.591 | 0.075 | 0.040 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Table 36c. Interaction effect of cutting pattern, nutrient levels and spacing on net income and B: C ratio under open condition

| Treatments | Net income (Rs $ha^{-1}$) | | B: C ratio | |
|---|---|---|---|---|
| | First year | Second year | First year | Second year |
| $c_1n_1s_1$ | 37201 | 49325 | 1.34 | 1.50 |
| $c_1n_1s_2$ | 38251 | 48675 | 1.37 | 1.49 |
| $c_1n_1s_3$ | 34185 | 46225 | 1.36 | 1.47 |
| $c_1n_2s_1$ | 64723 | 62697 | 1.59 | 1.62 |
| $c_1n_2s_2$ | 52173 | 62347 | 1.50 | 1.62 |
| $c_1n_2s_3$ | 54157 | 51797 | 1.57 | 1.52 |
| $c_1n_3s_1$ | 86212 | 71886 | 1.77 | 1.70 |
| $c_1n_3s_2$ | 66312 | 70236 | 1.63 | 1.69 |
| $c_1n_3s_3$ | 62396 | 54086 | 1.64 | 1.53 |
| $c_2n_1s_1$ | 46261 | 59635 | 1.43 | 1.62 |
| $c_2n_1s_2$ | 47261 | 33735 | 1.47 | 1.35 |
| $c_2n_1s_3$ | 44845 | 48135 | 1.49 | 1.51 |
| $c_2n_2s_1$ | 79633 | 74607 | 1.74 | 1.77 |
| $c_2n_2s_2$ | 88683 | 65207 | 1.88 | 1.67 |
| $c_2n_2s_3$ | 72417 | 53157 | 1.78 | 1.55 |
| $c_2n_3s_1$ | 105872 | 78196 | 1.97 | 1.79 |
| $c_2n_3s_2$ | 92822 | 76446 | 1.91 | 1.77 |
| $c_2n_3s_3$ | 76056 | 59196 | 1.80 | 1.60 |
| SEm (±) | 11033.472 | 5656.276 | 0.106 | 0.056 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

influenced by the chemical fertilizer treatments in both the years. During first year $N_3$ (81,611 Rs. $ha^{-1}$) was observed to be significantly superior to $N_2$ (68,631 Rs. $ha^{-1}$) and $N_1$ (41,334 Rs. $ha^{-1}$). During second year also $N_3$ (68,341 Rs. $ha^{-1}$) was observed to be significantly superior to $N_2$ (61,635 Rs. $ha^{-1}$) and $N_1$ (47,621 Rs. $ha^{-1}$). The different spacing treatments showed no significant effect on net income in first year whereas significant effect on net income was noticed in second year. During second year highest net income was recorded by treatment involving narrow spacing ($S_1$) (60 cm x 30 cm) (66,057 Rs. $ha^{-1}$) which was on a par with $S_2$ (59,441 Rs. $ha^{-1}$) and significantly superior to $S_3$ (52099 Rs. $ha^{-1}$). $S_2$ was found significantly superior to $S_3$.

None of the interactions was found to have significant influence on net income.

#### *4.1.8.2 B: C Ratio*

The effect of cutting pattern, nutrient levels and plant spacing on benefit: cost ratio of palisade grass under open condition in the first and second year is presented in Table 36a, 36b and 36c.

The different treatments involving cutting height showed significant effect on benefit: cost ratio in the first year whereas no significance was noticed in the second year. The cutting treatments of 10 cm from ground level produced maximum benefit: cost ratio (1.72) in the first year. The benefit: cost ratio was significantly influenced by the chemical fertilizer treatments in both the years. During first year $N_3$ (1.79) was observed to be significantly superior to $N_2$ (1.68) and $N_1$ (1.42). During second year also $N_3$ (1.68) was observed to be significantly superior to $N_2$ (1.62) and $N_1$ (1.49). The different spacing treatments showed no significant effect on benefit: cost ratio in first year whereas significant effect was noticed in second year. During second year highest benefit: cost ratio was recorded by treatment involving narrow spacing ($S_1$) (1.67) which was significantly superior to $S_2$ (1.60) and $S_3$ (1.53).

None of the interactions was found to have significant influence on benefit: cost ratio.

### 4.1.9 Pooled Analysis

The pooled result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) for two years with respect to green fodder yield, crude protein content, crude fibre content, net income and B: C ratio of palisade grass under open condition are presented in Table 37a, 37b and 37c.

The different treatments involving cutting height showed significant effect on total green fodder yield, crude protein content, crude fibre content, net income and B: C ratio. The cutting treatments of 10 cm from ground level produced maximum GFY, crude protein content, net income and B: C ratio net income and lowest crude fibre content. Among the fertilizer treatments highest GFY, crude protein content, net income and B: C ratio was registered by the treatment $N_3$ and $N_1$ recorded lowest crude fibre content. Among spacing treatments highest GFY, net income and B: C ratio was recorded by $S_1$. Also lowest crude fibre content was recorded by $S_1$.

Significant interactions were noticed between cutting height and nutrient levels in total green fodder yield. Highest total green fodder yield was recorded by the treatment $c_2n_3$ (121.05 kg ha$^{-1}$). The interaction between cutting height and spacing and nutrient levels and spacing treatments were also found to be significant. Highest total green fodder yield were recorded by the treatment $c_2s_1$ (117.25 kg ha$^{-1}$) and $n_3s_1$ (127.12 kg ha$^{-1}$) respectively.

Significant interactions were noticed between cutting height and nutrient levels, cutting height and spacing and nutrient levels and spacing treatments in crude fibre content. The lowest crude fibre content were recorded by the treatment combinations of $c_2n_3$ (28.17 %), $c_2s_1$ (28.11 %) and $n_3s_1$ (28.13 %) respectively.

Table 37a. Effect of cutting pattern, nutrient levels and spacing on total green fodder yield, crude protein content, crude fibre content, net income and B: C ratio under open condition (pooled data of 2 years)

| Treatments | Total green fodder yield (t ha$^{-1}$) | Crude protein content (%) | Crude fibre content (%) | Net income (Rs ha$^{-1}$) | B: C ratio |
|---|---|---|---|---|---|
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 105.13 | 8.23 | 29.68 | 56271 | 1.55 |
| $C_2$ | 110.10 | 8.38 | 28.43 | 66786 | 1.67 |
| SEm (±) | 1.670 | 0.015 | 0.121 | 2314.216 | 0.020 |
| CD (0.05) | 4.810 | 0.044 | 0.351 | 6662.630 | 0.060 |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 95.07 | 8.09 | 29.89 | 44477 | 1.45 |
| $N_2$ | 110.03 | 8.36 | 28.84 | 65133 | 1.65 |
| $N_3$ | 117.765 | 8.48 | 28.43 | 74976 | 1.73 |
| SEm (±) | 2.046 | 0.022 | 0.148 | 2834.324 | 0.029 |
| CD (0.05) | 5.893 | 0.066 | 0.428 | 8160.021 | 0.085 |
| **Spacing (S)** | | | | | |
| $S_1$ | 114.26 | 8.30 | 28.79 | 68020 | 1.65 |
| $S_2$ | 108.06 | 8.30 | 29.35 | 61845 | 1.61 |
| $S_3$ | 100.53 | 8.31 | 29.13 | 54721 | 1.57 |
| SEm (±) | 2.046 | 0.022 | 0.148 | 2834.324 | 0.029 |
| CD (0.05) | 5.893 | NS | 0.428 | 8160.021 | 0.085 |

NS- Not significant

Table 37b. Interaction effect of cutting pattern, nutrient levels and spacing on total green fodder yield, crude protein content, crude fibre content, net income and B: C ratio under open condition (pooled data of 2 years)

| Treatments | Total green fodder yield (t $ha^{-1}$) | Crude protein content (%) | Crude fibre content (%) | Net income (Rs $ha^{-1}$) | B: C ratio |
|---|---|---|---|---|---|
| $c_1n_1$ | 94.65 | 8.01 | 30.91 | 42310 | 1.42 |
| $c_1n_2$ | 106.28 | 8.24 | 29.43 | 57982 | 1.57 |
| $c_1n_3$ | 114.48 | 8.43 | 28.69 | 68521 | 1.66 |
| $c_2n_1$ | 95.49 | 8.16 | 28.88 | 46645 | 1.48 |
| $c_2n_2$ | 113.77 | 8.47 | 28.25 | 72284 | 1.7 |
| $c_2n_3$ | 121.05 | 8.53 | 28.17 | 81431 | 1.80 |
| SEm (±) | 2.896 | 0.030 | 0.209 | 4008.344 | 0.039 |
| CD (0.05) | 8.339 | NS | 0.604 | 11540.024 | 0.115 |
| $c_1s_1$ | 111.28 | 8.22 | 29.45 | 62007 | 1.59 |
| $c_1s_2$ | 105.40 | 8.23 | 29.95 | 56332 | 1.55 |
| $c_1s_3$ | 98.72 | 8.23 | 29.63 | 50474 | 1.51 |
| $c_2s_1$ | 117.25 | 8.39 | 28.11 | 74034 | 1.72 |
| $c_2s_2$ | 110.72 | 8.38 | 28.55 | 67359 | 1.67 |
| $c_2s_3$ | 102.35 | 8.39 | 28.63 | 58967 | 1.62 |
| SEm (±) | 2.896 | 0.030 | 0.209 | 4008.344 | 0.039 |
| CD (0.05) | 8.339 | NS | 0.604 | 11540.024 | 0.115 |
| $n_1s_1$ | 99.80 | 8.11 | 29.96 | 48105 | 1.47 |
| $n_1s_2$ | 93.64 | 8.06 | 29.89 | 41980 | 1.42 |
| $n_1s_3$ | 91.77 | 8.09 | 29.84 | 43347 | 1.46 |
| $n_2s_1$ | 115.87 | 8.32 | 28.26 | 70415 | 1.68 |
| $n_2s_2$ | 111.57 | 8.36 | 29.15 | 67102 | 1.66 |
| $n_2s_3$ | 102.65 | 8.38 | 29.11 | 57882 | 1.60 |
| $n_3s_1$ | 127.12 | 8.48 | 28.13 | 85541 | 1.81 |
| $n_3s_2$ | 118.98 | 8.49 | 28.72 | 76454 | 1.75 |
| $n_3s_3$ | 107.19 | 8.46 | 28.44 | 62933 | 1.64 |
| SEm (±) | 3.545 | 0.037 | 0.259 | 4909.198 | 0.049 |
| CD (0.05) | 10.207 | NS | 0.747 | 14133.582 | 0.143 |

NS- Not significant

Table 37c. Interaction effect of cutting pattern, nutrient levels and spacing on total green fodder yield, crude protein content, crude fibre content, net income and B: C ratio under open condition (pooled data of 2 years)

| Treatments | Total green fodder yield (t ha$^{-1}$) | Crude protein content (%) | Crude fibre content (%) | Net income (Rs. ha$^{-1}$) | B: C ratio |
|---|---|---|---|---|---|
| $c_1n_1s_1$ | 97.60 | 7.99 | 30.98 | 43263 | 1.42 |
| $c_1n_1s_2$ | 95.65 | 7.99 | 30.78 | 43463 | 1.44 |
| $c_1n_1s_3$ | 90.70 | 8.06 | 30.96 | 40205 | 1.41 |
| $c_1n_2s_1$ | 112.42 | 8.25 | 28.86 | 63710 | 1.61 |
| $c_1n_2s_2$ | 106.03 | 8.26 | 29.75 | 57260 | 1.56 |
| $c_1n_2s_3$ | 100.40 | 8.23 | 29.70 | 52977 | 1.54 |
| $c_1n_3s_1$ | 123.82 | 8.43 | 28.51 | 79049 | 1.74 |
| $c_1n_3s_2$ | 114.55 | 8.44 | 29.33 | 68274 | 1.66 |
| $c_1n_3s_3$ | 105.08 | 8.41 | 28.23 | 58241 | 1.58 |
| $c_2n_1s_1$ | 102.01 | 8.23 | 28.93 | 52948 | 1.53 |
| $c_2n_1s_2$ | 91.63 | 8.13 | 29.00 | 40498 | 1.41 |
| $c_2n_1s_3$ | 92.85 | 8.12 | 28.72 | 46490 | 1.50 |
| $c_2n_2s_1$ | 119.32 | 8.40 | 27.66 | 77120 | 1.76 |
| $c_2n_2s_2$ | 117.11 | 8.47 | 28.55 | 76945 | 1.77 |
| $c_2n_2s_3$ | 104.90 | 8.54 | 28.53 | 62787 | 1.67 |
| $c_2n_3s_1$ | 130.43 | 8.54 | 27.75 | 92034 | 1.88 |
| $c_2n_3s_2$ | 123.42 | 8.54 | 28.12 | 84634 | 1.84 |
| $c_2n_3s_3$ | 109.30 | 8.51 | 28.65 | 67626 | 1.70 |
| SEm (±) | 5.012 | 0.051 | 0.365 | 6942.654 | 0.069 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Significant interactions were noticed between cutting height and nutrient levels, cutting height and spacing and nutrient levels and spacing with respect to net income. The highest net income was recorded by the treatment combinations of $c_2n_3$ (81,431 Rs. $ha^{-1}$), $c_2s_1$ (74,034 Rs. $ha^{-1}$) and $n_3s_1$ (85,541 Rs. $ha^{-1}$) respectively.

Significant interactions were noticed between cutting height and nutrient levels, cutting height and spacing and nutrient levels and spacing with respect to benefit cost ratio. The highest benefit cost ratio was recorded by the treatment combinations of $c_2n_3$ (1.80), $c_2s_1$ (1.72) and $n_3s_1$ (1.81) respectively.

The combined interaction between cutting height, nutrient levels and spacing was found to be non significant.

## 4.2 EXPERIMENT- 2: STANDARDISING THE CUTTING PATTERN, N, P, K LEVELS AND SPACING IN PALISADE GRASS UNDER PARTIAL SHADED CONDITION

### 4.2.1 Biometric Observations

#### *4.2.1.1 Plant Height*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) regarding plant height of palisade grass under partial shade condition during the first year are presented in Table 38a, 38b and 38c.

The result revealed that the treatments had significant impact on plant height during first year. The effect of cutting pattern on plant height was significant on the second, third and sixth harvest. Significantly higher plant height was recorded by the cutting at 10 cm height from ground level in the second (100.90 cm), third (104.53 cm) and sixth harvest (118.10 cm). Significant effect of nutrients on plant height was observed in all the harvests except first and third harvests. The highest plant height was recorded by $N_3$ (300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) in fourth (109.89 cm) and fifth (115.96 cm) harvests and in second and sixth harvest $N_3$ (300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) and $N_2$ (250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$)

Table 38a. Effect of cutting pattern, nutrient levels and spacing on plant height under partial shade condition during first year, cm

| Treatments | Plant height | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 83.87 | 85.95 | 95.68 | 95.57 | 100.40 | 105.85 |
| $C_2$ | 84.48 | 100.90 | 104.53 | 103.11 | 108.11 | 118.10 |
| SEm (±) | 1.846 | 3.966 | 1.942 | 3.330 | 3.521 | 4.223 |
| CD (0.05) | NS | 11.420 | 5.593 | NS | NS | 12.160 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 80.33 | 82.35 | 97.73 | 91.51 | 96.58 | 100.82 |
| $N_2$ | 84.65 | 94.19 | 99.51 | 96.62 | 100.22 | 114.37 |
| $N_3$ | 87.54 | 103.73 | 103.07 | 109.89 | 115.96 | 120.74 |
| SEm (±) | 2.262 | 4.857 | 2.379 | 4.079 | 4.312 | 5.172 |
| CD (0.05) | NS | 13.986 | NS | 11.744 | 12.416 | 14.893 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 86.17 | 102.17 | 100.52 | 107.90 | 110.18 | 118.84 |
| $S_2$ | 84.99 | 90.80 | 104.32 | 98.50 | 104.52 | 113.31 |
| $S_3$ | 81.36 | 87.30 | 95.47 | 91.62 | 98.07 | 103.78 |
| SEm (±) | 2.262 | 4.857 | 2.379 | 4.079 | 4.312 | 5.172 |
| CD (0.05) | NS | 13.986 | 6.850 | 11.744 | NS | NS |

NS- Not Significant

Table 38b. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under partial shade condition during first year, cm

| Treatments | Plant height | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 80.30 | 81.08 | 95.26 | 88.61 | 93.64 | 98.00 |
| $c_1n_2$ | 84.63 | 85.61 | 94.85 | 94.24 | 98.71 | 106.87 |
| $c_1n_3$ | 86.67 | 91.15 | 96.94 | 103.86 | 108.86 | 112.68 |
| $c_2n_1$ | 80.36 | 83.62 | 100.21 | 94.41 | 99.53 | 103.64 |
| $c_2n_2$ | 84.66 | 102.77 | 104.17 | 99.00 | 101.73 | 121.86 |
| $c_2n_3$ | 88.41 | 116.31 | 109.20 | 115.92 | 123.06 | 128.80 |
| SEm (±) | 3.911 | 6.870 | 3.364 | 5.768 | 6.098 | 7.315 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 85.56 | 93.02 | 95.43 | 102.63 | 104.95 | 110.98 |
| $c_1s_2$ | 84.70 | 88.28 | 99.94 | 95.16 | 101.73 | 108.76 |
| $c_1s_3$ | 81.34 | 76.54 | 91.68 | 88.92 | 94.53 | 97.81 |
| $c_2s_1$ | 86.77 | 111.33 | 105.62 | 113.17 | 115.41 | 126.70 |
| $c_2s_2$ | 85.28 | 93.31 | 108.70 | 101.83 | 107.31 | 117.85 |
| $c_2s_3$ | 81.37 | 98.06 | 99.26 | 94.32 | 101.61 | 109.75 |
| SEm (±) | 3.911 | 6.870 | 3.364 | 5.768 | 6.098 | 7.315 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 83.61 | 92.06 | 96.33 | 99.61 | 101.83 | 108.25 |
| $n_1s_2$ | 81.45 | 72.13 | 101.90 | 90.06 | 97.63 | 102.56 |
| $n_1s_3$ | 75.93 | 82.86 | 94.98 | 84.85 | 90.30 | 91.65 |
| $n_2s_1$ | 86.00 | 102.26 | 102.83 | 100.13 | 106.33 | 116.21 |
| $n_2s_2$ | 85.30 | 93.43 | 103.95 | 96.80 | 100.43 | 117.45 |
| $n_2s_3$ | 82.65 | 86.88 | 91.76 | 92.93 | 93.90 | 109.45 |
| $n_3s_1$ | 88.90 | 112.20 | 102.41 | 123.96 | 122.38 | 132.06 |
| $n_3s_2$ | 88.23 | 106.83 | 107.11 | 108.63 | 115.50 | 119.91 |
| $n_3s_3$ | 85.50 | 92.16 | 99.68 | 97.08 | 110.01 | 110.25 |
| SEm (±) | 3.918 | 8.414 | 4.120 | 7.065 | 7.469 | 8.960 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 38c. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under partial shade condition during first year, cm

| Treatments | Plant height | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 83.83 | 84.96 | 94.00 | 100.10 | 97.83 | 106.90 |
| $c_1n_1s_2$ | 82.53 | 83.76 | 97.06 | 85.33 | 92.46 | 97.03 |
| $c_1n_1s_3$ | 74.53 | 74.53 | 94.73 | 80.40 | 90.63 | 90.06 |
| $c_1n_2s_1$ | 85.93 | 93.16 | 94.40 | 98.23 | 105.23 | 108.33 |
| $c_1n_2s_2$ | 85.00 | 86.23 | 102.00 | 94.03 | 99.33 | 113.83 |
| $c_1n_2s_3$ | 82.96 | 77.43 | 88.16 | 90.46 | 91.56 | 98.46 |
| $c_1n_3s_1$ | 86.93 | 100.93 | 97.90 | 109.56 | 111.80 | 117.73 |
| $c_1n_3s_2$ | 86.56 | 94.86 | 100.76 | 106.13 | 113.40 | 115.43 |
| $c_1n_3s_3$ | 86.53 | 77.66 | 92.16 | 95.90 | 101.40 | 104.90 |
| $c_2n_1s_1$ | 83.40 | 99.16 | 98.66 | 99.13 | 105.83 | 109.60 |
| $c_2n_1s_2$ | 80.36 | 60.50 | 106.73 | 94.80 | 102.80 | 108.10 |
| $c_2n_1s_3$ | 77.33 | 91.20 | 95.23 | 89.30 | 89.96 | 93.23 |
| $c_2n_2s_1$ | 86.06 | 111.36 | 111.26 | 102.03 | 107.43 | 124.10 |
| $c_2n_2s_2$ | 85.60 | 100.63 | 105.90 | 99.56 | 101.53 | 121.06 |
| $c_2n_2s_3$ | 82.33 | 96.33 | 95.36 | 95.40 | 96.23 | 120.43 |
| $c_2n_3s_1$ | 90.86 | 123.46 | 106.93 | 138.36 | 132.96 | 146.40 |
| $c_2n_3s_2$ | 89.90 | 118.80 | 113.46 | 111.13 | 117.60 | 124.40 |
| $c_2n_3s_3$ | 84.46 | 106.66 | 107.20 | 98.26 | 118.63 | 115.60 |
| SEm (±) | 5.540 | 11.899 | 5.828 | 9.991 | 10.564 | 12.671 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

were found to be on a par. The effect of plant spacing was observed to be significant in the second, third and fourth harvest where the increased plant spacing decreased the plant height. Maximum plant height was registered by the treatment involving narrow spacing $S_1$ (60 cm x 20 cm) in second and fourth harvests and was on a par with $S_2$. In the third harvest, $S_2$ (104.32 cm) recorded maximum plant height and was found to be on a par with $S_1$ (100.52 cm).

The interaction between cutting pattern and nutrients levels, cutting pattern and spacing and nutrient level and spacing was observed non significant in all the harvests during the first year. The combined interaction was also found to be non significant.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) regarding plant height of palisade grass under partial shade condition in the second year are presented in Table 39a, 39b and 39c.

The significant effect of cutting pattern on plant height was noticed on second, fifth and sixth harvests. Plant height was significantly increased by increasing the cutting height ($C_2$) to 10 cm in the second (106.80 cm), fifth (118.94 cm) and sixth (101.44 cm) harvest. In the second, fifth and sixth harvest $C_2$ was found superior to $C_1$. Significant effect of nutrients on plant height was observed in all the harvests except first, second and sixth harvests. The plant height was significantly influenced by increasing the nutrient levels up to 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ in all the harvests except first, second and sixth harvests. In the third, fourth and seventh harvests $N_3$ were found superior to $N_2$ and $N_1$. In the fifth harvest $N_3$ and $N_2$ was found to be on a par. The significant effect of plant spacing on plant height was observed only on third, fourth, fifth and sixth harvests. In the third and fifth harvests $S_1$ recorded maximum plant height and was on a par with $S_2$. In the sixth harvest $S_1$ was found significantly superior to $S_2$ and $S_3$. In the fourth harvest highest plant height was observed with $S_3$ and was found significantly superior to $S_2$ and $S_1$.

Table 39a. Effect of cutting pattern, nutrient levels and spacing on plant height under partial shade condition during second year, cm

| Treatments | Plant height | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 98.48 | 89.11 | 92.57 | 98.40 | 105.35 | 92.85 | 84.56 |
| $C_2$ | 102.65 | 106.80 | 100.11 | 103.99 | 118.94 | 101.44 | 85.38 |
| SEm (±) | 2.184 | 3.430 | 3.330 | 3.141 | 3.570 | 1.498 | 1.810 |
| CD (0.05) | NS | 9.877 | NS | NS | 10.280 | 4.313 | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 100.35 | 91.43 | 88.51 | 94.58 | 100.38 | 95.38 | 79.81 |
| $N_2$ | 99.93 | 96.53 | 93.62 | 98.22 | 117.26 | 97.46 | 84.18 |
| $N_3$ | 101.42 | 105.91 | 106.89 | 110.79 | 118.80 | 98.60 | 90.93 |
| SEm (±) | 2.675 | 4.201 | 4.079 | 3.847 | 4.373 | 1.834 | 2.217 |
| CD (0.05) | NS | NS | 11.744 | 11.077 | 12.591 | NS | 6.383 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 104.79 | 103.21 | 104.90 | 94.58 | 122.17 | 103.31 | 86.58 |
| $S_2$ | 99.12 | 100.77 | 95.50 | 98.22 | 112.68 | 96.96 | 85.66 |
| $S_3$ | 97.80 | 89.88 | 88.62 | 110.79 | 101.58 | 91.17 | 82.68 |
| SEm (±) | 2.675 | 4.201 | 4.079 | 3.847 | 4.373 | 1.834 | 2.217 |
| CD (0.05) | NS | NS | 11.744 | 11.077 | 12.591 | 5.282 | NS |

NS- Not significant

Table 39b. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under partial shade condition during second year, cm

| Treatments | Plant height | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 100.55 | 82.58 | 85.61 | 91.64 | 95.43 | 93.48 | 79.30 |
| $c_1n_2$ | 97.76 | 88.68 | 91.24 | 96.71 | 106.06 | 94.86 | 84.10 |
| $c_1n_3$ | 97.14 | 96.06 | 100.86 | 106.86 | 114.57 | 90.21 | 90.30 |
| $c_2n_1$ | 100.15 | 100.28 | 91.41 | 97.53 | 105.33 | 97.27 | 80.32 |
| $c_2n_2$ | 102.11 | 104.37 | 96.00 | 99.73 | 128.46 | 100.06 | 84.27 |
| $c_2n_3$ | 105.70 | 115.75 | 112.92 | 114.72 | 123.02 | 107.00 | 91.56 |
| SEm (±) | 3.783 | 5.941 | 5.768 | 5.441 | 6.184 | 2.594 | 3.135 |
| CD (0.05) | NS | NS | NS | NS | NS | 7.470 | NS |
| $c_1s_1$ | 99.23 | 93.54 | 99.63 | 91.64 | 110.82 | 96.16 | 85.90 |
| $c_1s_2$ | 97.52 | 91.64 | 92.16 | 96.71 | 107.76 | 92.95 | 85.03 |
| $c_1s_3$ | 98.71 | 82.15 | 85.92 | 106.86 | 97.48 | 89.44 | 82.76 |
| $c_2s_1$ | 110.35 | 112.88 | 110.17 | 97.53 | 133.53 | 110.45 | 87.26 |
| $c_2s_2$ | 100.72 | 109.91 | 98.83 | 99.73 | 117.61 | 100.97 | 86.30 |
| $c_2s_3$ | 96.88 | 97.62 | 91.32 | 114.72 | 105.67 | 92.91 | 82.60 |
| SEm (±) | 3.783 | 5.941 | 5.768 | 5.441 | 6.184 | 2.594 | 3.135 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 100.70 | 94.90 | 96.61 | 99.83 | 106.75 | 98.33 | 82.61 |
| $n_1s_2$ | 102.15 | 95.13 | 87.06 | 95.63 | 102.70 | 94.45 | 81.46 |
| $n_1s_3$ | 98.21 | 84.28 | 81.85 | 88.30 | 91.70 | 93.36 | 75.35 |
| $n_2s_1$ | 106.15 | 104.55 | 97.13 | 104.33 | 121.86 | 103.61 | 85.00 |
| $n_2s_2$ | 96.41 | 99.33 | 93.80 | 98.43 | 116.45 | 100.45 | 84.30 |
| $n_2s_3$ | 97.25 | 85.71 | 89.93 | 91.90 | 113.48 | 88.33 | 83.26 |
| $n_3s_1$ | 107.53 | 110.20 | 120.96 | 112.75 | 137.91 | 107.98 | 92.13 |
| $n_3s_2$ | 98.80 | 107.86 | 105.63 | 113.41 | 118.91 | 96.00 | 91.23 |
| $n_3s_3$ | 97.93 | 99.66 | 94.08 | 106.21 | 99.56 | 91.83 | 89.43 |
| SEm (±) | 4.634 | 7.277 | 7.065 | 6.664 | 7.574 | 3.177 | 3.839 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 39c. Interaction effect of cutting pattern, nutrient levels and spacing on plant height under partial shade condition during second year, cm

| Treatments | Plant height | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 85.96 | 98.23 | 97.10 | 95.83 | 99.16 | 96.23 | 82.83 |
| $c_1n_1s_2$ | 85.43 | 101.23 | 82.33 | 90.46 | 96.03 | 90.90 | 81.53 |
| $c_1n_1s_3$ | 76.36 | 102.20 | 77.40 | 88.63 | 91.10 | 93.33 | 73.53 |
| $c_1n_2s_1$ | 96.73 | 101.23 | 95.23 | 103.23 | 107.90 | 97.96 | 84.93 |
| $c_1n_2s_2$ | 93.56 | 93.96 | 91.03 | 97.33 | 112.83 | 99.13 | 84.00 |
| $c_1n_2s_3$ | 75.76 | 98.10 | 87.46 | 89.56 | 97.46 | 87.50 | 83.36 |
| $c_1n_3s_1$ | 97.93 | 98.23 | 106.56 | 109.80 | 125.40 | 94.30 | 89.93 |
| $c_1n_3s_2$ | 95.93 | 97.36 | 103.13 | 111.40 | 114.43 | 88.83 | 89.56 |
| $c_1n_3s_3$ | 94.33 | 95.83 | 92.90 | 99.40 | 103.90 | 87.50 | 91.40 |
| $c_2n_1s_1$ | 103.83 | 103.16 | 96.13 | 103.83 | 114.33 | 100.43 | 82.40 |
| $c_2n_1s_2$ | 104.83 | 103.06 | 91.80 | 100.80 | 109.36 | 98.00 | 81.40 |
| $c_2n_1s_3$ | 92.20 | 94.23 | 86.30 | 87.96 | 92.30 | 93.40 | 77.16 |
| $c_2n_2s_1$ | 112.36 | 111.06 | 99.03 | 105.43 | 135.83 | 109.26 | 85.06 |
| $c_2n_2s_2$ | 105.10 | 98.86 | 96.56 | 99.53 | 120.06 | 101.76 | 84.60 |
| $c_2n_2s_3$ | 95.66 | 96.40 | 92.40 | 94.23 | 129.50 | 89.16 | 83.16 |
| $c_2n_3s_1$ | 122.46 | 116.83 | 135.36 | 115.70 | 150.43 | 121.66 | 94.33 |
| $c_2n_3s_2$ | 119.80 | 100.23 | 108.13 | 115.43 | 123.40 | 103.16 | 92.90 |
| $c_2n_3s_3$ | 105.00 | 100.03 | 95.26 | 113.03 | 95.23 | 96.16 | 87.46 |
| SEm (±) | 6.554 | 10.291 | 9.991 | 9.424 | 10.712 | 4.493 | 5.430 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

The interaction between cutting pattern and nutrients levels, cutting pattern and spacing and nutrient level and spacing was observed non significant in all the harvests during the second year. The combined interaction was also found to be non significant.

#### *4.2.1.2 Tillers Plant$^{-1}$*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to tiller number plant$^{-1}$ of palisade grass under partial shade condition in the first year are presented in Table 40a, 40b and 40c.

Significant effect of cutting pattern on number of tillers plant$^{-1}$ was noticed on the third, fourth and fifth harvest. The tiller number plant$^{-1}$ was increased by decreasing the cutting height from 10 cm to ground level in the third (32.30), fourth (36.42) and fifth harvest (34.36). The tiller number plant$^{-1}$ was significantly increased by increasing the nutrient levels at all the harvests. Among the fertilizer treatments, the highest nutrient level of $N_3$ recorded the highest number of tillers plant$^{-1}$ in first (14.85) and fourth (40.64) harvests. In the third and fifth harvests maximum number of tillers plant$^{-1}$ with $N_3$ and was on a par with $N_2$. In the second harvest maximum number of tillers plant$^{-1}$ was noticed with $N_2$ and was on a par with $N_3$. The effect of plant spacing on number of tillers plant$^{-1}$ was noticed on third, fourth and fifth harvests. In the third and fifth harvests maximum number of tillers plant$^{-1}$ was noticed on $S_3$ and was on a par with $S_2$ whereas in the fourth harvest highest number of tillers plant$^{-1}$ was noticed on $S_3$ and was significantly superior to $S_2$ and $S_1$.

None of the interactions were significant.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to tiller number plant$^{-1}$ of palisade grass under partial shade condition in the second year are presented in Table 41a, 41b and 41c.

In third, fourth and sixth harvests cutting pattern produced a significant impact on number of tillers plant$^{-1}$ which was increased by decreasing the cutting

Table 40a. Effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under partial shade condition during first year

| Treatments | Tiller plant$^{-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 13.68 | 28.17 | 32.30 | 36.42 | 34.36 | 33.37 |
| $C_2$ | 13.58 | 28.28 | 28.60 | 32.44 | 30.25 | 33.36 |
| SEm (±) | 0.336 | 0.289 | 0.911 | 1.172 | 1.127 | 1.665 |
| CD (0.05) | NS | NS | 2.624 | 3.375 | 3.245 | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 12.61 | 27.51 | 27.20 | 30.97 | 27.63 | 29.11 |
| $N_2$ | 13.44 | 28.67 | 31.51 | 31.68 | 33.21 | 33.64 |
| $N_3$ | 14.85 | 28.48 | 32.65 | 40.64 | 36.07 | 37.35 |
| SEm (±) | 0.412 | 0.354 | 1.116 | 1.435 | 1.380 | 2.040 |
| CD (0.05) | 1.187 | 1.021 | 3.214 | 4.134 | 3.975 | 5.874 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 13.16 | 27.80 | 28.85 | 32.47 | 30.03 | 31.22 |
| $S_2$ | 13.52 | 28.35 | 29.82 | 33.25 | 32.66 | 33.32 |
| $S_3$ | 14.22 | 28.52 | 32.69 | 37.57 | 34.22 | 35.56 |
| SEm (±) | 0.412 | 0.354 | 1.116 | 1.435 | 1.380 | 2.040 |
| CD (0.05) | NS | NS | 3.214 | 4.134 | 3.975 | NS |

NS- Not significant

Table 40b. Interaction effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under partial shade condition during first year

| Treatments | Tiller plant $^{-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1$ | 12.48 | 27.51 | 29.20 | 32.22 | 30.30 | 27.66 |
| $c_1n_2$ | 13.46 | 28.35 | 33.43 | 32.60 | 34.70 | 33.68 |
| $c_1n_3$ | 15.11 | 28.64 | 34.28 | 44.44 | 38.10 | 38.77 |
| $c_2n_1$ | 12.73 | 27.51 | 25.20 | 29.73 | 24.97 | 30.55 |
| $c_2n_2$ | 13.42 | 29.00 | 29.58 | 30.76 | 31.73 | 33.60 |
| $c_2n_3$ | 14.60 | 28.33 | 31.02 | 36.84 | 34.04 | 35.93 |
| SEm (±) | 0.583 | 0.501 | 1.573 | 2.030 | 1.952 | 2.885 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 13.20 | 27.86 | 29.28 | 33.66 | 32.21 | 30.44 |
| $c_1s_2$ | 13.62 | 28.31 | 31.42 | 34.17 | 34.30 | 34.04 |
| $c_1s_3$ | 14.24 | 28.33 | 36.21 | 41.42 | 36.58 | 35.64 |
| $c_2s_1$ | 13.13 | 27.73 | 28.41 | 31.28 | 27.86 | 32.00 |
| $c_2s_2$ | 13.42 | 28.40 | 28.22 | 32.33 | 31.02 | 32.60 |
| $c_2s_3$ | 14.20 | 28.71 | 29.17 | 33.72 | 31.86 | 35.48 |
| SEm (±) | 0.583 | 0.501 | 1.573 | 2.030 | 1.952 | 2.885 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 11.90 | 26.90 | 24.55 | 27.93 | 23.28 | 26.33 |
| $n_1s_2$ | 12.60 | 27.76 | 27.10 | 29.96 | 29.76 | 29.16 |
| $n_1s_3$ | 13.33 | 27.86 | 29.95 | 35.03 | 29.86 | 31.83 |
| $n_2s_1$ | 13.06 | 28.20 | 31.20 | 31.73 | 32.48 | 30.80 |
| $n_2s_2$ | 13.36 | 28.86 | 30.31 | 29.06 | 32.91 | 33.30 |
| $n_2s_3$ | 13.90 | 28.96 | 33.01 | 34.25 | 34.25 | 36.83 |
| $n_3s_1$ | 14.53 | 28.30 | 30.80 | 37.76 | 34.35 | 36.53 |
| $n_3s_2$ | 14.60 | 28.43 | 32.05 | 40.73 | 35.30 | 37.50 |
| $n_3s_3$ | 15.43 | 28.73 | 35.11 | 43.43 | 38.56 | 38.03 |
| SEm (±) | 0.714 | 0.614 | 1.926 | 2.486 | 2.391 | 3.533 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 40c. Interaction effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under partial shade condition during first year

| Treatments | Tiller plant $^{-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 11.46 | 27.06 | 24.55 | 28.33 | 25.63 | 24.46 |
| $c_1n_1s_2$ | 12.46 | 27.80 | 27.10 | 30.86 | 32.46 | 28.53 |
| $c_1n_1s_3$ | 13.53 | 27.66 | 29.95 | 37.46 | 32.80 | 30.00 |
| $c_1n_2s_1$ | 13.06 | 28.06 | 31.20 | 32.66 | 34.36 | 29.20 |
| $c_1n_2s_2$ | 13.33 | 28.40 | 30.31 | 28.06 | 34.13 | 34.00 |
| $c_1n_2s_3$ | 14.00 | 28.60 | 33.01 | 37.06 | 35.60 | 37.86 |
| $c_1n_3s_1$ | 15.06 | 28.46 | 30.80 | 40.00 | 36.63 | 37.66 |
| $c_1n_3s_2$ | 15.06 | 28.73 | 32.05 | 43.60 | 36.30 | 39.60 |
| $c_1n_3s_3$ | 15.20 | 28.73 | 35.11 | 49.73 | 41.36 | 39.06 |
| $c_2n_1s_1$ | 12.33 | 26.73 | 24.55 | 27.53 | 20.93 | 28.20 |
| $c_2n_1s_2$ | 12.73 | 27.73 | 27.10 | 29.06 | 27.06 | 29.80 |
| $c_2n_1s_3$ | 13.13 | 28.06 | 29.95 | 32.60 | 26.93 | 33.66 |
| $c_2n_2s_1$ | 13.06 | 28.33 | 31.20 | 30.80 | 30.60 | 32.40 |
| $c_2n_2s_2$ | 13.40 | 29.33 | 30.31 | 30.06 | 31.70 | 32.60 |
| $c_2n_2s_3$ | 13.80 | 29.33 | 33.01 | 31.43 | 32.90 | 35.80 |
| $c_2n_3s_1$ | 14.00 | 28.13 | 30.80 | 35.53 | 32.06 | 35.40 |
| $c_2n_3s_2$ | 14.13 | 28.13 | 32.05 | 37.86 | 34.30 | 35.40 |
| $c_2n_3s_3$ | 15.66 | 28.73 | 35.11 | 37.13 | 35.76 | 37.00 |
| SEm (±) | 1.010 | 0.868 | 2.734 | 3.517 | 3.381 | 4.997 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 41a. Effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under partial shade condition during second year

| Treatments | Tiller plant$^{-1}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 29.30 | 28.70 | 32.63 | 30.76 | 29.68 | 29.24 | 28.94 |
| $C_2$ | 29.41 | 27.02 | 29.52 | 27.14 | 29.57 | 25.32 | 27.92 |
| SEm (±) | 0.289 | 0.881 | 1.032 | 1.267 | 1.420 | 0.842 | 1.056 |
| CD (0.05) | NS | NS | 2.972 | 3.650 | NS | 2.426 | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 28.64 | 25.63 | 27.64 | 24.93 | 26.54 | 23.45 | 25.08 |
| $N_2$ | 29.81 | 27.61 | 28.68 | 28.76 | 29.80 | 29.30 | 29.43 |
| $N_3$ | 29.62 | 30.35 | 36.90 | 33.17 | 32.54 | 29.10 | 30.77 |
| SEm (±) | 0.354 | 1.079 | 1.264 | 1.552 | 1.740 | 1.032 | 1.293 |
| CD (0.05) | 1.021 | 3.108 | 3.640 | 4.470 | 5.01 | 2.972 | 3.724 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 28.93 | 26.23 | 29.58 | 26.67 | 28.10 | 25.53 | 26.38 |
| $S_2$ | 29.48 | 27.87 | 30.25 | 29.87 | 29.02 | 26.37 | 28.57 |
| $S_3$ | 29.65 | 29.48 | 33.38 | 30.31 | 31.76 | 29.93 | 30.33 |
| SEm (±) | 0.354 | 1.079 | 1.264 | 1.552 | 1.740 | 1.032 | 1.293 |
| CD (0.05) | NS | NS | 3.640 | NS | NS | 2.972 | 3.724 |

NS- Not significant

Table 41b. Interaction effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under partial shade condition during second year

| Treatments | Tiller plant$^{-1}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1$ | 28.64 | 26.71 | 28.33 | 28.44 | 25.53 | 24.38 | 25.17 |
| $c_1n_2$ | 29.48 | 27.92 | 29.60 | 29.33 | 29.66 | 32.13 | 29.55 |
| $c_1n_3$ | 29.77 | 31.48 | 39.95 | 34.51 | 33.86 | 31.21 | 32.08 |
| $c_2n_1$ | 28.64 | 24.55 | 26.95 | 21.42 | 27.55 | 22.51 | 25.00 |
| $c_2n_2$ | 30.13 | 27.30 | 27.76 | 28.18 | 29.93 | 26.46 | 29.32 |
| $c_2n_3$ | 29.46 | 29.21 | 33.84 | 31.83 | 31.22 | 26.98 | 29.45 |
| SEm (±) | 0.501 | 1.526 | 1.787 | 1.635 | 2.460 | 1.459 | 1.829 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 29.00 | 27.23 | 30.66 | 28.16 | 27.53 | 26.66 | 25.38 |
| $c_1s_2$ | 29.44 | 28.48 | 31.17 | 31.06 | 28.77 | 27.98 | 28.48 |
| $c_1s_3$ | 29.46 | 30.40 | 36.04 | 33.05 | 32.75 | 33.07 | 32.94 |
| $c_2s_1$ | 28.86 | 25.24 | 28.51 | 25.18 | 28.66 | 24.40 | 27.38 |
| $c_2s_2$ | 29.53 | 27.25 | 29.33 | 28.67 | 29.26 | 24.76 | 28.66 |
| $c_2s_3$ | 29.84 | 28.56 | 30.72 | 27.57 | 30.77 | 26.80 | 27.72 |
| SEm (±) | 0.501 | 1.526 | 1.787 | 1.635 | 2.460 | 1.459 | 1.829 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 28.03 | 23.88 | 25.26 | 21.00 | 24.30 | 20.13 | 21.20 |
| $n_1s_2$ | 28.90 | 26.10 | 26.96 | 26.66 | 26.00 | 24.20 | 26.03 |
| $n_1s_3$ | 29.00 | 26.91 | 30.70 | 27.13 | 29.33 | 26.01 | 28.03 |
| $n_2s_1$ | 29.33 | 26.56 | 28.73 | 26.91 | 27.13 | 30.10 | 27.43 |
| $n_2s_2$ | 30.00 | 26.96 | 26.06 | 28.78 | 29.10 | 27.78 | 29.93 |
| $n_2s_3$ | 30.10 | 29.30 | 31.25 | 30.58 | 33.16 | 30.01 | 30.95 |
| $n_3s_1$ | 29.43 | 28.26 | 34.76 | 32.11 | 32.86 | 26.36 | 30.53 |
| $n_3s_2$ | 29.56 | 30.55 | 37.73 | 34.16 | 31.96 | 27.15 | 29.76 |
| $n_3s_3$ | 29.86 | 32.23 | 38.20 | 33.23 | 32.80 | 33.78 | 32.01 |
| SEm (±) | 0.614 | 1.870 | 2.189 | 2.003 | 3.013 | 1.787 | 2.240 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 41c. Interaction effect of cutting pattern, nutrient levels and spacing on tillers plant$^{-1}$ under partial shade condition during second year

| Treatments | Tiller plant$^{-1}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 28.20 | 24.76 | 25.33 | 23.96 | 23.06 | 19.90 | 20.00 |
| $c_1n_1s_2$ | 28.93 | 26.26 | 27.86 | 30.33 | 24.86 | 23.73 | 25.86 |
| $c_1n_1s_3$ | 28.80 | 29.10 | 31.80 | 31.03 | 28.66 | 29.53 | 29.66 |
| $c_1n_2s_1$ | 29.20 | 28.20 | 29.66 | 27.36 | 25.53 | 32.16 | 24.83 |
| $c_1n_2s_2$ | 29.53 | 27.20 | 25.06 | 27.13 | 29.26 | 32.66 | 30.06 |
| $c_1n_2s_3$ | 29.73 | 28.36 | 34.06 | 33.50 | 34.20 | 31.56 | 33.76 |
| $c_1n_3s_1$ | 29.60 | 28.73 | 37.00 | 33.16 | 34.00 | 27.93 | 31.33 |
| $c_1n_3s_2$ | 29.86 | 32.00 | 40.60 | 35.73 | 32.20 | 27.56 | 29.53 |
| $c_1n_3s_3$ | 29.86 | 33.73 | 42.26 | 34.63 | 35.40 | 38.13 | 35.40 |
| $c_2n_1s_1$ | 27.86 | 23.00 | 25.20 | 18.03 | 25.53 | 20.36 | 22.40 |
| $c_2n_1s_2$ | 28.86 | 25.93 | 26.06 | 23.00 | 27.13 | 24.66 | 26.20 |
| $c_2n_1s_3$ | 29.20 | 24.73 | 29.60 | 23.23 | 30.00 | 22.50 | 26.40 |
| $c_2n_2s_1$ | 29.46 | 24.93 | 27.80 | 26.46 | 28.73 | 28.03 | 30.03 |
| $c_2n_2s_2$ | 30.46 | 26.73 | 27.06 | 30.43 | 28.93 | 22.90 | 29.80 |
| $c_2n_2s_3$ | 30.46 | 30.23 | 28.43 | 27.66 | 32.13 | 28.46 | 28.13 |
| $c_2n_3s_1$ | 29.26 | 27.80 | 32.53 | 31.06 | 31.73 | 24.80 | 29.73 |
| $c_2n_3s_2$ | 29.26 | 29.10 | 34.86 | 32.60 | 31.73 | 26.73 | 30.00 |
| $c_2n_3s_3$ | 29.86 | 30.73 | 34.13 | 31.83 | 30.20 | 29.43 | 28.63 |
| SEm (±) | 0.868 | 2.644 | 3.096 | 2.833 | 4.262 | 2.528 | 3.168 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

height from 10 cm to ground level. The tiller number plant$^{-1}$ was significantly influenced by the nutrient levels in all the harvests. In the second, fourth, fifth and seventh harvests maximum number of tillers plant$^{-1}$ was noticed by $N_3$ and it were on a par with $N_2$. In the first and sixth harvests maximum number of tillers plant$^{-1}$ was noticed by $N_2$ and were on a par with $N_3$. In third harvest highest number of tillers plant$^{-1}$ was produced by $N_3$ and was found superior to $N_2$ and $N_1$.

The effect of plant spacing on number of tillers plant$^{-1}$ recorded was noticed in third, sixth and seventh harvests. Among the different spacing treatments, the highest tiller number was produced when wider spacing was adopted. In third and seventh harvests maximum number of tillers plant$^{-1}$ was noticed by $S_3$ and was on a par with $S_2$ whereas in the sixth harvest highest number of tillers plant$^{-1}$ was noticed on $S_3$ and was significantly superior to $S_2$ and $S_1$.

The interactions effects were non significant.

***4.2.1.3 Leaf: Stem Ratio***

The effect of cutting pattern, nutrient levels and plant spacing on leaf: stem ratio of palisade grass under partial shade condition in the first year are presented in Table 42a, 42b and 42c.

No significant effect of cutting pattern on leaf: stem ratio was observed during first year. The leaf: stem ratio was significantly increased by increasing the nutrient levels in second, third and fifth harvests. In the second harvest, highest leaf: stem ratio (1.04) was recorded by $N_3$ and was found superior to $N_2$ and $N_1$. In the third (1.31) and fifth (1.41) harvest maximum leaf: stem ratio was recorded by $N_3$ and was found to be on a par with $N_2$. In the sixth harvest maximum leaf: stem ratio (1.33) was recorded by $N_2$ and was found to be on a par with $N_3$.

The significant effect of plant spacing on leaf: stem ratio was observed on all harvests except first. In the second harvest maximum leaf: stem ratio was recorded by $S_1$ (1.05) and was found to be on a par with $S_2$. In third (1.42),

Table 42a. Effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under partial shade condition during first year

| Treatments | Leaf: stem ratio | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 0.80 | 1.02 | 1.25 | 1.15 | 1.33 | 1.27 |
| $C_2$ | 0.80 | 1.02 | 1.27 | 1.14 | 1.37 | 1.32 |
| SEm (±) | 0.001 | 0.007 | 0.018 | 0.020 | 0.028 | 0.024 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 0.80 | 1.00 | 1.22 | 1.14 | 1.27 | 1.22 |
| $N_2$ | 0.80 | 1.01 | 1.26 | 1.12 | 1.39 | 1.33 |
| $N_3$ | 0.81 | 1.04 | 1.31 | 1.18 | 1.41 | 1.32 |
| SEm (±) | 0.005 | 0.009 | 0.021 | 0.025 | 0.034 | 0.028 |
| CD (0.05) | NS | 0.027 | 0.061 | NS | 0.100 | 0.081 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 0.81 | 1.05 | 1.42 | 1.27 | 1.53 | 1.43 |
| $S_2$ | 0.80 | 1.02 | 1.23 | 1.10 | 1.35 | 1.27 |
| $S_3$ | 0.80 | 0.99 | 1.14 | 1.07 | 1.17 | 1.17 |
| SEm (±) | 0.005 | 0.009 | 0.021 | 0.025 | 0.034 | 0.028 |
| CD (0.05) | NS | 0.027 | 0.061 | 0.074 | 0.100 | 0.081 |

NS- Not significant

Table 42b. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under partial shade condition during first year

| Treatments | Leaf: stem ratio | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 0.80 | 1.00 | 1.21 | 1.17 | 1.30 | 1.23 |
| $c_1n_2$ | 0.80 | 1.01 | 1.26 | 1.13 | 1.36 | 1.32 |
| $c_1n_3$ | 0.81 | 1.05 | 1.29 | 1.16 | 1.34 | 1.25 |
| $c_2n_1$ | 0.80 | 1.00 | 1.23 | 1.11 | 1.23 | 1.21 |
| $c_2n_2$ | 0.80 | 1.01 | 1.26 | 1.11 | 1.42 | 1.35 |
| $c_2n_3$ | 0.81 | 1.03 | 1.33 | 1.20 | 1.47 | 1.39 |
| SEm (±) | 0.003 | 0.014 | 0.028 | 0.040 | 0.050 | 0.041 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 0.80 | 1.07 | 1.38 | 1.29 | 1.51 | 1.43 |
| $c_1s_2$ | 0.80 | 1.01 | 1.25 | 1.11 | 1.31 | 1.21 |
| $c_1s_3$ | 0.80 | 0.98 | 1.12 | 1.06 | 1.18 | 1.16 |
| $c_2s_1$ | 0.81 | 1.03 | 1.45 | 1.26 | 1.56 | 1.43 |
| $c_2s_2$ | 0.81 | 1.02 | 1.21 | 1.09 | 1.40 | 1.32 |
| $c_2s_3$ | 0.79 | 1.00 | 1.16 | 1.07 | 1.16 | 1.19 |
| SEm (±) | 0.003 | 0.014 | 0.028 | 0.040 | 0.050 | 0.041 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 0.80 | 1.02 | 1.32 | 1.14 | 1.44 | 1.34 |
| $n_1s_2$ | 0.80 | 1.01 | 1.23 | 1.13 | 1.28 | 1.23 |
| $n_1s_3$ | 0.80 | 0.97 | 1.10 | 1.16 | 1.08 | 1.09 |
| $n_2s_1$ | 0.81 | 1.03 | 1.40 | 1.28 | 1.53 | 1.45 |
| $n_2s_2$ | 0.80 | 1.02 | 1.21 | 1.06 | 1.38 | 1.26 |
| $n_2s_3$ | 0.80 | 0.98 | 1.16 | 1.01 | 1.25 | 1.29 |
| $n_3s_1$ | 0.82 | 1.10 | 1.54 | 1.40 | 1.63 | 1.50 |
| $n_3s_2$ | 0.81 | 1.02 | 1.24 | 1.11 | 1.40 | 1.31 |
| $n_3s_3$ | 0.80 | 1.01 | 1.15 | 1.03 | 1.19 | 1.14 |
| SEm (±) | 0.005 | 0.018 | 0.035 | 0.047 | 0.062 | 0.054 |
| CD (0.05) | NS | NS | NS | 0.138 | NS | NS |

NS- Not significant

Table 42c. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under partial shade condition during first year

| Treatments | Leaf: stem ratio | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1s_1$ | 0.79 | 1.03 | 1.30 | 1.18 | 1.45 | 1.38 |
| $c_1n_1s_2$ | 0.80 | 1.01 | 1.23 | 1.15 | 1.30 | 1.20 |
| $c_1n_1s_3$ | 0.80 | 0.96 | 1.10 | 1.19 | 1.17 | 1.11 |
| $c_1n_2s_1$ | 0.80 | 1.04 | 1.34 | 1.26 | 1.52 | 1.45 |
| $c_1n_2s_2$ | 0.81 | 1.02 | 1.26 | 1.13 | 1.30 | 1.21 |
| $c_1n_2s_3$ | 0.81 | 0.97 | 1.17 | 1.00 | 1.26 | 1.30 |
| $c_1n_3s_1$ | 0.82 | 1.14 | 1.51 | 1.43 | 1.56 | 1.46 |
| $c_1n_3s_2$ | 0.81 | 1.00 | 1.26 | 1.06 | 1.33 | 1.23 |
| $c_1n_3s_3$ | 0.79 | 1.00 | 1.10 | 1.00 | 1.13 | 1.06 |
| $c_2n_1s_1$ | 0.81 | 1.02 | 1.33 | 1.09 | 1.44 | 1.30 |
| $c_2n_1s_2$ | 0.81 | 1.02 | 1.24 | 1.11 | 1.26 | 1.26 |
| $c_2n_1s_3$ | 0.79 | 0.97 | 1.11 | 1.13 | 1.00 | 1.07 |
| $c_2n_2s_1$ | 0.82 | 1.02 | 1.46 | 1.30 | 1.54 | 1.46 |
| $c_2n_2s_2$ | 0.80 | 1.02 | 1.16 | 1.00 | 1.47 | 1.31 |
| $c_2n_2s_3$ | 0.79 | 1.00 | 1.16 | 1.03 | 1.24 | 1.27 |
| $c_2n_3s_1$ | 0.82 | 1.06 | 1.57 | 1.38 | 1.70 | 1.55 |
| $c_2n_3s_2$ | 0.81 | 1.03 | 1.22 | 1.16 | 1.47 | 1.40 |
| $c_2n_3s_3$ | 0.80 | 1.02 | 1.21 | 1.06 | 1.25 | 1.23 |
| SEm (±) | 0.007 | 0.027 | 0.054 | 0.065 | 0.084 | 0.074 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

fourth (1.27), fifth (1.53) and sixth (1.43) harvests highest leaf: stem ratio was recorded by $S_1$ and were found significantly superior to $S_2$ and $S_3$.

Significant interaction was observed between nutrient levels and spacing in the fourth harvest. Highest leaf: stem ratio (1.40) was recorded with application of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ of fertilizer along with a spacing of 60 cm x 20 cm. All other interactions was found non significant.

The effect of cutting pattern, nutrient levels and plant spacing on leaf: stem ratio of palisade grass under partial shade condition in the second year are presented in Table 43a, 43b and 43c.

No significant effect of cutting pattern on leaf: stem ratio was observed during second year. The leaf: stem ratio was significantly increased by the nutrient levels only in third harvest. In third harvest maximum leaf: stem ratio was produced by $N_2$ and it was on a par with $N_3$. Significant effect of plant spacing on leaf: stem ratio was noticed in all the harvests. Among the different spacing treatments, the highest leaf: stem ratio was produced when narrow spacing (60 cm x 20 cm) was adopted in all harvests.

Significant interaction was observed between nutrient levels and spacing in the sixth harvest. Maximum leaf: stem ratio (1.57) was recorded with application of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ of fertilizer along with a spacing of 60 cm x 20 cm and was on a par with application of 200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ of fertilizer along with a spacing of 60 cm x 20 cm. The interaction between cutting pattern and spacing was observed to be significant in seventh harvest. In seventh harvest maximum leaf: stem ratio (1.38) was recorded with $c_1s_2$ and was found to be on a par with $c_2s_1$. All other interactions were found non significant.

#### *4.2.1.4 Regeneration Percentage*

The effect of cutting pattern, nutrient levels and plant spacing with respect to regeneration percentage of palisade grass under partial shade condition in the first year are presented in Table 44a, 44b and 44c.

Table 43a. Effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under partial shade condition during second year

| Treatments | Leaf: stem ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 1.18 | 1.30 | 1.30 | 1.45 | 1.45 | 1.38 | 1.21 |
| $C_2$ | 1.18 | 1.33 | 1.36 | 1.49 | 1.41 | 1.40 | 1.23 |
| SEm (±) | 0.013 | 0.022 | 0.025 | 0.037 | 0.033 | 0.016 | 0.017 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 1.15 | 1.27 | 1.22 | 1.44 | 1.41 | 1.37 | 1.24 |
| $N_2$ | 1.19 | 1.33 | 1.39 | 1.53 | 1.47 | 1.42 | 1.21 |
| $N_3$ | 1.21 | 1.33 | 1.37 | 1.45 | 1.40 | 1.38 | 1.21 |
| SEm (±) | 0.019 | 0.026 | 0.030 | 0.044 | 0.040 | 0.023 | 0.023 |
| CD (0.05) | NS | NS | 0.089 | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 1.30 | 1.44 | 1.46 | 1.62 | 1.60 | 1.50 | 1.37 |
| $S_2$ | 1.17 | 1.31 | 1.33 | 1.48 | 1.45 | 1.39 | 1.17 |
| $S_3$ | 1.08 | 1.19 | 1.19 | 1.32 | 1.23 | 1.28 | 1.12 |
| SEm (±) | 0.019 | 0.026 | 0.030 | 0.044 | 0.040 | 0.023 | 0.023 |
| CD (0.05) | 0.057 | 0.077 | 0.089 | 0.129 | 0.116 | 0.067 | 0.068 |

NS- Not significant

Table 43b. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under partial shade condition during second year

| Treatments | Leaf: stem ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1$ | 1.14 | 1.24 | 1.16 | 1.40 | 1.43 | 1.37 | 1.21 |
| $c_1n_2$ | 1.20 | 1.34 | 1.42 | 1.52 | 1.46 | 1.38 | 1.19 |
| $c_1n_3$ | 1.20 | 1.32 | 1.32 | 1.44 | 1.45 | 1.40 | 1.24 |
| $c_2n_1$ | 1.11 | 1.30 | 1.29 | 1.48 | 1.39 | 1.37 | 1.27 |
| $c_2n_2$ | 1.18 | 1.33 | 1.36 | 1.53 | 1.48 | 1.47 | 1.23 |
| $c_2n_3$ | 1.21 | 1.35 | 1.43 | 1.46 | 1.35 | 1.36 | 1.19 |
| SEm (±) | 0.026 | 0.035 | 0.041 | 0.058 | 0.057 | 0.031 | 0.030 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 1.32 | 1.42 | 1.41 | 1.59 | 1.56 | 1.50 | 1.38 |
| $c_1s_2$ | 1.17 | 1.30 | 1.30 | 1.45 | 1.50 | 1.38 | 1.12 |
| $c_1s_3$ | 1.06 | 1.18 | 1.19 | 1.32 | 1.28 | 1.27 | 1.14 |
| $c_2s_1$ | 1.29 | 1.46 | 1.51 | 1.65 | 1.64 | 1.51 | 1.36 |
| $c_2s_2$ | 1.17 | 1.32 | 1.36 | 1.51 | 1.41 | 1.41 | 1.23 |
| $c_2s_3$ | 1.09 | 1.20 | 1.20 | 1.32 | 1.18 | 1.29 | 1.10 |
| SEm (±) | 0.026 | 0.035 | 0.041 | 0.058 | 0.057 | 0.031 | 0.030 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | 0.088 |
| $n_1s_1$ | 1.22 | 1.35 | 1.33 | 1.52 | 1.51 | 1.41 | 1.34 |
| $n_1s_2$ | 1.16 | 1.35 | 1.26 | 1.45 | 1.43 | 1.39 | 1.23 |
| $n_1s_3$ | 1.07 | 1.12 | 1.07 | 1.34 | 1.30 | 1.31 | 1.15 |
| $n_2s_1$ | 1.31 | 1.44 | 1.48 | 1.63 | 1.63 | 1.52 | 1.38 |
| $n_2s_2$ | 1.19 | 1.27 | 1.38 | 1.60 | 1.56 | 1.43 | 1.15 |
| $n_2s_3$ | 1.07 | 1.29 | 1.32 | 1.35 | 1.23 | 1.32 | 1.11 |
| $n_3s_1$ | 1.38 | 1.52 | 1.58 | 1.71 | 1.66 | 1.57 | 1.39 |
| $n_3s_2$ | 1.15 | 1.32 | 1.35 | 1.40 | 1.37 | 1.36 | 1.15 |
| $n_3s_3$ | 1.09 | 1.17 | 1.18 | 1.25 | 1.17 | 1.20 | 1.10 |
| SEm (±) | 0.032 | 0.047 | 0.054 | 0.073 | 0.067 | 0.039 | 0.036 |
| CD (0.05) | NS | NS | NS | NS | NS | 0.113 | NS |

NS- Not significant

Table 43c. Interaction effect of cutting pattern, nutrient levels and spacing on leaf: stem ratio under partial shade condition during second year

| Treatments | Leaf: stem ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 1.24 | 1.33 | 1.38 | 1.51 | 1.46 | 1.42 | 1.36 |
| $c_1n_1s_2$ | 1.16 | 1.33 | 1.33 | 1.40 | 1.43 | 1.40 | 1.16 |
| $c_1n_1s_3$ | 1.03 | 1.06 | 1.15 | 1.29 | 1.41 | 1.30 | 1.10 |
| $c_1n_2s_1$ | 1.32 | 1.43 | 1.52 | 1.58 | 1.60 | 1.52 | 1.35 |
| $c_1n_2s_2$ | 1.21 | 1.27 | 1.36 | 1.57 | 1.56 | 1.39 | 1.06 |
| $c_1n_2s_3$ | 1.08 | 1.32 | 1.20 | 1.43 | 1.23 | 1.23 | 1.16 |
| $c_1n_3s_1$ | 1.40 | 1.50 | 1.64 | 1.70 | 1.63 | 1.57 | 1.42 |
| $c_1n_3s_2$ | 1.13 | 1.30 | 1.40 | 1.40 | 1.51 | 1.36 | 1.13 |
| $c_1n_3s_3$ | 1.08 | 1.16 | 1.25 | 1.24 | 1.21 | 1.28 | 1.16 |
| $c_2n_1s_1$ | 1.21 | 1.38 | 1.29 | 1.54 | 1.56 | 1.41 | 1.32 |
| $c_2n_1s_2$ | 1.16 | 1.36 | 1.20 | 1.50 | 1.43 | 1.38 | 1.30 |
| $c_2n_1s_3$ | 1.12 | 1.18 | 1.00 | 1.40 | 1.19 | 1.33 | 1.20 |
| $c_2n_2s_1$ | 1.30 | 1.45 | 1.43 | 1.68 | 1.66 | 1.53 | 1.41 |
| $c_2n_2s_2$ | 1.18 | 1.27 | 1.40 | 1.63 | 1.56 | 1.48 | 1.23 |
| $c_2n_2s_3$ | 1.06 | 1.26 | 1.45 | 1.28 | 1.23 | 1.40 | 1.06 |
| $c_2n_3s_1$ | 1.37 | 1.55 | 1.53 | 1.72 | 1.68 | 1.58 | 1.36 |
| $c_2n_3s_2$ | 1.17 | 1.33 | 1.30 | 1.40 | 1.23 | 1.36 | 1.17 |
| $c_2n_3s_3$ | 1.09 | 1.17 | 1.12 | 1.27 | 1.13 | 1.13 | 1.03 |
| SEm (±) | 0.042 | 0.065 | 0.077 | 0.105 | 0.094 | 0.052 | 0.054 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 44a. Effect of cutting pattern, nutrient levels and spacing on regeneration percentage under partial shade condition during first year, per cent

| Treatments | Regeneration percentage | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 98.62 | 98.34 | 98.19 | 98.19 | 98.19 | 98.19 |
| $C_2$ | 99.24 | 99.02 | 98.87 | 98.87 | 98.87 | 98.87 |
| SEm (±) | 0.24 | 0.22 | 0.18 | 0.18 | 0.18 | 0.18 |
| CD (0.05) | NS | 0.630 | 0.509 | 0.509 | 0.509 | 0.509 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 98.68 | 98.30 | 98.12 | 98.12 | 98.12 | 98.12 |
| $N_2$ | 99.07 | 98.98 | 98.76 | 98.76 | 98.76 | 98.76 |
| $N_3$ | 99.04 | 98.76 | 98.71 | 98.71 | 98.71 | 98.71 |
| SEm (±) | 0.29 | 0.27 | 0.22 | 0.22 | 0.22 | 0.22 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | 98.27 | 97.61 | 97.33 | 97.33 | 97.33 | 97.33 |
| $S_2$ | 98.86 | 98.77 | 98.60 | 98.60 | 98.60 | 98.60 |
| $S_3$ | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 |
| SEm (±) | 0.29 | 0.27 | 0.22 | 0.22 | 0.22 | 0.22 |
| CD (0.05) | 0.838 | 0.772 | 0.624 | 0.624 | 0.624 | 0.624 |

NS- Not significant

Table 44b. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under partial shade condition during first year, per cent

| Treatments | Regeneration percentage | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 98.30 | 97.85 | 97.85 | 97.85 | 97.85 | 97.85 |
| $c_1n_2$ | 98.93 | 98.75 | 98.42 | 98.42 | 98.42 | 98.42 |
| $c_1n_3$ | 98.64 | 98.42 | 98.31 | 98.31 | 98.31 | 98.31 |
| $c_2n_1$ | 99.07 | 98.74 | 98.40 | 98.40 | 98.40 | 98.40 |
| $c_2n_2$ | 99.22 | 99.22 | 99.11 | 99.11 | 99.11 | 99.11 |
| $c_2n_3$ | 99.44 | 99.11 | 99.11 | 99.11 | 99.11 | 99.11 |
| SEm (±) | 0.41 | 0.38 | 0.30 | 0.30 | 0.30 | 0.30 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 98.11 | 97.44 | 97.00 | 97.00 | 97.00 | 97.00 |
| $c_1s_2$ | 98.43 | 98.25 | 98.25 | 98.25 | 98.25 | 98.25 |
| $c_1s_3$ | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 |
| $c_2s_1$ | 98.44 | 97.77 | 97.66 | 97.66 | 97.66 | 97.66 |
| $c_2s_2$ | 99.30 | 99.30 | 98.95 | 98.95 | 98.95 | 98.95 |
| $c_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.41 | 0.38 | 0.30 | 0.30 | 0.30 | 0.30 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 98.83 | 97.66 | 97.66 | 97.66 | 97.66 | 97.66 |
| $n_1s_2$ | 97.90 | 97.90 | 97.38 | 97.38 | 97.38 | 97.38 |
| $n_1s_3$ | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 |
| $n_2s_1$ | 97.50 | 97.50 | 96.83 | 96.83 | 96.83 | 96.83 |
| $n_2s_2$ | 99.73 | 99.46 | 99.46 | 99.46 | 99.46 | 99.46 |
| $n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $n_3s_1$ | 98.50 | 97.66 | 97.50 | 97.50 | 97.50 | 97.50 |
| $n_3s_2$ | 98.96 | 98.96 | 98.96 | 98.96 | 98.96 | 98.96 |
| $n_3s_3$ | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 | 99.66 |
| SEm (±) | 0.50 | 0.46 | 0.37 | 0.37 | 0.37 | 0.37 |
| CD (0.05) | NS | NS | 1.080 | 1.080 | 1.080 | 1.080 |

NS- Not significant

Table 44c. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under partial condition during first year, per cent

| Treatments | Regeneration percentage | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 98.33 | 97.00 | 97.00 | 97.00 | 97.00 | 97.00 |
| $c_1n_1s_2$ | 97.90 | 97.90 | 97.90 | 97.90 | 97.90 | 97.90 |
| $c_1n_1s_3$ | 98.66 | 98.66 | 98.66 | 98.66 | 98.66 | 98.66 |
| $c_1n_2s_1$ | 97.33 | 97.33 | 96.33 | 96.33 | 96.33 | 96.33 |
| $c_1n_2s_2$ | 99.46 | 98.93 | 98.93 | 98.93 | 98.93 | 98.93 |
| $c_1n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_1n_3s_1$ | 98.66 | 98.00 | 97.66 | 97.66 | 97.66 | 97.66 |
| $c_1n_3s_2$ | 97.93 | 97.93 | 97.93 | 97.93 | 97.93 | 97.93 |
| $c_1n_3s_3$ | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 |
| $c_2n_1s_1$ | 99.33 | 98.33 | 98.33 | 98.33 | 98.33 | 98.33 |
| $c_2n_1s_2$ | 97.90 | 97.90 | 96.86 | 96.86 | 96.86 | 96.86 |
| $c_2n_1s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_2s_1$ | 97.66 | 97.66 | 97.33 | 97.33 | 97.33 | 97.33 |
| $c_2n_2s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_3s_1$ | 98.33 | 97.33 | 97.33 | 97.33 | 97.33 | 97.33 |
| $c_2n_3s_2$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_3s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| SEm (±) | 0.71 | 0.65 | 0.53 | 0.53 | 0.53 | 0.53 |
| CD (0.05) | NS | NS | 1.528 | 1.528 | 1.528 | 1.528 |

NS- Not significant

There was significant effect of cutting pattern on regeneration percentage on all harvests except initial harvest. The highest regeneration percentage was observed by cutting at 10 cm from the ground level. The regeneration percentage was not significantly influenced by increasing the nutrient levels at all the harvests. Significant effect of plant spacing on regeneration percentage was noticed on all harvests. In all harvests highest regeneration percentage was obtained with a spacing of 60 cm x 40 cm.

Significant interaction was observed between nutrient levels and spacing in the third, fourth, fifth and sixth harvest. In these harvests maximum regeneration percentage was observed in $n_2s_3$.. Significant interaction was observed between cutting height, nutrient levels and spacing in the third, fourth, fifth and sixth harvest. In these harvests maximum regeneration percentage was observed in $c_1n_2s_3$, $c_2n_1s_3$, $c_2n_2s_2$, $c_2n_2s_3$, $c_2n_3s_2$ and $c_2n_3s_3$,

The effect of cutting pattern, nutrient levels and plant spacing with respect to regeneration percentage of palisade grass under partial shade condition in the second year are presented in Table 45a, 45b and 45c.

There was no significant effect of cutting pattern on regeneration percentage on all harvests. The regeneration percentage was not significantly influenced by increasing the nutrient levels at all the harvests. Significant effect of plant spacing on regeneration percentage was noticed on all harvests except first harvest. In all harvests highest regeneration percentage was obtained with a spacing of 60 cm x 40 cm.

The interactions effects were non significant.

### 4.2.2 Yield Parameters

#### *4.2.2.1 Green Fodder Yield*

The treatments (cutting pattern, nutrient levels and plant spacing) had significant influence on green fodder yield of palisade grass under partial shade condition in the first year (Table 46a, 46b and 46c).

Table 45a. Effect of cutting pattern, nutrient levels and spacing on regeneration percentage under partial shade condition during second year, per cent

| Treatments | Regeneration percentage | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 99.12 | 98.84 | 98.61 | 98.42 | 98.31 | 98.02 | 97.78 |
| $C_2$ | 99.09 | 98.53 | 98.42 | 98.21 | 97.75 | 97.75 | 97.70 |
| SEm (±) | 0.256 | 0.256 | 0.545 | 0.209 | 0.256 | 0.238 | 0.309 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 99.60 | 98.67 | 98.42 | 98.33 | 97.81 | 97.81 | 97.66 |
| $N_2$ | 99.09 | 98.98 | 98.81 | 98.31 | 98.31 | 97.88 | 97.68 |
| $N_3$ | 98.62 | 98.40 | 98.31 | 98.31 | 97.97 | 97.97 | 97.86 |
| SEm (±) | 0.313 | 0.313 | 0.302 | 0.256 | 0.314 | 0.347 | 0.379 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 98.77 | 97.77 | 97.44 | 97.05 | 96.88 | 96.94 | 96.77 |
| $S_2$ | 99.21 | 98.95 | 98.77 | 98.68 | 98.25 | 97.82 | 97.65 |
| $S_3$ | 99.33 | 99.33 | 99.33 | 99.22 | 98.96 | 98.90 | 98.79 |
| SEm (±) | 0.313 | 0.313 | 0.302 | 0.256 | 0.314 | 0.347 | 0.379 |
| CD (0.05) | NS | 0.904 | 0.871 | 0.739 | 0.906 | 1.000 | 1.093 |

NS- Not significant

Table 45b. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under partial shade condition during second year, per cent

| Treatments | Regeneration percentage | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 99.21 | 98.36 | 98.18 | 98.18 | 98.18 | 98.18 | 97.90 |
| $c_1n_2$ | 99.15 | 99.15 | 98.82 | 98.26 | 98.26 | 97.40 | 97.17 |
| $c_1n_3$ | 99.00 | 99.00 | 98.82 | 98.82 | 98.48 | 98.48 | 98.26 |
| $c_2n_1$ | 100.00 | 98.98 | 98.65 | 98.47 | 97.43 | 97.43 | 97.43 |
| $c_2n_2$ | 99.03 | 98.81 | 98.81 | 98.36 | 98.36 | 98.36 | 98.20 |
| $c_2n_3$ | 98.25 | 97.81 | 97.81 | 97.81 | 97.46 | 97.46 | 97.46 |
| SEm (±) | 0.444 | 0.444 | 0.427 | 0.362 | 0.444 | 0.491 | 0.536 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 98.77 | 98.11 | 97.77 | 97.44 | 97.11 | 97.11 | 96.77 |
| $c_1s_2$ | 99.47 | 99.30 | 98.94 | 98.94 | 98.94 | 98.07 | 97.90 |
| $c_1s_3$ | 99.11 | 99.11 | 99.11 | 98.88 | 98.88 | 98.88 | 98.66 |
| $c_2s_1$ | 98.77 | 97.44 | 97.11 | 96.66 | 96.66 | 96.77 | 96.77 |
| $c_2s_2$ | 98.95 | 98.61 | 98.61 | 98.43 | 97.56 | 97.56 | 97.40 |
| $c_2s_3$ | 99.55 | 99.55 | 99.55 | 99.55 | 99.03 | 98.92 | 98.92 |
| SEm (±) | 0.444 | 0.444 | 0.427 | 0.362 | 0.444 | 0.491 | 0.536 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 99.66 | 97.66 | 97.16 | 97.16 | 97.16 | 97.16 | 97.00 |
| $n_1s_2$ | 99.48 | 98.70 | 98.43 | 98.16 | 97.38 | 97.38 | 97.11 |
| $n_1s_3$ | 99.66 | 99.66 | 99.66 | 99.66 | 98.88 | 98.88 | 98.88 |
| $n_2s_1$ | 99.00 | 98.66 | 98.16 | 97.00 | 97.00 | 97.00 | 96.66 |
| $n_2s_2$ | 98.95 | 98.95 | 98.95 | 98.95 | 98.95 | 97.65 | 97.40 |
| $n_2s_3$ | 99.33 | 99.33 | 99.33 | 99.00 | 99.00 | 99.00 | 99.00 |
| $n_3s_1$ | 97.66 | 97.00 | 97.00 | 97.00 | 96.50 | 96.66 | 96.66 |
| $n_3s_2$ | 99.21 | 99.21 | 98.95 | 98.95 | 98.43 | 98.43 | 98.43 |
| $n_3s_3$ | 99.00 | 99.00 | 99.00 | 99.00 | 99.00 | 98.83 | 98.50 |
| SEm (±) | 0.544 | 0.544 | 0.524 | 0.444 | 0.544 | 0.601 | 0.657 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 45c. Interaction effect of cutting pattern, nutrient levels and spacing on regeneration percentage under partial shade condition during second year, per cent

| Treatments | Regeneration percentage | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 99.33 | 97.33 | 97.33 | 97.33 | 97.33 | 97.33 | 97.00 |
| $c_1n_1s_2$ | 98.96 | 98.43 | 97.90 | 97.90 | 97.90 | 97.90 | 97.36 |
| $c_1n_1s_3$ | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 99.30 | 99.33 |
| $c_1n_2s_1$ | 99.33 | 99.33 | 98.33 | 97.33 | 97.33 | 97.33 | 96.66 |
| $c_1n_2s_2$ | 99.46 | 99.46 | 99.46 | 99.46 | 99.46 | 96.86 | 96.86 |
| $c_1n_2s_3$ | 98.66 | 98.66 | 98.66 | 98.00 | 98.00 | 98.00 | 98.00 |
| $c_1n_3s_1$ | 97.66 | 97.66 | 97.66 | 97.66 | 96.66 | 96.66 | 96.66 |
| $c_1n_3s_2$ | 100.00 | 100.00 | 99.46 | 99.46 | 99.46 | 99.46 | 99.46 |
| $c_1n_3s_3$ | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 99.33 | 98.66 |
| $c_2n_1s_1$ | 100.00 | 98.00 | 97.00 | 97.00 | 97.00 | 97.00 | 97.00 |
| $c_2n_1s_2$ | 100.00 | 98.96 | 98.96 | 98.43 | 96.86 | 96.86 | 96.86 |
| $c_2n_1s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 98.43 | 98.43 | 98.43 |
| $c_2n_2s_1$ | 98.66 | 98.00 | 98.00 | 96.6 | 96.66 | 96.66 | 96.66 |
| $c_2n_2s_2$ | 98.43 | 98.43 | 98.43 | 98.43 | 98.43 | 98.43 | 97.93 |
| $c_2n_2s_3$ | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| $c_2n_3s_1$ | 97.66 | 96.33 | 96.33 | 96.33 | 96.33 | 96.66 | 96.66 |
| $c_2n_3s_2$ | 98.43 | 98.43 | 98.43 | 98.43 | 97.40 | 97.40 | 97.40 |
| $c_2n_3s_3$ | 98.66 | 98.66 | 98.66 | 98.66 | 98.66 | 98.33 | 98.33 |
| SEm (±) | 0.769 | 0.769 | 0.740 | 0.628 | 0.770 | 0.850 | 0.929 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 46a. Effect of cutting pattern, nutrient levels and spacing on GFY under partial shade condition during first year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Total yield** |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 12.34 | 13.64 | 15.25 | 23.16 | 17.94 | 16.51 | 98.87 |
| $C_2$ | 12.14 | 16.24 | 15.07 | 24.41 | 18.95 | 17.86 | 104.47 |
| SEm (±) | 0.350. | 0.304 | 0.379 | 0.335 | 0.381 | 0.388 | 0.755 |
| CD (0.05) | NS | 0.877 | NS | NS | NS | 1.118 | 5.054 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 11.44 | 14.20 | 12.39 | 19.67 | 15.36 | 15.51 | 88.04 |
| $N_2$ | 12.16 | 15.57 | 14.53 | 22.66 | 17.41 | 17.67 | 100.01 |
| $N_3$ | 13.13 | 15.05 | 18.56 | 29.03 | 22.57 | 18.37 | 116.96 |
| SEm (±) | 0.428 | 0.370 | 0.940 | 1.946 | 1.080 | 0.475 | 2.150 |
| CD (0.05) | 1.235 | 1.066 | 2.708 | 5.603 | 3.110 | 1.370 | 6.190 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 12.59 | 15.62 | 15.99 | 26.79 | 18.97 | 17.96 | 105.92 |
| $S_2$ | 12.26 | 14.32 | 14.29 | 23.50 | 19.00 | 17.29 | 100.67 |
| $S_3$ | 11.88 | 14.88 | 15.20 | 21.08 | 17.38 | 16.31 | 96.42 |
| SEm (±) | 0.428 | 0.370 | 0.940 | 1.946 | 1.080 | 0.475 | 2.150 |
| CD (0.05) | NS | 1.066 | NS | 5.603 | NS | 1.370 | 6.190 |

NS- Not significant

Table 46b. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under partial shade condition during first year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| $c_1n_1$ | 11.42 | 13.04 | 12.02 | 18.20 | 15.04 | 14.42 | 84.15 |
| $c_1n_2$ | 12.16 | 14.72 | 14.98 | 22.71 | 17.28 | 17.11 | 98.98 |
| $c_1n_3$ | 13.45 | 13.16 | 18.74 | 28.58 | 21.50 | 18.02 | 113.47 |
| $c_2n_1$ | 11.46 | 15.35 | 12.76 | 21.15 | 15.68 | 16.61 | 91.93 |
| $c_2n_2$ | 12.16 | 16.43 | 14.07 | 22.61 | 17.53 | 18.24 | 101.03 |
| $c_2n_3$ | 12.81 | 16.94 | 18.38 | 29.47 | 23.65 | 18.73 | 120.45 |
| SEm (±) | 0.606 | 0.523 | 1.328 | 2.752 | 1.527 | 0.672 | 3.040 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 12.93 | 15.12 | 16.27 | 28.01 | 17.14 | 17.14 | 106.63 |
| $c_1s_2$ | 12.44 | 12.31 | 14.31 | 22.80 | 20.36 | 16.83 | 99.06 |
| $c_1s_3$ | 11.66 | 13.50 | 15.16 | 18.69 | 16.32 | 15.57 | 90.92 |
| $c_2s_1$ | 12.25 | 16.12 | 15.71 | 25.56 | 20.80 | 18.78 | 109.21 |
| $c_2s_2$ | 12.07 | 16.33 | 14.27 | 24.20 | 17.63 | 17.75 | 102.27 |
| $c_2s_3$ | 12.11 | 16.27 | 15.24 | 23.47 | 18.44 | 17.04 | 101.93 |
| SEm (±) | 0.606 | 0.523 | 1.328 | 2.752 | 1.527 | 0.672 | 3.040 |
| CD (0.05) | NS | 1.508 | NS | NS | NS | NS | NS |
| $n_1s_1$ | 12.06 | 15.40 | 11.68 | 19.95 | 14.13 | 16.56 | 89.80 |
| $n_1s_2$ | 11.23 | 12.85 | 11.73 | 20.51 | 17.80 | 14.98 | 89.11 |
| $n_1s_3$ | 11.03 | 14.35 | 13.76 | 18.56 | 14.16 | 15.00 | 85.21 |
| $n_2s_1$ | 11.86 | 15.41 | 16.16 | 26.28 | 16.23 | 18.73 | 104.65 |
| $n_2s_2$ | 12.61 | 14.71 | 12.05 | 21.45 | 17.98 | 18.95 | 97.76 |
| $n_2s_3$ | 12.01 | 16.60 | 15.38 | 20.25 | 18.01 | 15.35 | 97.61 |
| $n_3s_1$ | 13.85 | 16.05 | 20.13 | 34.13 | 26.55 | 18.60 | 129.31 |
| $n_3s_2$ | 12.93 | 15.40 | 19.10 | 28.53 | 21.21 | 17.95 | 115.13 |
| $n_3s_3$ | 12.61 | 13.71 | 16.46 | 24.43 | 19.96 | 18.58 | 106.45 |
| SEm (±) | 0.742 | 0.639 | 1.627 | 3.370 | 1.871 | 0.823 | 3.723 |
| CD (0.05) | NS | 1.842 | NS | NS | NS | NS | NS |

NS- Not significant

Table 46c. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under partial shade condition during first year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| $c_1n_1s_1$ | 11.66 | 15.13 | 10.43 | 21.06 | 14.13 | 16.23 | 88.66 |
| $c_1n_1s_2$ | 11.36 | 11.63 | 11.90 | 16.63 | 17.00 | 13.73 | 82.26 |
| $c_1n_1s_3$ | 11.23 | 12.36 | 13.73 | 16.90 | 14.00 | 13.30 | 81.53 |
| $c_1n_2s_1$ | 12.46 | 15.00 | 17.13 | 28.00 | 12.76 | 17.53 | 102.90 |
| $c_1n_2s_2$ | 12.76 | 12.83 | 12.43 | 22.36 | 19.96 | 18.86 | 99.23 |
| $c_1n_2s_3$ | 11.26 | 16.33 | 15.40 | 17.76 | 19.13 | 14.93 | 94.83 |
| $c_1n_3s_1$ | 14.66 | 15.23 | 21.26 | 34.96 | 24.53 | 17.66 | 128.33 |
| $c_1n_3s_2$ | 13.20 | 12.46 | 18.60 | 29.40 | 24.13 | 17.90 | 115.70 |
| $c_1n_3s_3$ | 12.50 | 11.80 | 16.36 | 21.40 | 15.83 | 18.50 | 96.40 |
| $c_2n_1s_1$ | 12.46 | 15.66 | 12.93 | 18.83 | 14.13 | 16.90 | 90.93 |
| $c_2n_1s_2$ | 11.10 | 14.06 | 11.56 | 24.40 | 18.60 | 16.23 | 95.96 |
| $c_2n_1s_3$ | 10.83 | 16.33 | 13.80 | 20.23 | 14.33 | 16.70 | 88.90 |
| $c_2n_2s_1$ | 11.26 | 15.83 | 15.20 | 24.56 | 19.70 | 19.93 | 106.40 |
| $c_2n_2s_2$ | 12.46 | 16.60 | 11.66 | 20.53 | 16.00 | 19.03 | 96.30 |
| $c_2n_2s_3$ | 12.76 | 16.86 | 15.36 | 22.73 | 16.90 | 15.76 | 100.40 |
| $c_2n_3s_1$ | 13.03 | 16.86 | 19.00 | 33.30 | 28.56 | 19.53 | 130.30 |
| $c_2n_3s_2$ | 12.66 | 18.33 | 19.60 | 27.66 | 18.30 | 18.00 | 114.56 |
| $c_2n_3s_3$ | 12.73 | 15.63 | 16.56 | 27.46 | 24.10 | 18.66 | 116.50 |
| SEm (±) | 1.051 | 0.906 | 2.302 | 4.766 | 2.646 | 1.165 | 5.266 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

The results revealed that significant effect of cutting pattern on green fodder yield was noticed in second and sixth harvests. The total green fodder yield was also significantly influenced by cutting height. The highest green fodder yield was obtained when cutting at 10 cm from the ground level was followed in second (16.24 t $ha^{-1}$), sixth harvests (17.86 t $ha^{-1}$) and total green fodder yield (104.47 t $ha^{-1}$). The effect of nutrients on green fodder yield was observed in all the harvests. The green fodder yield was significantly influenced by increasing the fertilizer levels. With respect to total yield application of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ ($N_3$) recorded highest yield (116.96 t $ha^{-1}$) which was significantly superior to other nutrient levels. The result indicated that spacing treatments was found significant in first, fourth, sixth harvest and total yield. As the spacing was increased the green fodder yield was found to exhibit a decreasing trend and the higher green fodder yield was recorded by the treatment involving narrow spacing. In first, fourth, sixth harvest and total yield $S_1$ (60 cm x 20 cm) recorded higher green fodder yield and was found to be on a par with $S_2$ (60 cm x 30 cm).

Significant interaction was observed between cutting pattern and spacing in second harvest. Maximum green fodder yield (16.33 t $ha^{-1}$) was recorded with a cutting height of 10 cm along with a spacing of 60 cm x 30 cm and was on a par with $c_2s_3$, $c_2s_1$, and $c_1s_1$. Also significant interaction was observed between nutrient levels and spacing in second harvest. Maximum green fodder yield (16.60 t $ha^{-1}$) was recorded with $n_2s_3$ and was on a par with $n_1s_1$, $n_2s_1$, $n_3s_1$ and $n_3s_2$.

The combined interaction between cutting pattern, nutrient levels and spacing was found to be non significant.

The treatments (cutting pattern, nutrient levels and plant spacing) had significant influence on green fodder yield of palisade grass under partial shade condition in the second year are presented in Table 47a, 47b and 47c.

The result showed that the cutting pattern had significant impact on green fodder yield in sixth and seventh harvests. In sixth harvest ground level cutting

Table 47a. Effect of cutting pattern, nutrient levels and spacing on GFY under partial shade condition during second year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| **Cutting pattern (C)** | | | | | | | | |
| $C_1$ | 14.76 | 15.20 | 14.39 | 15.60 | 12.53 | 11.85 | 11.63 | 95.91 |
| $C_2$ | 15.33 | 16.03 | 14.60 | 15.08 | 12.66 | 10.69 | 12.65 | 96.86 |
| SEm (±) | 0.645 | 0.398 | 0.488 | 0.483 | 0.266 | 0.246 | 0.344 | 0.968 |
| CD (0.05) | NS | NS | NS | NS | NS | 0.709 | 0.991 | NS |
| **Nutrient levels (N)** | | | | | | | | |
| $N_1$ | 12.68 | 14.29 | 13.06 | 13.32 | 12.31 | 10.97 | 11.88 | 88.27 |
| $N_2$ | 15.13 | 15.98 | 14.05 | 15.73 | 12.52 | 11.40 | 11.80 | 96.67 |
| $N_3$ | 17.31 | 16.57 | 16.36 | 16.97 | 12.96 | 11.43 | 12.75 | 104.21 |
| SEm (±) | 0.790 | 0.488 | 0.598 | 1.226 | 0.389 | 0.680 | 0.810 | 1.186 |
| CD (0.05) | 2.277 | 1.405 | 1.723 | NS | 1.120 | NS | NS | 3.416 |
| **Spacing (N)** | | | | | | | | |
| $S_1$ | 16.06 | 16.38 | 15.24 | 17.95 | 12.55 | 11.55 | 12.32 | 101.13 |
| $S_2$ | 14.62 | 15.79 | 14.05 | 14.66 | 12.07 | 11.16 | 11.67 | 94.05 |
| $S_3$ | 14.45 | 14.67 | 14.18 | 13.41 | 13.16 | 11.10 | 12.44 | 93.97 |
| SEm (±) | 0.790 | 0.488 | 0.598 | 1.226 | 0.389 | 0.680 | 0.810 | 1.186 |
| CD (0.05) | NS | 1.405 | NS | 3.532 | NS | NS | NS | 3.416 |

NS- Not significant

Table 47b. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under partial shade condition during second year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| $c_1n_1$ | 12.56 | 16.38 | 13.55 | 12.95 | 12.45 | 11.38 | 11.52 | 87.92 |
| $c_1n_2$ | 14.92 | 15.79 | 13.68 | 16.04 | 12.61 | 12.10 | 11.71 | 96.68 |
| $c_1n_3$ | 16.80 | 14.67 | 15.93 | 17.82 | 12.53 | 12.06 | 11.67 | 103.13 |
| $c_2n_1$ | 12.81 | 16.38 | 12.57 | 13.70 | 12.17 | 10.56 | 12.24 | 88.63 |
| $c_2n_2$ | 15.35 | 15.79 | 14.42 | 15.43 | 12.43 | 10.70 | 11.90 | 96.66 |
| $c_2n_3$ | 17.82 | 14.67 | 16.80 | 16.12 | 13.38 | 10.81 | 13.83 | 105.28 |
| SEm (±) | 1.118 | 0.690 | 0.846 | 1.734 | 0.550 | 0.426 | 0.596 | 1.677 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 15.97 | 15.81 | 13.64 | 18.71 | 12.21 | 11.78 | 11.64 | 99.34 |
| $c_1s_2$ | 14.03 | 15.72 | 15.86 | 15.11 | 11.77 | 11.90 | 11.32 | 95.73 |
| $c_1s_3$ | 14.27 | 14.07 | 13.66 | 13.00 | 13.61 | 11.86 | 11.94 | 92.66 |
| $c_2s_1$ | 16.15 | 16.95 | 16.84 | 17.20 | 12.90 | 11.31 | 13.01 | 102.92 |
| $c_2s_2$ | 15.21 | 15.86 | 12.24 | 14.22 | 12.37 | 10.43 | 12.02 | 92.37 |
| $c_2s_3$ | 14.62 | 15.26 | 14.71 | 13.83 | 12.72 | 10.33 | 12.94 | 95.28 |
| SEm (±) | 1.118 | 0.690 | 0.846 | 1.734 | 0.550 | 0.426 | 0.596 | 1.677 |
| CD (0.05) | NS | NS | 2.436 | NS | NS | NS | NS | NS |
| $n_1s_1$ | 12.65 | 15.31 | 14.65 | 15.03 | 13.66 | 11.80 | 13.18 | 94.63 |
| $n_1s_2$ | 13.08 | 14.06 | 12.30 | 12.86 | 11.28 | 9.88 | 10.95 | 84.43 |
| $n_1s_3$ | 12.33 | 13.50 | 12.25 | 12.08 | 12.00 | 11.25 | 11.51 | 85.76 |
| $n_2s_1$ | 17.16 | 17.23 | 13.73 | 18.93 | 11.41 | 11.00 | 11.41 | 100.90 |
| $n_2s_2$ | 12.86 | 16.86 | 13.65 | 14.40 | 12.55 | 12.68 | 11.66 | 94.68 |
| $n_2s_3$ | 15.38 | 13.85 | 14.78 | 13.88 | 13.60 | 10.51 | 12.33 | 94.45 |
| $n_3s_1$ | 18.38 | 16.60 | 17.35 | 19.90 | 12.58 | 11.85 | 12.38 | 107.86 |
| $n_3s_2$ | 17.91 | 16.45 | 16.21 | 16.73 | 12.40 | 10.93 | 12.40 | 103.05 |
| $n_3s_3$ | 15.63 | 16.66 | 15.53 | 14.28 | 13.90 | 11.53 | 13.48 | 101.71 |
| SEm (±) | 1.369 | 0.845 | 1.345 | 2.125 | 0.674 | 0.522 | 0.730 | 2.054 |
| CD (0.05) | NS | NS | NS | NS | NS | 1.504 | NS | NS |

NS- Not significant

Table 47c. Interaction effect of cutting pattern, nutrient levels and spacing on GFY under partial shade condition during second year, t ha$^{-1}$

| Treatments | Green fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| $c_1n_1s_1$ | 11.36 | 15.23 | 15.00 | 13.86 | 13.33 | 11.16 | 12.03 | 90.66 |
| $c_1n_1s_2$ | 13.60 | 13.40 | 12.83 | 13.16 | 12.36 | 10.00 | 11.83 | 87.20 |
| $c_1n_1s_3$ | 12.73 | 11.80 | 12.83 | 11.83 | 11.66 | 13.00 | 10.70 | 85.90 |
| $c_1n_2s_1$ | 18.13 | 16.03 | 11.10 | 20.00 | 11.00 | 11.53 | 11.00 | 98.80 |
| $c_1n_2s_2$ | 12.23 | 17.36 | 15.63 | 14.36 | 12.50 | 14.50 | 11.66 | 98.26 |
| $c_1n_2s_3$ | 14.40 | 13.43 | 14.33 | 13.76 | 14.33 | 10.26 | 12.46 | 93.00 |
| $c_1n_3s_1$ | 18.43 | 16.16 | 14.83 | 22.26 | 12.30 | 12.66 | 11.90 | 108.56 |
| $c_1n_3s_2$ | 16.26 | 16.40 | 19.13 | 17.80 | 10.46 | 11.20 | 10.46 | 101.73 |
| $c_1n_3s_3$ | 15.70 | 17.00 | 13.83 | 13.40 | 14.83 | 12.33 | 12.66 | 99.10 |
| $c_2n_1s_1$ | 13.93 | 15.40 | 14.30 | 16.20 | 14.00 | 12.43 | 14.33 | 98.60 |
| $c_2n_1s_2$ | 12.56 | 14.73 | 11.76 | 12.56 | 10.20 | 9.76 | 10.06 | 81.66 |
| $c_2n_1s_3$ | 11.93 | 15.20 | 11.66 | 12.33 | 12.33 | 9.50 | 12.33 | 85.63 |
| $c_2n_2s_1$ | 16.20 | 18.43 | 16.36 | 17.86 | 11.83 | 10.46 | 11.83 | 103.00 |
| $c_2n_2s_2$ | 13.50 | 16.36 | 11.66 | 14.43 | 12.60 | 10.86 | 11.66 | 91.10 |
| $c_2n_2s_3$ | 16.36 | 14.26 | 15.23 | 14.00 | 12.86 | 10.76 | 12.20 | 95.90 |
| $c_2n_3s_1$ | 18.33 | 17.03 | 19.86 | 17.53 | 12.86 | 11.03 | 12.87 | 107.16 |
| $c_2n_3s_2$ | 19.56 | 16.50 | 13.30 | 15.66 | 14.33 | 10.66 | 14.33 | 104.36 |
| $c_2n_3s_3$ | 15.56 | 16.33 | 17.23 | 15.16 | 12.96 | 10.73 | 14.30 | 104.33 |
| SEm (±) | 0.624 | 0.668 | 0.701 | 0.700 | 0.733 | 0.738 | 0.712 | 2.542 |
| CD (0.05) | NS | NS | NS | NS | NS | 2.127 | NS | NS |

NS- Not significant

produced highest green fodder yield of 11.84 t $ha^{-1}$ and in seventh harvest 10 cm cutting produced highest green fodder yield of 12.65 t $ha^{-1}$. The total green fodder yield was not significantly influenced by cutting height. The fertilizer treatments had significant effect on green fodder yield in first, second, third, fifth harvest and total yield. In the first and second harvest $N_3$ and $N_2$ was on a par whereas in the fifth harvest $N_3$ was on a par with $N_2$ and $N_1$. In the third harvest and total fodder yield, $N_3$ was found significantly superior to $N_2$ and $N_1$.

The significant effect of plant spacing was noticed on second and fourth harvests and also total yield. In all these harvests narrow plant spacing of 60 cm x 20 cm recorded maximum fodder yield of 16.38 t $ha^{-1}$, 17.95 t $ha^{-1}$ and 101.13 t $ha^{-1}$ respectively. In second and fourth harvest $S_1$ and $S_2$ were on a par and with respect to total yield $S_1$ was significantly superior to $S_2$ and $S_3$.

Significant interaction was observed between cutting height and spacing in the third harvest. Maximum green fodder yield was recorded when 10 cm cutting and 60 cm x 20 cm spacing was followed (16.84 t $ha^{-1}$) which was on a par with $c_1s_2$ (15.86 t $ha^{-1}$) and $c_2s_3$ (14.71 t $ha^{-1}$). Significant interaction was observed between nutrient levels and spacing in sixth harvest. Maximum green fodder yield (12.68 t $ha^{-1}$) was recorded with $n_2s_3$ and was on a par with $n_1s_1$, $n_3s_1$, $n_3s_3$ and $n_1s_3$. Significant interaction was observed between cutting height, nutrient levels and spacing in the sixth harvest. Maximum green fodder yield was recorded when ground level cutting, 200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ and 60 cm x 30 cm spacing was followed (14.50 t $ha^{-1)}$) which was on a par with $c_1n_1s_3$ (13.00 t $ha^{-1}$), $c_1n_3s_1$ (12.66 t $ha^{-1}$) and $c_2n_1s_1$ (12.43 t $ha^{-1}$).

#### *4.2.2.2 Dry Fodder Yield*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with regard to dry fodder yield of palisade grass under partial shade condition in the first year are presented in Table 48a, 48b and 48c.

Table 48a. Effect of cutting pattern, nutrient levels and spacing on DFY under partial shade condition during first year, t $ha^{-1}$

| Treatments | Dry fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 3.05 | 3.42 | 3.35 | 6.08 | 4.62 | 4.22 | 24.76 |
| $C_2$ | 3.00 | 4.19 | 3.62 | 6.43 | 4.90 | 4.60 | 26.75 |
| SEm (±) | 0.069 | 0.086 | 0.087 | 0.200 | 0.116 | 0.108 | 0.496 |
| CD (0.05) | NS | 0.250 | NS | NS | NS | 0.313 | 1.428 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 2.70 | 3.48 | 2.81 | 5.01 | 3.80 | 3.84 | 21.65 |
| $N_2$ | 2.90 | 3.86 | 3.57 | 5.83 | 4.37 | 4.45 | 24.99 |
| $N_3$ | 3.47 | 4.07 | 4.07 | 7.92 | 6.12 | 4.94 | 30.62 |
| SEm (±) | 0.120 | 0.106 | 0.179 | 0.544 | 0.302 | 0.133 | 0.607 |
| CD (0.05) | 0.346 | 0.307 | 0.516 | 1.567 | 0.871 | 0.383 | 1.749 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 3.12 | 3.17 | 3.69 | 7.09 | 4.91 | 3.84 | 27.43 |
| $S_2$ | 3.03 | 3.62 | 3.25 | 6.17 | 4.91 | 4.45 | 25.44 |
| $S_3$ | 2.92 | 3.48 | 3.50 | 5.50 | 4.46 | 4.94 | 24.40 |
| SEm (±) | 0.120 | 0.106 | 0.179 | 0.544 | 0.302 | 0.133 | 0.607 |
| CD (0.05) | NS | 0.307 | NS | NS | NS | 0.383 | 1.749 |

NS- Not significant

Table 48b. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under partial shade condition during first year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Total yield** |
| $c_1n_1$ | 2.69 | 3.17 | 2.86 | 4.59 | 3.71 | 3.53 | 20.56 |
| $c_1n_2$ | 2.90 | 3.62 | 3.69 | 5.85 | 4.34 | 4.29 | 24.71 |
| $c_1n_3$ | 3.56 | 3.48 | 3.48 | 7.80 | 5.82 | 4.84 | 29.01 |
| $c_2n_1$ | 2.71 | 3.80 | 2.76 | 5.42 | 3.89 | 4.15 | 22.74 |
| $c_2n_2$ | 2.90 | 4.10 | 3.44 | 5.82 | 4.41 | 4.60 | 25.27 |
| $c_2n_3$ | 3.38 | 4.66 | 4.66 | 8.05 | 6.42 | 5.04 | 32.24 |
| SEm (±) | 0.169 | 0.150 | 0.253 | 0.769 | 0.427 | 0.188 | 0.858 |
| CD (0.05) | NS | NS | 0.730 | NS | NS | NS | NS |
| $c_1s_1$ | 3.22 | 3.83 | 3.59 | 7.44 | 4.40 | 4.40 | 26.89 |
| $c_1s_2$ | 3.08 | 3.07 | 3.03 | 5.98 | 5.30 | 4.31 | 24.76 |
| $c_1s_3$ | 2.86 | 3.38 | 3.42 | 4.83 | 4.17 | 3.96 | 22.63 |
| $c_2s_1$ | 3.03 | 4.11 | 3.80 | 6.74 | 5.42 | 4.86 | 27.96 |
| $c_2s_2$ | 2.98 | 4.17 | 3.48 | 6.37 | 4.53 | 4.57 | 26.11 |
| $c_2s_3$ | 2.99 | 4.28 | 3.59 | 6.17 | 4.76 | 4.37 | 26.18 |
| SEm (±) | 0.169 | 0.150 | 0.253 | 0.769 | 0.427 | 0.188 | 0.858 |
| CD (0.05) | NS | 0.433 | NS | NS | NS | NS | NS |
| $n_1s_1$ | 2.87 | 3.81 | 2.77 | 5.08 | 3.45 | 4.14 | 22.14 |
| $n_1s_2$ | 2.64 | 3.13 | 2.78 | 5.24 | 4.48 | 3.69 | 21.95 |
| $n_1s_3$ | 2.59 | 3.51 | 2.88 | 4.70 | 3.46 | 3.70 | 20.86 |
| $n_2s_1$ | 2.82 | 3.81 | 4.02 | 6.84 | 4.04 | 4.74 | 26.28 |
| $n_2s_2$ | 3.03 | 3.62 | 2.87 | 5.50 | 4.53 | 4.80 | 24.37 |
| $n_2s_3$ | 2.86 | 4.14 | 3.80 | 5.17 | 4.54 | 3.80 | 24.33 |
| $n_3s_1$ | 3.67 | 4.29 | 4.29 | 9.35 | 7.23 | 5.00 | 33.86 |
| $n_3s_2$ | 3.42 | 4.11 | 4.11 | 7.79 | 5.74 | 4.82 | 30.00 |
| $n_3s_3$ | 3.33 | 3.82 | 3.82 | 6.64 | 5.39 | 5.00 | 28.01 |
| SEm (±) | 0.208 | 0.184 | 0.310 | 0.942 | 0.524 | 0.230 | 1.052 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 48c. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under partial shade condition during first year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Total yield |
| $c_1n_1s_1$ | 2.76 | 3.73 | 2.42 | 5.40 | 3.45 | 4.04 | 21.82 |
| $c_1n_1s_2$ | 2.68 | 2.83 | 2.83 | 4.15 | 4.26 | 3.34 | 20.03 |
| $c_1n_1s_3$ | 2.64 | 2.96 | 3.34 | 4.23 | 3.42 | 3.22 | 19.83 |
| $c_1n_2s_1$ | 2.99 | 3.70 | 4.29 | 7.34 | 3.07 | 4.41 | 25.81 |
| $c_1n_2s_2$ | 3.07 | 3.09 | 2.98 | 5.76 | 5.09 | 4.78 | 24.78 |
| $c_1n_2s_3$ | 2.65 | 4.07 | 3.81 | 4.47 | 4.85 | 3.68 | 23.55 |
| $c_1n_3s_1$ | 3.90 | 4.06 | 4.06 | 9.59 | 6.67 | 4.74 | 33.04 |
| $c_1n_3s_2$ | 3.49 | 3.29 | 3.29 | 8.03 | 6.55 | 4.81 | 29.48 |
| $c_1n_3s_3$ | 3.30 | 3.10 | 3.10 | 5.79 | 4.23 | 4.98 | 24.50 |
| $c_2n_1s_1$ | 2.99 | 3.88 | 3.12 | 4.77 | 3.45 | 4.23 | 22.46 |
| $c_2n_1s_2$ | 2.60 | 3.44 | 2.74 | 6.33 | 4.70 | 4.04 | 23.87 |
| $c_2n_1s_3$ | 2.53 | 4.07 | 2.43 | 5.16 | 3.51 | 4.17 | 21.89 |
| $c_2n_2s_1$ | 2.65 | 3.93 | 3.75 | 6.34 | 5.01 | 5.08 | 26.75 |
| $c_2n_2s_2$ | 2.99 | 4.14 | 2.76 | 5.24 | 3.98 | 4.83 | 23.96 |
| $c_2n_2s_3$ | 3.07 | 4.22 | 3.80 | 5.86 | 4.23 | 3.91 | 25.11 |
| $c_2n_3s_1$ | 3.45 | 4.52 | 4.52 | 9.12 | 7.80 | 5.27 | 34.69 |
| $c_2n_3s_2$ | 3.34 | 4.93 | 4.93 | 7.54 | 4.92 | 4.84 | 30.52 |
| $c_2n_3s_3$ | 3.36 | 4.55 | 4.55 | 7.49 | 6.55 | 5.02 | 31.53 |
| SEm (±) | 0.294 | 0.260 | 0.439 | 1.332 | 0.740 | 0.326 | 1.487 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

The results revealed that the effect of cutting pattern on dry fodder yield was significant in second and sixth harvest and total yield. The highest dry fodder yield was obtained when cutting at 10 cm from the ground level was followed in second (4.19 t $ha^{-1}$), and sixth (4.60 t $ha^{-1}$) harvest and total yield (26.75 t $ha^{-1}$). The effect of nutrients on dry fodder yield was observed in all the harvests. In the second and third harvest $N_2$ and $N_3$ was found to be on a par. With respect to total yield application of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ recorded maximum yield (30.62 t $ha^{-1}$) which was significantly superior to other nutrient levels. The result indicated that spacing treatments was found significant in second, sixth and total yield. In the second harvest $S_2$ (60 cm x 30 cm) recorded maximum dry fodder yield of 3.62 t $ha^{-1}$ and was on a par with $S_3$. In the sixth harvest $S_3$ recorded highest DFY and was significantly superior to $S_1$ and $S_2$ Regarding total yield also $S_1$ (60 cm x 20 cm) recorded highest DFY and was significantly superior to $S_2$ and $S_3$.

The interactions effects were non significant.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to dry fodder yield of palisade grass under partial shade condition in the second year are presented in Table 49a, 49b and 49c.

The result showed that the cutting pattern had significant impact on dry fodder yield in sixth and seventh harvests. In the sixth harvest ground level cutting produced highest dry fodder yield of 2.56 t $ha^{-1}$ whereas in seventh harvest maximum dry fodder yield of 2.69 t $ha^{-1}$ was recorded when cutting height of 10 cm was followed. The total dry fodder yield was not significantly influenced by cutting height. The fertilizer treatments had significant effect on green fodder yield in all harvests except fourth. In all harvests except fourth harvest highest level of nutrients produced highest dry fodder yield. The total dry fodder yield was significantly influenced by all the fertilizer treatments. The maximum dry fodder yield was recorded by highest fertilizer level ($N_3$) (24.47 t $ha^{-1}$) which was superior to the application of 200: 50: 50 kg N, $P_2O_5$ and $K_2O$

Table 49a. Effect of cutting pattern, nutrient levels and spacing on DFY under partial shade condition during second year, t $ha^{-1}$

| Treatments | Dry fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| **Cutting pattern (C)** | | | | | | | | |
| $C_1$ | 3.29 | 3.40 | 3.20 | 3.35 | 2.73 | 2.56 | 2.47 | 21.02 |
| $C_2$ | 3.43 | 3.60 | 3.25 | 3.47 | 2.76 | 2.27 | 2.69 | 21.50 |
| SEm (±) | 0.161 | 0.102 | 0.122 | 0.217 | 0.079 | 0.061 | 0.075 | 0.290 |
| CD (0.05) | NS | NS | NS | NS | NS | 0.177 | 0.216 | NS |
| **Nutrient levels (N)** | | | | | | | | |
| $N_1$ | 2.67 | 3.07 | 2.76 | 3.35 | 2.57 | 2.24 | 2.33 | 18.64 |
| $N_2$ | 3.28 | 3.48 | 3.01 | 3.47 | 2.63 | 2.35 | 2.50 | 20.67 |
| $N_3$ | 4.12 | 3.94 | 3.89 | 3.35 | 3.04 | 2.66 | 2.90 | 24.47 |
| SEm (±) | 0.197 | 0.125 | 0.149 | 0.265 | 0.097 | 0.075 | 0.091 | 0.356 |
| CD (0.05) | 0.570 | 0.361 | 0.431 | NS | 0.280 | 0.217 | 0.264 | 1.026 |
| **Spacing (S)** | | | | | | | | |
| $S_1$ | 3.61 | 3.69 | 3.41 | 3.87 | 2.74 | 2.49 | 2.57 | 22.41 |
| $S_2$ | 3.25 | 3.53 | 3.11 | 3.22 | 2.62 | 2.39 | 2.51 | 20.68 |
| $S_3$ | 3.21 | 3.27 | 3.14 | 3.13 | 2.89 | 2.37 | 2.66 | 20.70 |
| SEm (±) | 0.197 | 0.125 | 0.149 | 0.265 | 0.097 | 0.075 | 0.091 | 0.356 |
| CD (0.05) | NS | 0.391 | NS | NS | NS | NS | NS | 1.026 |

NS- Not significant

Table 49b. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under partial shade condition during second year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** | **Total yield** |
| $c_1n_1$ | 2.64 | 2.87 | 2.89 | 2.82 | 2.61 | 2.34 | 2.28 | 18.47 |
| $c_1n_2$ | 3.23 | 3.40 | 2.92 | 3.45 | 2.65 | 2.52 | 2.48 | 20.68 |
| $c_1n_3$ | 4.00 | 3.93 | 3.78 | 3.78 | 2.93 | 2.82 | 2.66 | 23.92 |
| $c_2n_1$ | 2.70 | 3.28 | 2.64 | 3.09 | 2.54 | 2.14 | 2.39 | 18.80 |
| $c_2n_2$ | 3.34 | 3.56 | 3.10 | 3.32 | 2.60 | 2.17 | 2.53 | 20.67 |
| $c_2n_3$ | 4.25 | 3.95 | 4.00 | 4.00 | 3.15 | 2.50 | 3.15 | 25.02 |
| SEm (±) | 0.109 | 0.200 | 0.211 | 0.210 | 0.208 | 0.215 | 0.234 | 0.322 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 3.59 | 3.55 | 3.01 | 3.66 | 2.65 | 2.55 | 2.45 | 21.48 |
| $c_1s_2$ | 3.10 | 3.53 | 3.56 | 3.49 | 2.54 | 2.57 | 2.43 | 21.25 |
| $c_1s_3$ | 3.17 | 3.12 | 3.01 | 2.91 | 3.00 | 2.56 | 2.54 | 20.34 |
| $c_2s_1$ | 3.64 | 3.84 | 3.81 | 4.09 | 2.82 | 2.43 | 2.68 | 23.33 |
| $c_2s_2$ | 3.40 | 3.54 | 2.66 | 2.96 | 2.69 | 2.21 | 2.60 | 20.11 |
| $c_2s_3$ | 3.25 | 3.42 | 3.27 | 3.35 | 2.78 | 2.18 | 2.78 | 21.06 |
| SEm (±) | 0.109 | 0.200 | 0.211 | 0.210 | 0.208 | 0.215 | 0.234 | 0.322 |
| CD (0.05) | NS | NS | 0.609 | NS | NS | NS | NS | NS |
| $n_1s_1$ | 2.66 | 3.33 | 3.16 | 3.26 | 2.91 | 2.45 | 2.46 | 20.25 |
| $n_1s_2$ | 2.77 | 3.01 | 2.57 | 2.71 | 2.32 | 1.97 | 2.23 | 17.61 |
| $n_1s_3$ | 2.58 | 2.87 | 2.56 | 2.89 | 2.50 | 2.31 | 2.31 | 18.05 |
| $n_2s_1$ | 3.79 | 3.81 | 2.93 | 4.23 | 2.35 | 2.25 | 2.35 | 21.74 |
| $n_2s_2$ | 2.71 | 3.67 | 2.91 | 3.10 | 2.63 | 2.67 | 2.41 | 20.18 |
| $n_2s_3$ | 3.34 | 2.96 | 3.19 | 2.83 | 2.90 | 2.13 | 2.75 | 20.11 |
| $n_3s_1$ | 4.39 | 3.95 | 4.14 | 4.14 | 2.94 | 2.76 | 2.89 | 25.24 |
| $n_3s_2$ | 4.28 | 3.91 | 3.85 | 3.85 | 2.90 | 2.53 | 2.90 | 24.25 |
| $n_3s_3$ | 3.71 | 3.97 | 3.68 | 3.68 | 3.27 | 2.68 | 2.92 | 23.93 |
| SEm (±) | 0.110 | 0.177 | 0.146 | 0.158 | 0.168 | 0.130 | 0.158 | 0.266 |
| CD (0.05) | NS | NS | NS | NS | 0.485 | 0.376 | NS | NS |

NS- Not significant

Table 49c. Interaction effect of cutting pattern, nutrient levels and spacing on DFY under partial shade condition during second year, t ha$^{-1}$

| Treatments | Dry fodder yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII | Total yield |
| $c_1n_1s_1$ | 2.34 | 3.31 | 3.25 | 2.97 | 2.83 | 2.29 | 2.34 | 19.34 |
| $c_1n_1s_2$ | 2.90 | 2.85 | 2.71 | 2.79 | 2.59 | 2.00 | 2.46 | 18.30 |
| $c_1n_1s_3$ | 2.68 | 2.45 | 2.71 | 2.71 | 2.41 | 2.75 | 2.05 | 17.77 |
| $c_1n_2s_1$ | 4.03 | 3.51 | 2.27 | 4.50 | 2.25 | 2.38 | 2.25 | 21.21 |
| $c_1n_2s_2$ | 2.56 | 3.84 | 3.41 | 3.09 | 2.62 | 3.12 | 2.41 | 21.07 |
| $c_1n_2s_3$ | 3.10 | 2.86 | 3.08 | 2.77 | 3.08 | 2.06 | 2.78 | 19.75 |
| $c_1n_3s_1$ | 4.41 | 3.84 | 3.51 | 3.51 | 2.87 | 2.97 | 2.77 | 23.90 |
| $c_1n_3s_2$ | 3.86 | 3.90 | 4.58 | 4.58 | 2.41 | 2.60 | 2.41 | 24.38 |
| $c_1n_3s_3$ | 3.72 | 4.05 | 3.26 | 3.26 | 3.51 | 2.88 | 2.80 | 23.49 |
| $c_2n_1s_1$ | 2.98 | 3.35 | 3.07 | 3.55 | 3.00 | 2.61 | 2.58 | 21.16 |
| $c_2n_1s_2$ | 2.65 | 3.18 | 2.44 | 2.64 | 2.05 | 1.94 | 2.01 | 16.92 |
| $c_2n_1s_3$ | 2.48 | 3.30 | 2.41 | 3.08 | 2.58 | 1.87 | 2.58 | 18.33 |
| $c_2n_2s_1$ | 3.55 | 4.11 | 3.59 | 3.97 | 2.46 | 2.11 | 2.46 | 22.26 |
| $c_2n_2s_2$ | 2.87 | 3.51 | 2.41 | 3.11 | 2.65 | 2.22 | 2.41 | 19.28 |
| $c_2n_2s_3$ | 3.59 | 3.07 | 3.31 | 2.88 | 2.71 | 2.19 | 2.71 | 20.48 |
| $c_2n_3s_1$ | 4.38 | 4.06 | 4.77 | 4.77 | 3.02 | 2.56 | 3.02 | 26.58 |
| $c_2n_3s_2$ | 4.69 | 3.93 | 3.12 | 3.12 | 3.38 | 2.47 | 3.38 | 24.12 |
| $c_2n_3s_3$ | 3.69 | 3.88 | 4.11 | 4.11 | 3.04 | 2.48 | 3.04 | 24.37 |
| SEm (±) | 0.213 | 0.227 | 0.261 | 0.225 | 0.238 | 0.184 | 0.224 | 0.336 |
| CD (0.05) | NS | NS | NS | NS | 0.686 | 0.532 | 0.647 | NS |

NS- Not significant

$ha^{-1}$ and 150: 32.5: 32.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$. The significant effect of plant spacing was noticed on second harvest and also total yield. In second harvest $S_1$ recorded maximum DFY and was on a par with $S_2$. With respect to total yield narrow plant spacing of 60 cm x 20 cm recorded highest DFY and was found significantly superior to 60 cm x 30 cm and 60 cm x 40 cm spacing.

Significant interaction was observed between cutting height and spacing in the third harvest. The maximum dry fodder yield was recorded by $c_2s_1$ (3.81 t $ha^{-1}$) which was on a par with $c_1s_2$ (3.56 t $ha^{-1}$) and $c_2s_3$ (3.27 t $ha^{-1}$). Significant interaction was observed between nutrient levels and spacing in fifth and sixth harvest. In fifth harvest maximum dry fodder yield was recorded by $n_3s_3$ (3.27 t $ha^{-1}$) which was on a par with $n_1s_1$ (2.91 t $ha^{-1}$), $n_2s_3$ (2.90 t $ha^{-1}$), $n_3s_1$ (2.94 t $ha^{-1}$) and $n_3s_2$ (2.90 t $ha^{-1}$). In sixth harvest maximum dry fodder yield was recorded by $n_3s_1$ (2.76 t $ha^{-1}$) which was on a par with $n_3s_2$ (2.53 t $ha^{-1}$), $n_3s_3$ (2.68 t $ha^{-1}$) and $n_1s_1$ (2.45 t $ha^{-1}$). Significant interaction was observed between cutting pattern, nutrient levels and spacing in the fifth, sixth and seventh harvest. In the fifth harvest maximum dry fodder yield was recorded by $c_1n_3s_2$ (3.51 t $ha^{-1}$) which was on a par with $c_1n_2s_3$, $c_1n_3s_1$, $c_2n_1s_1$ $c_2n_3s_1$, $c_2n_3s_2$, $c_2n_3s_3$. In the sixth harvest maximum dry fodder yield was recorded by $c_1n_2s_2$ (3.12 t $ha^{-1}$)) which was on a par with $c_1n_1s_2$, $c_1n_3s_1$, $c_1n_3s_2$ $c_1n_3s_1$, $c_2n_3s_3$ and $c_2n_1s_1$. In the seventh harvest maximum dry fodder yield was recorded by $c_2n_3s_2$ (3.38 t $ha^{-1}$)) which was on a par with $c_1n_2s_3$, $c_1n_3s_1$, $c_1n_3s_3$ $c_2n_3s_1$ and $c_2n_3s_3$.

### 4.2.3 Physiological Observations

#### *4.2.3.1 Dry Matter Production*

The effect of cutting pattern, nutrient levels and plant spacing on DMP of palisade grass under partial shade condition in the first year are presented in Table 50a, 50b and 50c.

The result showed that the cutting pattern had significant impact on dry matter production only in second harvest. In the second harvest, $C_2$ recorded highest DMP of 156.40 g $plant^{-1}$. The DMP was significantly influenced by the

Table 50a. Effect of cutting pattern, nutrient levels and spacing on dry matter production under partial shade condition during first year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 134.77 | 143.65 | 158.03 | 208.03 | 183.36 | 168.75 |
| $C_2$ | 135.85 | 156.40 | 168.66 | 235.18 | 184.87 | 177.77 |
| SEm (±) | 3.300 | 2.886 | 7.280 | 16.810 | 9.180 | 3.440 |
| CD (0.05) | NS | 8.311 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 128.46 | 142.33 | 142.44 | 195.66 | 163.19 | 160.27 |
| $N_2$ | 136.81 | 157.76 | 158.31 | 210.24 | 182.83 | 174.24 |
| $N_3$ | 140.67 | 149.98 | 189.29 | 258.92 | 206.32 | 185.27 |
| SEm (±) | 4.041 | 3.535 | 8.922 | 20.590 | 11.249 | 4.212 |
| CD (0.05) | NS | 10.178 | 25.688 | NS | 32.387 | 12.128 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 85.48 | 88.75 | 87.57 | 104.60 | 88.33 | 87.75 |
| $S_2$ | 141.49 | 152.48 | 172.91 | 257.67 | 211.17 | 193.59 |
| $S_3$ | 178.97 | 208.84 | 229.56 | 302.54 | 252.84 | 238.44 |
| SEm (±) | 4.041 | 3.535 | 8.922 | 20.590 | 11.249 | 4.212 |
| CD (0.05) | 11.636 | 10.178 | 25.688 | 59.280 | 32.387 | 12.128 |

NS- Not significant

Table 50b. Interaction effect of cutting pattern, nutrient levels and spacing on dry matter production under partial shade condition during first year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 129.92 | 137.64 | 142.62 | 173.95 | 157.99 | 147.98 |
| $c_1n_2$ | 133.53 | 157.31 | 152.89 | 200.89 | 195.41 | 172.61 |
| $c_1n_3$ | 140.87 | 135.99 | 178.59 | 249.25 | 196.67 | 185.67 |
| $c_2n_1$ | 127.00 | 147.02 | 142.26 | 217.37 | 168.39 | 172.57 |
| $c_2n_2$ | 140.10 | 158.21 | 163.74 | 219.58 | 170.25 | 175.88 |
| $c_2n_3$ | 140.47 | 163.97 | 199.98 | 268.59 | 215.97 | 184.86 |
| SEm (±) | 5.71 | 4.99 | 12.62 | 29.12 | 15.91 | 5.96 |
| CD (0.05) | NS | 14.39 | NS | NS | NS | NS |
| $c_1s_1$ | 84.96 | 88.29 | 88.28 | 103.32 | 86.22 | 88.85 |
| $c_1s_2$ | 143.38 | 142.02 | 162.74 | 250.45 | 225.30 | 188.83 |
| $c_1s_3$ | 175.99 | 200.63 | 223.08 | 270.32 | 238.55 | 228.57 |
| $c_2s_1$ | 86.00 | 89.21 | 86.85 | 105.89 | 90.44 | 86.65 |
| $c_2s_2$ | 139.60 | 162.95 | 183.09 | 264.89 | 197.04 | 198.35 |
| $c_2s_3$ | 181.96 | 217.05 | 236.04 | 334.76 | 267.13 | 248.31 |
| SEm (±) | 5.71 | 4.99 | 12.62 | 29.12 | 15.91 | 5.96 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 87.05 | 91.08 | 85.60 | 91.40 | 81.22 | 90.31 |
| $n_1s_2$ | 130.82 | 137.29 | 146.45 | 226.82 | 198.76 | 169.72 |
| $n_1s_3$ | 167.51 | 198.63 | 195.27 | 268.77 | 209.59 | 220.79 |
| $n_2s_1$ | 84.66 | 87.88 | 85.80 | 102.94 | 86.48 | 86.45 |
| $n_2s_2$ | 145.16 | 156.55 | 149.72 | 236.42 | 200.67 | 210.70 |
| $n_2s_3$ | 180.63 | 228.87 | 239.43 | 291.34 | 261.35 | 225.59 |
| $n_3s_1$ | 84.74 | 87.30 | 91.30 | 119.48 | 97.30 | 86.50 |
| $n_3s_2$ | 148.49 | 163.62 | 222.57 | 309.77 | 234.08 | 200.36 |
| $n_3s_3$ | 188.79 | 199.03 | 253.99 | 347.50 | 287.59 | 268.95 |
| SEm (±) | 7.00 | 6.12 | 15.45 | 35.66 | 19.48 | 7.29 |
| CD (0.05) | NS | 17.629 | NS | NS | NS | NS |

NS- Not significant

Table 50c. Interaction effect of cutting pattern, nutrient levels and spacing on dry matter production under partial shade condition during first year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 87.36 | 92.49 | 86.20 | 88.80 | 76.12 | 89.23 |
| $c_1n_1s_2$ | 132.18 | 135.01 | 137.84 | 186.70 | 190.52 | 156.79 |
| $c_1n_1s_3$ | 170.23 | 185.43 | 203.83 | 246.36 | 207.35 | 197.91 |
| $c_1n_2s_1$ | 83.34 | 85.80 | 89.08 | 98.88 | 88.76 | 88.00 |
| $c_1n_2s_2$ | 146.70 | 147.44 | 143.38 | 245.90 | 221.10 | 209.84 |
| $c_1n_2s_3$ | 170.55 | 238.71 | 226.23 | 257.91 | 276.31 | 219.99 |
| $c_1n_3s_1$ | 84.18 | 86.60 | 89.58 | 122.28 | 93.80 | 89.33 |
| $c_1n_3s_2$ | 151.26 | 143.62 | 207.00 | 318.76 | 264.24 | 199.87 |
| $c_1n_3s_3$ | 187.19 | 177.75 | 239.19 | 306.71 | 231.99 | 267.83 |
| $c_2n_1s_1$ | 86.73 | 89.66 | 85.00 | 94.00 | 86.33 | 91.40 |
| $c_2n_1s_2$ | 129.47 | 139.57 | 155.07 | 266.94 | 207.01 | 182.64 |
| $c_2n_1s_3$ | 164.79 | 211.83 | 186.71 | 291.19 | 211.83 | 243.67 |
| $c_2n_2s_1$ | 85.97 | 89.96 | 82.53 | 107.01 | 84.20 | 84.90 |
| $c_2n_2s_2$ | 143.62 | 165.65 | 156.06 | 226.95 | 180.18 | 211.56 |
| $c_2n_2s_3$ | 190.71 | 219.03 | 252.63 | 324.78 | 246.39 | 231.19 |
| $c_2n_3s_1$ | 85.30 | 88.00 | 93.02 | 116.68 | 100.80 | 83.66 |
| $c_2n_3s_2$ | 145.72 | 183.62 | 238.14 | 300.79 | 203.93 | 200.86 |
| $c_2n_3s_3$ | 190.39 | 220.31 | 268.79 | 388.30 | 343.19 | 270.07 |
| SEm (±) | 9.900 | 8.659 | 21.855 | 50.436 | 27.555 | 10.318 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

chemical fertilizer treatments in all the harvests except initial and fourth harvest. In second harvest, highest DMP was noticed with $N_2$ (157.76 g plant$^{-1}$) whereas in all other harvests $N_3$ highest DMP. The significant effect of plant spacing was noticed on all harvests. $S_3$ registered highest DMP of 178.97, 208.84, 229.56, 302.54, 252.84 and 238.44 g plant$^{-1}$ in all harvests respectively.

Significant interaction was observed between cutting height and nutrient levels in second harvest. The treatment combination $c_2s_3$ recorded highest DMP of 163.97 g plant$^{-1}$ in the second harvest. Significant interaction was observed between nutrient levels and spacing in the second harvest. The treatment combination $n_3s_3$ recorded highest DMP of 228.87 g plant$^{-1}$ in the second harvest.

The effect of cutting pattern, nutrient levels and plant spacing on DMP of palisade grass under partial shade condition in the second year are presented in Table 51a, 51b and 51c.

The result showed that the cutting pattern had significant impact on dry matter production only in sixth and seventh harvest. In the sixth and seventh harvest, $C_2$ recorded highest DMP of 108.24 g plant$^{-1}$ and 125.29 g plant$^{-1}$ respectively. The DMP was significantly influenced by the chemical fertilizer treatments only in first three harvests. In first harvest, maximum DMP was noticed with $N_3$ (152.87 g plant$^{-1}$) and on a par with $N_2$. In second harvest, highest DMP was noticed with $N_3$ (155.41 g plant$^{-1}$) and on a par with $N_2$. In third harvest, highest DMP was noticed with $N_3$ (151.58 g plant$^{-1}$) and on a par with $N_2$. The significant effect of plant spacing was noticed on all harvests. $S_3$ registered highest DMP of 186.87, 191.56, 186.15, 186.90, 168.57, 144.34 and 162.36 g plant$^{-1}$ in first, second, third, fourth, fifth, sixth and seventh harvest respectively.

Significant interaction was observed between nutrient levels and spacing in second harvest and sixth harvest. In both second and sixth harvest maximum DMP was recorded by $n_3s_3$. Significant interaction was observed between cutting height and spacing in the third harvest and sixth $c_2s_3$ recorded maximum DMP of 192.41 g plant$^{-1}$ in the third harvest and 153.54 g plant$^{-1}$ in the sixth harvest.

Table 51a. Effect of cutting pattern, nutrient levels and spacing on dry matter production under partial shade condition during second year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 137.11 | 142.33 | 142.15 | 136.85 | 125.73 | 119.20 | 119.41 |
| $C_2$ | 140.88 | 148.08 | 135.74 | 144.02 | 123.86 | 108.24 | 125.29 |
| SEm (±) | 5.51 | 3.47 | 4.28 | 8.96 | 2.86 | 1.98 | 2.76 |
| CD (0.05) | NS | NS | NS | NS | NS | 5.696 | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 126.31 | 135.09 | 125.37 | 131.34 | 117.76 | 109.69 | 116.27 |
| $N_2$ | 137.80 | 145.11 | 139.87 | 135.66 | 127.82 | 116.20 | 125.11 |
| $N_3$ | 152.87 | 155.41 | 151.58 | 154.32 | 128.80 | 115.27 | 125.67 |
| SEm (±) | 6.75 | 4.26 | 5.25 | 10.98 | 3.51 | 2.42 | 3.38 |
| CD (0.05) | 19.431 | 12.256 | 15.109 | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 84.76 | 86.36 | 88.70 | 87.16 | 86.16 | 85.17 | 85.11 |
| $S_2$ | 145.35 | 157.69 | 141.91 | 147.25 | 119.64 | 111.65 | 119.58 |
| $S_3$ | 186.87 | 191.56 | 186.15 | 186.90 | 168.57 | 144.34 | 162.36 |
| SEm (±) | 6.75 | 4.26 | 5.25 | 10.98 | 3.51 | 2.42 | 3.38 |
| CD (0.05) | 19.431 | 12.256 | 15.109 | 31.610 | 10.100 | 6.976 | 9.724 |

NS- Not significant

Table 51b. Interaction effect of cutting pattern, nutrient levels and spacing on dry matter production under partial shade condition during second year, g $plant^{-1}$

| Treatments | Dry matter production | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 129.80 | 126.11 | 129.73 | 130.42 | 120.58 | 116.88 | 115.39 |
| $c_1n_2$ | 132.32 | 144.79 | 143.78 | 133.61 | 130.48 | 121.21 | 126.15 |
| $c_1n_3$ | 149.20 | 156.09 | 152.93 | 146.52 | 126.12 | 119.50 | 116.70 |
| $c_2n_1$ | 122.83 | 144.08 | 121.00 | 132.25 | 114.94 | 102.49 | 117.14 |
| $c_2n_2$ | 143.27 | 145.43 | 135.97 | 137.70 | 125.17 | 111.19 | 124.08 |
| $c_2n_3$ | 156.53 | 154.72 | 150.24 | 162.11 | 131.48 | 111.03 | 134.64 |
| SEm (±) | 9.54 | 6.02 | 7.42 | 15.53 | 4.96 | 3.43 | 4.78 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 86.64 | 85.58 | 87.84 | 86.39 | 86.40 | 85.66 | 85.22 |
| $c_1s_2$ | 139.89 | 157.00 | 158.72 | 151.38 | 116.88 | 118.39 | 116.34 |
| $c_1s_3$ | 184.79 | 184.41 | 179.88 | 172.79 | 173.91 | 153.54 | 156.68 |
| $c_2s_1$ | 82.88 | 87.14 | 89.55 | 87.93 | 85.93 | 84.68 | 85.00 |
| $c_2s_2$ | 150.80 | 158.39 | 125.24 | 143.13 | 122.41 | 104.90 | 122.82 |
| $c_2s_3$ | 188.95 | 198.70 | 192.41 | 201.00 | 163.24 | 135.14 | 168.04 |
| SEm (±) | 9.54 | 6.02 | 7.42 | 15.53 | 4.96 | 3.43 | 4.78 |
| CD (0.05) | NS | NS | 21.36 | NS | NS | 9.866 | NS |
| $n_1s_1$ | 86.38 | 86.06 | 87.46 | 84.99 | 86.43 | 83.16 | 85.33 |
| $n_1s_2$ | 131.13 | 141.71 | 125.78 | 130.64 | 112.30 | 99.75 | 112.92 |
| $n_1s_3$ | 161.43 | 177.51 | 162.87 | 178.39 | 154.55 | 146.15 | 150.55 |
| $n_2s_1$ | 86.16 | 86.11 | 88.15 | 87.00 | 85.73 | 85.66 | 84.50 |
| $n_2s_2$ | 129.16 | 167.56 | 138.21 | 144.79 | 123.99 | 125.66 | 119.50 |
| $n_2s_3$ | 198.07 | 181.66 | 193.27 | 175.19 | 173.75 | 137.27 | 171.35 |
| $n_3s_1$ | 81.74 | 86.91 | 90.48 | 89.51 | 86.33 | 86.68 | 85.50 |
| $n_3s_2$ | 175.75 | 163.80 | 161.96 | 166.33 | 122.64 | 109.53 | 126.33 |
| $n_3s_3$ | 201.11 | 215.51 | 202.31 | 207.11 | 177.43 | 149.59 | 165.19 |
| SEm (±) | 11.69 | 7.37 | 9.09 | 19.02 | 6.07 | 4.19 | 5.85 |
| CD (0.05) | NS | 21.22 | NS | NS | NS | 12.083 | NS |

NS- Not significant

Table 51c. Interaction effect of cutting pattern, nutrient levels and spacing on dry matter production under partial shade condition during second year, g plant$^{-1}$

| Treatments | Dry matter production | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 87.30 | 85.73 | 88.60 | 88.43 | 88.86 | 82.66 | 87.33 |
| $c_1n_1s_2$ | 135.87 | 135.50 | 130.70 | 133.41 | 122.33 | 100.79 | 121.10 |
| $c_1n_1s_3$ | 166.23 | 157.11 | 169.91 | 169.43 | 150.55 | 167.19 | 137.76 |
| $c_1n_2s_1$ | 87.43 | 85.56 | 86.96 | 83.73 | 85.33 | 87.00 | 86.00 |
| $c_1n_2s_2$ | 123.32 | 172.18 | 156.55 | 144.49 | 123.56 | 142.39 | 119.50 |
| $c_1n_2s_3$ | 186.23 | 176.63 | 187.83 | 172.63 | 182.55 | 134.24 | 172.95 |
| $c_1n_3s_1$ | 85.20 | 85.46 | 87.96 | 87.02 | 85.00 | 87.33 | 82.33 |
| $c_1n_3s_2$ | 160.49 | 163.31 | 188.91 | 176.24 | 104.73 | 112.00 | 108.42 |
| $c_1n_3s_3$ | 201.91 | 219.51 | 181.91 | 176.31 | 188.63 | 159.19 | 159.35 |
| $c_2n_1s_1$ | 85.46 | 86.40 | 86.33 | 81.54 | 84.00 | 83.66 | 83.33 |
| $c_2n_1s_2$ | 126.39 | 147.93 | 120.85 | 127.87 | 102.27 | 98.70 | 104.73 |
| $c_2n_1s_3$ | 156.63 | 197.91 | 155.83 | 187.35 | 158.55 | 125.12 | 163.35 |
| $c_2n_2s_1$ | 84.90 | 86.66 | 89.33 | 90.26 | 86.13 | 84.33 | 83.00 |
| $c_2n_2s_2$ | 135.01 | 162.94 | 119.87 | 145.10 | 124.42 | 108.92 | 119.50 |
| $c_2n_2s_3$ | 209.91 | 186.70 | 198.71 | 177.75 | 164.95 | 140.31 | 169.75 |
| $c_2n_3s_1$ | 78.28 | 88.36 | 93.00 | 92.00 | 87.66 | 86.04 | 88.66 |
| $c_2n_3s_2$ | 191.01 | 164.30 | 135.01 | 156.42 | 140.55 | 107.07 | 144.24 |
| $c_2n_3s_3$ | 200.31 | 211.51 | 222.71 | 237.91 | 166.23 | 139.99 | 171.03 |
| SEm (±) | 16.53 | 10.43 | 12.85 | 26.89 | 8.59 | 5.93 | 8.27 |
| CD (0.05) | NS | NS | NS | NS | 24.741 | 17.088 | NS |

NS- Not significant

Significant interaction was observed between cutting height, nutrient levels and spacing in the fifth and sixth harvest. In the fifth harvest highest DMP was recorded with application of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ of fertilizer along with ground level cutting and a spacing of 60 cm x 40 cm. In the sixth harvest highest DMP was recorded with application of 150: 32.5: 32.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ of fertilizer along with ground level cutting and a spacing of 60 cm x 40 cm.

#### *4.2.3.2 Leaf Area Index*

The data indicated that significant difference was observed between treatments (cutting pattern, nutrient levels and plant spacing) with respect to LAI of palisade grass under partial shade condition in the first year (Table 52a, 52b and 52c).

Significant effect of cutting height on leaf area index was noticed on third, fourth and fifth harvests. The ground level cutting treatments produced highest leaf area index of 2.98, 3.36 and 2.34 in the third, fourth and fifth harvests respectively. The leaf area index was significantly influenced by the chemical fertilizer treatments in all the harvests except fifth harvest. $N_3$ (1.39 and 3.77) was observed to be significantly superior to $N_2$ (1.26 and 2.97) in first and fourth harvests respectively. In the second, third and sixth harvest $N_3$ and $N_2$ was on a par. The different spacing treatments showed significant effect on leaf area index in all the harvests except fifth. Among the different spacing treatments $S_1$ recorded highest leaf area index in all the harvests except fifth harvest.

None of the interactions was found to have significant influence on leaf area index.

The application of treatments (cutting pattern, nutrient levels and plant spacing) had significant influence on LAI of palisade grass under partial shade condition in the second year are presented in Table 53a, 53b and 53c.

Table 52a. Effect of cutting pattern, nutrient levels and spacing on LAI under partial shade condition during first year

| Treatments | Leaf area index | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 1.28 | 2.65 | 2.98 | 3.36 | 2.34 | 3.09 |
| $C_2$ | 1.27 | 2.66 | 2.69 | 3.04 | 1.97 | 3.11 |
| SEm (±) | 0.031 | 0.025 | 0.089 | 0.112 | 0.094 | 0.145 |
| CD (0.05) | NS | NS | 0.259 | 0.323 | 0.273 | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 1.17 | 2.58 | 2.51 | 2.85 | 1.95 | 2.69 |
| $N_2$ | 1.26 | 2.70 | 2.96 | 2.97 | 2.17 | 3.11 |
| $N_3$ | 1.39 | 2.68 | 3.04 | 3.77 | 2.36 | 3.51 |
| SEm (±) | 0.038 | 0.042 | 0.110 | 0.137 | 0.116 | 0.177 |
| CD (0.05) | 0.112 | 0.122 | 0.317 | 0.396 | NS | 0.512 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 1.72 | 3.63 | 3.77 | 4.24 | 2.06 | 4.08 |
| $S_2$ | 1.17 | 2.47 | 2.60 | 2.90 | 2.17 | 2.90 |
| $S_3$ | 0.93 | 1.86 | 2.13 | 2.45 | 2.23 | 2.32 |
| SEm (±) | 0.038 | 0.042 | 0.110 | 0.137 | 0.116 | 0.177 |
| CD (0.05) | 0.112 | 0.122 | 0.317 | 0.396 | NS | 0.512 |

NS- Not significant

Table 52b. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under partial shade condition during first year

| Treatments | Leaf area index | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1$ | 1.15 | 2.59 | 2.66 | 2.95 | 2.26 | 4.08 |
| $c_1n_2$ | 1.26 | 2.67 | 3.11 | 3.05 | 2.27 | 2.90 |
| $c_1n_3$ | 1.42 | 2.70 | 3.16 | 4.09 | 2.49 | 2.32 |
| $c_2n_1$ | 1.19 | 2.58 | 2.36 | 2.75 | 1.63 | 4.08 |
| $c_2n_2$ | 1.26 | 2.72 | 2.80 | 2.90 | 2.07 | 2.90 |
| $c_2n_3$ | 1.36 | 2.67 | 2.91 | 3.46 | 2.22 | 2.32 |
| SEm (±) | 0.054 | 0.044 | 0.155 | 0.194 | 0.163 | 0.251 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 1.72 | 3.64 | 3.83 | 4.40 | 2.31 | 3.98 |
| $c_1s_2$ | 1.18 | 2.47 | 2.74 | 2.98 | 2.32 | 2.96 |
| $c_1s_3$ | 0.93 | 1.85 | 2.36 | 2.71 | 2.39 | 2.33 |
| $c_2s_1$ | 1.71 | 3.62 | 3.71 | 4.09 | 1.82 | 4.18 |
| $c_2s_2$ | 1.17 | 2.47 | 2.46 | 2.82 | 2.02 | 2.84 |
| $c_2s_3$ | 0.92 | 1.87 | 1.90 | 2.20 | 2.08 | 2.32 |
| SEm (±) | 0.054 | 0.044 | 0.155 | 0.194 | 0.163 | 0.251 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 1.55 | 3.51 | 3.21 | 3.65 | 1.83 | 3.44 |
| $n_1s_2$ | 1.10 | 2.42 | 2.36 | 2.61 | 2.06 | 2.54 |
| $n_1s_3$ | 0.87 | 1.82 | 1.96 | 2.29 | 1.95 | 2.08 |
| $n_2s_1$ | 1.71 | 3.68 | 4.08 | 4.15 | 2.12 | 4.03 |
| $n_2s_2$ | 1.16 | 2.52 | 2.64 | 2.53 | 2.15 | 2.90 |
| $n_2s_3$ | 0.91 | 1.89 | 2.15 | 2.24 | 2.24 | 2.41 |
| $n_3s_1$ | 1.90 | 3.70 | 4.03 | 4.93 | 2.24 | 4.78 |
| $n_3s_2$ | 1.27 | 2.48 | 2.79 | 3.55 | 2.31 | 3.27 |
| $n_3s_3$ | 1.01 | 1.88 | 2.29 | 2.84 | 2.52 | 2.48 |
| SEm (±) | 0.067 | 0.054 | 0.190 | 0.238 | 0.200 | 0.308 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 52c. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under partial shade condition during first year

| Treatments | Leaf area index | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1s_1$ | 1.50 | 3.54 | 3.26 | 3.70 | 2.29 | 3.20 |
| $c_1n_1s_2$ | 1.09 | 2.42 | 2.46 | 2.69 | 2.36 | 2.48 |
| $c_1n_1s_3$ | 0.88 | 1.81 | 2.25 | 2.45 | 2.14 | 1.96 |
| $c_1n_2s_1$ | 1.71 | 3.67 | 4.16 | 4.27 | 2.25 | 3.82 |
| $c_1n_2s_2$ | 1.16 | 2.48 | 2.82 | 2.45 | 2.23 | 2.96 |
| $c_1n_2s_3$ | 0.92 | 1.87 | 2.36 | 2.42 | 2.33 | 2.48 |
| $c_1n_3s_1$ | 1.97 | 3.72 | 4.07 | 5.23 | 2.39 | 4.92 |
| $c_1n_3s_2$ | 1.31 | 2.50 | 2.94 | 3.80 | 2.37 | 3.45 |
| $c_1n_3s_3$ | 0.99 | 1.88 | 2.49 | 3.25 | 2.70 | 2.55 |
| $c_2n_1s_1$ | 1.61 | 3.49 | 3.17 | 3.60 | 1.37 | 3.69 |
| $c_2n_1s_2$ | 1.11 | 2.42 | 2.26 | 2.53 | 1.77 | 2.60 |
| $c_2n_1s_3$ | 0.85 | 1.83 | 1.66 | 2.13 | 1.76 | 2.20 |
| $c_2n_2s_1$ | 1.71 | 3.70 | 4.00 | 4.03 | 2.00 | 4.24 |
| $c_2n_2s_2$ | 1.17 | 2.56 | 2.47 | 2.62 | 2.07 | 2.84 |
| $c_2n_2s_3$ | 0.90 | 1.91 | 1.95 | 2.05 | 2.15 | 2.34 |
| $c_2n_3s_1$ | 1.83 | 3.68 | 3.98 | 4.64 | 2.10 | 4.63 |
| $c_2n_3s_2$ | 1.23 | 2.45 | 2.65 | 3.30 | 2.24 | 3.09 |
| $c_2n_3s_3$ | 1.02 | 1.88 | 2.10 | 2.43 | 2.34 | 2.42 |
| SEm (±) | 0.095 | 0.077 | 0.269 | 0.336 | 0.284 | 0.435 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 53a. Effect of cutting pattern, nutrient levels and spacing on LAI under partial shade condition during second year

| Treatments | Leaf area index | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 2.76 | 2.68 | 3.03 | 2.85 | 2.77 | 2.69 | 2.65 |
| $C_2$ | 2.76 | 2.51 | 2.76 | 2.53 | 2.77 | 2.37 | 2.63 |
| SEm (±) | 0.025 | 0.075 | 0.103 | 0.085 | 0.129 | 0.082 | 0.110 |
| CD (0.05) | NS | NS | NS | 0.246 | NS | 0.237 | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 2.69 | 2.38 | 2.55 | 2.28 | 2.45 | 2.14 | 2.29 |
| $N_2$ | 2.80 | 2.58 | 2.69 | 2.67 | 2.75 | 2.77 | 2.74 |
| $N_3$ | 2.79 | 2.82 | 3.44 | 3.12 | 3.11 | 2.67 | 2.89 |
| SEm (±) | 0.031 | 0.092 | 0.126 | 0.104 | 0.158 | 0.100 | 0.135 |
| CD (0.05) | 0.090 | 0.267 | 0.365 | 0.301 | 0.457 | 0.290 | 0.390 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 3.78 | 3.43 | 3.87 | 3.49 | 3.67 | 3.34 | 3.45 |
| $S_2$ | 2.57 | 2.43 | 2.63 | 2.60 | 2.53 | 2.30 | 2.49 |
| $S_3$ | 1.94 | 1.92 | 2.18 | 1.98 | 2.11 | 1.95 | 1.98 |
| SEm (±) | 0.031 | 0.092 | 0.126 | 0.104 | 0.158 | 0.100 | 0.135 |
| CD (0.05) | 0.090 | 0.267 | 0.365 | 0.301 | 0.457 | 0.290 | 0.390 |

NS- Not significant

Table 53b. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under partial shade condition during second year

| Treatments | Leaf area index | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 2.69 | 2.47 | 2.60 | 2.60 | 2.35 | 2.20 | 2.27 |
| $c_1n_2$ | 2.78 | 2.64 | 2.76 | 2.71 | 2.70 | 3.04 | 2.69 |
| $c_1n_3$ | 2.81 | 2.91 | 3.71 | 3.24 | 3.26 | 2.85 | 2.99 |
| $c_2n_1$ | 2.69 | 2.29 | 2.50 | 1.96 | 2.55 | 2.09 | 2.31 |
| $c_2n_2$ | 2.83 | 2.52 | 2.61 | 2.64 | 2.79 | 2.50 | 2.79 |
| $c_2n_3$ | 2.77 | 2.72 | 3.17 | 2.99 | 2.96 | 2.50 | 2.79 |
| SEm (±) | 0.044 | 0.131 | 0.179 | 0.147 | 0.224 | 0.124 | 0.191 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 3.79 | 3.56 | 4.01 | 3.68 | 3.60 | 3.48 | 3.32 |
| $c_1s_2$ | 2.56 | 2.48 | 2.72 | 2.70 | 2.51 | 2.44 | 2.48 |
| $c_1s_3$ | 1.92 | 1.98 | 2.36 | 2.16 | 2.21 | 2.16 | 2.15 |
| $c_2s_1$ | 3.77 | 3.30 | 3.73 | 3.29 | 3.75 | 3.19 | 3.58 |
| $c_2s_2$ | 2.57 | 2.37 | 2.55 | 2.50 | 2.55 | 2.15 | 2.49 |
| $c_2s_3$ | 1.95 | 1.86 | 2.01 | 1.80 | 2.01 | 1.75 | 1.81 |
| SEm (±) | 0.044 | 0.131 | 0.179 | 0.147 | 0.224 | 0.124 | 0.191 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 3.66 | 3.12 | 3.30 | 2.74 | 3.17 | 2.63 | 2.77 |
| $n_1s_2$ | 2.52 | 2.27 | 2.35 | 2.32 | 2.26 | 2.11 | 2.27 |
| $n_1s_3$ | 1.89 | 1.76 | 2.01 | 1.77 | 1.91 | 1.70 | 1.83 |
| $n_2s_1$ | 3.83 | 3.47 | 3.76 | 3.52 | 3.54 | 3.94 | 3.59 |
| $n_2s_2$ | 2.61 | 2.35 | 2.27 | 2.51 | 2.53 | 2.42 | 2.61 |
| $n_2s_3$ | 1.97 | 1.91 | 2.04 | 2.00 | 2.16 | 1.96 | 2.02 |
| $n_3s_1$ | 3.85 | 3.69 | 4.54 | 4.20 | 4.30 | 3.45 | 3.99 |
| $n_3s_2$ | 2.58 | 2.66 | 3.29 | 2.98 | 2.79 | 2.36 | 2.59 |
| $n_3s_3$ | 1.95 | 2.10 | 2.50 | 2.17 | 2.24 | 2.21 | 2.09 |
| SEm (±) | 0.053 | 0.160 | 0.219 | 0.180 | 0.275 | 0.174 | 0.234 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 53c. Interaction effect of cutting pattern, nutrient levels and spacing on LAI under partial shade condition during second year

| Treatments | Leaf area index | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1s_1$ | 3.69 | 3.24 | 3.31 | 3.13 | 3.01 | 2.60 | 2.62 |
| $c_1n_1s_2$ | 2.52 | 2.29 | 2.43 | 2.64 | 2.17 | 2.07 | 2.26 |
| $c_1n_1s_3$ | 1.88 | 1.90 | 2.08 | 2.03 | 1.87 | 1.93 | 1.94 |
| $c_1n_2s_1$ | 3.82 | 3.69 | 3.88 | 3.58 | 3.34 | 4.21 | 3.25 |
| $c_1n_2s_2$ | 2.57 | 2.37 | 2.19 | 2.36 | 2.55 | 2.85 | 2.62 |
| $c_1n_2s_3$ | 1.94 | 1.85 | 2.23 | 2.19 | 2.23 | 2.06 | 2.20 |
| $c_1n_3s_1$ | 3.87 | 3.75 | 4.84 | 4.34 | 4.45 | 3.65 | 4.10 |
| $c_1n_3s_2$ | 2.60 | 2.79 | 3.54 | 3.11 | 2.81 | 2.40 | 2.57 |
| $c_1n_3s_3$ | 1.95 | 2.20 | 2.76 | 2.26 | 2.52 | 2.49 | 2.31 |
| $c_2n_1s_1$ | 3.64 | 3.01 | 3.30 | 2.36 | 3.34 | 2.67 | 2.93 |
| $c_2n_1s_2$ | 2.50 | 2.26 | 2.27 | 2.00 | 2.36 | 2.15 | 2.28 |
| $c_2n_1s_3$ | 1.91 | 1.61 | 1.93 | 1.51 | 1.96 | 1.47 | 1.72 |
| $c_2n_2s_1$ | 3.85 | 3.26 | 3.63 | 3.46 | 3.75 | 3.67 | 3.93 |
| $c_2n_2s_2$ | 2.65 | 2.33 | 2.36 | 2.65 | 2.52 | 1.99 | 2.60 |
| $c_2n_2s_3$ | 1.99 | 1.97 | 1.86 | 1.80 | 2.10 | 1.86 | 1.84 |
| $c_2n_3s_1$ | 3.83 | 3.63 | 4.25 | 4.06 | 4.15 | 3.24 | 3.89 |
| $c_2n_3s_2$ | 2.55 | 2.54 | 3.04 | 2.84 | 2.77 | 2.33 | 2.61 |
| $c_2n_3s_3$ | 1.95 | 2.01 | 2.23 | 2.08 | 1.97 | 1.92 | 1.87 |
| SEm (±) | 0.076 | 0.227 | 0.310 | 0.255 | 0.385 | 0.246 | 0.332 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

A significant response was noticed by the treatments with cutting height on leaf area index. Among the two cutting patterns cutting at ground level was significantly superior to cutting at 10 cm from the ground level in fourth and sixth harvests. Regarding fertilizer treatments significant response was indicated in all harvests. In the first and sixth harvest the maximum leaf area index of 2.80 and 2.77 was obtained with a fertilizer dose of 200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$. In the third and fourth harvests $N_3$ recorded highest leaf area index of 3.44 and 3.12 respectively. In the second, fifth and seventh harvests $N_3$ and $N_2$ were on a par. There was a significant influence of plant spacing treatments on the LAI at all harvests. Among the different spacing treatments the highest LAI was observed in the 60 cm x 20 cm in all harvests.

No significant interaction effects was noticed on the leaf area index.

#### *4.2.3.3 Relative Growth Rate*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to RGR of palisade grass under partial shade condition in the first year are presented in Table 54a, 54b and 54c.

A significant response was noticed by the treatments with cutting height on RGR only between first and second harvest. Among the two cutting patterns cutting at10 cm from ground level recorded highest RGR of 2.11 g $g^{-1}$ $day^{-1}$. Regarding fertilizer treatments significant response was indicated between all harvests. Maximum RGR was registered with a fertilizer dose of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ followed in all harvests. There was a significant influence of plant spacing treatments on RGR between all harvests. Among the different spacing treatments the highest RGR was observed in the 60 cm x 40 cm.

Significant interaction was observed between cutting height and nutrient level between first and second harvest and fifth and sixth harvest. The treatment combination $c_2n_3$ recorded highest RGR of 2.13 g $g^{-1}$ $day^{-1}$in between first and second harvest and $c_1n_3$ recorded highest RGR of 2.17 g $g^{-1}$ $day^{-1}$ in between fifth and sixth harvest. Significant interaction was observed between nutrient levels

Table 54a. Effect of cutting pattern, nutrient levels and spacing on RGR under partial shade condition during first year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 2.08 | 2.11 | 2.22 | 2.16 | 2.14 |
| $C_2$ | 2.11 | 2.13 | 2.24 | 2.16 | 2.15 |
| SEm (±) | 0.007 | 0.014 | 0.024 | 0.018 | 0.007 |
| CD (0.05) | 0.021 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 2.08 | 2.07 | 2.17 | 2.11 | 2.12 |
| $N_2$ | 2.11 | 2.11 | 2.22 | 2.16 | 2.15 |
| $N_3$ | 2.09 | 2.18 | 2.30 | 2.20 | 2.17 |
| SEm (±) | 0.009 | 0.018 | 0.030 | 0.022 | 0.008 |
| CD (0.05) | 0.026 | 0.053 | 0.087 | 0.066 | 0.025 |
| **Spacing (S)** | | | | | |
| $S_1$ | 1.90 | 1.89 | 1.96 | 1.89 | 1.90 |
| $S_2$ | 2.13 | 2.17 | 2.33 | 2.26 | 2.23 |
| $S_3$ | 2.26 | 2.29 | 2.39 | 2.32 | 2.32 |
| SEm (±) | 0.009 | 0.018 | 0.030 | 0.022 | 0.008 |
| CD (0.05) | 0.026 | 0.053 | 0.087 | 0.066 | 0.025 |

NS- Not significant

Table 54b. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under partial shade condition during first year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 2.07 | 2.07 | 2.15 | 2.10 | 2.09 |
| $c_1n_2$ | 2.11 | 2.10 | 2.21 | 2.18 | 2.15 |
| $c_1n_3$ | 2.06 | 2.15 | 2.30 | 2.19 | 2.17 |
| $c_2n_1$ | 2.09 | 2.07 | 2.20 | 2.13 | 2.15 |
| $c_2n_2$ | 2.12 | 2.12 | 2.23 | 2.13 | 2.15 |
| $c_2n_3$ | 2.13 | 2.20 | 2.30 | 2.22 | 2.16 |
| SEm (±) | 0.012 | 0.026 | 0.042 | 0.032 | 0.01 |
| CD (0.05) | 0.037 | NS | NS | NS | 0.03 |
| $c_1s_1$ | 1.90 | 1.90 | 1.96 | 1.88 | 1.90 |
| $c_1s_2$ | 2.10 | 2.14 | 2.33 | 2.29 | 2.21 |
| $c_1s_3$ | 2.24 | 2.29 | 2.37 | 2.30 | 2.30 |
| $c_2s_1$ | 1.90 | 1.89 | 1.97 | 1.91 | 1.89 |
| $c_2s_2$ | 2.16 | 2.20 | 2.34 | 2.23 | 2.24 |
| $c_2s_3$ | 2.28 | 2.30 | 2.42 | 2.35 | 2.33 |
| SEm (±) | 0.012 | 0.026 | 0.042 | 0.032 | 0.012 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 1.91 | 1.88 | 1.91 | 1.86 | 1.91 |
| $n_1s_2$ | 2.08 | 2.11 | 2.28 | 2.23 | 2.17 |
| $n_1s_3$ | 2.24 | 2.23 | 2.33 | 2.25 | 2.28 |
| $n_2s_1$ | 1.90 | 1.89 | 1.96 | 1.89 | 1.89 |
| $n_2s_2$ | 2.14 | 2.12 | 2.31 | 2.24 | 2.26 |
| $n_2s_3$ | 2.30 | 2.32 | 2.38 | 2.34 | 2.29 |
| $n_3s_1$ | 1.89 | 1.91 | 2.02 | 1.93 | 1.89 |
| $n_3s_2$ | 2.15 | 2.28 | 2.41 | 2.30 | 2.24 |
| $n_3s_3$ | 2.24 | 2.34 | 2.47 | 2.38 | 2.37 |
| SEm (±) | 0.015 | 0.031 | 0.052 | 0.039 | 0.015 |
| CD (0.05) | 0.045 | NS | NS | NS | 0.044 |

NS- Not significant

Table 54c. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under partial shade condition during first year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 1.92 | 1.92 | 1.90 | 1.83 | 1.91 |
| $c_1n_1s_2$ | 2.08 | 2.08 | 2.22 | 2.22 | 2.14 |
| $c_1n_1s_3$ | 2.21 | 2.21 | 2.33 | 2.24 | 2.24 |
| $c_1n_2s_1$ | 1.89 | 1.89 | 1.94 | 1.90 | 1.90 |
| $c_1n_2s_2$ | 2.12 | 2.12 | 2.33 | 2.28 | 2.26 |
| $c_1n_2s_3$ | 2.33 | 2.33 | 2.35 | 2.37 | 2.28 |
| $c_1n_3s_1$ | 1.89 | 1.89 | 2.04 | 1.91 | 1.91 |
| $c_1n_3s_2$ | 2.10 | 2.10 | 2.44 | 2.36 | 2.24 |
| $c_1n_3s_3$ | 2.19 | 2.19 | 2.43 | 2.29 | 2.37 |
| $c_2n_1s_1$ | 1.91 | 1.91 | 1.92 | 1.89 | 1.91 |
| $c_2n_1s_2$ | 2.09 | 2.09 | 2.34 | 2.24 | 2.20 |
| $c_2n_1s_3$ | 2.27 | 2.27 | 2.33 | 2.26 | 2.33 |
| $c_2n_2s_1$ | 1.91 | 1.91 | 1.98 | 1.88 | 1.88 |
| $c_2n_2s_2$ | 2.17 | 2.17 | 2.29 | 2.20 | 2.27 |
| $c_2n_2s_3$ | 2.28 | 2.28 | 2.42 | 2.32 | 2.31 |
| $c_2n_3s_1$ | 1.90 | 1.90 | 2.01 | 1.95 | 1.87 |
| $c_2n_3s_2$ | 2.21 | 2.21 | 2.39 | 2.25 | 2.25 |
| $c_2n_3s_3$ | 2.29 | 2.29 | 2.50 | 2.47 | 2.37 |
| SEm (±) | 0.021 | 0.045 | 0.073 | 0.055 | 0.021 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

and spacing between first and second harvest and fifth and sixth harvest. The treatment combination $n_2s_3$ recorded highest RGR of 2.30 g $g^{-1}$ $day^{-1}$ in between first and second harvest and $n_3s_3$ recorded highest RGR of 2.37 g $g^{-1}$ $day^{-1}$ in between fifth and sixth harvest.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to RGR of palisade grass under partial shade condition in the second year are presented in Table 55a, 55b and 55c

A significant response was noticed by the treatments with cutting height on RGR only between fifth and sixth harvest. Among the two cutting patterns cutting at ground level recorded highest RGR of 2.01 g $g^{-1}$ $day^{-1}$. Regarding fertilizer treatments significant response was indicated between first and second harvest, second and third harvest and fifth and sixth harvest. Maximum RGR was registered with a fertilizer dose of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ between first and second harvest, second and third harvest whereas $N_2$ recorded highest RGR between fifth and sixth harvest. There was a significant influence of plant spacing treatments on RGR between all harvests. Among the different spacing treatments the highest RGR was observed in the 60 cm x 40 cm spacing treatment.

Significant interaction was observed between cutting height and nutrient levels between sixth and seventh harvest. The treatment combination $c_2n_3$ recorded highest RGR of 2.06 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between cutting height and spacing between second and third harvest. The treatment combination $c_2s_3$ recorded highest RGR of 2.22 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between nutrient level and spacing between fifth and sixth harvest. The treatment combination $n_3s_3$ recorded highest RGR of 2.12 g $g^{-1}$ $day^{-1}$.

Significant interaction was observed between cutting height, nutrient levels and spacing between fourth and fifth harvest, fifth and sixth harvest and sixth and seventh harvests. The treatment combination $c_1n_3s_3$ recorded highest RGR of

Table 55a. Effect of cutting pattern, nutrient levels and spacing on RGR under partial shade condition during second year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 2.081 | 2.080 | 2.067 | 2.032 | 2.016 | 2.016 |
| $C_2$ | 2.097 | 2.061 | 2.072 | 2.030 | 1.980 | 2.035 |
| SEm (±) | 0.009 | 0.010 | 0.020 | 0.009 | 0.006 | 0.007 |
| CD (0.05) | NS | NS | NS | NS | 0.020 | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 2.063 | 2.035 | 2.048 | 2.011 | 1.980 | 2.008 |
| $N_2$ | 2.089 | 2.073 | 2.061 | 2.040 | 2.009 | 2.033 |
| $N_3$ | 2.114 | 2.104 | 2.101 | 2.042 | 2.004 | 2.035 |
| SEm (±) | 0.011 | 0.012 | 0.025 | 0.011 | 0.008 | 0.009 |
| CD (0.05) | 0.032 | 0.037 | NS | NS | 0.024 | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | 1.895 | 1.905 | 1.897 | 1.893 | 1.888 | 1.887 |
| $S_2$ | 2.146 | 2.093 | 2.110 | 2.026 | 1.998 | 2.028 |
| $S_3$ | 2.227 | 2.214 | 2.202 | 2.174 | 2.107 | 2.161 |
| SEm (±) | 0.011 | 0.012 | 0.025 | 0.011 | 0.008 | 0.009 |
| CD (0.05) | 0.032 | 0.037 | 0.072 | 0.032 | 0.024 | 0.028 |

NS- Not significant

Table 55b. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under partial shade condition during second year, g $g^{-1}$ $day^{-1}$

| Treatments | RGR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 2.039 | 2.048 | 2.052 | 2.023 | 2.001 | 2.009 |
| $c_1n_2$ | 2.089 | 2.084 | 2.054 | 2.047 | 2.028 | 2.036 |
| $c_1n_3$ | 2.114 | 2.109 | 2.096 | 2.027 | 2.018 | 2.002 |
| $c_2n_1$ | 2.088 | 2.022 | 2.043 | 1.999 | 1.959 | 2.007 |
| $c_2n_2$ | 2.090 | 2.061 | 2.068 | 2.033 | 1.991 | 2.030 |
| $c_2n_3$ | 2.114 | 2.100 | 2.106 | 2.058 | 1.990 | 2.068 |
| SEm (±) | 0.015 | 0.018 | 0.035 | 0.015 | 0.012 | 0.013 |
| CD (0.05) | NS | NS | NS | NS | NS | 0.039 |
| $c_1s_1$ | 1.890 | 1.900 | 1.896 | 1.893 | 1.890 | 1.888 |
| $c_1s_2$ | 2.143 | 2.140 | 2.124 | 2.014 | 2.022 | 2.017 |
| $c_1s_3$ | 2.209 | 2.201 | 2.182 | 2.189 | 2.134 | 2.142 |
| $c_2s_1$ | 1.900 | 1.910 | 1.899 | 1.893 | 1.887 | 1.886 |
| $c_2s_2$ | 2.148 | 2.047 | 2.096 | 2.037 | 1.974 | 2.040 |
| $c_2s_3$ | 2.244 | 2.227 | 2.222 | 2.160 | 2.079 | 2.179 |
| SEm (±) | 0.015 | 0.018 | 0.035 | 0.015 | 0.012 | 0.013 |
| CD (0.05) | NS | 0.053 | NS | NS | NS | NS |
| $n_1s_1$ | 1.893 | 1.898 | 1.887 | 1.893 | 1.877 | 1.888 |
| $n_1s_2$ | 2.102 | 2.047 | 2.068 | 2.002 | 1.953 | 2.007 |
| $n_1s_3$ | 2.195 | 2.160 | 2.188 | 2.138 | 2.110 | 2.128 |
| $n_2s_1$ | 1.893 | 1.902 | 1.897 | 1.892 | 1.892 | 1.883 |
| $n_2s_2$ | 2.170 | 2.083 | 2.107 | 2.042 | 2.048 | 2.030 |
| $n_2s_3$ | 2.205 | 2.233 | 2.180 | 2.187 | 2.088 | 2.185 |
| $n_3s_1$ | 1.898 | 1.915 | 1.908 | 1.895 | 1.897 | 1.888 |
| $n_3s_2$ | 2.165 | 2.150 | 2.155 | 2.033 | 1.993 | 2.048 |
| $n_3s_3$ | 2.280 | 2.248 | 2.238 | 2.198 | 2.122 | 2.168 |
| SEm (±) | 0.019 | 0.022 | 0.043 | 0.019 | 0.014 | 0.016 |
| CD (0.05) | NS | NS | NS | NS | 0.042 | NS |

NS- Not significant

Table 55c. Interaction effect of cutting pattern, nutrient levels and spacing on RGR under partial shade condition during second year, g g$^{-1}$ day$^{-1}$

| Treatments | RGR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1s_1$ | 1.890 | 1.903 | 1.907 | 1.903 | 1.873 | 1.900 |
| $c_1n_1s_2$ | 2.083 | 2.060 | 2.077 | 2.040 | 1.957 | 2.037 |
| $c_1n_1s_3$ | 2.143 | 2.180 | 2.173 | 2.127 | 2.173 | 2.090 |
| $c_1n_2s_1$ | 1.890 | 1.893 | 1.880 | 1.890 | 1.897 | 1.890 |
| $c_1n_2s_2$ | 2.183 | 2.140 | 2.103 | 2.037 | 2.107 | 2.030 |
| $c_1n_2s_3$ | 2.193 | 1.893 | 2.180 | 2.213 | 2.080 | 2.187 |
| $c_1n_3s_1$ | 1.890 | 2.140 | 1.900 | 1.887 | 1.900 | 1.873 |
| $c_1n_3s_2$ | 2.163 | 2.220 | 2.193 | 1.967 | 2.003 | 1.983 |
| $c_1n_3s_3$ | 2.290 | 1.903 | 2.193 | 2.227 | 2.150 | 2.150 |
| $c_2n_1s_1$ | 1.897 | 2.220 | 1.867 | 1.883 | 1.880 | 1.877 |
| $c_2n_1s_2$ | 2.120 | 2.203 | 2.060 | 1.963 | 1.950 | 1.977 |
| $c_2n_1s_3$ | 2.247 | 1.893 | 2.203 | 2.150 | 2.047 | 2.167 |
| $c_2n_2s_1$ | 1.897 | 2.033 | 1.913 | 1.893 | 1.887 | 1.877 |
| $c_2n_2s_2$ | 2.157 | 2.140 | 2.110 | 2.047 | 1.990 | 2.030 |
| $c_2n_2s_3$ | 2.217 | 1.910 | 2.180 | 2.160 | 2.097 | 2.183 |
| $c_2n_3s_1$ | 1.907 | 2.027 | 1.917 | 1.903 | 1.893 | 1.903 |
| $c_2n_3s_2$ | 2.167 | 2.247 | 2.117 | 2.100 | 1.983 | 2.113 |
| $c_2n_3s_3$ | 2.270 | 1.927 | 2.283 | 2.170 | 2.093 | 2.187 |
| SEm (±) | 0.027 | 0.031 | 0.061 | 0.026 | 0.020 | 0.023 |
| CD (0.05) | NS | NS | NS | 0.077 | 0.060 | 0.068 |

NS- Not significant

2.22 g $g^{-1}$ $day^{-1}$ between fourth and fifth harvest, $c_1n_1s_3$ recorded highest RGR of 2.17 g $g^{-1}$ $day^{-1}$ between fifth and sixth harvest and $c_1n_2s_3$ and $c_2n_3s_3$ recorded highest RGR of 2.18 g $g^{-1}$ $day^{-1}$ between sixth and seventh harvests

#### *4.2.3.4 Crop Growth Rate*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to CGR of palisade grass under partial shade condition in the first year are presented in Table 56a, 56b and 56c.

A significant response was not noticed by the cutting treatments on CGR. A significant variation was observed by the treatments involving chemical fertilizer between second and third harvest. $N_3$ recorded highest CGR of 4.36 g $m^{-2}$ $day^{-1}$. There was a significant influence of plant spacing treatments on CGR between first and second harvest. Among the different spacing treatments the highest CGR of 2.76 g $m^{-2}$ $day^{-1}$ was observed by $S_3$.

No significant interaction effect was noticed on the CGR.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to CGR of palisade grass under partial shade condition in the second year are presented in Table 57a, 57b and 57c.

A significant response was noticed by the treatments with cutting height on CGR only between sixth and seventh harvest. Among the two cutting patterns cutting at 10 cm from ground level recorded highest CGR of 1.77 g $m^{-2}$ $day^{-1}$. Regarding fertilizer treatments no significant response was indicated. There was significant influence of plant spacing treatments on CGR between second and third harvest and fifth and sixth harvests. The highest CGR was recorded with a spacing of 60 cm x 20 cm.

Significant interaction was observed between cutting height and spacing between second and third harvest. The treatment combination $c_2s_1$ recorded highest CGR of 0.44 g $m^{-2}$ $day^{-1}$. Significant interaction was observed between nutrient and spacing between sixth and seventh harvest. The treatment

Table 56a. Effect of cutting pattern, nutrient levels and spacing on CGR under partial shade condition during first year, g $m^{-2}$ $day^{-1}$

| Treatments | CGR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 0.91 | 1.54 | 5.99 | -3.07 | -1.64 |
| $C_2$ | 2.24 | 1.26 | 7.58 | -5.83 | -0.76 |
| SEm (±) | 0.479 | 0.738 | 2.084 | 2.059 | 0.911 |
| CD (0.05) | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 1.47 | -0.06 | 5.93 | -3.61 | -0.28 |
| $N_2$ | 2.15 | -0.08 | 6.22 | -3.41 | -0.69 |
| $N_3$ | 1.09 | 4.36 | 8.21 | -6.33 | -2.63 |
| SEm (±) | 0.590 | 0.906 | 2.553 | 2.518 | 1.116 |
| CD (0.05) | NS | 2.609 | NS | NS | NS |
| **Spacing (S)** | | | | | |
| $S_1$ | 0.60 | -0.22 | 3.15 | -3.01 | -0.10 |
| $S_2$ | 1.35 | 2.52 | 10.46 | -5.74 | -2.17 |
| $S_3$ | 2.76 | 1.91 | 6.75 | -4.60 | -1.33 |
| SEm (±) | 0.590 | 0.906 | 2.553 | 2.518 | 1.116 |
| CD (0.05) | 1.701 | NS | NS | NS | NS |

NS- Not significant

Table 56b. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under partial shade condition during first year, g m$^{-2}$ day$^{-1}$

| Treatments | CGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 0.90 | 0.29 | 3.48 | -1.83 | -0.86 |
| $c_1n_2$ | 2.28 | -0.35 | 5.80 | -1.07 | -2.25 |
| $c_1n_3$ | -0.45 | 4.68 | 8.70 | -6.30 | -1.81 |
| $c_2n_1$ | 2.04 | -0.42 | 8.38 | -5.39 | 0.29 |
| $c_2n_2$ | 2.02 | 0.18 | 6.65 | -5.75 | 0.86 |
| $c_2n_3$ | 2.64 | 4.05 | 7.72 | -6.36 | -3.44 |
| SEm (±) | 0.834 | 1.275 | 3.612 | 3.562 | 1.577 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 0.61 | -0.01 | 2.78 | -3.16 | 0.48 |
| $c_1s_2$ | -0.16 | 2.55 | 10.82 | -3.10 | -4.50 |
| $c_1s_3$ | 2.28 | 2.07 | 4.37 | -2.94 | -0.92 |
| $c_2s_1$ | 0.59 | -0.43 | 3.52 | -2.86 | -0.70 |
| $c_2s_2$ | 2.88 | 2.48 | 10.10 | -8.37 | 0.16 |
| $c_2s_3$ | 3.24 | 1.75 | 9.14 | -6.26 | -1.74 |
| SEm (±) | 0.834 | 1.275 | 3.612 | 3.562 | 1.577 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 0.74 | -1.01 | 1.07 | -1.88 | 1.68 |
| $n_1s_2$ | 0.79 | 1.13 | 9.92 | -3.46 | -3.58 |
| $n_1s_3$ | 2.88 | -0.31 | 6.80 | -5.48 | 1.03 |
| $n_2s_1$ | 0.59 | -0.38 | 3.17 | -3.04 | -0.01 |
| $n_2s_2$ | 1.40 | -0.84 | 10.70 | -4.41 | 1.23 |
| $n_2s_3$ | 4.46 | 0.97 | 4.80 | -2.77 | -3.31 |
| $n_3s_1$ | 0.47 | 0.74 | 5.21 | -4.11 | -2.00 |
| $n_3s_2$ | 1.86 | 7.27 | 10.76 | -9.34 | -4.16 |
| $n_3s_3$ | 0.94 | 5.08 | 8.65 | -5.54 | -1.72 |
| SEm (±) | 1.023 | 1.566 | 4.428 | 4.363 | 1.932 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 56c. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under partial shade condition during first year, g m$^{-2}$ day$^{-1}$

| Treatments | CGR | | | | |
|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 0.94 | -1.16 | 0.48 | -2.35 | 2.43 |
| $c_1n_1s_2$ | 0.35 | 0.35 | 6.03 | 0.47 | -4.16 |
| $c_1n_1s_3$ | 1.40 | 1.70 | 3.94 | -3.61 | -0.87 |
| $c_1n_2s_1$ | 0.45 | 0.60 | 1.81 | -1.87 | -0.14 |
| $c_1n_2s_2$ | 0.09 | -0.50 | 12.65 | -3.05 | -1.39 |
| $c_1n_2s_3$ | 6.31 | -1.15 | 2.93 | 1.70 | -5.21 |
| $c_1n_3s_1$ | 0.45 | 0.55 | 6.05 | -5.27 | -0.82 |
| $c_1n_3s_2$ | -0.94 | 7.82 | 13.79 | -6.73 | -7.94 |
| $c_1n_3s_3$ | -0.87 | 5.68 | 6.25 | -6.91 | 3.31 |
| $c_2n_1s_1$ | 0.54 | -0.86 | 1.66 | -1.42 | 0.94 |
| $c_2n_1s_2$ | 1.24 | 1.91 | 13.81 | -7.40 | -3.01 |
| $c_2n_1s_3$ | 4.35 | -2.32 | 9.67 | -7.35 | 2.94 |
| $c_2n_2s_1$ | 0.74 | -1.38 | 4.53 | -4.22 | 0.13 |
| $c_2n_2s_2$ | 2.72 | -1.18 | 8.75 | -5.77 | 3.87 |
| $c_2n_2s_3$ | 2.62 | 3.11 | 6.68 | -7.26 | -1.40 |
| $c_2n_3s_1$ | 0.49 | 0.93 | 4.38 | -2.94 | -3.17 |
| $c_2n_3s_2$ | 4.67 | 6.73 | 7.73 | -11.95 | -0.38 |
| $c_2n_3s_3$ | 2.77 | 4.49 | 11.06 | -4.18 | -6.77 |
| SEm (±) | 1.446 | 2.212 | 6.259 | 6.170 | 2.733 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 57a. Effect of cutting pattern, nutrient levels and spacing on CGR under partial shade condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | CGR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 0.62 | 0.07 | -0.58 | -1.38 | -0.61 | -0.01 |
| $C_2$ | 0.87 | -1.40 | 0.51 | -2.14 | -1.66 | 1.77 |
| SEm (±) | 0.665 | 0.515 | 1.398 | 1.021 | 0.420 | 0.384 |
| CD (0.05) | NS | NS | NS | NS | NS | 1.106 |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 0.91 | -1.02 | 0.98 | -1.40 | -0.97 | 0.81 |
| $N_2$ | 1.07 | -0.72 | -1.37 | -0.97 | -1.06 | 0.72 |
| $N_3$ | 0.27 | -0.26 | 0.28 | -2.91 | -1.37 | 1.09 |
| SEm (±) | 0.813 | 0.634 | 1.714 | 1.251 | 0.515 | 0.470 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | 0.29 | 0.43 | -0.26 | -0.18 | -0.18 | -0.01 |
| $S_2$ | 1.52 | -1.93 | 0.09 | -3.40 | -0.98 | 0.98 |
| $S_3$ | 0.43 | -0.50 | 0.06 | -1.69 | -2.24 | 1.66 |
| SEm (±) | 0.813 | 0.634 | 1.714 | 1.251 | 0.515 | 0.470 |
| CD (0.05) | NS | 1.828 | NS | NS | 1.484 | NS |

NS- Not significant

Table 57b. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under partial shade condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | CGR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | -0.39 | 0.37 | -0.01 | -1.01 | -0.75 | 0.21 |
| $c_1n_2$ | 1.59 | -0.21 | -1.29 | -0.45 | -0.61 | 0.19 |
| $c_1n_3$ | 0.67 | 0.04 | -0.46 | -2.68 | -0.46 | -0.45 |
| $c_2n_1$ | 2.21 | -2.41 | 1.97 | -1.79 | -1.20 | 1.40 |
| $c_2n_2$ | 0.54 | -1.23 | -1.45 | -1.50 | -1.50 | 1.26 |
| $c_2n_3$ | -0.13 | -0.57 | 1.03 | -3.13 | -2.28 | 2.65 |
| SEm (±) | 1.152 | 0.895 | 2.423 | 1.772 | 0.728 | 0.662 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | -0.19 | 0.41 | -0.23 | 0.01 | -0.13 | -0.08 |
| $c_1s_2$ | 2.11 | 0.21 | -0.87 | -4.26 | 0.18 | -0.25 |
| $c_1s_3$ | -0.03 | -0.42 | -0.65 | 0.10 | -1.88 | 0.29 |
| $c_2s_1$ | 0.78 | 0.44 | -0.30 | -0.37 | -0.23 | 0.06 |
| $c_2s_2$ | 0.93 | -4.09 | 1.06 | -2.55 | -2.16 | 2.21 |
| $c_2s_3$ | 0.90 | -0.58 | 0.79 | -3.49 | -2.60 | 3.04 |
| SEm (±) | 1.152 | 0.895 | 2.423 | 1.772 | 0.728 | 0.662 |
| CD (0.05) | NS | 2.579 | NS | NS | NS | NS |
| $n_1s_1$ | -0.06 | 0.25 | -0.40 | 0.26 | -0.60 | 0.40 |
| $n_1s_2$ | 1.30 | -1.96 | 1.91 | -2.26 | -1.55 | 1.62 |
| $n_1s_3$ | 1.49 | -1.35 | 1.43 | -2.20 | -0.77 | 0.40 |
| $n_2s_1$ | -0.03 | 0.38 | -0.21 | -0.23 | -0.01 | -0.21 |
| $n_2s_2$ | 4.74 | -3.62 | -2.23 | -2.57 | 0.20 | -0.76 |
| $n_2s_3$ | -1.52 | 1.07 | -1.67 | -0.13 | -3.37 | 3.15 |
| $n_3s_1$ | 0.95 | 0.66 | -0.18 | -0.59 | 0.06 | -0.22 |
| $n_3s_2$ | -1.47 | -0.22 | 0.59 | -5.39 | -1.61 | 2.07 |
| $n_3s_3$ | 1.33 | -1.22 | 0.44 | -2.74 | -2.57 | 1.44 |
| SEm (±) | 1.412 | 1.095 | 2.968 | 2.172 | 0.890 | 0.809 |
| CD (0.05) | NS | NS | NS | NS | NS | 2.330 |

NS- Not significant

Table 57c. Interaction effect of cutting pattern, nutrient levels and spacing on CGR under partial shade condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | CGR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| $c_1n_1s_1$ | -0.29 | 0.53 | 0.07 | 0.08 | -1.14 | 0.86 |
| $c_1n_1s_2$ | -0.04 | -0.59 | -0.06 | -1.37 | -2.66 | 2.50 |
| $c_1n_1s_3$ | -0.84 | 1.18 | -0.04 | -1.74 | 1.54 | -2.72 |
| $c_1n_2s_1$ | -0.34 | 0.26 | -0.59 | 0.29 | 0.31 | -0.18 |
| $c_1n_2s_2$ | 6.03 | -1.93 | -1.87 | -2.58 | 2.32 | -2.82 |
| $c_1n_2s_3$ | -0.89 | 1.03 | -1.40 | 0.92 | -4.47 | 3.58 |
| $c_1n_3s_1$ | 0.05 | 0.46 | -0.17 | -0.37 | 0.43 | -0.92 |
| $c_1n_3s_2$ | 0.35 | 3.16 | -0.69 | -8.83 | 0.90 | -0.44 |
| $c_1n_3s_3$ | 1.63 | -3.48 | -0.52 | 1.14 | -2.72 | 0.01 |
| $c_2n_1s_1$ | 0.17 | -0.01 | -0.88 | 0.45 | -0.06 | -0.06 |
| $c_2n_1s_2$ | 2.66 | -3.34 | 3.89 | -3.16 | -0.44 | 0.74 |
| $c_2n_1s_3$ | 3.82 | -3.89 | 2.91 | -2.66 | -3.09 | 3.53 |
| $c_2n_2s_1$ | 0.33 | 0.49 | 0.17 | -0.76 | -0.33 | -0.24 |
| $c_2n_2s_2$ | 3.44 | -5.31 | -2.58 | -2.55 | -1.91 | 1.30 |
| $c_2n_2s_3$ | -2.15 | 1.11 | -1.94 | -1.18 | -2.28 | 2.72 |
| $c_2n_3s_1$ | 1.86 | 0.85 | -0.18 | -0.80 | -0.30 | 0.48 |
| $c_2n_3s_2$ | -3.30 | -3.61 | 1.88 | -1.95 | -4.13 | 4.59 |
| $c_2n_3s_3$ | 1.03 | 1.04 | 1.40 | -6.63 | -2.43 | 2.87 |
| SEm (±) | 1.996 | 1.549 | 4.197 | 3.070 | 1.262 | 1.149 |
| CD (0.05) | NS | NS | NS | NS | 3.635 | 3.309 |

NS- Not significant

combination $n_3s_2$ recorded highest CGR of 2.07 g $m^{-2}$ $day^{-1}$. Significant interaction was observed between cutting height, nutrient and spacing between fifth and sixth harvests and sixth and seventh harvests. Between fifth and sixth harvests $c_2n_2s_2$ recorded highest CGR of 2.32 g $m^{-2}$ $day^{-1}$. Between sixth and seventh harvests $c_2n_3s_2$ recorded highest CGR of 4.59 g $m^{-2}$ $day^{-1}$.

### *4.2.3.5 Net Assimilation Rate*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to NAR of palisade grass under partial shade condition in the first year are presented in Table 58a, 58b and 58c.

A significant response was not noticed by the cutting treatments on NAR. A significant variation was observed by the treatments involving chemical fertilizer only between second and third harvest. $N_3$ recorded highest NAR of 0.007 g $m^{-2}$ $day^{-1}$. There was a significant influence of plant spacing treatments on NAR between first and second harvests. Among the different spacing treatments the highest NAR of 0.007 g $m^{-2}$ $day^{-1}$ was observed by $S_3$.

None of the interactions was found to have significant influence on NAR.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to NAR of palisade grass under partial shade condition in the second year are presented in Table 59a, 59b and 59c.

A significant response was not noticed by the treatments with cutting height on NAR Regarding fertilizer treatments no significant response was indicated between all harvests. There was a significant influence of plant spacing treatments on NAR between fifth and sixth harvests. The highest NAR was recorded by 60 cm x 40 cm spacing.

None of the interactions was found to have significant influence on NAR.

Table 58a. Effect of cutting pattern, nutrient levels and spacing on NAR under partial shade condition during first year, g m$^{-2}$ day$^{-1}$

| Treatments | NAR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 0.003 | 0.003 | 0.009 | -0.004 | -0.003 |
| $C_2$ | 0.004 | 0.002 | 0.012 | -0.011 | -0.001 |
| SEm (±) | 0.0010 | 0.0013 | 0.0038 | 0.0038 | 0.0017 |
| CD (0.05) | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 0.003 | 0.001 | 0.011 | -0.007 | -0.001 |
| $N_2$ | 0.005 | 0.001 | 0.009 | -0.006 | -0.002 |
| $N_3$ | 0.002 | 0.007 | 0.011 | -0.009 | -0.004 |
| SEm (±) | 0.0013 | 0.0017 | 0.0045 | 0.0045 | 0.0020 |
| CD (0.05) | NS | 0.005 | NS | NS | NS |
| **Spacing (S)** | | | | | |
| $S_1$ | 0.001 | -0.001 | 0.003 | -0.004 | 0.001 |
| $S_2$ | 0.002 | 0.004 | 0.018 | -0.010 | -0.004 |
| $S_3$ | 0.007 | 0.004 | 0.011 | -0.008 | -0.002 |
| SEm (±) | 0.0013 | 0.0017 | 0.0045 | 0.0045 | 0.0020 |
| CD (0.05) | 0.004 | NS | NS | NS | NS |

NS- Not significant

Table 58b. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under partial shade condition during first year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1$ | 0.002 | 0.001 | 0.007 | -0.003 | -0.002 |
| $c_1n_2$ | 0.006 | -0.001 | 0.009 | -0.002 | -0.004 |
| $c_1n_3$ | -0.001 | 0.008 | 0.011 | -0.008 | -0.003 |
| $c_2n_1$ | 0.004 | -0.001 | 0.016 | -0.011 | 0.001 |
| $c_2n_2$ | 0.004 | 0.001 | 0.010 | -0.010 | -0.001 |
| $c_2n_3$ | 0.005 | 0.006 | 0.012 | -0.010 | -0.006 |
| SEm (±) | 0.0017 | 0.0024 | 0.0062 | 0.0065 | 0.0031 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 0.001 | -0.001 | 0.002 | -0.004 | 0.001 |
| $c_1s_2$ | -0.001 | 0.004 | 0.017 | -0.005 | -0.007 |
| $c_1s_3$ | 0.007 | 0.004 | 0.007 | -0.005 | -0.003 |
| $c_2s_1$ | 0.001 | -0.001 | 0.004 | -0.004 | -0.001 |
| $c_2s_2$ | 0.005 | 0.004 | 0.018 | -0.016 | -0.002 |
| $c_2s_3$ | 0.007 | 0.003 | 0.015 | -0.011 | -0.002 |
| SEm (±) | 0.0017 | 0.0024 | 0.0062 | 0.0065 | 0.0031 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 0.002 | -0.002 | 0.001 | -0.003 | 0.003 |
| $n_1s_2$ | 0.001 | 0.002 | 0.022 | -0.008 | -0.006 |
| $n_1s_3$ | 0.006 | -0.002 | 0.011 | -0.011 | 0.001 |
| $n_2s_1$ | 0.001 | -0.001 | 0.003 | -0.004 | -0.002 |
| $n_2s_2$ | 0.003 | -0.002 | 0.018 | -0.008 | -0.002 |
| $n_2s_3$ | 0.013 | 0.002 | 0.007 | -0.005 | -0.004 |
| $n_3s_1$ | 0.001 | 0.001 | 0.005 | -0.005 | -0.003 |
| $n_3s_2$ | 0.003 | 0.012 | 0.014 | -0.014 | -0.006 |
| $n_3s_3$ | 0.002 | 0.009 | 0.016 | -0.008 | -0.004 |
| SEm (±) | 0.0020 | 0.0027 | 0.0076 | 0.0079 | 0.0038 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 58c. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under partial shade condition during first year, g m$^{-2}$ day$^{-1}$

| Treatments | NAR | | | | |
|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1s_1$ | 0.003 | -0.002 | -0.002 | -0.002 | 0.004 |
| $c_1n_1s_2$ | 0.001 | 0.001 | 0.014 | 0.002 | -0.007 |
| $c_1n_1s_3$ | 0.003 | 0.004 | 0.007 | -0.008 | -0.004 |
| $c_1n_2s_1$ | 0.001 | 0.001 | 0.002 | -0.003 | -0.002 |
| $c_1n_2s_2$ | 0.001 | -0.001 | 0.020 | -0.005 | -0.002 |
| $c_1n_2s_3$ | 0.019 | -0.002 | 0.005 | 0.003 | -0.009 |
| $c_1n_3s_1$ | 0.001 | 0.002 | 0.006 | -0.006 | -0.001 |
| $c_1n_3s_2$ | -0.002 | 0.013 | 0.018 | -0.009 | -0.012 |
| $c_1n_3s_3$ | -0.002 | 0.010 | 0.009 | -0.009 | 0.005 |
| $c_2n_1s_1$ | 0.001 | -0.001 | 0.003 | -0.003 | 0.002 |
| $c_2n_1s_2$ | 0.002 | 0.004 | 0.030 | -0.017 | -0.004 |
| $c_2n_1s_3$ | 0.008 | -0.004 | 0.014 | -0.014 | 0.007 |
| $c_2n_2s_1$ | 0.001 | -0.002 | 0.005 | -0.006 | 0.001 |
| $c_2n_2s_2$ | 0.005 | -0.002 | 0.015 | -0.011 | -0.001 |
| $c_2n_2s_3$ | 0.006 | 0.007 | 0.009 | -0.013 | 0.001 |
| $c_2n_3s_1$ | 0.001 | 0.001 | 0.005 | -0.004 | -0.004 |
| $c_2n_3s_2$ | 0.008 | 0.010 | 0.009 | -0.020 | -0.002 |
| $c_2n_3s_3$ | 0.007 | 0.008 | 0.022 | -0.007 | -0.012 |
| SEm (±) | 0.0031 | 0.0035 | 0.0111 | 0.0111 | 0.0052 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 59a. Effect of cutting pattern, nutrient levels and spacing on NAR under partial shade condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | -1.703 | -0.001 | -0.001 | -0.002 | 0.002 | 0.001 |
| $C_2$ | 0.001 | -0.003 | 0.001 | -0.004 | 0.004 | -3.552 |
| SEm (±) | 1.2020 | 0.0010 | 0.0020 | 0.0020 | 0.0060 | 2.5090 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 0.001 | -0.003 | 0.001 | -0.003 | 0.003 | -5.332 |
| $N_2$ | -2.554 | -0.001 | -0.001 | -0.001 | 0.003 | 0.002 |
| $N_3$ | 0.001 | -0.001 | 0.001 | -0.005 | 0.003 | 0.002 |
| SEm (±) | 1.4730 | 0.0013 | 0.0027 | 0.0024 | 0.0010 | 3.0730 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | 0.001 | 0.001 | -0.001 | 0.001 | 0.001 | 0.001 |
| $S_2$ | -2.553 | -0.004 | 0.001 | -0.006 | 0.002 | -5.331 |
| $S_3$ | 0.001 | -0.002 | -0.001 | -0.004 | 0.005 | 0.004 |
| SEm (±) | 1.4730 | 0.0013 | 0.0027 | 0.0024 | 0.0010 | 3.0730 |
| CD (0.05) | NS | NS | NS | NS | 0.003 | NS |

NS- Not significant

Table 59b. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under partial shade condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | -0.001 | -0.001 | 0.002 | -0.002 | 0.002 | 0.001 |
| $c_1n_2$ | -5.108 | -0.001 | -0.002 | -0.002 | 0.002 | 0.001 |
| $c_1n_3$ | 0.001 | -0.006 | -0.001 | -0.004 | 0.001 | -0.001 |
| $c_2n_1$ | 0.004 | -0.006 | 0.002 | -0.004 | 0.004 | -10.663 |
| $c_2n_2$ | 0.002 | -0.002 | -0.002 | -0.002 | 0.004 | 0.003 |
| $c_2n_3$ | -0.001 | -0.001 | 0.002 | -0.007 | 0.004 | 0.005 |
| SEm (±) | 2.0837 | 0.0017 | 0.0038 | 0.0034 | 0.0013 | 4.3466 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | -0.002 | 0.001 | -0.002 | 0.001 | 0.001 | 0.001 |
| $c_1s_2$ | -5.107 | -0.001 | -0.002 | -0.007 | 0.001 | 0.001 |
| $c_1s_3$ | -0.001 | -0.001 | -0.001 | 0.002 | 0.004 | 0.004 |
| $c_2s_1$ | 0.001 | 0.001 | -0.001 | -0.001 | 0.001 | 0.001 |
| $c_2s_2$ | 0.001 | -0.007 | 0.004 | -0.005 | 0.004 | -10.663 |
| $c_2s_3$ | 0.002 | -0.002 | 0.001 | -0.007 | 0.007 | 0.008 |
| SEm (±) | 2.0837 | 0.0017 | 0.0038 | 0.0034 | 0.0013 | 4.3466 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | -0.001 | 0.002 | -0.001 | 0.002 | 0.002 | 0.001 |
| $n_1s_2$ | 0.001 | -0.004 | 0.001 | -0.004 | 0.004 | -15.997 |
| $n_1s_3$ | 0.003 | -0.005 | 0.003 | -0.005 | 0.002 | 0.001 |
| $n_2s_1$ | 0.002 | 0.002 | -0.001 | 0.001 | -0.001 | -0.001 |
| $n_2s_2$ | -7.658 | -0.007 | 0.001 | -0.004 | 0.001 | -0.001 |
| $n_2s_3$ | -0.003 | 0.002 | -0.004 | 0.001 | 0.008 | 0.008 |
| $n_3s_1$ | 0.001 | 0.001 | -0.001 | -0.001 | -0.001 | -0.004 |
| $n_3s_2$ | -0.003 | -0.001 | 0.001 | -0.009 | 0.003 | 0.004 |
| $n_3s_3$ | 0.003 | -0.002 | 0.001 | -0.006 | 0.005 | 0.003 |
| SEm (±) | 2.5519 | 0.0020 | 0.0045 | 0.0041 | 0.0017 | 5.3237 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 59c. Interaction effect of cutting pattern, nutrient levels and spacing on NAR under partial shade condition during second year, g $m^{-2}$ $day^{-1}$

| Treatments | NAR | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | -0.001 | 0.001 | -0.001 | 0.002 | 0.002 | 0.001 |
| $c_1n_1s_2$ | -0.002 | -0.001 | 0.001 | -0.002 | 0.006 | 0.005 |
| $c_1n_1s_3$ | -0.002 | 0.001 | 0.001 | -0.004 | -0.004 | -0.006 |
| $c_1n_2s_1$ | -0.001 | 0.004 | -0.001 | 0.003 | -0.002 | -0.001 |
| $c_1n_2s_2$ | -15.322 | -0.004 | -0.004 | -0.005 | -0.003 | -0.004 |
| $c_1n_2s_3$ | -0.002 | 0.002 | -0.003 | 0.002 | 0.010 | 0.007 |
| $c_1n_3s_1$ | 0.002 | 0.002 | -0.003 | -0.002 | -0.001 | -0.001 |
| $c_1n_3s_2$ | 0.002 | 0.005 | -0.002 | -0.013 | -0.002 | -0.001 |
| $c_1n_3s_3$ | 0.004 | -0.006 | -0.002 | 0.002 | 0.005 | 0.001 |
| $c_2n_1s_1$ | 0.004 | 0.002 | -0.001 | 0.001 | 0.002 | -0.001 |
| $c_2n_1s_2$ | 0.003 | -0.006 | 0.002 | -0.006 | 0.001 | -0.001 |
| $c_2n_1s_3$ | 0.009 | -0.011 | 0.007 | -0.006 | 0.008 | 0.008 |
| $c_2n_2s_1$ | 0.003 | 0.001 | 0.002 | -0.001 | 0.004 | -0.004 |
| $c_2n_2s_2$ | 0.006 | -0.010 | 0.005 | -0.004 | 0.004 | 0.003 |
| $c_2n_2s_3$ | -0.005 | 0.002 | -0.006 | -0.001 | 0.007 | 0.008 |
| $c_2n_3s_1$ | 0.002 | 0.001 | -0.002 | -0.001 | 0.002 | 0.001 |
| $c_2n_3s_2$ | -0.005 | -0.005 | 0.004 | -0.005 | 0.007 | 0.008 |
| $c_2n_3s_3$ | 0.002 | 0.002 | 0.002 | -0.014 | 0.005 | 0.007 |
| SEm (±) | 3.6080 | 0.0031 | 0.0062 | 0.0059 | 0.0034 | 7.5290 |
| CD (0.05) | NS | NS | NS | NS | 0.010 | NS |

NS- Not significant

*4.2.3.6 Per Day Productivity*

The different treatments involving cutting height showed significant effect on per day productivity in the first year whereas no significance was noticed in the second year (Table 60a, 60b and 60c). The cutting treatments of 10 cm from ground level produced maximum per day productivity of 0.36 t $ha^{-1}$ $day^{-1}$. The per day productivity was significantly influenced by the chemical fertilizer treatments in both the years. $N_3$ was observed to be significantly superior to $N_2$ and $N_1$. The different spacing treatments showed significant effect on per day productivity in both the years. Among the different spacing treatments $S_3$ recorded highest per day productivity of 0.40 t $ha^{-1}$ $day^{-1}$ in first year whereas $S_1$ recorded highest per day productivity of 0.39 t $ha^{-1}$ $day^{-1}$ in second year.

Significant interaction was observed between cutting height and spacing in the second year. The treatment combination $c_2s_1$ recorded highest per day productivity of 0.30 t $ha^{-1}$ $day^{-1}$ .

**4.2.4 Quality Studies**

***4.2.4.1 Crude Protein Content***

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to crude protein content of palisade grass under partial shade condition in the first year are presented in Table 61a, 61b and 61c.

The effect of cutting pattern on crude protein content was noticed on all harvest except first and sixth harvest. The crude protein content was increased by increasing the cutting height to 10 cm from ground level. Among the fertilizer treatments, the highest nutrient level recorded the highest protein content in all the harvests except first and fifth harvest. In the third harvest $N_3$ recorded highest protein content of 9.08 % whereas in second, fourth and sixth harvest $N_3$ was found to be on a par with $N_2$. Among the different spacing treatments significant effect was noticed in second and fifth harvest. In the second harvest the maximum crude protein content of 8.98 % was observed in the 60 cm x 40 cm

Table 60a. Effect of cutting pattern, nutrient levels and spacing on per day productivity under partial shade condition, t ha$^{-1}$ day$^{-1}$

| Treatments | Per day productivity | |
|---|---|---|
| | **First year** | **Second year** |
| **Cutting pattern (C)** | | |
| $C_1$ | 0.34 | 0.28 |
| $C_2$ | 0.36 | 0.28 |
| SEm (±) | 0.006 | 0.005 |
| CD (0.05) | 0.019 | NS |
| **Nutrient levels (N)** | | |
| $N_1$ | 0.30 | 0.26 |
| $N_2$ | 0.34 | 0.28 |
| $N_3$ | 0.40 | 0.30 |
| SEm (±) | 0.007 | 0.002 |
| CD (0.05) | 0.023 | 0.008 |
| **Spacing (S)** | | |
| $S_1$ | 0.30 | 0.29 |
| $S_2$ | 0.34 | 0.27 |
| $S_3$ | 0.40 | 0.27 |
| SEm (±) | 0.007 | 0.003 |
| CD (0.05) | 0.023 | 0.010 |

NS- Not significant

Table 60b. Interaction effect of cutting pattern, nutrient levels and spacing on per day productivity under partial shade condition, t $ha^{-1}$ $day^{-1}$

| Treatments | Per day productivity | |
|---|---|---|
| | **First year** | **Second year** |
| $c_1n_1$ | 0.29 | 0.26 |
| $c_1n_2$ | 0.34 | 0.28 |
| $c_1n_3$ | 0.39 | 0.30 |
| $c_2n_1$ | 0.30 | 0.26 |
| $c_2n_2$ | 0.35 | 0.28 |
| $c_2n_3$ | 0.42 | 0.30 |
| SEm (±) | 0.003 | 0.005 |
| CD (0.05) | NS | NS |
| $c_1s_1$ | 0.37 | 0.29 |
| $c_1s_2$ | 0.34 | 0.28 |
| $c_1s_3$ | 0.31 | 0.27 |
| $c_2s_1$ | 0.38 | 0.30 |
| $c_2s_2$ | 0.35 | 0.26 |
| $c_2s_3$ | 0.35 | 0.28 |
| SEm (±) | 0.004 | 0.005 |
| CD (0.05) | NS | 0.015 |
| $n_1s_1$ | 0.31 | 0.28 |
| $n_1s_2$ | 0.30 | 0.24 |
| $n_1s_3$ | 0.29 | 0.25 |
| $n_2s_1$ | 0.36 | 0.29 |
| $n_2s_2$ | 0.33 | 0.28 |
| $n_2s_3$ | 0.33 | 0.27 |
| $n_3s_1$ | 0.45 | 0.31 |
| $n_3s_2$ | 0.40 | 0.29 |
| $n_3s_3$ | 0.37 | 0.30 |
| SEm (±) | 0.006 | 0.007 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 60c. Interaction effect of cutting pattern, nutrient levels and spacing on per day productivity under partial shade condition, t $ha^{-1}$ $day^{-1}$

| Treatments | Per day productivity | |
|---|---|---|
| | First year | Second year |
| $c_1n_1s_1$ | 0.30 | 0.27 |
| $c_1n_1s_2$ | 0.28 | 0.25 |
| $c_1n_1s_3$ | 0.28 | 0.25 |
| $c_1n_2s_1$ | 0.35 | 0.28 |
| $c_1n_2s_2$ | 0.34 | 0.29 |
| $c_1n_2s_3$ | 0.33 | 0.27 |
| $c_1n_3s_1$ | 0.44 | 0.31 |
| $c_1n_3s_2$ | 0.40 | 0.29 |
| $c_1n_3s_3$ | 0.33 | 0.29 |
| $c_2n_1s_1$ | 0.31 | 0.29 |
| $c_2n_1s_2$ | 0.33 | 0.24 |
| $c_2n_1s_3$ | 0.31 | 0.25 |
| $c_2n_2s_1$ | 0.37 | 0.30 |
| $c_2n_2s_2$ | 0.33 | 0.26 |
| $c_2n_2s_3$ | 0.34 | 0.28 |
| $c_2n_3s_1$ | 0.46 | 0.31 |
| $c_2n_3s_2$ | 0.40 | 0.29 |
| $c_2n_3s_3$ | 0.40 | 0.31 |
| SEm (±) | 0.019 | 0.008 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 61a. Effect of cutting pattern, nutrient levels and spacing on crude protein content under partial shade condition during first year, per cent

| Treatments | Crude protein content | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 8.72 | 8.81 | 8.81 | 8.87 | 8.72 | 8.84 |
| $C_2$ | 8.80 | 9.02 | 9.02 | 9.07 | 9.00 | 8.93 |
| SEm (±) | 0.045 | 0.060 | 0.041 | 0.033 | 0.047 | 0.043 |
| CD (0.05) | NS | 0.173 | 0.119 | 0.097 | 0.138 | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 8.67 | 8.67 | 8.81 | 8.88 | 8.81 | 8.77 |
| $N_2$ | 8.81 | 8.97 | 8.87 | 8.97 | 8.82 | 8.88 |
| $N_3$ | 8.80 | 9.11 | 9.08 | 9.06 | 8.95 | 9.00 |
| SEm (±) | 0.055 | 0.073 | 0.050 | 0.041 | 0.057 | 0.052 |
| CD (0.05) | NS | 0.212 | 0.146 | 0.119 | NS | 0.151 |
| **Spacing (S)** | | | | | | |
| $S_1$ | 8.76 | 8.85 | 8.86 | 8.92 | 8.9 | 8.86 |
| $S_2$ | 8.74 | 8.92 | 8.90 | 8.90 | 8.79 | 8.92 |
| $S_3$ | 8.77 | 8.98 | 8.99 | 9.03 | 8.82 | 8.87 |
| SEm (±) | 0.055 | 0.073 | 0.050 | 0.041 | 0.057 | 0.052 |
| CD (0.05) | NS | 0.212 | NS | NS | 0.165 | NS |

NS- Not significant

Table 61b. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under partial shade condition during first year, per cent

| Treatments | Crude protein content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1$ | 8.73 | 8.63 | 8.71 | 8.74 | 8.64 | 8.80 |
| $c_1n_2$ | 8.68 | 8.71 | 8.77 | 8.86 | 8.72 | 8.83 |
| $c_1n_3$ | 8.74 | 9.10 | 8.96 | 9.02 | 8.81 | 8.88 |
| $c_2n_1$ | 8.61 | 8.71 | 8.91 | 9.02 | 8.98 | 8.75 |
| $c_2n_2$ | 8.94 | 9.23 | 8.96 | 9.07 | 8.92 | 8.94 |
| $c_2n_3$ | 8.85 | 9.13 | 9.20 | 9.11 | 9.08 | 9.11 |
| SEm (±) | 0.111 | 0.104 | 0.103 | 0.120 | 0.125 | 0.101 |
| CD (0.05) | NS | 0.300 | NS | NS | NS | NS |
| $c_1s_1$ | 8.72 | 8.67 | 8.86 | 8.82 | 8.82 | 8.78 |
| $c_1s_2$ | 8.71 | 8.88 | 8.75 | 8.87 | 8.70 | 8.91 |
| $c_1s_3$ | 8.73 | 8.87 | 8.83 | 8.93 | 8.65 | 8.82 |
| $c_2s_1$ | 8.81 | 9.02 | 8.86 | 9.02 | 9.12 | 8.93 |
| $c_2s_2$ | 8.77 | 8.95 | 9.05 | 9.05 | 8.88 | 8.94 |
| $c_2s_3$ | 8.82 | 9.10 | 9.15 | 9.13 | 8.98 | 8.93 |
| SEm (±) | 0.111 | 0.104 | 0.103 | 0.120 | 0.125 | 0.101 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 8.70 | 8.56 | 8.70 | 8.73 | 8.90 | 8.71 |
| $n_1s_2$ | 8.55 | 8.70 | 8.73 | 8.86 | 8.70 | 8.78 |
| $n_1s_3$ | 8.76 | 8.68 | 9.00 | 9.05 | 8.85 | 8.83 |
| $n_2s_1$ | 8.68 | 8.91 | 8.90 | 9.00 | 8.96 | 8.86 |
| $n_2s_2$ | 8.86 | 8.91 | 8.83 | 8.91 | 8.73 | 8.90 |
| $n_2s_3$ | 8.90 | 9.08 | 8.88 | 9.00 | 8.76 | 8.90 |
| $n_3s_1$ | 8.91 | 9.06 | 9.00 | 9.03 | 9.05 | 9.00 |
| $n_3s_2$ | 8.81 | 9.08 | 9.15 | 9.11 | 8.95 | 9.10 |
| $n_3s_3$ | 8.66 | 9.20 | 9.10 | 9.05 | 8.85 | 8.90 |
| SEm (±) | 0.123 | 0.105 | 0.112 | 0.156 | 0.133 | 0.100 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 61c. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under partial shade condition during first year, per cent

| Treatments | Crude protein content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| $c_1n_1s_1$ | 8.73 | 8.50 | 8.80 | 8.56 | 8.76 | 8.73 |
| $c_1n_1s_2$ | 8.70 | 8.83 | 8.56 | 8.76 | 8.43 | 8.83 |
| $c_1n_1s_3$ | 8.76 | 8.56 | 8.76 | 8.90 | 8.73 | 8.83 |
| $c_1n_2s_1$ | 8.43 | 8.53 | 8.86 | 8.90 | 8.76 | 8.73 |
| $c_1n_2s_2$ | 8.70 | 8.76 | 8.63 | 8.83 | 8.80 | 8.90 |
| $c_1n_2s_3$ | 8.93 | 8.83 | 8.83 | 8.86 | 8.60 | 8.86 |
| $c_1n_3s_1$ | 9.00 | 9.00 | 8.93 | 9.00 | 8.93 | 8.90 |
| $c_1n_3s_2$ | 8.73 | 9.06 | 9.06 | 9.03 | 8.86 | 9.00 |
| $c_1n_3s_3$ | 8.50 | 9.23 | 8.90 | 9.03 | 8.63 | 8.76 |
| $c_2n_1s_1$ | 8.66 | 8.63 | 8.60 | 8.90 | 9.03 | 8.70 |
| $c_2n_1s_2$ | 8.40 | 8.70 | 8.90 | 8.96 | 8.96 | 8.73 |
| $c_2n_1s_3$ | 8.76 | 8.80 | 9.23 | 9.20 | 8.96 | 8.83 |
| $c_2n_2s_1$ | 8.93 | 9.30 | 8.93 | 9.10 | 9.16 | 9.00 |
| $c_2n_2s_2$ | 9.03 | 9.06 | 9.03 | 9.00 | 8.66 | 8.90 |
| $c_2n_2s_3$ | 8.86 | 9.33 | 8.93 | 9.13 | 8.93 | 8.93 |
| $c_2n_3s_1$ | 8.83 | 9.13 | 9.06 | 9.06 | 9.16 | 9.10 |
| $c_2n_3s_2$ | 8.90 | 9.10 | 9.23 | 9.20 | 9.03 | 9.20 |
| $c_2n_3s_3$ | 8.83 | 9.16 | 9.30 | 9.06 | 9.06 | 9.03 |
| SEm (±) | 0.135 | 0.180 | 0.124 | 0.101 | 0.143 | 0.128 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

spacing. In the fifth harvest the maximum crude protein content of 8.90 % was observed in the 60 cm x 20 cm spacing.

Significant interactions between cutting pattern and nutrient levels were observed in the second harvest. The cutting height of 10 cm along with a fertilizer dose of 200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ recorded highest crude protein content of 9.23 % and it was on a par with $c_2n_3$ (9.13 %) and $c_1n_3$ (9.10 %).

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to protein content of palisade grass under partial shade condition in the second year are presented in Table 62a, 62b and 62c.

Only in seventh harvest cutting pattern produced a significant impact on crude protein content and the crude protein content was decreased by increasing the cutting height to 10 cm from ground level. The crude protein content was significantly influenced by the nutrient levels in all the harvests except first and sixth harvests. In all these harvests maximum crude protein content was recorded in $N_3$. Among the different spacing treatments, no significant difference was observed.

In the second year interactions between cutting pattern and nutrient levels were found significant in the first and second harvest. Significant interactions between cutting pattern and spacing were observed in third and sixth harvest. Only in first harvest significant interaction between nutrient levels and plant spacing was noticed.

#### *4.2.4.2 Crude Fibre Content*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) regarding crude fibre content of palisade grass under partial shade condition in the first and second year are presented in Table 63a, 63b and 63c.

The different treatments involving cutting height showed significant effect on crude fibre content both in the first and second year. The 10 cm cutting treatments produced lowest crude fibre content of 27.39 % in the first year and

Table 62a. Effect of cutting pattern, nutrient levels and spacing on crude protein content under partial shade condition during second year, per cent

| Treatments | Crude protein content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 8.62 | 8.59 | 8.69 | 8.64 | 8.68 | 8.54 | 8.66 |
| $C_2$ | 8.64 | 8.66 | 8.65 | 8.55 | 8.59 | 8.63 | 8.50 |
| SEm (±) | 0.041 | 0.046 | 0.030 | 0.039 | 0.046 | 0.051 | 0.049 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | 0.142 |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 8.57 | 8.47 | 8.73 | 8.41 | 8.49 | 8.50 | 8.42 |
| $N_2$ | 8.70 | 8.64 | 8.52 | 8.61 | 8.68 | 8.64 | 8.60 |
| $N_3$ | 8.63 | 8.77 | 8.76 | 8.75 | 8.73 | 8.61 | 8.69 |
| SEm (±) | 0.070 | 0.047 | 0.045 | 0.073 | 0.064 | 0.065 | 0.060 |
| CD (0.05) | NS | 0.138 | 0.132 | 0.211 | 0.186 | NS | 0.174 |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 8.56 | 8.61 | 8.60 | 8.61 | 8.62 | 8.52 | 8.57 |
| $S_2$ | 8.65 | 8.61 | 8.71 | 8.59 | 8.66 | 8.60 | 8.55 |
| $S_3$ | 8.68 | 8.63 | 8.67 | 8.57 | 8.62 | 8.62 | 8.62 |
| SEm (±) | 0.070 | 0.047 | 0.045 | 0.073 | 0.064 | 0.065 | 0.060 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 62b. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under partial shade condition during second year, per cent

| Treatments | Crude protein content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 8.64 | 8.33 | 8.73 | 8.50 | 8.50 | 8.54 | 8.51 |
| $c_1n_2$ | 8.67 | 8.61 | 8.55 | 8.58 | 8.70 | 8.53 | 8.73 |
| $c_1n_3$ | 8.56 | 8.82 | 8.79 | 8.84 | 8.84 | 8.55 | 8.74 |
| $c_2n_1$ | 8.50 | 8.60 | 8.74 | 8.33 | 8.40 | 8.46 | 8.33 |
| $c_2n_2$ | 8.72 | 8.67 | 8.49 | 8.65 | 8.66 | 8.75 | 8.53 |
| $c_2n_3$ | 8.70 | 8.71 | 8.73 | 8.66 | 8.63 | 8.66 | 8.65 |
| SEm (±) | 0.055 | 0.067 | 0.064 | 0.103 | 0.091 | 0.077 | 0.085 |
| CD (0.05) | 0.161 | 0.195 | NS | NS | NS | NS | NS |
| $c_1s_1$ | 8.49 | 8.58 | 8.55 | 8.64 | 8.69 | 8.52 | 8.67 |
| $c_1s_2$ | 8.67 | 8.59 | 8.78 | 8.62 | 8.68 | 8.60 | 8.61 |
| $c_1s_3$ | 8.71 | 8.60 | 8.74 | 8.65 | 8.66 | 8.51 | 8.70 |
| $c_2s_1$ | 8.64 | 8.68 | 8.72 | 8.58 | 8.56 | 8.53 | 8.47 |
| $c_2s_2$ | 8.63 | 8.64 | 8.63 | 8.57 | 8.64 | 8.61 | 8.41 |
| $c_2s_3$ | 8.65 | 8.66 | 8.60 | 8.49 | 8.57 | 8.74 | 8.55 |
| SEm (±) | 0.055 | 0.067 | 0.064 | 0.103 | 0.091 | 0.077 | 0.085 |
| CD (0.05) | NS | NS | 0.186 | NS | NS | 0.272 | NS |
| $n_1s_1$ | 8.54 | 8.42 | 8.63 | 8.43 | 8.48 | 8.40 | 8.32 |
| $n_1s_2$ | 8.57 | 8.49 | 8.79 | 8.40 | 8.47 | 8.51 | 8.45 |
| $n_1s_3$ | 8.60 | 8.49 | 8.78 | 8.41 | 8.51 | 8.60 | 8.50 |
| $n_2s_1$ | 8.76 | 8.66 | 8.49 | 8.63 | 8.67 | 8.75 | 8.66 |
| $n_2s_2$ | 8.60 | 8.62 | 8.57 | 8.63 | 8.76 | 8.67 | 8.61 |
| $n_2s_3$ | 8.67 | 8.64 | 8.49 | 8.58 | 8.62 | 8.51 | 8.63 |
| $n_3s_1$ | 8.40 | 8.82 | 8.78 | 8.77 | 8.73 | 8.43 | 8.74 |
| $n_3s_2$ | 8.71 | 8.73 | 8.76 | 8.75 | 8.75 | 8.63 | 8.60 |
| $n_3s_3$ | 8.78 | 8.76 | 8.74 | 8.72 | 8.72 | 8.76 | 8.75 |
| SEm (±) | 0.068 | 0.082 | 0.079 | 0.126 | 0.112 | 0.094 | 0.104 |
| CD (0.05) | 0.198 | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 62c. Interaction effect of cutting pattern, nutrient levels and spacing on crude protein content under partial shade condition during second year, per cent

| Treatments | Crude protein content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 8.61 | 8.27 | 8.57 | 8.49 | 8.49 | 8.60 | 8.51 |
| $c_1n_1s_2$ | 8.65 | 8.35 | 8.80 | 8.49 | 8.49 | 8.56 | 8.43 |
| $c_1n_1s_3$ | 8.67 | 8.37 | 8.83 | 8.53 | 8.53 | 8.46 | 8.61 |
| $c_1n_2s_1$ | 8.70 | 8.65 | 8.39 | 8.61 | 8.74 | 8.70 | 8.72 |
| $c_1n_2s_2$ | 8.67 | 8.55 | 8.67 | 8,53 | 8.73 | 8.53 | 8.68 |
| $c_1n_2s_3$ | 8.64 | 8.63 | 8.59 | 8.60 | 8.63 | 8.36 | 8.79 |
| $c_1n_3s_1$ | 8.16 | 8.82 | 8.70 | 8.84 | 8.84 | 8.26 | 8.80 |
| $c_1n_3s_2$ | 8.70 | 8.86 | 8.86 | 8.84 | 8.84 | 8.70 | 8.73 |
| $c_1n_3s_3$ | 8.88 | 8.79 | 8.81 | 8.84 | 8.84 | 8.70 | 8.70 |
| $c_2n_1s_1$ | 8.47 | 8.58 | 8.70 | 8.37 | 8.46 | 8.20 | 8.14 |
| $c_2n_1s_2$ | 8.49 | 8.63 | 8.78 | 8.32 | 8.45 | 8.46 | 8.46 |
| $c_2n_1s_3$ | 8.54 | 8.61 | 8.74 | 8.29 | 8.50 | 8.73 | 8.40 |
| $c_2n_2s_1$ | 8.82 | 8.66 | 8.60 | 8.66 | 8.60 | 8.80 | 8.60 |
| $c_2n_2s_2$ | 8.66 | 8.70 | 8.46 | 8.73 | 8.80 | 8.80 | 8.53 |
| $c_2n_2s_3$ | 8.70 | 8.64 | 8.40 | 8.57 | 8.60 | 8.66 | 8.46 |
| $c_2n_3s_1$ | 8.63 | 8.81 | 8.86 | 8.70 | 8.63 | 8.60 | 8.68 |
| $c_2n_3s_2$ | 8.73 | 8.60 | 8.66 | 8.67 | 8.67 | 8.57 | 8.40 |
| $c_2n_3s_3$ | 8.73 | 8.74 | 8.67 | 8.61 | 8.61 | 8.82 | 8.80 |
| SEm (±) | 0.096 | 0.117 | 0.111 | 0.179 | 0.158 | 0.133 | 0.148 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 63a. Effect of cutting pattern, nutrient levels and spacing on crude fibre content under partial shade condition, per cent

| Treatments | Crude fibre content | |
|---|---|---|
| | First year | Second year |
| **Cutting pattern (C)** | | |
| $C_1$ | 28.23 | 28.77 |
| $C_2$ | 27.39 | 28.12 |
| SEm (±) | 0.072 | 0.117 |
| CD (0.05) | 0.210 | 0.337 |
| **Nutrient levels (N)** | | |
| $N_1$ | 28.25 | 28.75 |
| $N_2$ | 27.76 | 28.30 |
| $N_3$ | 27.42 | 28.28 |
| SEm (±) | 0.089 | 0.142 |
| CD (0.05) | 0.257 | 0.411 |
| **Spacing (S)** | | |
| $S_1$ | 27.81 | 28.30 |
| $S_2$ | 27.83 | 28.53 |
| $S_3$ | 27.79 | 28.49 |
| SEm (±) | 0.089 | 0.142 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 63b. Interaction effect of cutting pattern, nutrient levels and spacing on crude fibre content under partial shade condition, per cent

| Treatments | Crude fibre content | |
|---|---|---|
| | First year | Second year |
| $c_1n_1$ | 28.85 | 29.27 |
| $c_1n_2$ | 28.20 | 28.64 |
| $c_1n_3$ | 27.64 | 28.38 |
| $c_2n_1$ | 27.64 | 28.22 |
| $c_2n_2$ | 27.32 | 27.95 |
| $c_2n_3$ | 27.21 | 28.18 |
| SEm (±) | 0.126 | 0.202 |
| CD (0.05) | 0.363 | NS |
| $c_1s_1$ | 28.24 | 28.72 |
| $c_1s_2$ | 28.26 | 28.72 |
| $c_1s_3$ | 28.18 | 28.86 |
| $c_2s_1$ | 27.37 | 27.88 |
| $c_2s_2$ | 27.40 | 28.35 |
| $c_2s_3$ | 27.40 | 28.12 |
| SEm (±) | 0.126 | 0.202 |
| CD (0.05) | NS | NS |
| $n_1s_1$ | 28.28 | 28.73 |
| $n_1s_2$ | 28.30 | 28.61 |
| $n_1s_3$ | 28.16 | 28.90 |
| $n_2s_1$ | 27.78 | 28.15 |
| $n_2s_2$ | 27.78 | 28.50 |
| $n_2s_3$ | 27.71 | 28.25 |
| $n_3s_1$ | 27.36 | 28.03 |
| $n_3s_2$ | 27.41 | 28.50 |
| $n_3s_3$ | 27.50 | 28.33 |
| SEm (±) | 0.154 | 0.246 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 63c. Interaction effect of cutting pattern, nutrient levels and spacing on crude fibre content under partial shade condition, per cent

| Treatments | Crude fibre content | |
|---|---|---|
| | First year | Second year |
| $c_1n_1s_1$ | 28.83 | 29.16 |
| $c_1n_1s_2$ | 28.93 | 29.23 |
| $c_1n_1s_3$ | 28.80 | 29.43 |
| $c_1n_2s_1$ | 28.26 | 28.60 |
| $c_1n_2s_2$ | 28.16 | 28.50 |
| $c_1n_2s_3$ | 28.16 | 28.83 |
| $c_1n_3s_1$ | 27.63 | 28.40 |
| $c_1n_3s_2$ | 27.70 | 28.43 |
| $c_1n_3s_3$ | 27.60 | 28.33 |
| $c_2n_1s_1$ | 27.73 | 28.30 |
| $c_2n_1s_2$ | 27.66 | 28.00 |
| $c_2n_1s_3$ | 27.53 | 28.36 |
| $c_2n_2s_1$ | 27.30 | 27.70 |
| $c_2n_2s_2$ | 27.40 | 28.50 |
| $c_2n_2s_3$ | 27.26 | 27.66 |
| $c_2n_3s_1$ | 27.10 | 27.66 |
| $c_2n_3s_2$ | 27.13 | 28.56 |
| $c_2n_3s_3$ | 27.40 | 28.33 |
| SEm (±) | 0.218 | 0.347 |
| CD (0.05) | NS | NS |

NS- Not significant

28.12 % in the second year. The crude fibre content was significantly influenced by the chemical fertilizer treatments in both the years. $N_3$ recorded lowest crude fibre content and was observed to be significantly superior to $N_2$ and $N_1$ in the first year whereas $N_3$ and $N_2$ was observed to be on a par in the second year. The different spacing treatments showed no significant effect on crude fibre content in both years.

Significant interaction was noticed between cutting pattern and nutrient levels in the first year.

#### *4.2.4.3 Nitrate Content*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to nitrate content of palisade grass under partial shade condition in the first year are presented in Table 64a, 64b and 64c.

The significant effect of cutting pattern on nitrate content was not noticed on all harvests. The nitrate content was significantly influenced by increasing the nutrient levels at third harvest only. Among the fertilizer treatments, the highest nutrient level ($N_3$) recorded the maximum nitrate content in third harvests (0.04 %) and was found on a par with $N_2$. Among the different spacing treatments $S_1$ recorded highest nitrate content of 0.06 % and was found significantly superior to $S_2$ in fourth harvest whereas $S_1$ recorded maximum nitrate content of 0.04, 0.05, 0.05 % in third, fifth and sixth harvests and was found on a par with $S_2$.

Significant interaction was noticed between cutting pattern and spacing in fifth harvest.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to nitrate content of palisade grass under partial shade condition in the second year are presented in Table 65a, 65b and 65c.

The cutting pattern produced no significant impact on nitrate content in all harvests. The protein content was significantly influenced by the nutrient levels in initial harvests. In the first harvest $N_2$ and $N_3$ was found to be on a par whereas

Table 64a. Effect of cutting pattern, nutrient levels and spacing on nitrate content under partial shade condition during first year, per cent

| Treatments | Nitrate content | | | | | |
|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI |
| **Cutting pattern (C)** | | | | | | |
| $C_1$ | 0.03 | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 |
| $C_2$ | 0.04 | 0.03 | 0.03 | 0.05 | 0.05 | 0.04 |
| SEm (±) | 0.006 | 0.004 | 0.001 | 0.003 | 0.001 | 0.003 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | |
| $N_1$ | 0.03 | 0.03 | 0.02 | 0.04 | 0.04 | 0.03 |
| $N_2$ | 0.03 | 0.03 | 0.03 | 0.05 | 0.04 | 0.04 |
| $N_3$ | 0.05 | 0.04 | 0.04 | 0.05 | 0.05 | 0.04 |
| SEm (±) | 0.005 | 0.005 | 0.004 | 0.002 | 0.005 | 0.004 |
| CD (0.05) | NS | NS | 0.017 | NS | NS | NS |
| **Spacing (S)** | | | | | | |
| $S_1$ | 0.04 | 0.04 | 0.04 | 0.06 | 0.05 | 0.05 |
| $S_2$ | 0.03 | 0.04 | 0.03 | 0.05 | 0.04 | 0.04 |
| $S_3$ | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 |
| SEm (±) | 0.005 | 0.005 | 0.004 | 0.002 | 0.005 | 0.004 |
| CD (0.05) | NS | 0.017 | 0.017 | 0.007 | 0.015 | 0.014 |

NS- Not significant

Table 64b. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under partial shade condition during first year, per cent

| Treatments | Nitrate content | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1$ | 0.02 | 0.04 | 0.02 | 0.03 | 0.04 | 0.03 |
| $c_1n_2$ | 0.03 | 0.04 | 0.04 | 0.06 | 0.03 | 0.04 |
| $c_1n_3$ | 0.04 | 0.05 | 0.03 | 0.04 | 0.05 | 0.04 |
| $c_2n_1$ | 0.03 | 0.03 | 0.02 | 0.05 | 0.05 | 0.03 |
| $c_2n_2$ | 0.04 | 0.02 | 0.04 | 0.04 | 0.05 | 0.04 |
| $c_2n_3$ | 0.05 | 0.04 | 0.04 | 0.05 | 0.04 | 0.05 |
| SEm (±) | 0.009 | 0.008 | 0.004 | 0.005 | 0.004 | 0.005 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |
| $c_1s_1$ | 0.03 | 0.05 | 0.04 | 0.06 | 0.04 | 0.05 |
| $c_1s_2$ | 0.03 | 0.05 | 0.03 | 0.04 | 0.04 | 0.04 |
| $c_1s_3$ | 0.03 | 0.03 | 0.02 | 0.03 | 0.04 | 0.02 |
| $c_2s_1$ | 0.05 | 0.04 | 0.04 | 0.07 | 0.06 | 0.05 |
| $c_2s_2$ | 0.03 | 0.03 | 0.02 | 0.05 | 0.05 | 0.03 |
| $c_2s_3$ | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 |
| SEm (±) | 0.009 | 0.008 | 0.004 | 0.005 | 0.004 | 0.005 |
| CD (0.05) | NS | NS | NS | NS | 0.013 | NS |
| $n_1s_1$ | 0.03 | 0.05 | 0.03 | 0.05 | 0.04 | 0.03 |
| $n_1s_2$ | 0.03 | 0.04 | 0.02 | 0.04 | 0.04 | 0.03 |
| $n_1s_3$ | 0.02 | 0.02 | 0.02 | 0.03 | 0.04 | 0.02 |
| $n_2s_1$ | 0.04 | 0.04 | 0.04 | 0.07 | 0.06 | 0.05 |
| $n_2s_2$ | 0.03 | 0.04 | 0.04 | 0.05 | 0.04 | 0.04 |
| $n_2s_3$ | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 | 0.02 |
| $n_3s_1$ | 0.06 | 0.05 | 0.05 | 0.07 | 0.07 | 0.07 |
| $n_3s_2$ | 0.04 | 0.05 | 0.03 | 0.05 | 0.05 | 0.04 |
| $n_3s_3$ | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 |
| SEm (±) | 0.007 | 0.011 | 0.005 | 0.006 | 0.006 | 0.008 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 64c. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under partial shade condition during first year, per cent

| Treatments | Nitrate content | | | | | |
|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** |
| $c_1n_1s_1$ | 0.02 | 0.07 | 0.04 | 0.03 | 0.03 | 0.05 |
| $c_1n_1s_2$ | 0.04 | 0.05 | 0.02 | 0.05 | 0.04 | 0.05 |
| $c_1n_1s_3$ | 0.03 | 0.02 | 0.02 | 0.03 | 0.06 | 0.05 |
| $c_1n_2s_1$ | 0.04 | 0.05 | 0.05 | 0.05 | 0.06 | 0.07 |
| $c_1n_2s_2$ | 0.04 | 0.06 | 0.07 | 0.05 | 0.03 | 0.07 |
| $c_1n_2s_3$ | 0.06 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 |
| $c_1n_3s_1$ | 0.06 | 0.06 | 0.07 | 0.06 | 0.05 | 0.06 |
| $c_1n_3s_2$ | 0.04 | 0.05 | 0.03 | 0.04 | 0.05 | 0.05 |
| $c_1n_3s_3$ | 0.02 | 0.05 | 0.01 | 0.04 | 0.04 | 0.03 |
| $c_2n_1s_1$ | 0.06 | 0.07 | 0.04 | 0.05 | 0.07 | 0.05 |
| $c_2n_1s_2$ | 0.03 | 0.06 | 0.02 | 0.04 | 0.07 | 0.03 |
| $c_2n_1s_3$ | 0.03 | 0.05 | 0.02 | 0.01 | 0.03 | 0.02 |
| $c_2n_2s_1$ | 0.06 | 0.05 | 0.05 | 0.05 | 0.07 | 0.06 |
| $c_2n_2s_2$ | 0.03 | 0.04 | 0.03 | 0.04 | 0.04 | 0.03 |
| $c_2n_2s_3$ | 0.03 | 0.04 | 0.03 | 0.01 | 0.03 | 0.02 |
| $c_2n_3s_1$ | 0.04 | 0.06 | 0.06 | 0.07 | 0.05 | 0.08 |
| $c_2n_3s_2$ | 0.07 | 0.06 | 0.04 | 0.05 | 0.05 | 0.06 |
| $c_2n_3s_3$ | 0.05 | 0.04 | 0.04 | 0.02 | 0.02 | 0.02 |
| SEm (±) | 0.012 | 0.016 | 0.006 | 0.009 | 0.007 | 0.012 |
| CD (0.05) | NS | NS | NS | NS | NS | NS |

NS- Not significant

Table 65a. Effect of cutting pattern, nutrient levels and spacing on nitrate content under partial shade condition during second year, per cent

| Treatments | Nitrate content | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Harvest I** | **Harvest II** | **Harvest III** | **Harvest IV** | **Harvest V** | **Harvest VI** | **Harvest VII** |
| **Cutting pattern (C)** | | | | | | | |
| $C_1$ | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 |
| $C_2$ | 0.04 | 0.05 | 0.03 | 0.04 | 0.05 | 0.04 | 0.05 |
| SEm (±) | 0.002 | 0.002 | 0.002 | 0.003 | 0.002 | 0.005 | 0.005 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | | | |
| $N_1$ | 0.03 | 0.05 | 0.03 | 0.03 | 0.05 | 0.04 | 0.04 |
| $N_2$ | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 |
| $N_3$ | 0.05 | 0.06 | 0.05 | 0.05 | 0.04 | 0.05 | 0.06 |
| SEm (±) | 0.006 | 0.001 | 0.001 | 0.003 | 0.005 | 0.004 | 0.006 |
| CD (0.05) | 0.019 | 0.004 | 0.003 | NS | NS | NS | NS |
| **Spacing (S)** | | | | | | | |
| $S_1$ | 0.04 | 0.06 | 0.05 | 0.05 | 0.06 | 0.06 | 0.05 |
| $S_2$ | 0.04 | 0.05 | 0.03 | 0.04 | 0.05 | 0.05 | 0.06 |
| $S_3$ | 0.03 | 0.04 | 0.02 | 0.02 | 0.04 | 0.03 | 0.04 |
| SEm (±) | 0.006 | 0.001 | 0.001 | 0.003 | 0.005 | 0.004 | 0.006 |
| CD (0.05) | NS | 0.004 | 0.003 | 0.010 | 0.015 | 0.014 | NS |

NS- Not significant

Table 65b. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under partial shade condition during second year, per cent

| Treatments | Nitrate content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1$ | 0.03 | 0.05 | 0.03 | 0.04 | 0.04 | 0.05 | 0.03 |
| $c_1n_2$ | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 | 0.06 | 0.05 |
| $c_1n_3$ | 0.04 | 0.05 | 0.04 | 0.05 | 0.05 | 0.05 | 0.07 |
| $c_2n_1$ | 0.04 | 0.06 | 0.03 | 0.03 | 0.06 | 0.03 | 0.04 |
| $c_2n_2$ | 0.04 | 0.04 | 0.03 | 0.03 | 0.05 | 0.04 | 0.05 |
| $c_2n_3$ | 0.05 | 0.06 | 0.05 | 0.05 | 0.04 | 0.05 | 0.05 |
| SEm (±) | 0.006 | 0.004 | 0.006 | 0.009 | 0.006 | 0.010 | 0.007 |
| CD (0.05) | NS | NS | NS | 0.026 | 0.019 | NS | NS |
| $c_1s_1$ | 0.04 | 0.06 | 0.05 | 0.05 | 0.05 | 0.06 | 0.05 |
| $c_1s_2$ | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 | 0.06 | 0.06 |
| $c_1s_3$ | 0.04 | 0.03 | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 |
| $c_2s_1$ | 0.05 | 0.06 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 |
| $c_2s_2$ | 0.04 | 0.05 | 0.03 | 0.04 | 0.05 | 0.04 | 0.06 |
| $c_2s_3$ | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.02 | 0.04 |
| SEm (±) | 0.006 | 0.004 | 0.006 | 0.009 | 0.006 | 0.010 | 0.007 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |
| $n_1s_1$ | 0.04 | 0.07 | 0.04 | 0.04 | 0.05 | 0.05 | 0.03 |
| $n_1s_2$ | 0.03 | 0.05 | 0.02 | 0.04 | 0.05 | 0.04 | 0.04 |
| $n_1s_3$ | 0.03 | 0.03 | 0.02 | 0.02 | 0.05 | 0.04 | 0.04 |
| $n_2s_1$ | 0.05 | 0.05 | 0.05 | 0.05 | 0.07 | 0.07 | 0.06 |
| $n_2s_2$ | 0.03 | 0.05 | 0.05 | 0.04 | 0.03 | 0.05 | 0.06 |
| $n_2s_3$ | 0.04 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 |
| $n_3s_1$ | 0.05 | 0.06 | 0.06 | 0.07 | 0.05 | 0.07 | 0.07 |
| $n_3s_2$ | 0.05 | 0.06 | 0.03 | 0.05 | 0.05 | 0.05 | 0.07 |
| $n_3s_3$ | 0.03 | 0.05 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 |
| SEm (±) | 0.009 | 0.004 | 0.004 | 0.009 | 0.004 | 0.009 | 0.010 |
| CD (0.05) | NS | NS | NS | NS | 0.013 | NS | NS |

NS- Not significant

Table 65c. Interaction effect of cutting pattern, nutrient levels and spacing on nitrate content under partial shade condition during second year, per cent

| Treatments | Nitrate content | | | | | | |
|---|---|---|---|---|---|---|---|
| | Harvest I | Harvest II | Harvest III | Harvest IV | Harvest V | Harvest VI | Harvest VII |
| $c_1n_1s_1$ | 0.02 | 0.05 | 0.03 | 0.03 | 0.02 | 0.03 | 0.02 |
| $c_1n_1s_2$ | 0.03 | 0.05 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 |
| $c_1n_1s_3$ | 0.02 | 0.03 | 0.02 | 0.02 | 0.06 | 0.03 | 0.04 |
| $c_1n_2s_1$ | 0.03 | 0.04 | 0.04 | 0.08 | 0.05 | 0.04 | 0.06 |
| $c_1n_2s_2$ | 0.03 | 0.04 | 0.04 | 0.07 | 0.04 | 0.06 | 0.07 |
| $c_1n_2s_3$ | 0.04 | 0.02 | 0.02 | 0.04 | 0.02 | 0.01 | 0.04 |
| $c_1n_3s_1$ | 0.06 | 0.05 | 0.05 | 0.07 | 0.07 | 0.07 | 0.07 |
| $c_1n_3s_2$ | 0.04 | 0.05 | 0.03 | 0.04 | 0.04 | 0.03 | 0.08 |
| $c_1n_3s_3$ | 0.03 | 0.04 | 0.02 | 0.03 | 0.04 | 0.03 | 0.05 |
| $c_2n_1s_1$ | 0.05 | 0.05 | 0.03 | 0.07 | 0.05 | 0.03 | 0.05 |
| $c_2n_1s_2$ | 0.03 | 0.03 | 0.01 | 0.06 | 0.06 | 0.02 | 0.05 |
| $c_2n_1s_3$ | 0.03 | 0.02 | 0.02 | 0.04 | 0.03 | 0.02 | 0.04 |
| $c_2n_2s_1$ | 0.05 | 0.03 | 0.05 | 0.06 | 0.07 | 0.06 | 0.06 |
| $c_2n_2s_2$ | 0.03 | 0.03 | 0.04 | 0.03 | 0.05 | 0.02 | 0.06 |
| $c_2n_2s_3$ | 0.04 | 0.01 | 0.03 | 0.02 | 0.05 | 0.03 | 0.04 |
| $c_2n_3s_1$ | 0.07 | 0.05 | 0.05 | 0.07 | 0.07 | 0.06 | 0.06 |
| $c_2n_3s_2$ | 0.05 | 0.05 | 0.03 | 0.06 | 0.05 | 0.06 | 0.06 |
| $c_2n_3s_3$ | 0.04 | 0.03 | 0.04 | 0.02 | 0.02 | 0.02 | 0.04 |
| SEm (±) | 0.007 | 0.006 | 0.008 | 0.011 | 0.009 | 0.013 | 0.016 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS |

NS- Not significant

in the second and third harvests $N_3$ was found superior to other nutrient levels. The significant effect of plant spacing on nitrate content was noticed on all harvests except first and seventh harvests. In the second and third harvest highest nitrate content was produced by $S_1$ and was significantly superior to $S_2$ and $S_3$. In fourth, fifth and sixth harvests $S_1$ and $S_2$ were on a par.

Significant interaction was noticed between cutting pattern and nutrient levels in fourth and fifth harvest whereas significant interaction between nutrient levels and spacing was found to be significant only in the fifth harvest.

### 4.2.5 Plant Analysis

#### *4.2.5.1 N Uptake*

The treatments registered significantly higher N uptake in palisade grass under partial shade condition in the first year (Table 66a, 66b and 66c).

The different treatments involving cutting height showed significant effect on N uptake. The cutting height of 10 cm from ground level produced highest N (257.62 kg $ha^{-1}$). The nitrogen uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of N (294.81 kg $ha^{-1}$) and was significantly superior to $N_2$ and $N_1$. The different spacing treatments showed significant effect on uptake of nitrogen. Among the different spacing treatments $S_1$ recorded maximum N uptake (256.01 kg $ha^{-1}$) uptake and was found on a par with $S_2$.

None of the interactions was found to have significant influence on uptake of nitrogen.

Significantly higher N uptake was noticed by different treatments (cutting pattern, nutrient levels and plant spacing) in palisade grass under partial shade condition in the second year are presented in Table 67a, 67b and 67c.

The different treatments involving cutting height showed significant effect on N uptake. The cutting height of 10 cm from ground level produced highest N

Table 66a. Effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under partial shade condition in the first year, kg $ha^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 229.80 | 26.00 | 211.73 | 90.97 | 79.19 |
| $C_2$ | 257.62 | 27.79 | 228.48 | 101.13 | 84.2 |
| SEm (±) | 5.108 | 0.515 | 4.196 | 3.384 | 1.699 |
| CD (0.05) | 14.707 | 1.483 | 12.083 | 9.743 | 4.892 |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 201.73 | 21.71 | 184.12 | 82.40 | 67.27 |
| $N_2$ | 234.63 | 26.00 | 213.51 | 89.53 | 80.06 |
| $N_3$ | 294.81 | 32.96 | 262.69 | 116.14 | 97.79 |
| SEm (±) | 6.256 | 0.630 | 5.140 | 4.144 | 2.080 |
| CD (0.05) | 18.012 | 1.816 | 14.799 | 11.932 | 5.991 |
| **Spacing (S)** | | | | | |
| $S_1$ | 256.01 | 28.59 | 234.37 | 98.91 | 87.67 |
| $S_2$ | 242.49 | 26.60 | 217.42 | 96.04 | 79.41 |
| $S_3$ | 232.67 | 25.48 | 208.53 | 93.19 | 78.04 |
| SEm (±) | 6.256 | 0.630 | 5.140 | 4.144 | 2.080 |
| CD (0.05) | 18.012 | 1.816 | 14.799 | NS | 5.991 |

NS- Not significant

Table 66b. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under partial shade condition in the first year, kg $ha^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1$ | 185.25 | 20.58 | 174.82 | 78.09 | 65.75 |
| $c_1n_2$ | 224.63 | 25.86 | 211.23 | 82.98 | 80.06 |
| $c_1n_3$ | 279.59 | 31.54 | 249.14 | 111.83 | 91.77 |
| $c_2n_1$ | 218.21 | 22.85 | 193.42 | 86.87 | 68.78 |
| $c_2n_2$ | 244.62 | 26.13 | 215.79 | 96.08 | 80.07 |
| $c_2n_3$ | 310.03 | 34.39 | 276.25 | 120.44 | 103.81 |
| SEm (±) | 8.847 | 0.892 | 7.269 | 5.861 | 2.943 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 245.74 | 28.46 | 230.10 | 91.31 | 87.49 |
| $c_1s_2$ | 232.04 | 26.07 | 211.81 | 94.29 | 78.98 |
| $c_1s_3$ | 211.69 | 23.46 | 193.20 | 87.30 | 71.11 |
| $c_2s_1$ | 266.27 | 28.73 | 238.58 | 106.50 | 87.85 |
| $c_2s_2$ | 252.93 | 27.14 | 223.02 | 97.80 | 79.85 |
| $c_2s_3$ | 253.65 | 27.50 | 223.86 | 99.09 | 84.96 |
| SEm (±) | 8.847 | 0.892 | 7.269 | 5.861 | 2.943 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 204.06 | 22.14 | 188.23 | 84.72 | 66.53 |
| $n_1s_2$ | 207.17 | 22.02 | 186.66 | 82.03 | 67.40 |
| $n_1s_3$ | 193.96 | 20.98 | 177.45 | 80.69 | 67.88 |
| $n_2s_1$ | 242.08 | 27.58 | 224.82 | 83.89 | 84.18 |
| $n_2s_2$ | 231.45 | 25.20 | 207.99 | 92.57 | 76.65 |
| $n_2s_3$ | 230.34 | 25.20 | 207.71 | 92.13 | 79.36 |
| $n_3s_1$ | 321.88 | 36.05 | 290.06 | 128.12 | 112.31 |
| $n_3s_2$ | 288.84 | 32.58 | 257.59 | 113.53 | 94.19 |
| $n_3s_3$ | 273.72 | 30.27 | 240.43 | 106.76 | 86.87 |
| SEm (±) | 10.836 | 1.092 | 8.903 | 7.178 | 3.604 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 66c. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under partial shade condition in the first year, kg $ha^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1s_1$ | 191.66 | 21.82 | 185.53 | 82.04 | 67.05 |
| $c_1n_1s_2$ | 183.71 | 20.03 | 170.28 | 74.77 | 65.46 |
| $c_1n_1s_3$ | 180.37 | 19.89 | 168.64 | 77.46 | 64.75 |
| $c_1n_2s_1$ | 231.11 | 28.39 | 221.96 | 64.22 | 84.46 |
| $c_1n_2s_2$ | 227.45 | 25.66 | 211.54 | 95.09 | 79.05 |
| $c_1n_2s_3$ | 215.34 | 23.55 | 200.20 | 89.64 | 76.68 |
| $c_1n_3s_1$ | 314.45 | 35.16 | 283.01 | 127.69 | 110.98 |
| $c_1n_3s_2$ | 284.96 | 32.51 | 253.62 | 113.01 | 92.44 |
| $c_1n_3s_3$ | 239.36 | 26.96 | 210.78 | 94.80 | 71.90 |
| $c_2n_1s_1$ | 216.46 | 22.46 | 190.94 | 87.40 | 66.01 |
| $c_2n_1s_2$ | 230.63 | 24.02 | 203.05 | 89.29 | 69.34 |
| $c_2n_1s_3$ | 207.55 | 22.07 | 186.27 | 83.92 | 71.00 |
| $c_2n_2s_1$ | 253.05 | 26.78 | 227.69 | 103.57 | 83.90 |
| $c_2n_2s_2$ | 235.46 | 24.75 | 204.45 | 90.05 | 74.26 |
| $c_2n_2s_3$ | 245.34 | 26.85 | 215.23 | 94.62 | 82.05 |
| $c_2n_3s_1$ | 329.32 | 36.94 | 297.11 | 128.54 | 113.64 |
| $c_2n_3s_2$ | 292.71 | 32.64 | 261.57 | 114.06 | 95.94 |
| $c_2n_3s_3$ | 308.08 | 33.58 | 270.08 | 118.72 | 101.85 |
| SEm (±) | 15.325 | 1.545 | 12.591 | 10.152 | 5.097 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 67a. Effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under partial shade condition in the second year, kg ha$^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 193.54 | 22.04 | 172.35 | 81.76 | 66.81 |
| $C_2$ | 208.62 | 22.27 | 176.63 | 82.89 | 67.88 |
| SEm (±) | 3.048 | 3.110 | 3.123 | 2.999 | 3.125 |
| CD (0.05) | 8.777 | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 172.92 | 18.64 | 152.43 | 71.78 | 58.97 |
| $N_2$ | 193.63 | 21.46 | 169.47 | 80.19 | 66.63 |
| $N_3$ | 236.69 | 26.38 | 201.57 | 95.01 | 76.44 |
| SEm (±) | 3.733 | 0.400 | 3.071 | 1.471 | 1.414 |
| CD (0.05) | 10.749 | 1.152 | 8.843 | 4.236 | 4.071 |
| **Spacing (S)** | | | | | |
| $S_1$ | 211.53 | 23.32 | 183.29 | 86.46 | 70.66 |
| $S_2$ | 196.31 | 21.55 | 169.83 | 80.49 | 65.94 |
| $S_3$ | 195.41 | 21.60 | 170.35 | 80.02 | 65.44 |
| SEm (±) | 3.733 | 0.400 | 3.071 | 1.471 | 1.414 |
| CD (0.05) | 10.749 | 1.152 | 8.843 | 4.236 | 4.071 |

NS- Not significant

Table 67b. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under partial shade condition in the second year, kg ha$^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1$ | 165.22 | 18.47 | 150.90 | 71.05 | 58.30 |
| $c_1n_2$ | 186.58 | 21.59 | 169.44 | 80.90 | 66.50 |
| $c_1n_3$ | 228.83 | 26.06 | 196.72 | 93.34 | 75.55 |
| $c_2n_1$ | 180.62 | 18.80 | 153.96 | 72.51 | 59.56 |
| $c_2n_2$ | 200.69 | 21.32 | 169.51 | 79.48 | 66.77 |
| $c_2n_3$ | 244.56 | 26.70 | 206.42 | 96.68 | 77.33 |
| SEm (±) | 5.279 | 1.629 | 4.343 | 2.080 | 1.999 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $c_1s_1$ | 194.92 | 22.73 | 176.03 | 84.10 | 68.29 |
| $c_1s_2$ | 196.50 | 22.27 | 174.14 | 82.97 | 68.58 |
| $c_1s_3$ | 189.21 | 21.12 | 166.89 | 78.22 | 63.56 |
| $c_2s_1$ | 228.14 | 23.91 | 190.55 | 88.83 | 73.03 |
| $c_2s_2$ | 196.12 | 20.83 | 165.53 | 78.01 | 63.30 |
| $c_2s_3$ | 201.61 | 22.08 | 173.80 | 81.83 | 67.32 |
| SEm (±) | 5.279 | 1.629 | 4.343 | 2.080 | 1.999 |
| CD (0.05) | 15.201 | NS | 12.506 | 5.990 | 5.757 |
| $n_1s_1$ | 190.12 | 20.25 | 164.96 | 78.28 | 64.45 |
| $n_1s_2$ | 163.12 | 17.60 | 143.92 | 68.12 | 55.53 |
| $n_1s_3$ | 165.53 | 18.05 | 148.41 | 68.94 | 56.94 |
| $n_2s_1$ | 202.93 | 22.8 | 177.51 | 84.07 | 68.89 |
| $n_2s_2$ | 188.65 | 20.79 | 165.88 | 78.38 | 66.23 |
| $n_2s_3$ | 189.31 | 20.78 | 165.02 | 78.12 | 64.77 |
| $n_3s_1$ | 241.53 | 26.92 | 207.41 | 97.05 | 78.64 |
| $n_3s_2$ | 237.17 | 26.26 | 199.69 | 94.98 | 76.06 |
| $n_3s_3$ | 231.38 | 25.96 | 197.61 | 93.01 | 74.62 |
| SEm (±) | 4.210 | 4.126 | 3.910 | 3.116 | 4.100 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 67c. Interaction effect of cutting pattern, nutrient levels and spacing on uptake of nitrogen, phosphorus, potassium, calcium and magnesium under partial shade condition in the second year, kg ha$^{-1}$

| Treatments | Uptake of Nitrogen | Uptake of Phosphorus | Uptake of Potassium | Uptake of Calcium | Uptake of Magnesium |
|---|---|---|---|---|---|
| $c_1n_1s_1$ | 169.18 | 19.34 | 157.31 | 75.39 | 61.92 |
| $c_1n_1s_2$ | 166.59 | 18.30 | 149.56 | 70.79 | 58.03 |
| $c_1n_1s_3$ | 159.90 | 17.77 | 145.84 | 66.98 | 55.22 |
| $c_1n_2s_1$ | 189.47 | 23.33 | 173.97 | 82.84 | 68.08 |
| $c_1n_2s_2$ | 189.69 | 21.70 | 172.96 | 82.24 | 68.83 |
| $c_1n_2s_3$ | 180.57 | 19.75 | 161.38 | 77.62 | 62.58 |
| $c_1n_3s_1$ | 226.10 | 25.53 | 196.81 | 94.08 | 74.88 |
| $c_1n_3s_2$ | 233.23 | 26.82 | 199.90 | 95.89 | 78.89 |
| $c_1n_3s_3$ | 227.15 | 25.84 | 193.45 | 90.07 | 72.89 |
| $c_2n_1s_1$ | 211.06 | 21.16 | 172.61 | 81.17 | 66.99 |
| $c_2n_1s_2$ | 159.65 | 16.92 | 138.29 | 65.45 | 53.03 |
| $c_2n_1s_3$ | 171.16 | 18.33 | 150.98 | 70.91 | 58.65 |
| $c_2n_2s_1$ | 216.39 | 22.26 | 181.05 | 85.29 | 69.71 |
| $c_2n_2s_2$ | 187.62 | 19.88 | 158.80 | 74.52 | 63.63 |
| $c_2n_2s_3$ | 198.06 | 21.82 | 168.67 | 78.62 | 66.96 |
| $c_2n_3s_1$ | 256.96 | 28.31 | 218.01 | 100.02 | 82.40 |
| $c_2n_3s_2$ | 241.10 | 25.70 | 199.49 | 94.07 | 73.24 |
| $c_2n_3s_3$ | 235.61 | 26.09 | 201.76 | 95.95 | 76.35 |
| SEm (±) | 9.145 | 0.979 | 7.524 | 3.604 | 3.463 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

uptake (208.62 kg ha$^{-1}$). The nutrient uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of N (236.69 kg ha$^{-1}$). The different spacing treatments showed significant effect on uptake of nutrients. Among the different spacing treatments $S_1$ recorded highest N uptake (211.53 kg ha$^{-1}$).

Significant interactions between cutting pattern and spacing were observed. The cutting height of 10 cm along with narrow spacing (60 cm x 20 cm) recorded highest N uptake of 228.14 kg ha$^{-1}$.

#### *4.2.5.2 P Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to P uptake of palisade grass under partial shade condition in the first year are presented in Table 66a, 66b and 66c.

The different treatments involving cutting height showed significant effect on P uptake. The cutting height of 10 cm from ground level produced highest uptake of P (27.79 kg ha$^{-1}$). The uptake of P was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of P (32.96 kg ha$^{-1}$). The different spacing treatments showed significant effect on uptake of P. Among the different spacing treatments $S_1$ was found to be on a par with $S_2$. None of the interactions was found to have significant influence on uptake of P.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to N uptake of palisade grass under partial shade condition in the second year are presented in Table 67a, 67b and 67c. The different treatments involving cutting height showed no significant effect on P uptake. The P uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of P (26.38 kg ha$^{-1}$). The different spacing treatments showed significant effect on uptake of P. Among the different spacing treatments $S_1$ recorded highest uptake of P (23.32 kg ha$^{-1}$).

None of the interactions was found to have significant influence on uptake of P.

#### *4.2.5.3 K Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to K uptake of palisade grass under partial shade condition in the first year are presented in Table 66a, 66b and 66c.

The different treatments involving cutting height showed significant effect on K uptake. The cutting height of 10 cm from ground level produced highest K (228.48 kg ha$^{-1}$). The K uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of P (262.69 kg ha$^{-1}$). The different spacing treatments showed significant effect on uptake of K. Among the different spacing treatments $S_1$ recorded highest K uptake (234.37 kg ha$^{-1}$).

None of the interactions was found to have significant influence on uptake of K.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to K uptake of palisade grass under partial shade condition in the second year are presented in Table 67a, 67b and 67c.

The different treatments involving cutting height showed no significant effect on K uptake. The K uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of K (201.57 kg ha$^{-1}$). The different spacing treatments showed significant effect on uptake of K. Among the different spacing treatments $S_1$ recorded highest K uptake (183.29 kg ha$^{-1}$).

Significant interactions between cutting pattern and spacing were observed. The cutting height of 10 cm along with narrow spacing (60 cm x 20 cm) recorded highest K uptake of 190.55 kg ha$^{-1}$.

#### *4.2.5.4 Ca Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Ca uptake of palisade grass under partial shade condition in the first year are presented in Table 66a, 66b and 66c.

The different treatments involving cutting height showed significant effect on Ca uptake. The cutting height of 10 cm from ground level produced highest Ca uptake (101.13 kg $ha^{-1}$). The uptake of Ca was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Ca (116.14 kg $ha^{-1}$). The different spacing treatments showed no significant effect on uptake of Ca.

None of the interactions was found to have significant influence on uptake of Ca.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Ca uptake of palisade grass under partial shade condition in the second year are presented in Table 67a, 67b and 67c.

The different treatments involving cutting height showed no significant effect on Ca uptake. The Ca uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Ca (95.01 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of Ca. Among the different spacing treatments $S_1$ recorded highest Ca uptake (86.46 kg $ha^{-1}$).

Significant interactions between cutting pattern and spacing were observed. The cutting height of 10 cm along with narrow spacing (60 cm x 20 cm) recorded maximum Ca uptake of 88.83 kg $ha^{-1}$ and was on a par with $c_1s_2$ (82.97 kg $ha^{-1}$).

#### *4.2.5.5 Mg Uptake*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Mg uptake of palisade grass under partial shade condition in the first year are presented in Table 66a, 66b and 66c.

The different treatments involving cutting height showed significant effect on Mg uptake. The cutting height of 10 cm from ground level produced highest Mg uptake (84.2 kg $ha^{-1}$). The uptake of Mg was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Mg (97.79 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of Mg. $S_1$ registered highest uptake of Mg (87.67 kg $ha^{-1}$).

None of the interactions was found to have significant influence on uptake of Mg.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to Mg uptake of palisade grass under partial shade condition in the second year are presented in Table 67a, 67b and 67c.

The different treatments involving cutting height showed no significant effect on Mg uptake. The Mg uptake was significantly increased by the chemical fertilizer treatments. $N_3$ registered highest uptake of Mg (76.44 kg $ha^{-1}$). The different spacing treatments showed significant effect on uptake of Mg. Among the different spacing treatments $S_1$ recorded highest Mg uptake (70.66 kg $ha^{-1}$).

Significant interactions between cutting pattern and spacing were observed. The cutting height of 10 cm along with narrow spacing (60 cm x 20 cm) recorded maximum Mg uptake of 73.03 kg $ha^{-1}$ and was on a par with $c_1s_1$, $c_1s_2$, $c_2s_3$.

#### *4.2.5.6 K : (Ca+ Mg) Ratio*

The results presented in Table 68a, 68b and 68c indicated that the treatments as well as their interaction were non significant with respect to K: (Ca + Mg) ratio in both first and second years.

#### *4.2.6.1 Available N*

The data revealed that the treatments (cutting pattern, nutrient levels and plant spacing) had significant effect on available nitrogen status of the soil after the experiment under partial shade condition in the first year (Table 69a, 69b and 69c).

Table 68a. Effect of cutting pattern, nutrient levels and spacing on K: (Ca + Mg) ratio under partial shade condition

| Treatments | K: (Ca +Mg) ratio | |
|---|---|---|
| | First year | Second year |
| **Cutting pattern (C)** | | |
| $C_1$ | 1.26 | 1.16 |
| $C_2$ | 1.23 | 1.17 |
| SEm (±) | 0.005 | 0.002 |
| CD (0.05) | NS | NS |
| **Nutrient levels (N)** | | |
| $N_1$ | 1.22 | 1.16 |
| $N_2$ | 1.29 | 1.15 |
| $N_3$ | 1.23 | 1.17 |
| SEm (±) | 0.004 | 0.006 |
| CD (0.05) | NS | NS |
| **Spacing (S)** | | |
| $S_1$ | 1.29 | 1.16 |
| $S_2$ | 1.23 | 1.16 |
| $S_3$ | 1.21 | 1.17 |
| SEm (±) | 0.004 | 0.006 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 68b. Interaction effect of cutting pattern, nutrient levels and spacing on K: (Ca + Mg) ratio under partial shade condition

| Treatments | K: (Ca +Mg) ratio | |
|---|---|---|
| | First year | Second year |
| $c_1n_1$ | 1.21 | 1.16 |
| $c_1n_2$ | 1.35 | 1.15 |
| $c_1n_3$ | 1.22 | 1.16 |
| $c_2n_1$ | 1.24 | 1.16 |
| $c_2n_2$ | 1.22 | 1.16 |
| $c_2n_3$ | 1.23 | 1.18 |
| SEm (±) | 0.060 | 0.011 |
| CD (0.05) | NS | NS |
| $c_1s_1$ | 1.35 | 1.15 |
| $c_1s_2$ | 1.22 | 1.15 |
| $c_1s_3$ | 1.21 | 1.17 |
| $c_2s_1$ | 1.22 | 1.17 |
| $c_2s_2$ | 1.25 | 1.17 |
| $c_2s_3$ | 1.21 | 1.16 |
| SEm (±) | 0.060 | 0.011 |
| CD (0.05) | NS | NS |
| $n_1s_1$ | 1.24 | 1.15 |
| $n_1s_2$ | 1.24 | 1.16 |
| $n_1s_3$ | 1.19 | 1.18 |
| $n_2s_1$ | 1.43 | 1.16 |
| $n_2s_2$ | 1.20 | 1.14 |
| $n_2s_3$ | 1.21 | 1.15 |
| $n_3s_1$ | 1.20 | 1.17 |
| $n_3s_2$ | 1.24 | 1.16 |
| $n_3s_3$ | 1.24 | 1.17 |
| SEm (±) | 0.073 | 0.013 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 68c. Interaction effect of cutting pattern, nutrient levels and spacing on K: (Ca + Mg) ratio under partial shade condition

| Treatments | K: (Ca +Mg) ratio | |
|---|---|---|
| | First year | Second year |
| $c_1n_1s_1$ | 1.24 | 1.10 |
| $c_1n_1s_2$ | 1.21 | 1.16 |
| $c_1n_1s_3$ | 1.18 | 1.19 |
| $c_1n_2s_1$ | 1.65 | 1.15 |
| $c_1n_2s_2$ | 1.21 | 1.14 |
| $c_1n_2s_3$ | 1.20 | 1.15 |
| $c_1n_3s_1$ | 1.18 | 1.16 |
| $c_1n_3s_2$ | 1.23 | 1.14 |
| $c_1n_3s_3$ | 1.26 | 1.18 |
| $c_2n_1s_1$ | 1.24 | 1.16 |
| $c_2n_1s_2$ | 1.28 | 1.16 |
| $c_2n_1s_3$ | 1.20 | 1.16 |
| $c_2n_2s_1$ | 1.21 | 1.17 |
| $c_2n_2s_2$ | 1.24 | 1.15 |
| $c_2n_2s_3$ | 1.21 | 1.16 |
| $c_2n_3s_1$ | 1.23 | 1.19 |
| $c_2n_3s_2$ | 1.24 | 1.19 |
| $c_2n_3s_3$ | 1.22 | 1.17 |
| SEm (±) | 0.104 | 0.019 |
| CD (0.05) | NS | NS |

NS- Not significant

Table 69a. Effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under partial shade condition in the first year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| **Cutting pattern (C)** | | | | |
| $C_1$ | 252.23 | 28.20 | 69.46 | 0.62 |
| $C_2$ | 245.21 | 29.30 | 70.10 | 0.62 |
| SEm (±) | 1.475 | 1.523 | 1.667 | 0.005 |
| CD (0.05) | 4.247 | NS | NS | NS |
| **Nutrient levels (N)** | | | | |
| $N_1$ | 251.67 | 28.81 | 69.96 | 0.62 |
| $N_2$ | 251.83 | 29.58 | 67.23 | 0.63 |
| $N_3$ | 242.67 | 27.98 | 72.16 | 0.60 |
| SEm (±) | 1.806 | 0.704 | 1.932 | 0.007 |
| CD (0.05) | 5.202 | NS | NS | 0.021 |
| **Spacing (S)** | | | | |
| $S_1$ | 241.42 | 25.66 | 65.14 | 0.62 |
| $S_2$ | 248.47 | 29.20 | 70.66 | 0.62 |
| $S_3$ | 256.28 | 31.51 | 73.55 | 0.62 |
| SEm (±) | 1.806 | 0.704 | 1.932 | 0.007 |
| CD (0.05) | 5.202 | 2.027 | 5.565 | NS |

NS- Not significant

Table 69b. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under partial shade condition in the first year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| $c_1n_1$ | 257.84 | 29.02 | 71.18 | 0.62 |
| $c_1n_2$ | 255.18 | 29.41 | 67.10 | 0.63 |
| $c_1n_3$ | 243.67 | 26.42 | 70.03 | 0.60 |
| $c_2n_1$ | 245.49 | 28.60 | 68.74 | 0.62 |
| $c_2n_2$ | 248.48 | 29.75 | 67.28 | 0.63 |
| $c_2n_3$ | 241.67 | 29.54 | 74.29 | 0.61 |
| SEm (±) | 2.555 | 0.995 | 2.733 | 0.010 |
| CD (0.05) | NS | NS | NS | NS |
| $c_1s_1$ | 246.81 | 24.71 | 63.26 | 0.61 |
| $c_1s_2$ | 251.92 | 28.45 | 71.30 | 0.62 |
| $c_1s_3$ | 257.95 | 31.69 | 73.82 | 0.62 |
| $c_2s_1$ | 236.03 | 26.61 | 67.02 | 0.62 |
| $c_2s_2$ | 245.01 | 29.96 | 70.01 | 0.62 |
| $c_2s_3$ | 254.60 | 31.32 | 73.28 | 0.62 |
| SEm (±) | 2.555 | 0.995 | 2.733 | 0.010 |
| CD (0.05) | NS | 2.866 | NS | NS |
| $n_1s_1$ | 245.96 | 24.65 | 64.97 | 0.62 |
| $n_1s_2$ | 249.23 | 31.75 | 71.39 | 0.62 |
| $n_1s_3$ | 259.81 | 30.03 | 73.52 | 0.62 |
| $n_2s_1$ | 242.65 | 25.83 | 65.15 | 0.62 |
| $n_2s_2$ | 253.10 | 30.79 | 66.43 | 0.64 |
| $n_2s_3$ | 259.74 | 32.12 | 70.12 | 0.64 |
| $n_3s_1$ | 235.64 | 26.51 | 65.30 | 0.60 |
| $n_3s_2$ | 243.08 | 25.07 | 74.16 | 0.60 |
| $n_3s_3$ | 249.28 | 32.37 | 77.02 | 0.62 |
| SEm (±) | 3.129 | 1.219 | 3.348 | 0.012 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Table 69c. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under partial shade condition in the first year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| $c_1n_1s_1$ | 251.79 | 24.77 | 64.66 | 0.61 |
| $c_1n_1s_2$ | 256.83 | 31.53 | 74.04 | 0.62 |
| $c_1n_1s_3$ | 264.90 | 30.77 | 74.83 | 0.63 |
| $c_1n_2s_1$ | 247.38 | 25.07 | 64.11 | 0.64 |
| $c_1n_2s_2$ | 256.54 | 30.33 | 66.06 | 0.65 |
| $c_1n_2s_3$ | 261.62 | 32.83 | 71.37 | 0.62 |
| $c_1n_3s_1$ | 241.26 | 24.30 | 61.03 | 0.57 |
| $c_1n_3s_2$ | 242.40 | 23.48 | 73.81 | 0.59 |
| $c_1n_3s_3$ | 247.35 | 31.49 | 75.27 | 0.63 |
| $c_2n_1s_1$ | 240.13 | 24.53 | 65.29 | 0.60 |
| $c_2n_1s_2$ | 241.63 | 31.97 | 68.73 | 0.63 |
| $c_2n_1s_3$ | 254.72 | 29.30 | 72.20 | 0.60 |
| $c_2n_2s_1$ | 237.93 | 26.58 | 66.19 | 0.60 |
| $c_2n_2s_2$ | 249.66 | 31.24 | 66.80 | 0.63 |
| $c_2n_2s_3$ | 257.86 | 31.42 | 68.86 | 0.67 |
| $c_2n_3s_1$ | 230.03 | 28.72 | 69.58 | 0.64 |
| $c_2n_3s_2$ | 243.75 | 26.66 | 74.51 | 0.60 |
| $c_2n_3s_3$ | 251.22 | 33.25 | 78.77 | 0.61 |
| SEm (±) | 4.425 | 1.724 | 4.734 | 0.018 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

The results revealed that treatments involving cutting height had significant effect on available nitrogen status of the soil. $C_1$ registered highest available nitrogen (252.23 kg $ha^{-1}$). The available nitrogen status of the soil was significantly increased by the chemical fertilizer treatments. $N_2$ registered maximum available nitrogen (251.83 kg $ha^{-1}$) and was on a par with $N_1$. Among the different spacing treatments $S_3$ recorded highest available nitrogen (256.28 kg $ha^{-1}$).

Interactions were non significant with respect to available nitrogen status of the soil.

The result indicated that treatments (cutting pattern, nutrient levels and plant spacing) produced significant difference in available nitrogen, status of the soil after the experiment under partial shade condition in the second year (Table 70a, 70b and 70c).

The results indicated that treatments involving cutting height had no significant effect on available nitrogen status of the soil. There was no significant variation in available nitrogen, status of the soil between different fertilizer treatments. Among the different spacing treatments $S_3$ recorded maximum available nitrogen (262.89 kg $ha^{-1}$) and was on a par with $S_2$.

Interactions were found to be non significant with respect to available nitrogen status of the soil.

#### *4.2.6.2 Available P*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available P status of the soil after the experiment under partial shade condition in the first year are presented in Table 69a, 69b and 69c.

The results revealed that treatments involving cutting height had no significant effect on available P status of the soil. There was no significant variation in available P status of the soil between different fertilizer treatments. Among the different spacing treatments $S_3$ recorded maximum available P (31.51 kg $ha^{-1}$) and was on a par with $S_2$.

Table 70a. Effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under partial shade condition in the second year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| **Cutting pattern (C)** | | | | |
| $C_1$ | 257.35 | 32.66 | 75.01 | 0.66 |
| $C_2$ | 257.97 | 32.48 | 77.87 | 0.65 |
| SEm (±) | 1.510 | 1.320 | 1.411 | 0.005 |
| CD (0.05) | NS | NS | NS | NS |
| **Nutrient levels (N)** | | | | |
| $N_1$ | 257.77 | 32.04 | 74.29 | 0.65 |
| $N_2$ | 258.85 | 33.49 | 78.46 | 0.66 |
| $N_3$ | 256.35 | 32.18 | 76.56 | 0.65 |
| SEm (±) | 1.856 | 1.317 | 1.129 | 0.006 |
| CD (0.05) | NS | NS | NS | NS |
| **Spacing (S)** | | | | |
| $S_1$ | 251.93 | 24.17 | 77.19 | 0.65 |
| $S_2$ | 258.16 | 34.28 | 74.38 | 0.65 |
| $S_3$ | 262.89 | 39.26 | 77.74 | 0.66 |
| SEm (±) | 1.856 | 1.317 | 1.129 | 0.006 |
| CD (0.05) | 5.344 | 3.792 | NS | NS |

NS- Not significant

Table 70b. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under partial shade condition in the second year

| Treatments | Available Nitrogen (kg ha$^{-1}$) | Available Phosphorus (kg ha$^{-1}$) | Available Potassium (kg ha$^{-1}$) | Organic Carbon (per cent) |
|---|---|---|---|---|
| $c_1n_1$ | 259.00 | 259.00 | 71.71 | 0.65 |
| $c_1n_2$ | 258.34 | 258.34 | 78.02 | 0.66 |
| $c_1n_3$ | 254.71 | 254.71 | 75.31 | 0.66 |
| $c_2n_1$ | 256.55 | 256.55 | 76.87 | 0.66 |
| $c_2n_2$ | 259.36 | 259.36 | 78.91 | 0.65 |
| $c_2n_3$ | 258.00 | 258.00 | 77.82 | 0.65 |
| SEm (±) | 2.624 | 1.862 | 2.886 | 0.009 |
| CD (0.05) | NS | NS | NS | NS |
| $c_1s_1$ | 251.38 | 251.38 | 75.52 | 0.66 |
| $c_1s_2$ | 260.23 | 260.23 | 71.66 | 0.65 |
| $c_1s_3$ | 260.43 | 260.43 | 77.85 | 0.66 |
| $c_2s_1$ | 252.48 | 252.48 | 78.86 | 0.64 |
| $c_2s_2$ | 256.09 | 256.09 | 77.11 | 0.65 |
| $c_2s_3$ | 265.34 | 265.34 | 77.63 | 0.66 |
| SEm (±) | 2.624 | 1.862 | 2.886 | 0.009 |
| CD (0.05) | NS | NS | NS | NS |
| $n_1s_1$ | 250.31 | 250.31 | 75.61 | 0.64 |
| $n_1s_2$ | 257.90 | 257.90 | 74.33 | 0.66 |
| $n_1s_3$ | 265.11 | 265.11 | 72.93 | 0.67 |
| $n_2s_1$ | 253.50 | 253.50 | 77.06 | 0.66 |
| $n_2s_2$ | 261.7 | 261.78 | 76.65 | 0.65 |
| $n_2s_3$ | 261.28 | 261.28 | 81.68 | 0.66 |
| $n_3s_1$ | 252.00 | 252.00 | 78.90 | 0.65 |
| $n_3s_2$ | 254.80 | 254.80 | 72.18 | 0.65 |
| $n_3s_3$ | 262.27 | 262.27 | 78.61 | 0.66 |
| SEm (±) | 3.214 | 2.281 | 3.534 | 0.011 |
| CD (0.05) | NS | 6.567 | NS | NS |

NS- Not significant

Table 70c. Interaction effect of cutting pattern, nutrient levels and spacing on available nitrogen, phosphorus, potassium and organic carbon content of soil under partial shade condition in the second year

| **Treatments** | **Available Nitrogen ($kg\ ha^{-1}$)** | **Available Phosphorus ($kg\ ha^{-1}$)** | **Available Potassium ($kg\ ha^{-1}$)** | **Organic Carbon (per cent)** |
|---|---|---|---|---|
| $c_1n_1s_1$ | 248.90 | 248.90 | 76.20 | 0.64 |
| $c_1n_1s_2$ | 264.66 | 264.66 | 66.83 | 0.64 |
| $c_1n_1s_3$ | 263.43 | 263.43 | 72.10 | 0.67 |
| $c_1n_2s_1$ | 254.16 | 254.16 | 73.13 | 0.68 |
| $c_1n_2s_2$ | 263.50 | 263.50 | 77.07 | 0.65 |
| $c_1n_2s_3$ | 257.36 | 257.36 | 83.86 | 0.66 |
| $c_1n_3s_1$ | 251.10 | 251.10 | 77.23 | 0.60 |
| $c_1n_3s_2$ | 252.50 | 252.53 | 71.10 | 0.66 |
| $c_1n_3s_3$ | 260.51 | 260.51 | 77.60 | 0.67 |
| $c_2n_1s_1$ | 251.73 | 251.73 | 75.03 | 0.64 |
| $c_2n_1s_2$ | 251.13 | 251.13 | 81.83 | 0.67 |
| $c_2n_1s_3$ | 266.80 | 266.80 | 73.76 | 0.67 |
| $c_2n_2s_1$ | 252.83 | 252.83 | 81.00 | 0.64 |
| $c_2n_2s_2$ | 260.07 | 260.07 | 76.23 | 0.68 |
| $c_2n_2s_3$ | 265.20 | 265.20 | 79.50 | 0.67 |
| $c_2n_3s_1$ | 252.90 | 252.90 | 80.57 | 0.66 |
| $c_2n_3s_2$ | 257.06 | 257.06 | 73.26 | 0.64 |
| $c_2n_3s_3$ | 264.03 | 264.03 | 79.63 | 0.65 |
| SEm (±) | 4.546 | 3.208 | 4.998 | 0.015 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Interaction between cutting pattern and spacing was significant with respect to available P status of the soil.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available P status of the soil after the experiment under partial shade condition in the second year are presented in Table 70a, 70b and 70c.

The results indicated that treatments involving cutting height had no significant effect on available P status of the soil. There was no significant variation in available P status of the soil between different fertilizer treatments. Among the different spacing treatments $S_3$ recorded highest available P (39.26 kg $ha^{-1}$).

Interaction between nutrient and spacing was found to be significant with respect to available P status of the soil.

#### *4.2.6.3 Available K*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available K status of the soil after the experiment under partial shade condition in the first year are presented in Table 69a, 69b and 69c.

The results revealed that treatments involving cutting height had no significant effect on available K status of the soil. There was no significant variation in available K status of the soil between different fertilizer treatments. Among the different spacing treatments $S_3$ recorded maximum available K (73.55 kg $ha^{-1}$) and was on a par with $S_2$.

Interactions were non significant with respect to available K status of the soil.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to available K status of the soil after the experiment under partial shade condition in the second year are presented in Table 70a, 70b and 70c.

The results indicated that treatments involving cutting height had no significant effect on available K status of the soil. There was no significant variation in available K status of the soil between different fertilizer treatments. Among the different spacing treatments also no significant variation was noticed.

Interactions were found to be non significant with respect to available K status of the soil.

#### *4.2.6.4 Organic Carbon*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to organic carbon status of the soil after the experiment under partial shade condition in the first year are presented in Table 69a, 69b and 69c.

The results revealed that treatments involving cutting height had no significant effect on organic carbon status of the soil. There was significant variation in organic carbon status of the soil between different fertilizer treatments. $N_2$ recorded highest organic carbon content of 0.63 %. Among the different spacing treatments no significant variation was observed.

Interactions were non significant with respect to organic carbon content of the soil.

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect organic carbon status of the soil after the experiment under partial shade condition in the second year are presented in Table 70a, 70b and 70c.

The results indicated that treatments involving cutting height had no significant effect on organic carbon status of the soil. There was no significant variation in organic carbon status of the soil between different fertilizer treatments. Among the different spacing treatments also no significant variation was noticed.

Interactions were found to be non significant with respect to organic carbon status of the soil.

### 4.2.7 Incidence of Pests and Diseases

The incidence of pest and disease was not noticed throughout the crop period in both years.

### 4.2.8. Economic Analysis

#### *4.2.8.1 Net Income*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to net income of palisade grass under partial shade condition in the first and second year are presented in Table 71a, 71b and 71c.

The different treatments involving cutting height showed significant effect on net income both in the first and second year. The cutting treatments of 10 cm from ground level produced highest net income of 48,937 Rs. $ha^{-1}$ and 40,400 Rs. $ha^{-1}$ in first and second year respectively. The net income was significantly influenced by the chemical fertilizer treatments in both the years. During first and second year $N_3$ was observed to be significantly superior to $N_2$ and $N_1$. The different spacing treatments showed no significant effect on net income both in first and second year.

None of the interactions was found to have significant influence on net income.

#### *4.2.8.2 B: C Ratio*

The result of the effect of treatments (cutting pattern, nutrient levels and plant spacing) with respect to benefit: cost ratio of palisade grass under partial shade condition in the first and second year are presented in Table 71a, 71b and 71c.

The different treatments involving cutting height showed significant effect on benefit: cost ratio both in the first and second year. The cutting treatments of

Table 71a. Effect of cutting pattern, nutrient levels and spacing on net income and B: C ratio under partial shade condition

| Treatments | Net income (Rs. $ha^{-1}$) | | B: C ratio | |
|---|---|---|---|---|
| | First year | Second year | First year | Second year |
| **Cutting pattern (C)** | | | | |
| $C_1$ | 37477 | 35917 | 1.33 | 1.33 |
| $C_2$ | 48937 | 40400 | 1.45 | 1.38 |
| SEm (±) | 2633.17 | 1453 | 0.024 | 0.013 |
| CD (0.05) | 7580.925 | 4183.287 | 0.071 | 0.039 |
| **Nutrient levels (N)** | | | | |
| $N_1$ | 24526 | 27755 | 1.23 | 1.26 |
| $N_2$ | 40720 | 38599 | 1.37 | 1.36 |
| $N_3$ | 64375 | 48121 | 1.58 | 1.44 |
| SEm (±) | 3224.973 | 1779.32 | 0.030 | 0.016 |
| CD (0.05) | 9284.699 | 5123.459 | 0.087 | 0.048 |
| **Spacing (S)** | | | | |
| $S_1$ | 40775 | 40415 | 1.33 | 1.36 |
| $S_2$ | 44482 | 38131 | 1.41 | 1.36 |
| $S_3$ | 44365 | 35930 | 1.44 | 1.34 |
| SEm (±) | 3224.9 | 1779.57 | 0.030 | 0.016 |
| CD (0.05) | NS | NS | 0.087 | NS |

NS- Not significant

Table 71b. Interaction effect of cutting pattern, nutrient levels and spacing on net income and B: C ratio under partial shade condition

| Treatments | Net income (Rs. ha$^{-1}$) | | B: C ratio | |
|---|---|---|---|---|
| | First year | Second year | First year | Second year |
| $c_1n_1$ | 17163 | 25692 | 1.16 | 1.24 |
| $c_1n_2$ | 37657 | 37086 | 1.34 | 1.34 |
| $c_1n_3$ | 57612 | 44975 | 1.50 | 1.41 |
| $c_2n_1$ | 31889 | 29819 | 1.31 | 1.28 |
| $c_2n_2$ | 43783 | 40113 | 1.41 | 1.38 |
| $c_2n_3$ | 71139 | 51268 | 1.65 | 1.48 |
| SEm (±) | 4560.798 | 2516.729 | 0.042 | 0.023 |
| CD (0.05) | NS | NS | NS | NS |
| $c_1s_1$ | 37311 | 36202 | 1.30 | 1.31 |
| $c_1s_2$ | 40543 | 39117 | 1.37 | 1.37 |
| $c_1s_3$ | 34577 | 32433 | 1.33 | 1.30 |
| $c_2s_1$ | 44238 | 44629 | 1.37 | 1.40 |
| $c_2s_2$ | 48420 | 37144 | 1.46 | 1.36 |
| $c_2s_3$ | 54153 | 39427 | 1.54 | 1.37 |
| SEm (±) | 4560.798 | 2516.729 | 0.042 | 0.023 |
| CD (0.05) | NS | NS | NS | NS |
| $n_1s_1$ | 15355 | 32429 | 1.13 | 1.29 |
| $n_1s_2$ | 28912 | 25461 | 1.27 | 1.24 |
| $n_1s_3$ | 29312 | 25377 | 1.30 | 1.24 |
| $n_2s_1$ | 35874 | 40073 | 1.29 | 1.36 |
| $n_2s_2$ | 40131 | 39080 | 1.37 | 1.37 |
| $n_2s_3$ | 46156 | 36646 | 1.46 | 1.35 |
| $n_3s_1$ | 71096 | 48745 | 1.58 | 1.43 |
| $n_3s_2$ | 64403 | 49852 | 1.59 | 1.47 |
| $n_3s_3$ | 57628 | 45768 | 1.56 | 1.43 |
| SEm (±) | 5585.818 | 3082.351 | 0.052 | 0.028 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

Table 71c. Interaction effect of cutting pattern, nutrient levels and spacing on net income and B: C ratio under partial shade condition

| Treatments | Net income (Rs. ha$^{-1}$) | | B: C ratio | |
|---|---|---|---|---|
| | First year | Second year | First year | Second year |
| $c_1n_1s_1$ | 12125 | 24949 | 1.10 | 1.22 |
| $c_1n_1s_2$ | 17107 | 28081 | 1.16 | 1.27 |
| $c_1n_1s_3$ | 22257 | 24047 | 1.22 | 1.23 |
| $c_1n_2s_1$ | 31719 | 35393 | 1.26 | 1.31 |
| $c_1n_2s_2$ | 40801 | 42925 | 1.37 | 1.40 |
| $c_1n_2s_3$ | 40451 | 32941 | 1.39 | 1.31 |
| $c_1n_3s_1$ | 68091 | 48265 | 1.54 | 1.42 |
| $c_1n_3s_2$ | 63723 | 46347 | 1.58 | 1.43 |
| $c_1n_3s_3$ | 41023 | 40313 | 1.39 | 1.37 |
| $c_2n_1s_1$ | 18585 | 39909 | 1.16 | 1.36 |
| $c_2n_1s_2$ | 40717 | 22841 | 1.39 | 1.22 |
| $c_2n_1s_3$ | 36367 | 26707 | 1.37 | 1.26 |
| $c_2n_2s_1$ | 40029 | 44753 | 1.33 | 1.40 |
| $c_2n_2s_2$ | 39461 | 35235 | 1.37 | 1.35 |
| $c_2n_2s_3$ | 51861 | 40351 | 1.52 | 1.39 |
| $c_2n_3s_1$ | 74101 | 49225 | 1.61 | 1.44 |
| $c_2n_3s_2$ | 65083 | 53357 | 1.61 | 1.51 |
| $c_2n_3s_3$ | 74233 | 51223 | 1.74 | 1.48 |
| SEm (±) | 7899.538 | 4359.114 | 0.073 | 0.040 |
| CD (0.05) | NS | NS | NS | NS |

NS- Not significant

10 cm from ground level produced highest benefit: cost ratio of 1.45 in first year and 1.38 in second year. The benefit: cost ratio was significantly influenced by the chemical fertilizer treatments in both the years. During first and second year $N_3$ was observed to be significantly superior to $N_2$. The different spacing treatments showed significant effect on benefit: cost ratio in first year whereas no significant effect was noticed in second year. During first year maximum benefit: cost ratio was recorded by treatment involving wider spacing ($S_3$) (60 cm x 40 cm) (1.44) which was on a par with $S_2$ (1.41).

None of the interactions was found to have significant influence on benefit: cost ratio.

### 4.2.9 Pooled Analysis

The pooled analysis result indicated that the effect of treatments (cutting pattern, nutrient levels and plant spacing) for two years with respect to GFY, crude protein content, crude fibre content, net income and B: C ratio of palisade grass under partial shade condition are presented in Table 72a, 72b and 72c.

The different treatments involving cutting height showed significant effect on crude fibre content, net income and B: C ratio. The cutting treatments of 10 cm from ground level produced maximum net income and B: C ratio and lowest crude fibre content. Among the fertilizer treatments highest GFY, crude protein content, net income and B: C ratio was registered by the treatment $N_3$ and $N_1$ recorded lowest crude fibre content. Among spacing treatments highest GFY, crude protein content and net income was recorded by $S_1$ and $S_3$ recorded highest B: C ratio. The lowest crude fibre content was recorded by $S_1$.

Significant interactions between cutting pattern and nutrient levels were observed in crude fibre content. The cutting height of 10 cm along with a fertilizer dose of 200: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ $c_2n_2$, recorded lowest crude fibre content of 27.64 % and was on a par with $c_2n_3$ (27.71).

Table 72a. Effect of cutting pattern, nutrient levels and spacing on total green fodder yield, crude protein content, crude fibre content, net income and B: C ratio under partial shade condition (pooled data of 2 years)

| **Treatments** | **Total green fodder yield (t ha$^{-1}$)** | **Crude protein content (%)** | **Crude fibre content (%)** | **Net income (Rs. ha$^{-1}$)** | **B: C ratio** |
|---|---|---|---|---|---|
| **Cutting pattern (C)** | | | | | |
| $C_1$ | 97.39 | 8.54 | 28.50 | 36697 | 1.33 |
| $C_2$ | 100.66 | 8.53 | 27.76 | 44668 | 1.42 |
| SEm (±) | 1.498 | 0.348 | 0.050 | 2266.006 | 0.023 |
| CD (0.05) | NS | NS | 0.145 | 6523.832 | 0.068 |
| **Nutrient levels (N)** | | | | | |
| $N_1$ | 88.16 | 8.29 | 28.49 | 26141 | 1.25 |
| $N_2$ | 98.34 | 8.53 | 28.03 | 39660 | 1.37 |
| $N_3$ | 110.58 | 8.84 | 27.86 | 56248 | 1.51 |
| SEm (±) | 1.836 | 0.426 | 0.060 | 2775.280 | 0.025 |
| CD (0.05) | 5.287 | 1.228 | 0.174 | 7990.033 | 0.074 |
| **Spacing (S)** | | | | | |
| $S_1$ | 104.52 | 8.66 | 28.05 | 40595 | 1.34 |
| $S_2$ | 97.36 | 8.56 | 28.19 | 41306 | 1.39 |
| $S_3$ | 95.20 | 8.50 | 28.14 | 40147 | 1.39 |
| SEm (±) | 1.836 | 0.426 | 0.060 | 2775.280 | 0.025 |
| CD (0.05) | 5.287 | 1.228 | 0.174 | 7990.033 | 0.074 |

NS- Not significant

Table 72b. Interaction effect of cutting pattern, nutrient levels and spacing on total green fodder yield, crude protein content, crude fibre content, net income and B: C ratio under partial shade condition (pooled data of 2 years)

| Treatments | Total green fodder yield (t ha$^{-1}$) | Crude protein content (%) | Crude fibre content (%) | Net income (Rs. ha$^{-1}$) | B: C ratio |
|---|---|---|---|---|---|
| $c_1n_1$ | 86.04 | 8.03 | 29.06 | 21427 | 1.20 |
| $c_1n_2$ | 97.83 | 8.13 | 28.42 | 37371 | 1.34 |
| $c_1n_3$ | 108.30 | 8.24 | 28.01 | 51293 | 1.46 |
| $c_2n_1$ | 90.28 | 8.55 | 27.93 | 30854 | 1.30 |
| $c_2n_2$ | 98.85 | 8.33 | 27.64 | 41948 | 1.39 |
| $c_2n_3$ | 112.87 | 8.72 | 27.71 | 61203 | 1.56 |
| SEm (±) | 2.597 | 0.603 | 0.089 | 3924.840 | 0.035 |
| CD (0.05) | NS | NS | 0.257 | NS | NS |
| $c_1s_1$ | 102.99 | 8.66 | 28.48 | 36757 | 1.31 |
| $c_1s_2$ | 97.40 | 8.16 | 28.49 | 39830 | 1.37 |
| $c_1s_3$ | 91.79 | 8.59 | 28.52 | 33505 | 1.32 |
| $c_2s_1$ | 106.06 | 8.86 | 27.63 | 44433 | 1.38 |
| $c_2s_2$ | 97.33 | 8.37 | 27.89 | 42782 | 1.41 |
| $c_2s_3$ | 98.61 | 8.37 | 27.76 | 46790 | 1.46 |
| SEm (±) | 2.597 | 0.603 | 0.089 | 3924.840 | 0.035 |
| CD (0.05) | NS | NS | NS | NS | NS |
| $n_1s_1$ | 92.21 | 8.36 | 28.50 | 23892 | 1.21 |
| $n_1s_2$ | 86.77 | 8.36 | 28.45 | 27186 | 1.26 |
| $n_1s_3$ | 85.49 | 8.15 | 28.53 | 27344 | 1.27 |
| $n_2s_1$ | 102.77 | 8.57 | 27.96 | 37973 | 1.33 |
| $n_2s_2$ | 96.22 | 8.08 | 28.14 | 39605 | 1.37 |
| $n_2s_3$ | 96.03 | 8.05 | 27.98 | 41401 | 1.40 |
| $n_3s_1$ | 118.59 | 8.35 | 27.70 | 59920 | 1.50 |
| $n_3s_2$ | 109.09 | 8.35 | 27.98 | 57127 | 1.53 |
| $n_3s_3$ | 104.08 | 8.75 | 27.91 | 51698 | 1.50 |
| SEm (±) | 3.177 | 0.737 | 0.110 | 4806.926 | 0.042 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

Table 72c. Interaction effect of cutting pattern, nutrient levels and spacing on total green fodder yield, crude protein content, crude fibre content, net income and B: C ratio under partial shade condition (pooled data of 2 years)

| Treatments | Total green fodder yield (t ha$^{-1}$) | Crude protein content (%) | Crude fibre content (%) | Net income (Rs ha$^{-1}$) | B: C ratio |
|---|---|---|---|---|---|
| $c_1n_1s_1$ | 89.67 | 8.60 | 29.00 | 18537 | 1.16 |
| $c_1n_1s_2$ | 84.73 | 8.66 | 29.08 | 22594 | 1.21 |
| $c_1n_1s_3$ | 83.71 | 8.68 | 29.11 | 23152 | 1.22 |
| $c_1n_2s_1$ | 100.85 | 8.67 | 28.43 | 33556 | 1.28 |
| $c_1n_2s_2$ | 98.75 | 8.70 | 28.33 | 41863 | 1.39 |
| $c_1n_2s_3$ | 93.91 | 8.70 | 28.50 | 36696 | 1.35 |
| $c_1n_3s_1$ | 118.45 | 8.73 | 28.01 | 58178 | 1.48 |
| $c_1n_3s_2$ | 108.71 | 8.79 | 28.06 | 55035 | 1.51 |
| $c_1n_3s_3$ | 97.75 | 8.78 | 27.96 | 40668 | 1.38 |
| $c_2n_1s_1$ | 94.76 | 8.52 | 28.01 | 29247 | 1.26 |
| $c_2n_1s_2$ | 88.82 | 8.59 | 27.83 | 31779 | 1.31 |
| $c_2n_1s_3$ | 87.26 | 8.70 | 27.95 | 31537 | 1.32 |
| $c_2n_2s_1$ | 104.70 | 8.77 | 27.50 | 42391 | 1.37 |
| $c_2n_2s_2$ | 93.70 | 8.76 | 27.95 | 37348 | 1.36 |
| $c_2n_2s_3$ | 98.15 | 8.71 | 27.47 | 46106 | 1.45 |
| $c_2n_3s_1$ | 118.73 | 8.79 | 27.38 | 61663 | 1.52 |
| $c_2n_3s_2$ | 109.47 | 8.72 | 27.90 | 59220 | 1.56 |
| $c_2n_3s_3$ | 110.41 | 8.77 | 27.86 | 62728 | 1.61 |
| SEm (±) | 4.494 | 0.042 | 0.151 | 6798.016 | 0.063 |
| CD (0.05) | NS | NS | NS | NS | NS |

NS- Not significant

# DISCUSSION

# 5. DISCUSSION

The present experiment was conducted in the Instructional Farm attached to the College of Agriculture, Vellayani during July 2014 to April 2016 to standardise the nutrient requirement, spacing and cutting pattern of palisade grass under open and partial shaded condition and to work out the economics of cultivation. The results of the experiment presented in the previous chapter are discussed here under.

## 5.1 EXPERIMENT- 1: STANDARDISING THE CUTTING PATTERN, N, P, K LEVELS AND SPACING IN PALISADE GRASS UNDER OPEN CONDITION

### 5.1.1 Effect of Cutting Pattern, Nutrient Levels and Spacing on Growth Parameters

The results revealed that plant height was significantly influenced by the cutting pattern during first and second years. During the first year plant height was significantly improved by increasing the cutting height from ground level to 10 cm in the third, fifth and sixth harvest and during the second year plant height was significantly higher in the first, third and sixth harvest. The higher cutting heights of grass promote deeper root growth into the soil while shorter heights of cut or cutting near the ground level promote shallower root systems. Deep root systems have naturally greater access to soil water and nutrient reserves thereby increasing their ability to tolerate environmental stresses. Shallower root systems require greater attention to supplementing soil water and nutrient needs to keep the plants healthy and minimize negative effects of adverse environmental stress. In addition to larger and deeper root systems, higher heights of cut restrict the amount of light reaching the soil surface.

The plant height was significantly influenced by increasing the nutrient levels. The highest level of nutrients recorded the maximum plant height in all the harvests in the first year and six harvests in the second year. The increased plant height on $N_3$ might be attributed to the increase in the quantity of nutrient especially nitrogen applied to soil (300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$) which lead to the formation of plant metabolites that helped to build the plant tissue. Similar result was reported by Nnadi *et al.* (2015) in guinea grass. When nitrogen and phosphorus were applied in higher dose there was significant influence on growth and it might be due to the synergistic effect of both the nutrients. Moreover the uptake of N and K were more at their higher doses, which might have contributed to the improved growth. Sumner and Farina (1986) reported that N and K at higher concentration resulted in growth stimulation and enhanced uptake of both the elements.

The plant height was significantly influenced by different spacing treatments. As the spacing was increased the plant height was found to exhibit a decreasing trend. The maximum plant height was registered by the treatment involving narrow spacing (60 cm x 30 cm) in three harvests during first and second year. Increase in plant density due to closer planting resulted in taller plants. This could be attributed to the fact that closer spacing could enhance the competition for available light. This result is in conformity with the findings of Blue (1970) who reported that plant height was markedly increased with increased plant population. Similar result was also reported by Wijitphan *et al.* (2009) in napier grass.

Interaction between cutting height and nutrient levels influenced plant height in first and sixth harvest during second year. The cutting height of 10 cm along with the fertilizer dose of either 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ or 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ registered the highest plant height in both the harvests.

The tiller number was significantly influenced by cutting pattern, nutrient levels and different spacing treatments. The tiller number was increased by decreasing the cutting height from 10 cm to ground level both in the first (three harvests) and second year (six harvests). The increase in the tiller number $plant^{-1}$

at ground level might be due to the stimulating effect of nutrients on various physiological processes of plant. Similar results were reported by Manohar *et al.* (1992) in pearl millet and Bilal *et al.* (2000) in mott grass.

The tiller number was significantly influenced by increasing the nutrient levels. Among the fertilizer treatments, the highest level of nutrients recorded the highest number of tillers in all the harvests in first year and significant effect was noticed in all harvests except initial and final harvest in the second year. Chand and Rao (1996) reported increased tiller number with increased potassium level in lemon grass. Among the three spacing, wider plant spacing (60 cm x 60 cm) produced significantly higher tiller number in three harvests in the first year and in all the harvests except initial harvest in the second year. Manjunatha *et al.* (2013) reported that row spacing of 60 cm recorded higher number of tillers than 45 cm or 30 cm row spacing in perennial fodder sorghum. Similar result was observed by Nazir *et al.* (1997) in multicut hybrid sorghum.

Different treatments had significant influence on leaf: stem ratio. The cutting height of 10 cm from the ground level produced highest leaf: stem ratio in three harvests in first year and two harvests in second year. Among the fertilizer treatments, the highest level of nutrients recorded the highest leaf: stem ratio in both the years. The increased nutrient application improved the leaf: stem ratio due to the increased leafy material compared to stem as observed by Lekshmi (2004) in guinea grass. Similar result was observed by Mahmud *et al.* (2003) in fodder sorghum. As the spacing was increased the plant height was found to exhibit a decreasing trend and hence the maximum leaf: stem ratio was recorded by the treatment involving narrow spacing in fourth and fifth harvests in first year and in all harvests except first harvest in the second year. This response might be due to the increased leaf area in narrow spacing treatments. This result is in conformity with the findings of Mounika *et al.* (2015) in bajra hybrid napier grass.

Significant effect of plant spacing on regeneration percentage was noticed on all harvests. In all harvests maximum regeneration percentage was obtained with a spacing of 60 cm x 60 cm and was significantly superior to 60 cm x 40 cm and 60 cm x 30 cm during first and second year.

Significant interaction was observed between nutrient levels and spacing in the fourth and fifth harvests. In fourth and fifth harvests maximum regeneration percentage was observed in $n_2s_3$ and $n_3s_3$ during first year.

### 5.1.2 Effect of Cutting Pattern, Nutrient Levels and Spacing on Yield Parameters

The results revealed that total green fodder yield was significantly influenced by cutting pattern only in first year (Fig. 5). The cutting height of 10 cm from the ground level produced 8.4 per cent yield increase when compared to ground level cutting. The highest plant height at 10 cm cutting height resulted in highest fodder yield. In forage crops that grows as clumps when cut close to the ground can eliminate much of the leaf area besides destroying large number of apical meristem which resulted in lower regeneration and production. During the second year ground level cutting produced the highest green fodder yield in third and fourth harvests (Fig. 6). This might be due to more number of tillers registered in this treatment. This result is in conformity with the findings of Onyeonagu and Asiegbu (2005) in guinea grass. The green fodder yield was significantly influenced by increasing the nutrient levels. Among the fertilizer treatments, the highest level of nutrients recorded the highest green fodder yield in third, fourth and fifth harvest in the first year and fourth, sixth and seventh harvest in the second year. In the total green fodder yield there was an yield increase of 23.7 per cent and 14.4 per cent in the first and second year respectively with the highest dose of fertilizer. The enhanced green fodder yield with increase in nutrient levels might be due to the increased nutrient uptake and positive interactions of nutrients. The beneficial effects of nutrients on cell division and elongation, formation of nucleotides and coenzymes might have resulted in increased meristematic activity and photosynthetic area and hence more production of green fodder. Pamo and Pieper (1989) showed that nitrogen

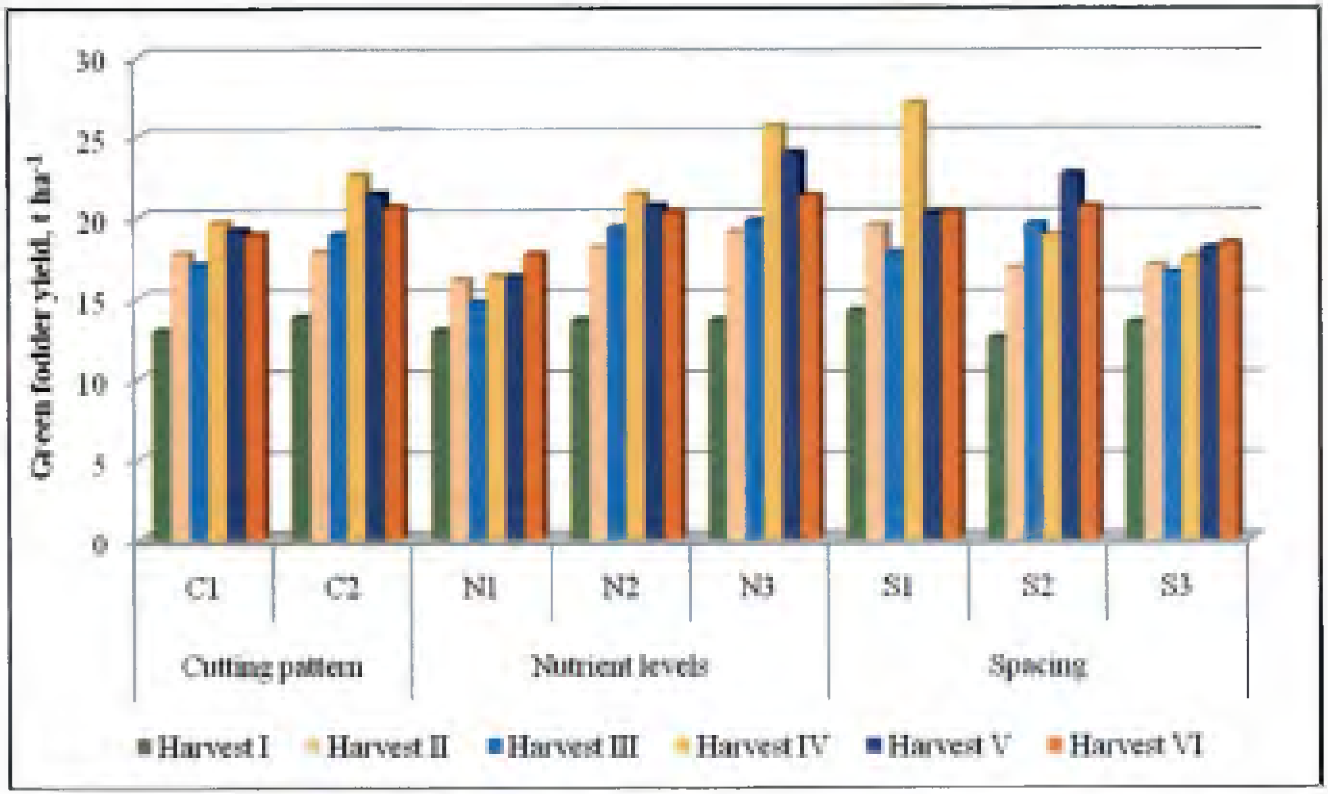


Fig. 5. Effect of cutting pattern, nutrient levels and spacing on green fodder yield under open condition during first year, t $ha^{-1}$

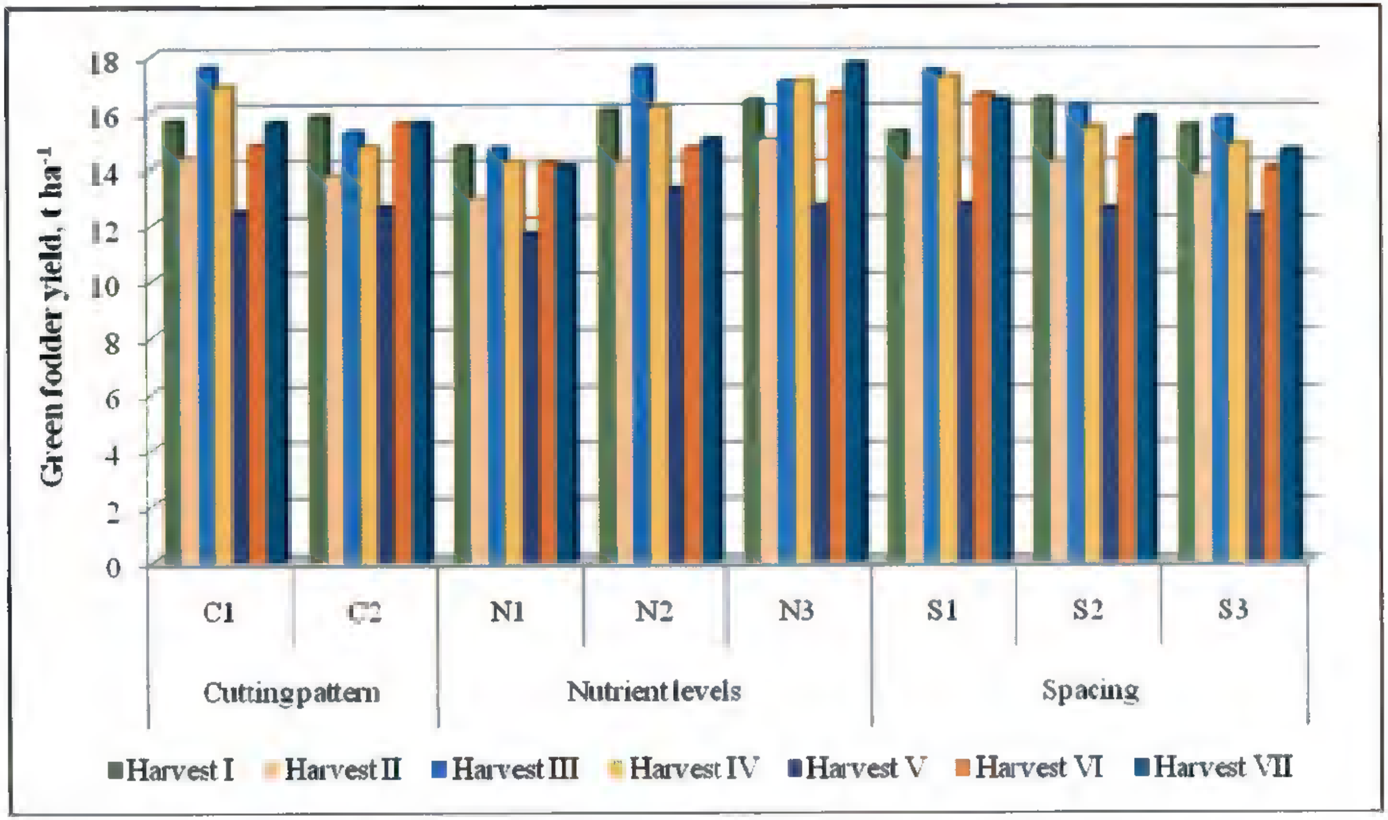


Fig. 6. Effect of cutting pattern, nutrient levels and spacing on green fodder yield under open condition during second year, t $ha^{-1}$

fertilization in combination with phosphorus and potassium increased the productivity of ruzi grass and recommended a fertilizer rate of 60-90 kg nitrogen $ha^{-1}$ after each cutting. The differences among the three nutrient doses were non significant in first two cuttings. However, from the third cutting onwards a significant increase in fodder yield was observed. This might be due to aging of crops. Similar results were reported by Sonia (1999) in signal grass and Vinayraj and Palled (2014) in hybrid napier. The results revealed that green fodder yield was significantly influenced by different spacing. The planting at 60 cm x 30 cm registered the highest fodder yield. Forage yield is a function of growth parameters, plant population, plant height, leaf to stem ratio, leaf area and leaf area index. In general a decline in yield was observed as the spacing between plants increased. There was an yield reduction of 15.3 per cent in first year and 8.5 per cent in second year when wider spacing of 60 cm x 60 cm was followed. This might be attributed to the fact that narrow rows make more efficient use of available resources and allow earlier canopy closure and this result in shading of the ground thereby ensuring weed control and increasing yield. This result is in agreement with Graybill *et al.* (1991), Wolf *et al.* (1993) and Mohammadi *et al.* (2012) in corn. The fodder production was found to be best in the first year with respect to cutting height, nutrient levels and spacing treatments. During the first year the rainfall pattern showed a uniform distribution whereas in the second year erratic distribution of rainfall was noticed. The favourable climatic condition might have contributed to the improved yield during first year.

Interaction effect was found significant between cutting height and spacing in fourth harvest during second year. The ground level cutting along with narrow spacing (60 cm x 30 cm) registered maximum green fodder yield and it was on a par with $c_2s_1$ and $c_2s_3$.

Total dry fodder yield was significantly highest in the cutting height of 10 cm in first year (Fig. 7). The dry fodder yield was significantly increased in fourth and sixth harvest in second year. This might be attributed to the highest green fodder yield registered in these treatments. This result is in agreement with

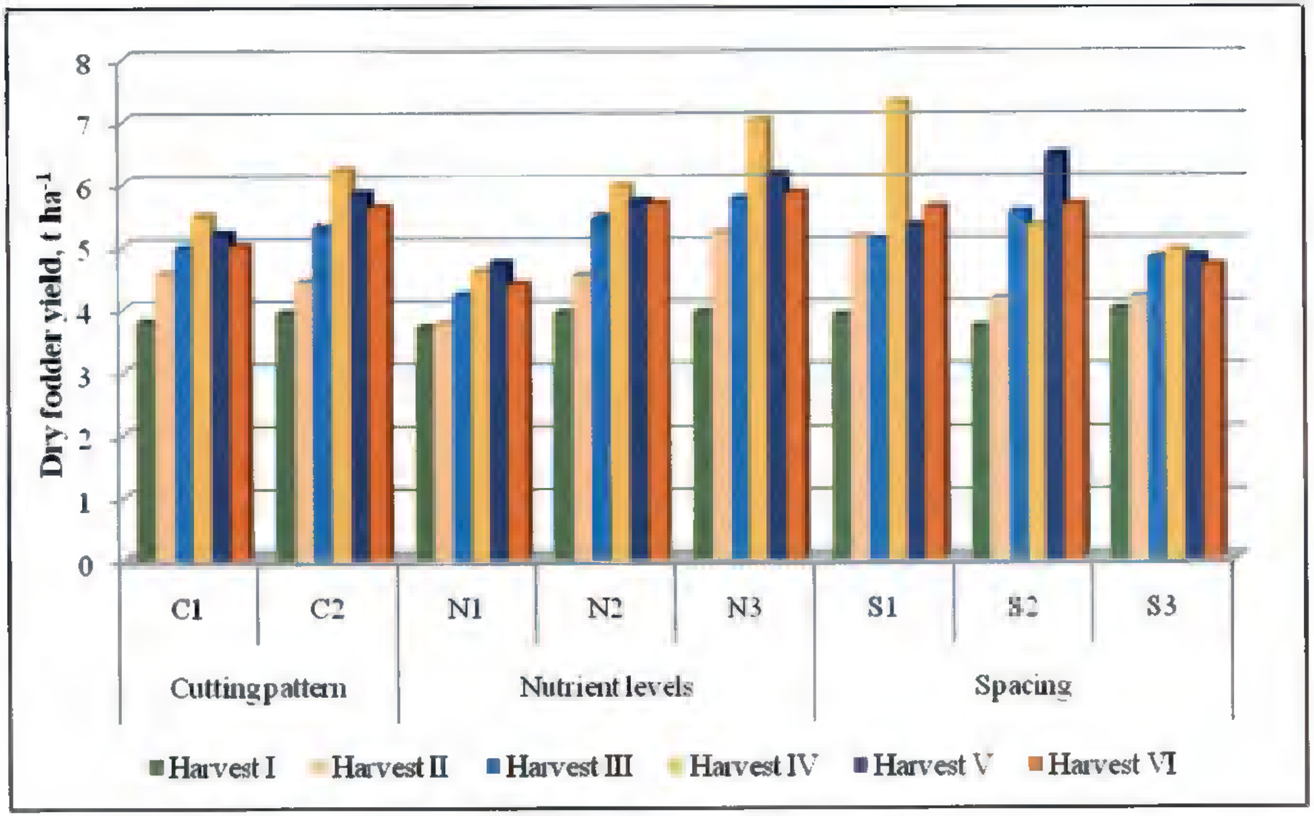


Fig. 7. Effect of cutting pattern, nutrient levels and spacing on dry fodder yield under open condition during first year, t $ha^{-1}$

Chaparro *et al.* (1995). During the second year, ground level cutting recorded the highest dry fodder yield in third harvest (Fig. 8). The lowest part of the stem was supposed to be the thickest, adding further to the proportion of stem material and this might have resulted in increased dry fodder yield. The dry fodder yield was significantly influenced by the nutrient levels. The dry fodder yield increased linearly with successive increments of chemical fertilizer in all harvests in both years. This might be due to the increased green fodder yield resulting from increased nutrient uptake and positive interactions of nutrients. The dry fodder yield was significantly influenced by the spacing treatments. As the spacing was decreased the dry fodder yield was found to exhibit an increasing trend. The maximum dry fodder yield was registered by the treatment involving narrow spacing (60 cm x 30 cm) in three harvests in first and four harvests in second year. The yield improvement with narrow rows and high plant densities might be due to greater solar energy interception and shading the soil surface more completely. Similar results were reported by Wijitphan *et al.* (2009) in napier grass and Bhatti *et al.* (1985) in elephant grass.

A significant interaction was noticed between cutting height, nutrient levels and spacing in sixth harvest during first year. The cutting height of 10 cm along with a nutrient dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ and spacing of 60 cm x 40 cm registered maximum dry fodder yield and it was on a par with $c_2n_2s_1$ and $c_1n_3s_1$. During second year significant interaction was noticed between cutting height and spacing in fourth harvest. The cutting height of 10 cm along with a spacing of 60 cm x 30 cm registered maximum dry fodder yield and it was on a par with $c_1s_2$.

### 5.1.3 Effect of Cutting Pattern, Nutrient Levels and Spacing on Physiological Parameters

The results revealed that dry matter was significantly increased by increasing the cutting height in both years and cutting at 10 cm from ground level ($C_2$) recorded higher dry matter production throughout the crop growth period.

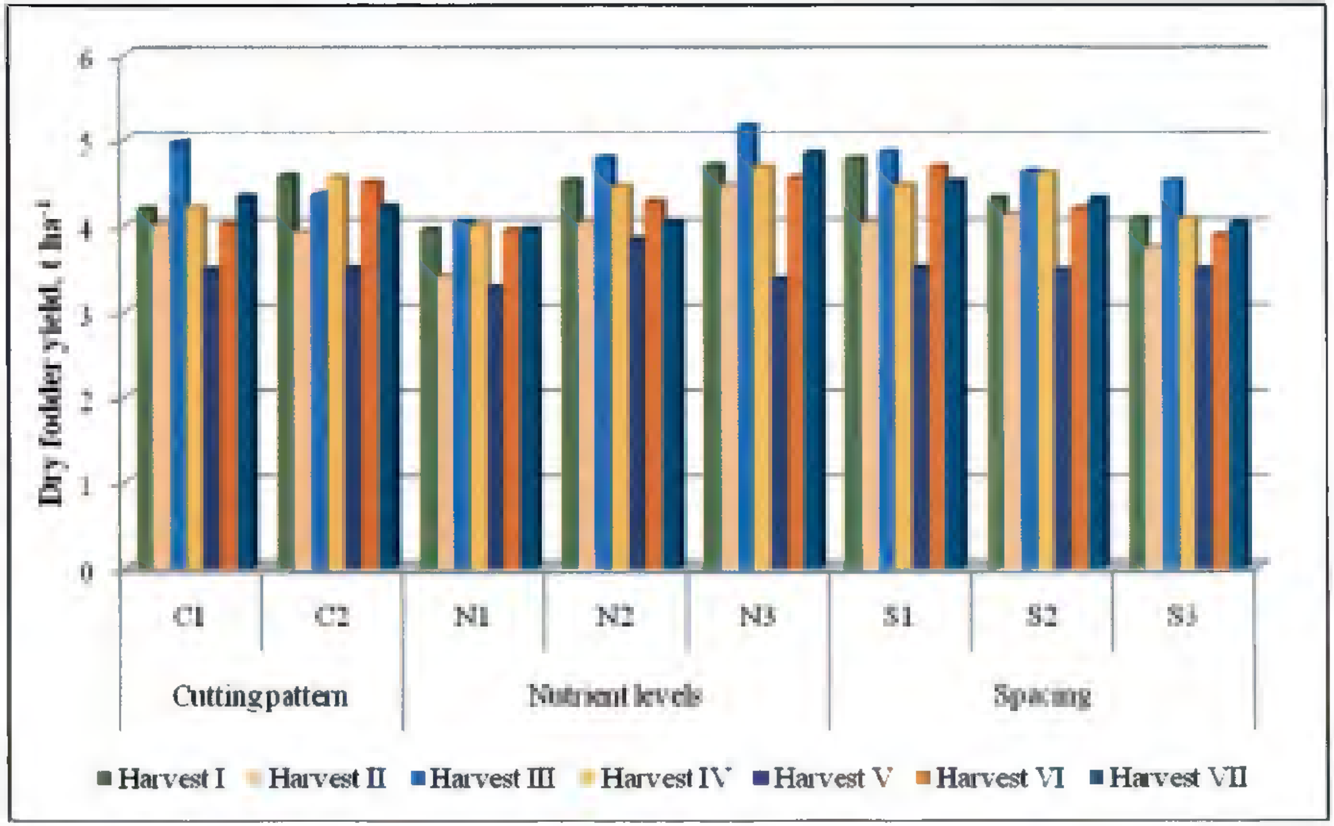


Fig. 8. Effect of cutting pattern, nutrient levels and spacing on dry fodder yield under open condition during second year, t $ha^{-1}$

This might be due to the deeper root system which might have resulted in increased nutrient uptake. Similar findings of increased DMP in *Brachiaria* hybrid cv. Mulato I was reported by Dutra *et al.* (2014). The DMP was significantly influenced by the nutrient levels. Among the nutrient levels, the highest dose registered the highest dry matter production. Dry matter yield responded well to fertilizer application which could be mostly due to the positive effect of increased nitrogen application. Similar finding was observed by Filho *et al.* (1989) in *Brachiaria brizantha* and Pamo (1991) in ruzi grass. The DMP was significantly influenced by the different spacing. The narrow spacing of 60 cm x 30 cm recorded highest dry matter production in both years which might be due to the highest plant height.

During second year, at fourth harvest highest DMP was produced when cutting at 10 cm height and nutrient level of 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ was followed. At sixth harvest highest DMP was produced when highest nutrient level was given along with a narrow spacing of 60 cm x 30 cm was followed.

The result revealed that leaf area index was significantly influenced by cutting height in both years. Between two cutting patterns, cutting at ground level ($C_1$) recorded the highest leaf area index in the both years. The highest dose of nutrients recorded maximum leaf area index in all harvests in the both years and this might be due to the higher plant height along with more number of tillers produced by the highest dose of fertilizers (300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$). Nitrogen fertilization promoted increase in photosynthetic leaf area which resulted in higher LAI and this is in conformity with the findings of Nabinger (2001). Leaf area is responsible for sunlight capture and larger leaf area allows better exposure to sunlight. Chapman and Lemaire (1993) pointed out that nitrogen supply affects the leaf elongation, resulting in larger leaf area. Sonia (1999) also reported higher leaf area index with increased nitrogen level from 100 to 200 kg $ha^{-1}$ in *Brachiaria decumbens.* Leaf area index was significantly influenced by different spacing. Highest LAI was registered with narrow spacing

(60 cm x 30 cm) in both years. Similar findings of higher LAI with 50 cm x 50 cm spacing in napier grass was reported by Miyagi (1980).

Significant response was noticed for cutting height on RGR. Among the two cutting patterns cutting at10 cm from ground level recorded the highest RGR in the first year. The higher dry matter production might have contributed to the higher RGR. The cutting at ground level recorded the highest RGR during second year. The higher LAI attained at ground level cutting might be the reason for increased RGR. Regarding fertilizer treatments maximum RGR was registered with a fertilizer dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ during both the years. The higher leaf area index obtained at the highest dose of nutrients might have contributed to the higher rate of DMP per unit original plant material which resulted in increased RGR. This is in conformity with the findings of Lekshmi (2004) in guinea grass and Kumar and Singh (2001) in maize. Among the different spacing treatments the highest RGR was observed in the 60 cm x 60 cm during both years.

During first year interaction between cutting height and spacing was significant between fifth and sixth harvests. Cutting at 10 cm height along with 60 cm x 30 cm ($c_2s_3$) recorded the highest RGR of 2.41 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between nutrient level and spacing between fifth and sixth harvests. The treatment combination $n_3s_3$ recorded highest RGR of 2.43 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between cutting height, nutrient level and spacing between fifth and sixth harvest. The treatment combination $c_2n_3s_3$ recorded the highest RGR of 2.50 g $g^{-1}$ $day^{-1.}$ During second year, significant interaction was observed between cutting height and nutrient levels between second and third harvests. The treatment combination $c_2n_2$ recorded the highest RGR of 2.13 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between cutting height and spacing between second and third harvests. Cutting at 10 cm height along with 60 cm x 30 cm spacing ($c_2s_3$) recorded the highest RGR of 2.27 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between cutting height and nutrient level between sixth and seventh harvest. The treatment combination $c_2n_3$

recorded the highest RGR of 2.14 g $g^{-1}$ $day^{-1}$. Significant interaction was observed between nutrient levels and spacing between third and fourth harvests. The treatment combination $n_1s_3$ recorded highest RGR of 2.15 g $g^{-1}$ $day^{-1}$.

Among the different spacing the highest CGR of 4.78 g $m^{-2}$ $day^{-1}$ was observed by $S_1$ between first and second harvests and 3.92 g $m^{-2}$ $day^{-1}$ by $S_2$ between fourth and fifth harvests during first year. During second year among the two cutting patterns cutting at ground level recorded the highest CGR of 3.22 g $m^{-2}$ $day^{-1}$. Maximum CGR was registered with a fertilizer dose of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ between fourth and fifth harvests. This is in conformity with the findings of Wadi *et al.* (2003) and Pillai (1986) in guinea grass. Spacing had no significant influence on CGR at different harvests. During first year significant interaction was observed between nutrient levels and spacing between fifth and sixth harvest. The treatment combination $n_2s_1$ recorded highest CGR of 4.48 g $m^{-2}$ $day^{-1}$. Significant interaction was observed between cutting height, nutrient level and spacing between fifth and sixth harvest. The treatment combination $c_1n_2s_1$ recorded highest CGR of 7.99 g $m^{-2}$ $day^{-1}$. During second year significant interaction was observed between cutting height and nutrient level between fifth and sixth harvest. The treatment combination $c_2n_3$ recorded highest CGR of 6.38 g $m^{-2}$ $day^{-1}$.

During first year, among the different spacing tried the highest NAR of 0.007 g $m^{-2}$ $day^{-1}$ was observed by $S_1$ between first and second harvests and 0.005 g $m^{-2}$ $day^{-1}$ by $S_2$ between fourth and fifth harvests. During second year, among the two cutting patterns cutting at ground level recorded highest NAR of 0.004 g $m^{-2}$ $day^{-1}$.

The per day productivity was significantly influenced by cutting pattern in first year. The per day productivity was superior when cutting height of 10 cm was followed in first year. The per day productivity was significantly influenced by nutrient doses. Highest nutrient dose recorded highest per day productivity in both years. The per day productivity was significantly influenced by spacing treatments. Among the different spacing levels, 60 cm x 30 cm produced maximum per day productivity in both years. This might be due to the increased green fodder and dry fodder production.

### 5.1.4 Effect of Cutting Pattern, Nutrient Levels and Spacing on Quality Parameters

The results revealed that crude protein content was significantly increased by increasing the cutting height in both the years (Fig. 9 and 10). This might be attributed to the higher leaf: stem ratio in 10 cm cutting height. Islam *et al.* (2003) opined that the proportion of leaf fraction is positively correlated to the crude protein content of plant. This result is in agreement with the findings of Costa *et al.* (2014). The highest dose of nutrients recorded the highest crude protein content in all the harvests in both the years. This response might be due to the enhanced uptake of nutrients by grasses. Mulato grass appears to efficiently absorb the increased nutrients provided in the soil and use it to form new plants as indicated by increased tillage number associated with chemical fertilizer and at the same time increased synthesis rate of nitrogenous substances of the plant tissues, either as protein or non protein nitrogen. The role of nitrogen and phosphorus in increasing the protein content is well known and its application might have increased the crude protein content. This is in agreement with the report of Aderinola *et al.* (2011) who reported increased crude protein content in forages with the addition of fertilizer. Similar findings were reported by Ruggieri *et al.* (1995) in *Brachiria brizantha* cv. Marandu forage.

Interaction between nutrient levels and spacing in fourth harvest was significant on crude protein in fourth harvest during first year. The highest nutrient dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ and spacing of 60 cm x 30 cm registered maximum crude protein content and it was on a par with $n_1s_1$, $n_2s_2$, $n_2s_3$, $n_3s_2$ and $n_3s_3$.

Crude fibre (CF) is one of the most important parameter influencing the quality of fodder crops. The higher the crude fibre contents lower will be the

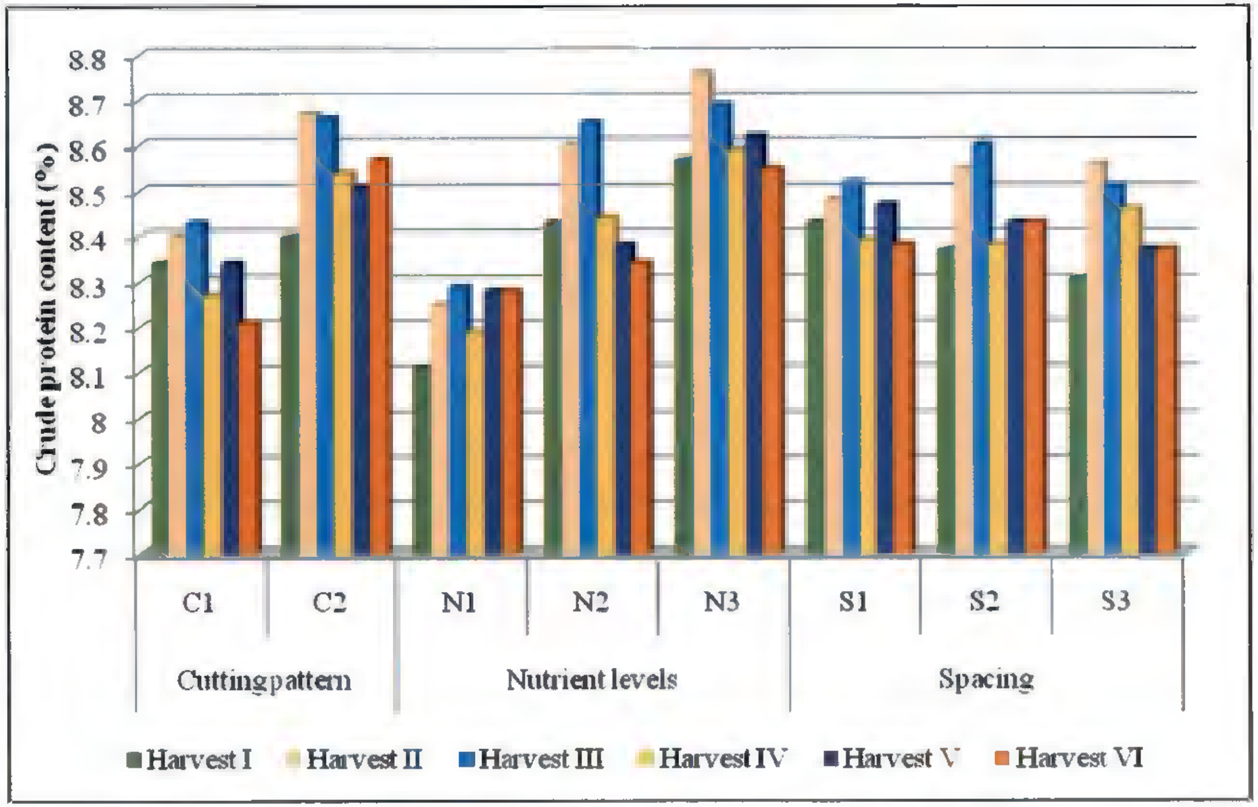


Fig. 9. Effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during first year, per cent

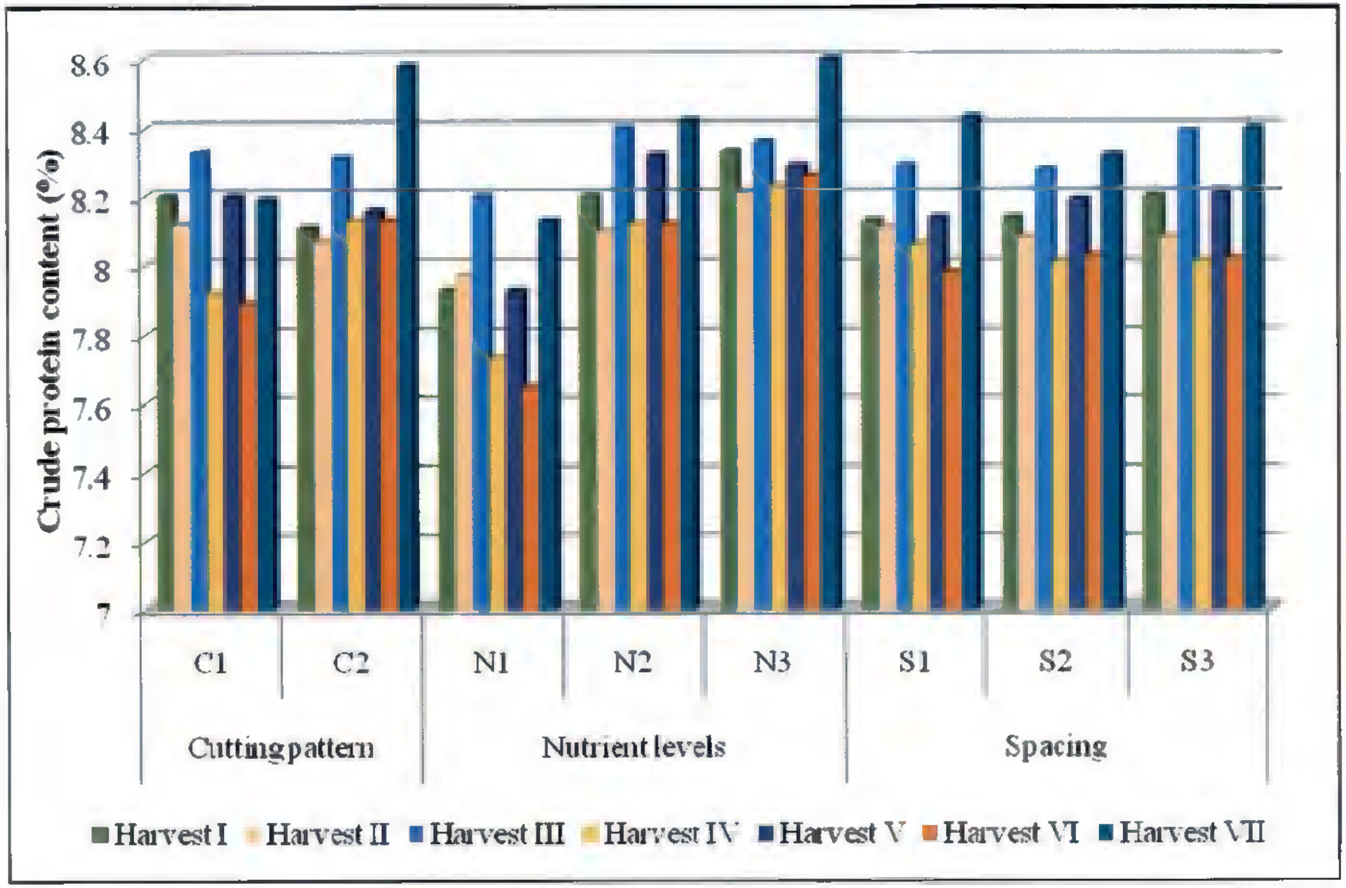


Fig. 10. Effect of cutting pattern, nutrient levels and spacing on crude protein content under open condition during second year, per cent

digestibility. The cutting height of 10 cm from the ground level recorded the lowest crude fibre content in both the years (Fig. 11 and 12). A reduction in crude fibre content of 3.0 per cent and 4.9 per cent was observed during first and second year respectively. The decrease in crude fibre content with increasing cutting height can possibly be attributed to the fact that the upper parts of the grass that were harvested at 10 cm height were inclined to contain fewer leaves than in the lower parts with ground level cutting. Hence fodder cut at 10 cm height was of higher quality as reflected in the higher crude protein content. This result is in conformity with the findings of Santos *et al.* (2001) in elephant grass. The crude fibre content was significantly reduced with increased application of nutrients. The nutrient dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ produced 3.0 per cent and 5.1 per cent reduction in crude fibre content in first and second year respectively. When nitrogen was applied in higher doses carbohydrates are utilized more for synthesis of protoplasm than for cell wall thickening, resulting in reduced fibre content. This result is in conformity with the findings of Vinayraj and Palled (2014) in hybrid napier and Lekshmi (2004) in guinea grass. This is in agreement with the findings of Aderinola *et al.* (2011) that crude fibre content of *Andropogon tectorum* grass decreased with increased fertilizer application level. Forages that have the availability of nitrogen will have the tendency of increasing growth rate, thus reducing the lignifications of the plant materials. During the second year, crude fibre content exhibited a reduction of 2.1 per cent when narrow spacing was followed. Similar finding was reported by Iptas and Acar (2006) in forage maize.

A significant interaction was noticed between cutting pattern and nutrient levels during first year. The cutting height of 10 cm along with a nutrient dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ registered the lowest crude fibre content and it was on a par with $c_2n_2$.

Nitrate content in fodder crops is detrimental to animal health. Nitrate nitrogen concentration of more than 2000 ppm was found critical and was reported to be toxic (Amandeep, 2009). The nitrate content was significantly

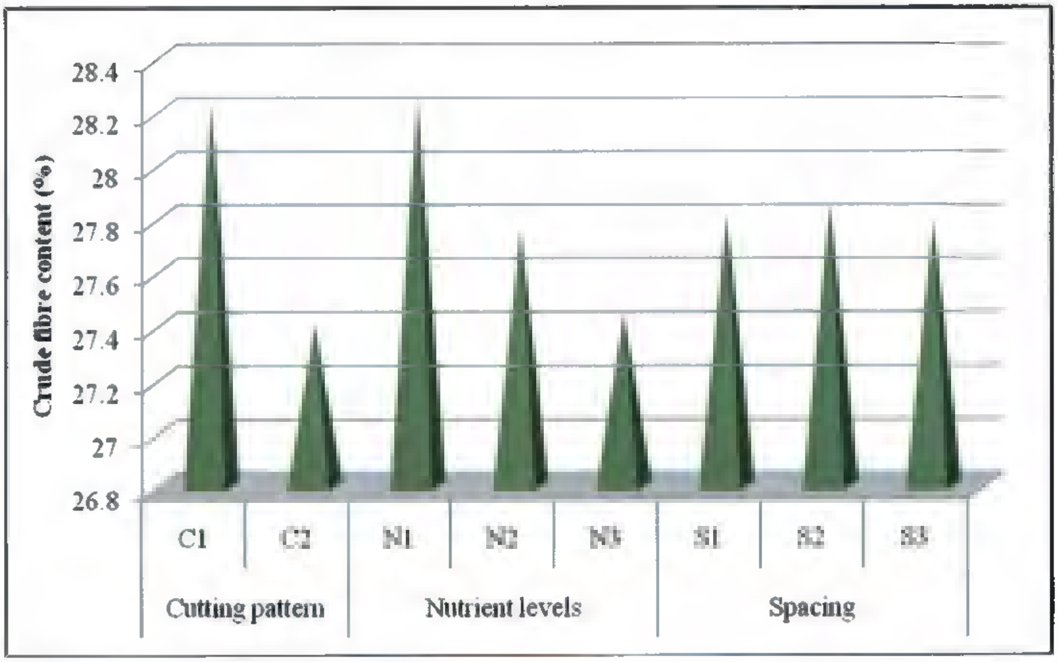


Fig. 11. Effect of cutting pattern, nutrient levels and spacing on crude fibre content under open condition during first year, per cent

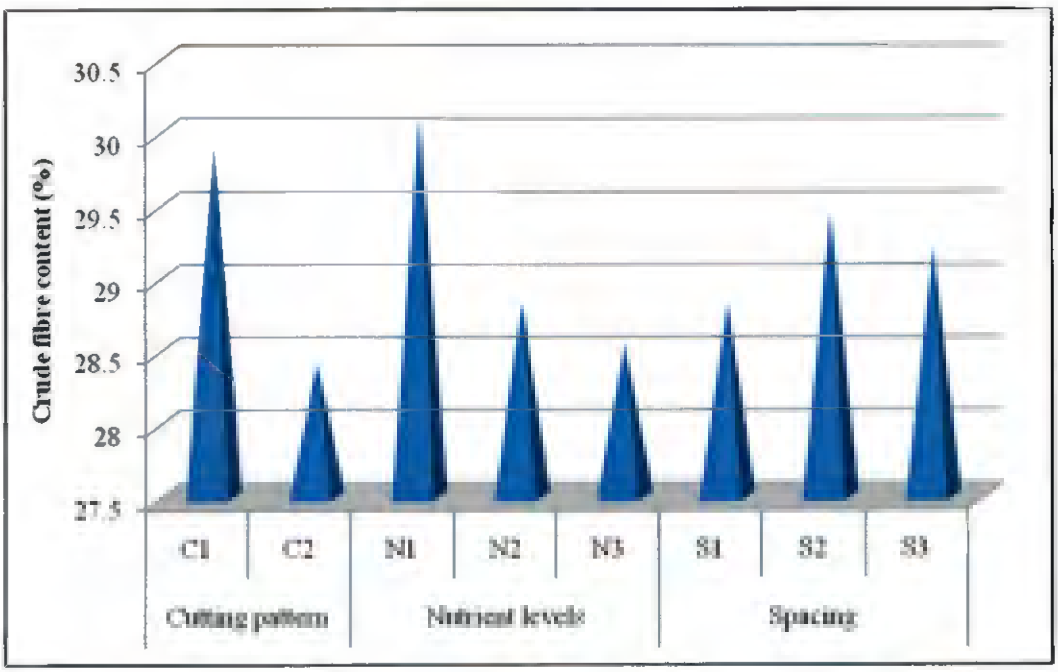


Fig. 12. Effect of cutting pattern, nutrient levels and spacing on crude fibre content under open condition during second year, per cent

increased by increasing the cutting height in sixth harvest in first year and fifth harvest in second year. Increase in fertilizer levels increased the nitrate content in both years. Similar findings of nitrate concentration with increased nitrogen levels was reported by Mishra (2011) in fodder oats, Tiwana *et al.* (2012) and Damame *et al.* (2013) in fodder pearl millet. The nitrate content was the highest in the spacing of 60 cm x 30 cm in third harvest in first year and third, fourth, fifth and sixth harvests in second year. However, the nitrate nitrogen content observed in the present study in all treatments ranged from 310 to 990 ppm which were below the toxic limits of 2000 ppm and are safe for animal health.

### 5.1.5 Effect of Cutting Pattern, Nutrient Levels and Spacing on Nutrient Uptake

Nutrient uptake is the function of nutrient concentration and dry matter production of the crop. The cutting height had significant effect on the uptake of nitrogen, phosphorus, potassium, calcium and magnesium in first year. During second year significant effect was noticed only on nitrogen uptake. The increased doses of N, P and K fertilizers favoured the uptake of N, P, K, Ca and Mg both in first and second year. The increase in nutrient uptake might be due to higher nutrient concentration and increased dry matter production. Palisade grass is a nutrient responsive crop and it responded well to higher levels of applied nutrients in addition to native soil fertility, which ultimately resulted in improved nutrient status of the plant. Moreover the positive interaction or synergistic effect of nutrients in the soil might have contributed to the increased uptake of nutrients. Sumner and Farina (1986) reported that nitrogen and potassium at higher concentration resulted in growth stimulation and enhanced uptake of both the nutrients. The potassium level increased with increase in fertilizer. This is in agreement with the finding of Galloway and Cowling (2002) who observed that nitrogen, potassium and phosphorus contributed satisfactorily to plant growth and were utilized well by grass. It was also observed that nutrient uptake was significantly influenced by spacing treatments. The narrow spacing recorded the maximum nutrient uptake in both years. This might be due to the fact that increasing plant population increased potential dry matter production and nutrient uptake.

None of the treatments either alone or in combination significantly affected the K: (Ca+ Mg) ratio of fodder.

### 5.1.6 Effect of Cutting Pattern, Nutrient Levels and Spacing on Soil Nutrient Status

The results of the chemical analysis of the soil after two years of the experiment revealed that available nitrogen, phosphorus, potassium and organic carbon content were not influenced by cutting pattern and spacing in the first year. However available N, P and K were significantly influenced by fertilizer levels. Significant increase in available N and available K was observed with application of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$. Several studies have shown that, higher level N can increase residual soil N which is susceptible to nitrate leaching (Chaney, 1990). With increase in K availability K fixation will be increased. The fixed K might be released slowly for plant uptake which might have increased the K status of soil. The application of 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ recorded the highest available phosphorus. This might be attributed to the increased phosphorus fixation in soil. During second year reducing the cutting height significantly increased the available nitrogen status of soil. This might be due to the decreased nitrogen uptake under ground level cutting. The available potassium was found to be the highest when 10 cm cutting height was followed. Among the fertilizer treatments, the highest dose recorded the highest available nitrogen, phosphorus and potassium status of soil. The increased application of nutrients might have resulted in increased nutrient status of the soil.

### 5.1.7 Effect of Cutting Pattern, Nutrient Levels and Spacing on Economics

During first year the net income and B: C ratio was significantly influenced by cutting pattern (Fig. 13 and 14). When 10 cm cutting height was followed

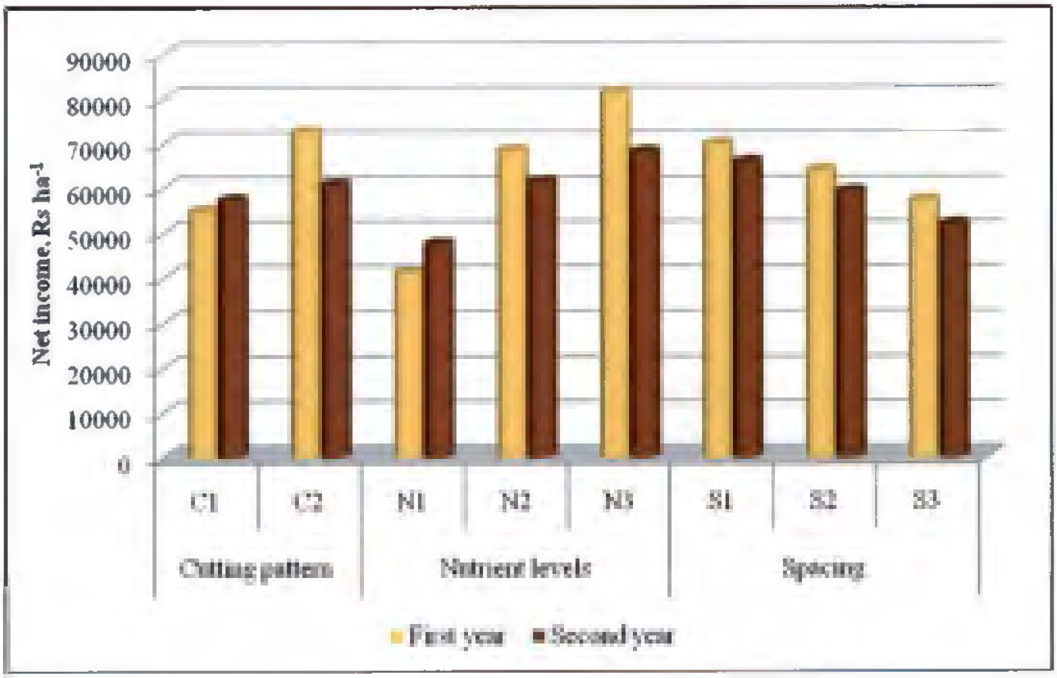


Fig. 13. Effect of cutting pattern, nutrient levels and spacing on net income under open condition, Rs $ha^{-1}$

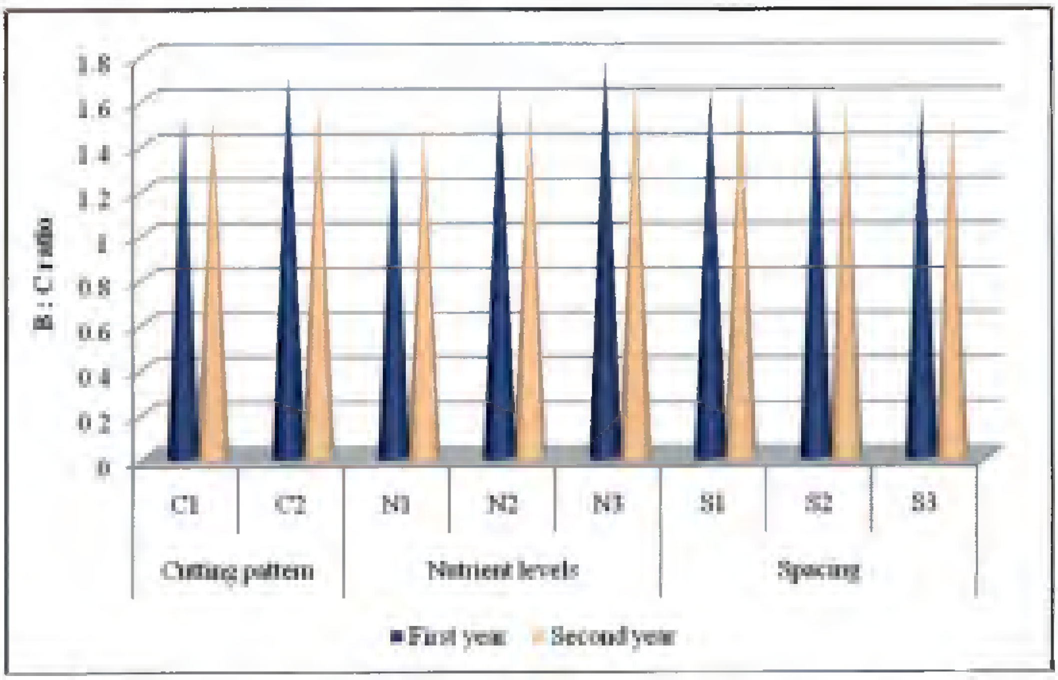


Fig. 14. Effect of cutting pattern, nutrient levels and spacing on B: C ratio under open condition

highest net income and B: C ratio was obtained. There was an increase of 24.2 per cent in net income and 11.0 per cent in B: C ratio. The increased uptake of nutrients and total green fodder yield had contributed to the increased net income and B: C ratio. During second year no significant difference was observed between cutting pattern treatments.

Among the nutrient levels $N_3$ recorded the highest net income and B: C ratio in both years. When highest dose of nutrients were applied 49.4 per cent and 30.3 per cent increase in net income and 20.7 per cent and 11.3 per cent increase in B: C ratio was obtained in first and second year respectively. Among the spacing treatments, lesser spacing registered the highest net income of 21.1 per cent and B: C ratio of 8.4 per cent in second year. Under open condition palisade grass can be economically cultivated with a nutrient dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ following 60 cm x 30 cm spacing and 10 cm cutting height.

## 5.2 EXPERIMENT- 2: STANDARDISING THE CUTTING PATTERN, N, P, K LEVELS AND SPACING IN PALISADE GRASS UNDER PARTIAL SHADE CONDITION

Grass tolerance to shade depends on the ability of the grass to adapt, morphologically and physiologically, to a particular level of irradiance (Dias-Filho, 2000). The response to shading depends on the forage species, level of shading and on soil fertility, especially nitrogen availability (Guenni *et al.*, 2008 and Soares *et al.*, 2009). However, even grasses that are fairly tolerant to shade, show a reduction in forage production under intense shade, especially when the level of shade exceeds 50 per cent of the incident radiation (Paciullo *et al.*, 2007 and Garcez Neto *et al.*, 2010). In Sri Lanka palisade grass has been reported to perform well under shades of coconut trees (Lagefoged, 1955). Hence the management practices under partial shade will be different from that of open. The results of the study conducted in partial shade condition are discussed below.

### 5.2.1 Effect of Cutting Pattern, Nutrient Levels and Spacing on Growth Parameters

The results revealed that during the first year plant height was significantly increased by increasing the cutting height from ground level to 10 cm in the second, third and sixth harvests and during the second year plant height was significantly higher in the second, fifth and sixth harvests. Progressive increase in plant height with increase in cutting height was reported by Gobbi *et al.* (2009). They observed that the lower incidence of PAR contributed to increased average canopy height and the length of petioles, stems and leaf blades in all cuttings in the canopy of the *Brachiaria decumbens* cultivar Basilisk. The plant height increased significantly with incremental application of fertilizer dose. The highest plant height was obtained with the highest nutrient level in both years. More pronounced stem growth is a normal tendency in plants cultivated under shade and is a strategy to compensate for the reduction in light (Castro *et al.*, 1999; Paciullo *et al.*, 2008). Etiolation or whitening of plants subjected to shading is a mechanism by which the plant searches for light by lifting its leaves towards the canopy. In grasses, this mechanism also permits a better distribution of radiation from the canopy along the tiller. An increase in plant height due to higher potassium application was reported by Mullakoya (1982) in guinea grass. This might be due to the fact that potassium promotes the growth of meristematic tissues (Tisdale *et al.*, 1995). Among the spacing, narrow spacing registered highest plant height in both first and second year. As the spacing was increased the plant height showed a decreasing trend.

Combinations of cutting pattern and nutrient levels were found significant in plant height at sixth harvest during second year. The cutting height of 10 cm along with a nutrient dose of 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ registered the highest plant height and it was on a par with $c_2n_2$.

The tiller number was increased by decreasing the cutting height from 10 cm to ground level both in the first and second year. Ground level cutting of fodder produced more number of tillers. Kipinis *et al.* (1977) observed that young stem of *Chloris gayana* showed the stimulus of defoliation and was negatively related to the distance between tiller base and the height of cut. Difante *et al.* (2011) reported that cutting height is important to ensure that solar radiation reaches the leaves closer to the ground, in good amount and quality, activating dormant buds and favoring the emergence of new tillers. Among the fertilizer treatments, the highest level of nutrients recorded the highest number of tillers in both the years. The positive response in plant tillering to the nitrogen fertilization is associated with the stimulus of nitrogen to plant cells growth and multiplication, since this nutrient is a component of cellular proteins and nucleic acids (Oliveira *et al.*, 2007). Paciullo *et al.* (2011) reported that tiller density varied with shading and nitrogen dose interaction in brachiaria species. Under full sunlight conditions, the response was linear, whereas for 36 per cent and 54 per cent shading, the responses were found to be quadratic, indicating that shade condition limited the plant response to the applied nitrogen, in terms of the appearance of new tillers. This result is in conformity with the findings of (Gautier *et al.*, 1999; Andrade *et al.*, 2004 and Paciullo *et al.*, 2008) and reinforces the importance of light in the production of new tillers in grass pasture. Jacob (1999) reported that more number of tillers were obtained in plots treated with fertilizer dose of 150: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ than the lower dose in congo signal under partial shaded condition. Among the different spacing, wider spacing of 60 cm x 40 cm recorded the highest number of tillers per plant. This may be due to the less competition for nutrients, light, water and space.

Leaf: stem ratio is a measure of the quality of fodder and hence determine its preference by animals. Among the fertilizer treatments, during first year the highest level of nutrients (250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$) recorded the highest leaf: stem ratio in second, third and fifth harvests whereas fertilizer dose of 200: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ produced the highest leaf: stem ratio in sixth harvest. During the second year significant difference was noticed only in third harvest and fertilizer applied @ 200: 50: 50 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ produced highest leaf: stem ratio. This was mainly due to the increased leaf area index resulted from the increased uptake of nutrients. Moreover, shading stimulates the response of the plants to the application of nitrogen, in terms of leaf elongation (Paciullo *et al.*, 2011). As the spacing was increased the leaf stem ratio was found to exhibit a decreasing trend. The maximum leaf: stem ratio was recorded by the treatment involving narrow spacing in all harvests except initial harvest both in first year and second year. This response might be due to the increased leaf area in narrow spacing treatments.

During first year, there was significant effect of cutting pattern on regeneration percentage on all harvests except initial harvest. The regeneration percentage after different harvests was not influenced by increasing the nutrient levels. Significant effect of plant spacing on regeneration percentage was noticed on all harvests. In all harvests highest regeneration percentage was obtained with a spacing of 60 cm x 40 cm. During second year plant spacing had significant effect on regeneration percentage in all harvests except first harvest. In all harvests highest regeneration percentage was obtained with a spacing of 60 cm x 40 cm.

During first year, significant interaction was observed between nutrient levels and spacing in the third, fourth and fifth harvest. In these harvests maximum regeneration percentage was observed in $n_2s_3$. Significant interaction was observed between cutting height, nutrient levels and spacing in the third, fourth and fifth harvest. In these harvests maximum regeneration percentage was observed in $c_1n_2s_3$, $c_2n_1s_3$, $c_2n_2s_2$, $c_2n_2s_3$, $c_2n_3s_2$ and $c_2n_3s_3$,

### 5.2.2 Effect of Cutting Pattern, Nutrient levels and Spacing on Yield Parameters

The results revealed that there was significant difference in green fodder yield between cutting pattern in both years. During first year cutting at 10 cm height recorded more fodder yield (5.4 %) compared to cutting at ground level (Fig. 15). This might be due to the increased plant height. It is a fact that plants grown in shade are taller than those in open condition. In open phytochrome

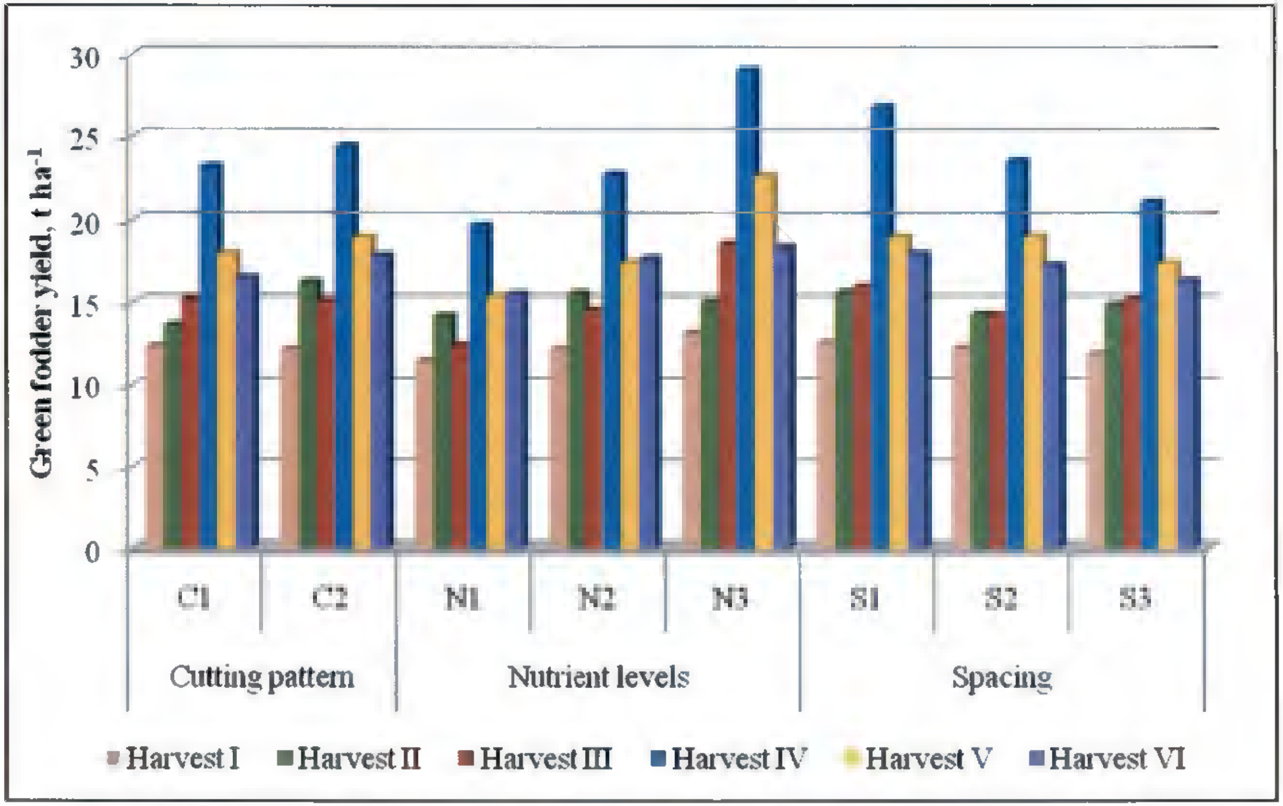


Fig. 15. Effect of cutting pattern, nutrient levels and spacing on green fodder yield under partial shade condition during first year, t $ha^{-1}$

pigment is present in Pr form which prevents elongation and results in increased intermodal length. Under shaded condition auxin production is more resulting in strong apical growth and preventing side shoot sprouting. This result is in conformity with the findings of Tudsri *et al.* (2002). During second year $C_2$ recorded highest green fodder yield in seventh harvest and $C_1$ recorded the highest yield in sixth harvest (Fig. 16). This might be due to more number of tillers in ground level cutting. Among the fertilizer treatments, the highest level of nutrients recorded the highest green fodder yield in both the years. There was an increase of 24.7 per cent and 15.3 per cent in first and second year respectively. The application of increased levels of nitrogen fertilizer presumably increased the availability of N which might have enhanced the meristematic growth and resulted in higher forage yield (Hazary *et al.,* 2015). Increased green fodder yield with higher level of phosphorus application was reported in thin napier grass by Dwivedi *et al.,* 1991, with higher potassium application in guinea grass by Anita (2002). The results revealed that green fodder yield was significantly increased by different spacing treatments. The planting geometry of 60 cm x 20 cm registered the highest green fodder yield (second, fourth, sixth and total yield) in first year and (second, fourth, and total yield) in second year. When narrow spacing was followed there was an increase of 9.0 per cent and 7.1 per cent in total green fodder yield in first and second year respectively. This result is in conformity with the findings of Kusvurani and Tansiz (2011) in annual ryegrass.

The result revealed that total dry fodder yield was significantly increased by increasing the cutting height in first year (Fig. 17). During second year $C_2$ registered highest dry fodder yield in seventh harvest and $C_1$ recorded highest yield in sixth harvest (Fig. 18). This might be due to the highest green fodder yield. The dry fodder yield increased with successive increments of chemical fertilizer in all harvests in first year. During second year significant difference was noticed in all harvests except fourth harvest. This was due to the improved moisture status of the soil under a low light environment which might have

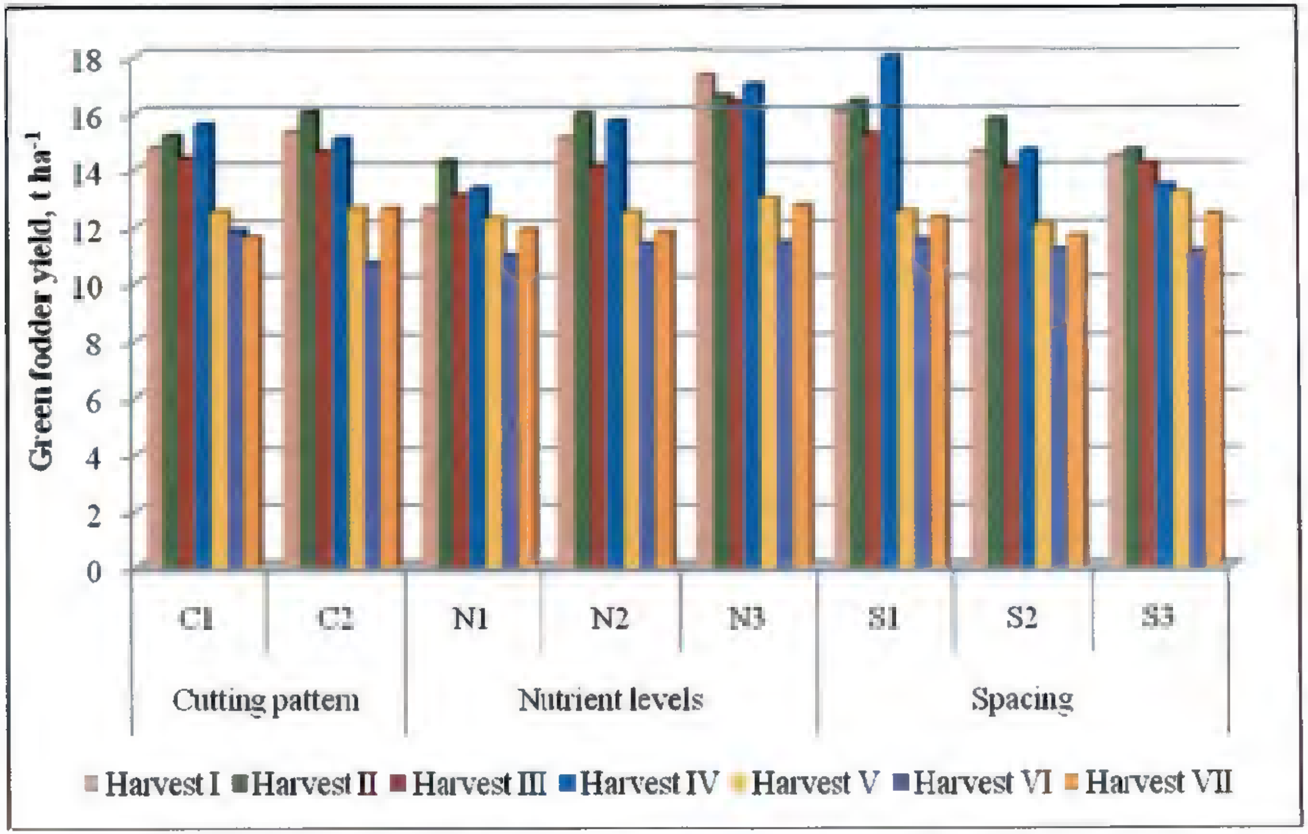


Fig. 16. Effect of cutting pattern on green fodder yield under partial shade condition during second year, t $ha^{-1}$

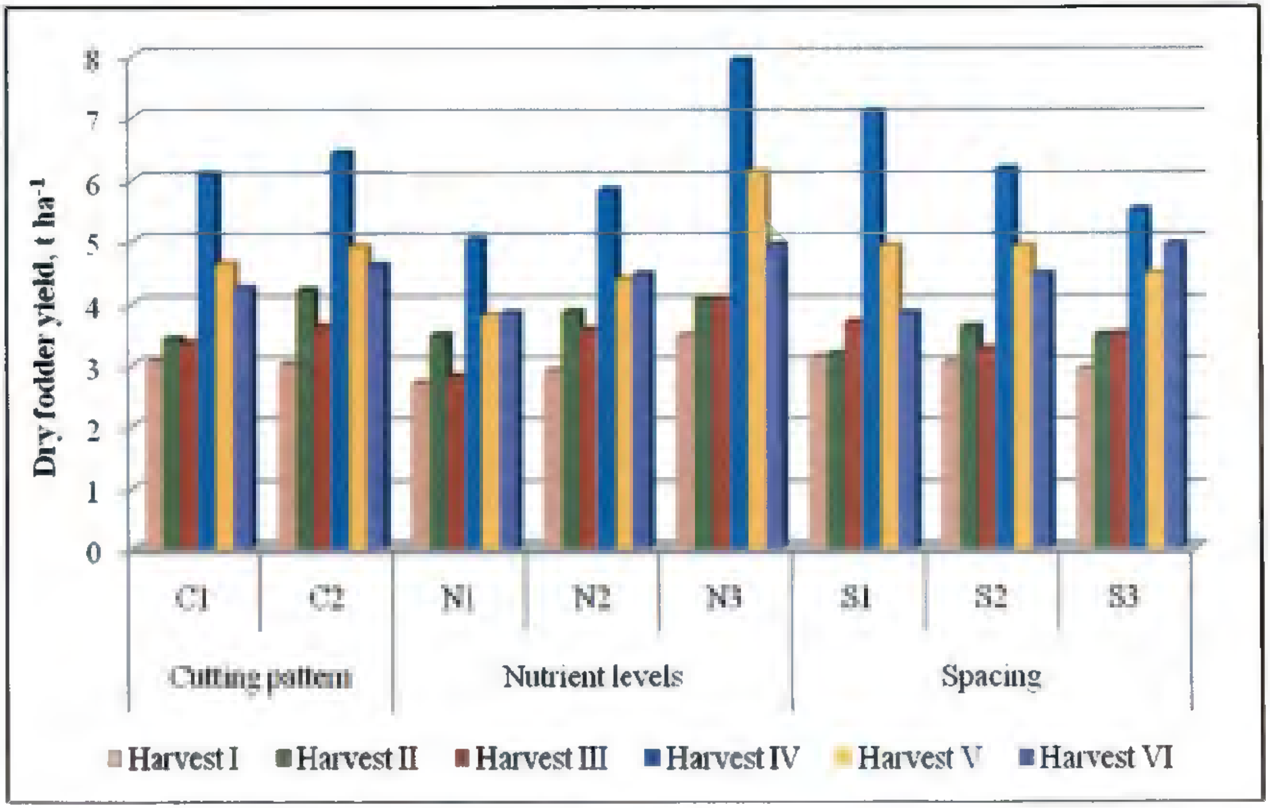


Fig. 17. Effect of cutting pattern on dry fodder yield under partial shade condition during first year, t $ha^{-1}$

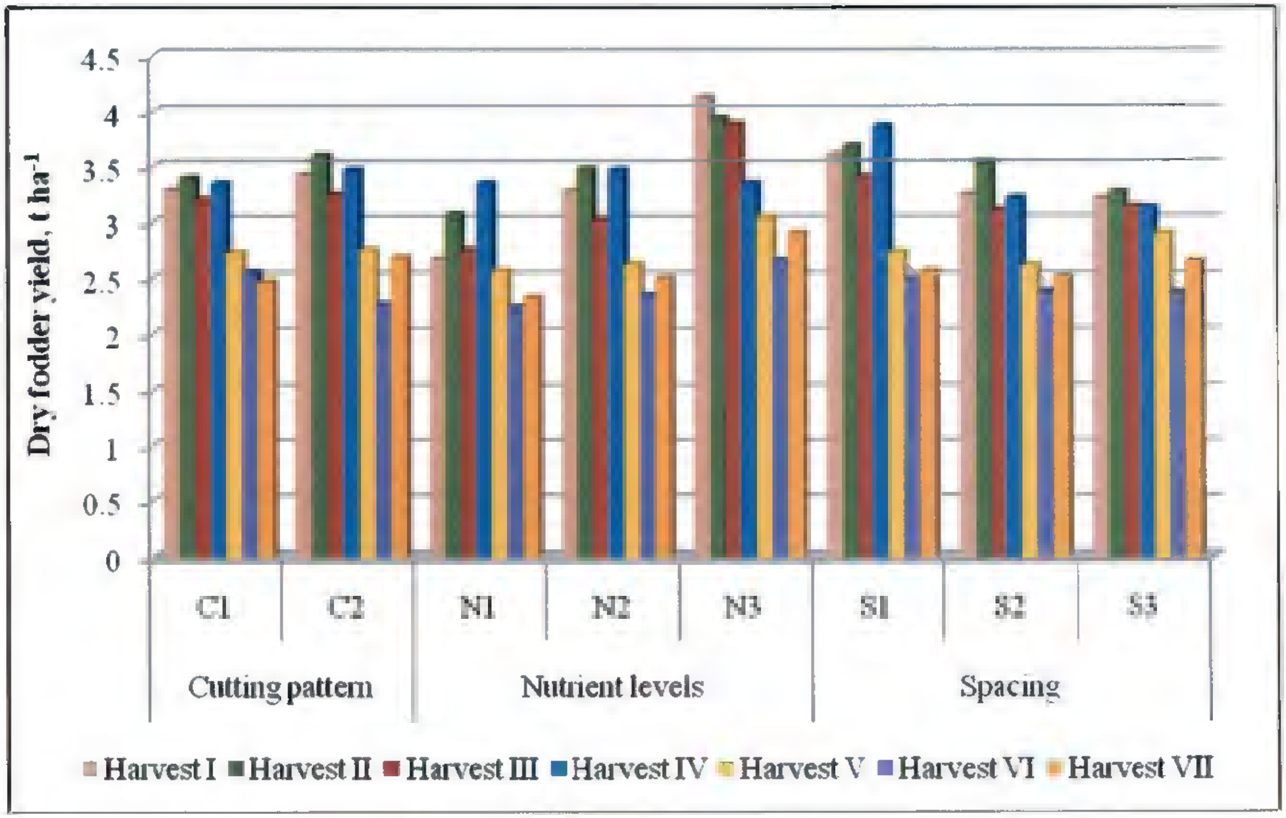


Fig. 18. Effect of cutting pattern on dry fodder yield under partial shade condition during second year, t $ha^{-1}$

increased growth characters and photosynthate accumulation. As the spacing was decreased the total dry fodder yield was found to exhibit an increasing trend. The maximum total dry fodder yield was registered by the treatment involving narrow spacing (60 cm x 20 cm) in both years.

### 5.2.3 Effect of Cutting Pattern, Nutrient Levels and Spacing on Physiological Parameters

The results revealed that dry matter production was significantly increased by increasing the cutting height in both years. $C_2$ recorded the highest dry matter production. This might be attributed to the deeper root system which might have resulted in increased nutrient uptake. Among the nutrient levels, highest dose registered highest dry matter production. The dry matter production increased with decreasing levels of shade and the highest dry matter production of 2684.76 g $cm^{-2}$ was obtained when para grass was grown under the coconut trees of age 50 years and fertilized with 225 kg N $ha^{-1}$. Nitrogen improves leaf elongation and leaf appearance rates and the length of the leaf blade. Shading stimulates the response of the plants to the application of nitrogen. Leaf area is responsible for sunlight capture in a way that a larger leaf area allows higher exposition to sunlight. Chapman and Lemaire (1993) pointed out that nitrogen supply affects the leaf elongation, resulting in larger leaf area. In addition, nitrogen is a driving factor in the processes of plant growth and development, allowing increases in biomass due to increase in carbon fixation (Nabinger, 2001). Thus, the larger energy capture area as evidenced from increased LAI might have resulted in higher biomass accumulation. The narrow spacing of 60 cm x 20 cm recorded highest dry matter production in both years.

Among the two cutting patterns $C_1$ recorded the highest leaf area index in both years. The highest dose of nutrients recorded maximum leaf area index in all harvests in both years. Leaf area of palisade grass at the first harvest was smaller than at the second and third harvests, because the energy used for root system formation was much smaller after the first growth period and consequently more energy was available for shoot growth. Increase in leaf area of forage grass lead to higher photosynthetic efficiency as it increased light interception area (Akmal and Janssen, 2004) and was a key factor for pasture yield. Leaf area is responsible for sunlight capture in a way that a larger leaf area allows higher exposure to sunlight. Chapman and Lemaire (1993) pointed out that nitrogen supply affects the leaf elongation, resulting in larger leaf area. Sonia (1999) reported that leaf area index was found to be increased with increase in the nitrogen level from 100 to 200 kg $ha^{-1}$ in *Brachiaria decumbens*. Regarding plant geometry highest leaf area index was registered with narrow spacing in both years.

During first year, among the two cutting patterns cutting at 10 cm from ground level recorded the highest RGR of 2.11 g $g^{-1}$ $day^{-1}$. Regarding fertilizer levels significant response was indicated between all harvests. Maximum RGR was registered in all harvests with a fertilizer dose of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$. There was significant influence of plant spacing on RGR between all harvests. Among the different spacing treatments the highest RGR was observed in the 60 cm x 40 cm. During second year, among the two cutting patterns, cutting at ground level recorded the highest RGR of 2.01 g $g^{-1}$ $day^{-1}$. Regarding fertilizer treatments significant response was indicated between first and second harvest, second and third harvest and fifth and sixth harvest. Maximum RGR was registered with a fertilizer dose of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ between first and second harvest, second and third harvest whereas $N_2$ recorded highest RGR between fifth and sixth harvest. There was a significant influence of plant spacing treatments on RGR between all harvests. Among the different spacing treatments the highest RGR was observed in the 60 cm x 40 cm spacing treatment.

During the first year, the interaction of cutting height and nutrient level was significant between first and second harvests and fifth and sixth harvests. The treatment combination $c_2n_3$ recorded the highest RGR of 2.13 g $g^{-1}$ $day^{-1}$ in between first and second harvest and $c_1n_3$ recorded the highest RGR of 2.17 g $g^{-1}$

day$^{-1}$ in between fifth and sixth harvest. Significant interaction was observed between nutrient levels and spacing between first and second harvest and fifth and sixth harvest. The treatment combination $n_2s_3$ recorded highest RGR of 2.30 g g$^{-1}$ day$^{-1}$ in between first and second harvest and $n_3s_3$ recorded highest RGR of 2.37 g g$^{-1}$ day$^{-1}$ in between fifth and sixth harvest. During second year, significant interaction was observed between cutting height and nutrient levels between sixth and seventh harvest. The treatment combination $c_2n_3$ recorded highest RGR of 2.06 g g$^{-1}$ day$^{-1}$. Significant interaction was observed between cutting height and spacing between second and third harvest. The treatment combination $c_2s_3$ recorded highest RGR of 2.22 g g$^{-1}$ day$^{-1}$. Significant interaction was observed between nutrient level and spacing between fifth and sixth harvest. The treatment combination $n_3s_3$ recorded highest RGR of 2.12 g g$^{-1}$ day$^{-1}$.

Interaction between cutting height, nutrient levels and spacing was significant between fourth and fifth harvests, fifth and sixth harvests and sixth and seventh harvests. The treatment combination $c_1n_3s_3$ recorded the highest RGR of 2.22 g g$^{-1}$ day$^{-1}$ between fourth and fifth harvests, $c_1n_1s_3$ recorded the highest RGR of 2.17 g g$^{-1}$ day$^{-1}$ between fifth and sixth harvests and $c_1n_2s_3$ and $c_2n_3s_3$ recorded the highest RGR of 2.18 g g$^{-1}$ day$^{-1}$ between sixth and seventh harvests.

During the first year, CGR showed a significant variation in chemical fertilizer levels between second and third harvests. $N_3$ recorded highest CGR of 4.36 g m$^{-2}$ day$^{-1}$. There was a significant influence of on CGR by spacing between first and second harvests. Among the different spacing treatments the highest CGR of 2.76 g m$^{-2}$ day$^{-1}$ was observed by $S_3$. Among the two cutting patterns cutting at 10 cm from ground level recorded highest CGR of 1.77 g m$^{-2}$ day$^{-1}$ during second year. Regarding fertilizer levels no significant response was indicated. There was significant influence of plant spacing treatments on CGR between second and third harvest and fifth and sixth harvests.

During second year, interaction between cutting height and spacing was significant between second and third harvests. The treatment combination $c_2s_1$

recorded the highest CGR of 0.44 g $m^{-2}$ $day^{-1}$. Combination of levels of nutrients and spacing influenced CGR between sixth and seventh harvests. The treatment combination $n_3s_2$ recorded the highest CGR of 2.07 g $m^{-2}$ $day^{-1}$. Cutting height, nutrient levels and spacing was significant between fifth and sixth harvests and sixth and seventh harvests. Between fifth and sixth harvests $c_2n_2s_2$ recorded highest CGR of 2.32 g $m^{-2}$ $day^{-1}$. Between sixth and seventh harvests $c_2n_3s_2$ recorded the highest CGR of 4.59 g $m^{-2}$ $day^{-1}$.

NAR is essentially an estimation of canopy photosynthesis per unit leaf area. During first year, significant variation was observed in NAR by nutrient levels between second and third harvests only. $N_3$ recorded the highest NAR of 0.007 g $m^{-2}$ $day^{-1}$. The higher leaf area index attained at higher level of nitrogen resulted in greater DMP per unit photosynthesizing area which contributed to higher NAR as reported by Gaborcik and Javorkova (1990) in Anthoxantho – Agrostietum. There was a significant influence of plant spacing treatments on NAR between first and second harvests. Among the different spacing treatments the highest NAR of 0.007 g $m^{-2}$ $day^{-1}$ was observed by $S_3$. During second year, plant spacing treatments influenced NAR between fifth and sixth harvests.

The per day productivity was significantly influenced by cutting pattern in first year. The per day productivity was superior when cutting height of 10 cm was followed in first year. Highest nutrient dose recorded the highest per day productivity in both years. Among the different spacing levels, 60 cm x 20 cm produced maximum per day productivity in first year whereas 60 cm x 40 cm produced maximum per day productivity in second year. This might be due to the increased green fodder and dry fodder production.

### 5.2.4 Effect of Cutting Pattern, Nutrient Levels and Spacing on Quality Parameters

The result revealed that crude protein content was significantly increased by increasing the cutting height in both the years. The crude protein content was the highest when cutting height of 10 cm was followed in all harvest except initial and final harvest during first year (Fig. 19). During the second year ground level cutting registered the highest crude protein content in final harvest only (Fig. 20). The crude protein content increased significantly with the increasing level of chemical fertilizer in both the years. This might be due to rapid synthesis of carbohydrates into protein and protoplasm leaving relatively smaller portion for cell wall synthesis. At equal P and K fertilizer background (P 60 and K 80), nitrogen rate N (60) increased the CP content in grass dry matter (Bumane, 2010). The crude protein content decreased towards the final harvests. Generally as plant matures, the CP decreases while the cell wall components increase and digestibility and energy content decline. The decline in protein concentration with advancing maturity occurs because of the decrease in protein both in the leaves and stems. In more mature forage, stems with their lower protein concentration, make up a larger portion of the herbage leading to reduced crude fibre. In an experiment with different Brachiaria species (*B. brizantha* cv. Marandu, *B. brizantha* cv. MG 4, *B. brizantha* cv. Xaraes, *B. brizantha* cv. Pista, *B. decumbens and B. ruziziensis) B. brizantha* cv. Xaraes produced the highest crude protein content of 15.19 in the first cut whereas in the remaining 5 cuts *B. brizantha* cv. Pista recorded the highest crude protein content of 14.17, 14.95, 10.19, 14.83 and 14.60 per cent respectively (Maia *et al.*, 2014). Among the spacing treatments during first year $S_1$ recorded the highest crude protein content in fifth harvest and $S_3$ recorded the highest crude protein content in second harvest.

Crude fibre is often used as a negative index of nutritive value in the prediction of total digestible nutrients (TDN) and net energy. Prediction equations assume that higher fibre means lower digestibility. The cutting height of 10 cm from the ground level produced the lowest crude fibre content in both years (Fig. 21 and 22). The crude fibre content was reduced to 3.0 per cent and 2.3 per cent in first and second year respectively. The crude fibre content was significantly reduced with increased application of nutrients in both years. The

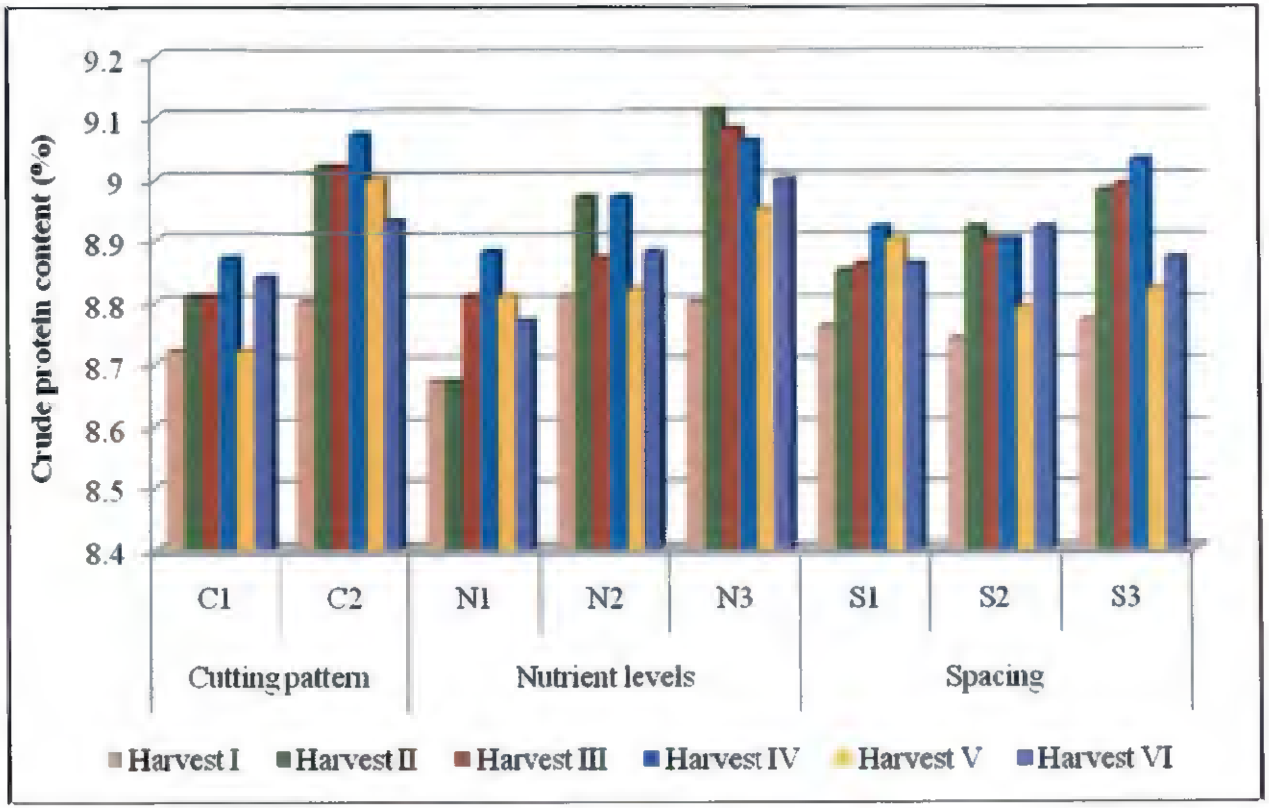


Fig. 19. Effect of cutting pattern on crude protein content under partial shade condition during first year, per cent

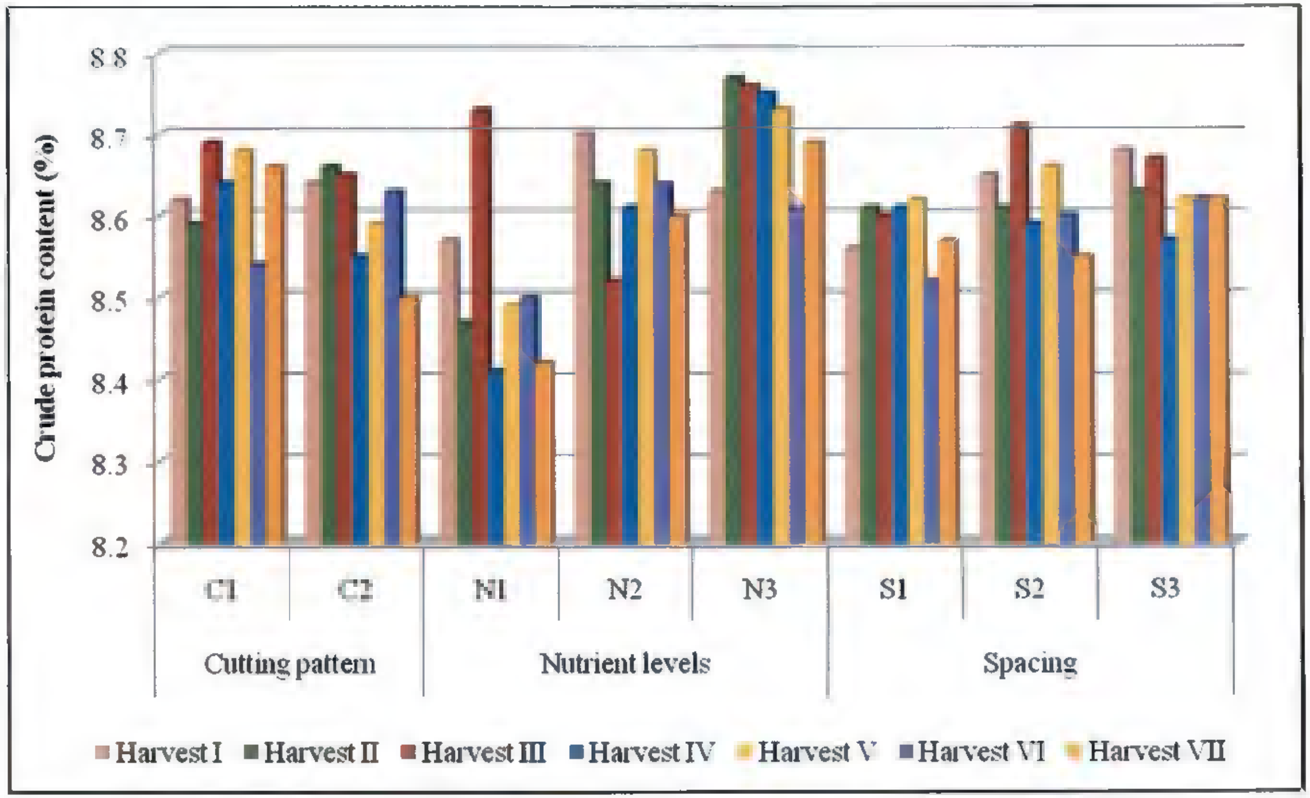


Fig. 20. Effect of cutting pattern on crude protein content under partial shade condition during second year, per cent

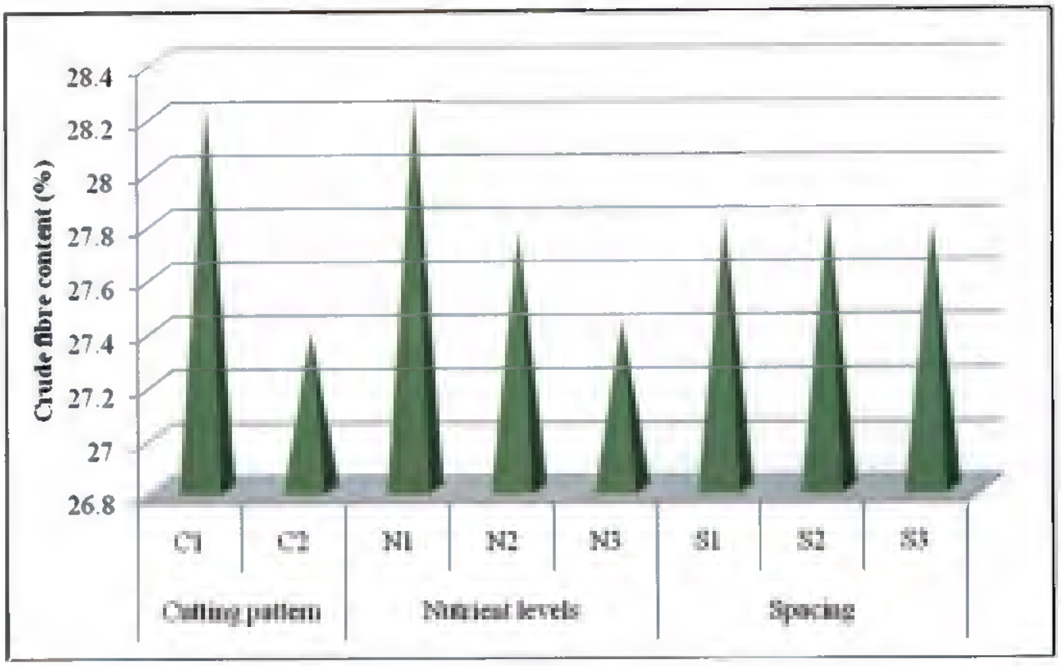


Fig. 21. Effect of cutting pattern, nutrient levels and spacing on crude Fibre content under partial shade condition during first year, per cent

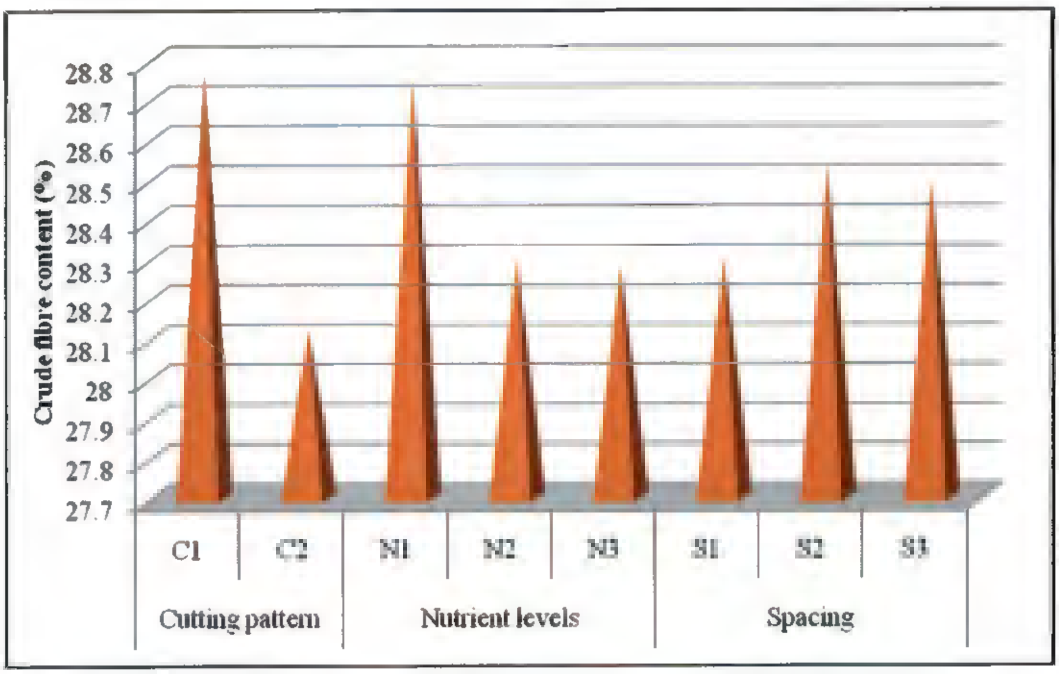


Fig. 22. Effect of cutting pattern, nutrient levels and spacing on crude Fibre content under partial shade condition during second year, per cent

application of nutrients @ 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ reduced the crude fibre content to 2.9 per cent and 1.6 per cent in first and second year respectively. When nitrogen was applied in higher doses carbohydrates are utilized more for synthesis of protoplasm than for cell wall thickening, resulting in reduced fibre content. The highest level of N (300 kg N $ha^{-1}$) and P (75 kg $P_2O_5$ $ha^{-1}$) produced lowest crude fibre content (30.63 %) in guinea grass under shaded conditions (Lekshmi, 2004).

One of the main reasons for nitrate toxicity is consumption of fodder containing high amounts of nitrate. Plants containing more than 1.76 per cent nitrate is dangerous as animal feed. Increase in fertilizer levels increased the nitrate content in both years. Highest nitrate content was observed in lesser spacing of 60 cm x 20 cm in both years. However, the nitrate nitrogen content observed in the present study in all treatments ranged from 310 to 990 ppm which were below the toxic limits and are at safer levels.

### 5.2.5 Effect of Cutting Pattern, Nutrient Levels and Spacing on Nutrient Uptake

The nutrient uptake refers to the process of nutrient movement from an external environment into a plant. The cutting height had significant effect on the uptake of nitrogen, phosphorus, potassium, calcium and magnesium in first year. During second year significant effect was noticed only on nitrogen uptake. The nutrient uptake was found to increase with enhanced application of fertilizers in both years. Due to their morphophysiological characteristics, such as plant architecture and photosynthetic efficiency, tropical forage grasses respond positively to high nitrogen rates (Cantarutti *et al*., 2002). The increased doses of N, P and K fertilizers favoured the uptake of N, P, K, Ca and Mg both in first and second year. The increase in nutrient uptake might be due to high soil moisture level associated with the more moderate soil temperature in shade that may result in a faster rate of N mineralization, litter breakdown, and turnover of N than that occurs in full sunlight. Similar results were found by Awan and Abbasi (2000) and Jacob (1999) in congo signal grass. It was also observed that nutrient uptake was significantly influenced by spacing treatments. The narrow spacing recorded the maximum nutrient uptake in both years. This may be due to higher number of plants per unit area that led to more efficient use of the environmental resources.

None of the treatments either alone or in combination significantly affected the K: (Ca+ Mg) ratio of fodder.

### 5.2.6 Effect of Cutting Pattern, Nutrient Levels and Spacing on Soil Nutrient Status

The results of the chemical analysis of the soil after the experiment revealed that only available nitrogen was significantly influenced by cutting pattern in the first year. According to Wilson (1998), soil humidity levels drop more slowly in shaded soil than in soil in full sunlight, which enhance microbial activity in the leaf litter, leading to a greater mineralization and nitrogen availability in the soil. However available phosphorus, available potassium and organic carbon content were not significantly influenced by fertilizer treatments. Among the fertilizer treatments available nitrogen and organic carbon content alone showed significant difference during first year. Similar findings were reported by Hazra and Tripathi (1989) in sweet clover. The highest fertilizer dose recorded the highest available nitrogen, and organic carbon content of soil. The increased application of nutrients might have resulted in increased nutrient status of the soil. Among the spacing treatments, wider spacing recorded the highest available nitrogen, phosphorus and potassium in first year and available nitrogen and phosphorus in second year.

### 5.2.7 Effect of Cutting Pattern, Nutrient Levels and Spacing on Economics

The data on economics of cultivation revealed that net income and B: C ratio were appreciably influenced by various treatments. Highest net income and B: C ratio were obtained with cutting at 10 cm from ground level in both years (Fig. 23

and 24). When 10 cm cutting height was adopted there was an increase of 8.3 per cent and 3.6 per cent in B: C ratio during first and second year respectively. There was progressive increase in net income and B: C ratio with increase in nutrient levels. The highest nutrient level ($N_3$) recorded highest net income and B: C ratio in both years. When highest dose of nutrients were applied 61.9 per cent and 42.3 per cent increase in net income and 22.2 per cent and 12.5 per cent increase in B: C ratio was obtained in first and second year respectively. Among the spacing treatments, closer spacing registered highest B: C ratio compared to wider spacing in first year. The lesser spacing treatment registered the highest B: C ratio of 7.6 per cent in first year. This might be due to highest green fodder and dry fodder yield produced from this grass in above treatment.

In general, yield of forages is linearly related to the amount of light available, provided that other factors affecting growth are not limiting. In the present study higher level of nutrients and cutting height and closer spacing had a marked effect on yield, quality and profit of palisade grass both under open and partial shaded condition.

When cutting height of 10 cm from ground level was followed there was an enhancement in total green fodder yield (8.6 %) and reduction in crude protein content (1.4 %) in open condition than partial shade condition. The pooled data indicated that the crude fibre content in shade condition was 27.76 per cent which was 2.4 per cent lower than that obtained under open condition. However higher net income of Rs. 66,786 $ha^{-1}$ was obtained when palisade grass was grown under no shade conditions, which was 33.1 per cent more than that under shade conditions. B: C ratio also exhibited an increase of 15.0 per cent under open condition.

Higher total green fodder yield, net income and B: C ratio were obtained in open conditions compared to tree shade at all levels of nutrients. The highest nutrient dose produced an increase of 6.1 per cent, 24.9 per cent and 12.7 per cent in total fodder yield, net income and B: C ratio respectively in open condition

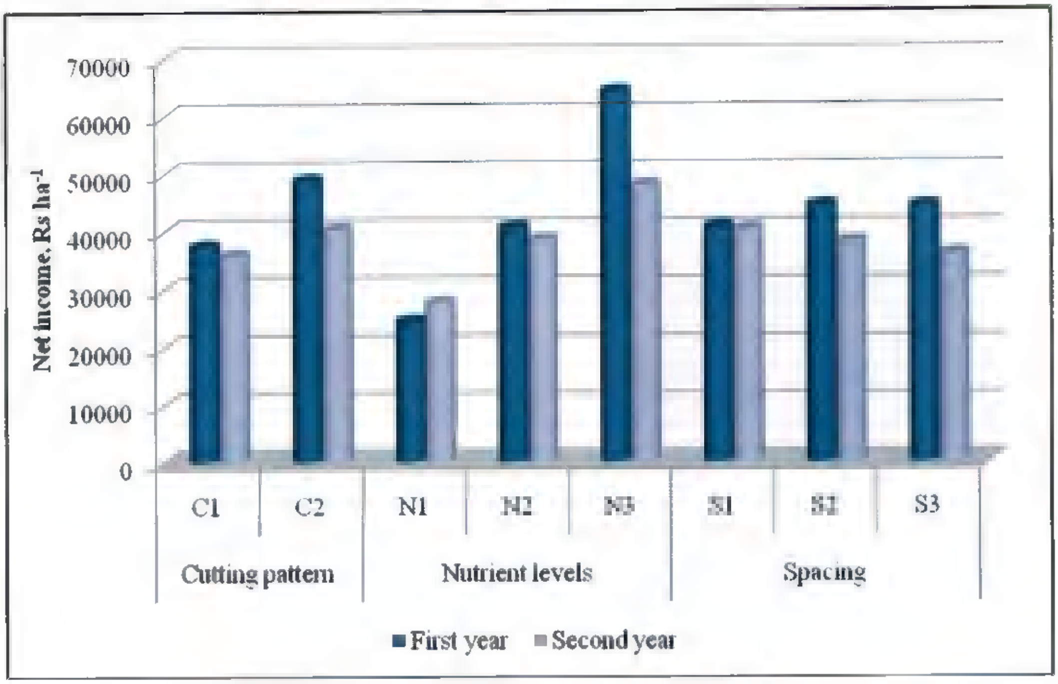


Fig. 23. Effect of cutting pattern, nutrient levels and spacing on net income under partial shade condition, Rs ha$^{-1}$

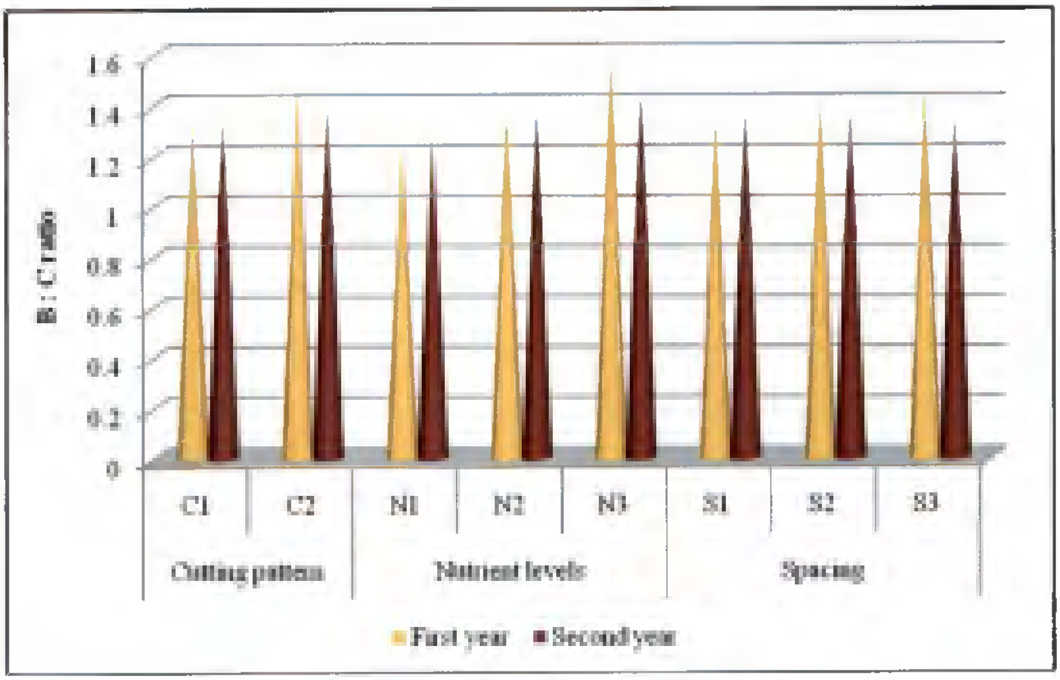


Fig. 24. Effect of cutting pattern, nutrient levels and spacing on B : C ratio under partial shade condition during first year

than shaded condition. However, the crude protein content showed an increase of 3.6 per cent in shade condition than open. The crude fibre content was better under shade conditions and also improved with increased application of nutrients. Partial shade conditions (40 % shade) improved the quality parameters without much reduction in yield. So farmers can stick on to intensification of cropping in areas planted with coconuts, in response to current market demands.

The total green fodder yield (8.5 %), net income (40.3 %) and B: C ratio (15.7 %) were higher in open conditions than under tree shade at closer spacing. The effect of shade conditions on elevating the crude protein content (3.5 %) and effect of sunlight in increasing the crude fibre content (2.6 %) in forage was observed with closer spacing. However, closely spaced palms, aged 8-25 years, are generally not suitable for intercropping. Mature plantations over 25 years old allow sufficient light to enter the understorey making conditions suitable for underplanting. So in this era of shrinking agricultural fields and the demand for good quality forage the farmers can also utilize coconut gardens to sustain a viable fodder production that will bridge the gap between demand and supply of fodder.

In open condition planting palisade grass at a spacing of 60 cm x 30 cm, with a nutrient dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$and harvesting the grass at a cutting height of 10 cm from the ground level resulted in the highest fodder yield, crude protein content, net income, B: C ratio and lowest crude fibre content.

In a partial shaded coconut garden of 40 % shade planting palisade grass at a spacing of 60 cm x 20 cm with a nutrient dose of 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ and harvesting the grass at a height of 10 cm from the ground level resulted in the highest fodder yield, crude protein content, net income, B: C ratio and lowest crude fibre content.

Based on this study, the palisade grass (*Brachiaria brizantha*) can be recommended for cultivation in open and in coconut garden with 40 per cent shade.

# SUMMARY

# 6. SUMMARY

The experiment entitled "Production package of palisade grass (*Brachiaria brizantha* (Hochst. ex A. Rich) Stapf.)" was conducted at the Instructional farm, College of Agriculture, Vellayani, Kerala for a period of two years from 2014-16. The main objectives were to standardise the nutrient requirement, spacing and cutting pattern of palisade grass under open and partial shaded condition and to work out the economics of cultivation.

The investigation was conducted as two separate experiments, one in open condition and another under partial shaded condition in coconut garden. Both the experiments were laid out in randomized block design with three replication. The treatments consisted of two cutting patterns, $C_1$ (cutting at ground level) and $C_2$ (cutting at 10 cm from the ground level) three nutrient levels, $N_1$ (200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$), $N_2$ (250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) and $N_3$ (300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) and three spacings, $S_1$ (60 cm x 30 cm), $S_2$ (60 cm x 40 cm) and $S_3$ (60 cm x 60 cm) in open condition. Under the partial shaded condition the treatments consisted of two cutting patterns, $C_1$ (cutting at ground level) and $C_2$ (cutting at 10 cm from the ground level), three nutrient levels, $N_1$ (150: 32.5: 32.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$, $N_2$ (200: 50: 50 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) and $N_3$ (250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$) and three spacings, $S_1$ (60 cm x 20 cm), $S_2$ (60 cm x 30 cm) and $S_3$ (60 cm x 40 cm). Farmyard manure @10 t $ha^{-1}$ was uniformly applied to all plots. Entire dose of phosphorus and potassium were applied as basal, nitrogen was top dressed in equal splits after each harvest.

The salient results of investigation- 1 are as follows.

Under open condition among the cutting pattern, $C_2$ (cutting at 10 cm from the ground level) recorded the highest plant height and $C_1$ (cutting at ground level) recorded the highest number of tillers $plant^{-1}$ and leaf: stem ratio during the first and second year. During first year increased plant spacing decreased the plant height and the highest plant height was registered by the treatment involving narrow spacing (60 cm x 30 cm) in all the harvests. Significantly higher number of tillers plant$^{-1}$ were produced in the wider spacing treatment in both the years.

Regarding leaf stem ratio, in the third harvest, highest leaf: stem ratio (1.25) was obtained with a spacing of 60 cm x 40 cm whereas in the fourth harvest leaf: stem ratio (1.13) was more with 60 cm x 30 cm spacing during first year. During second year the highest leaf: stem ratio was produced when narrow spacing (60 cm x 30 cm) was adopted. In all harvests highest regeneration percentage was obtained with a spacing of 60 cm x 60 cm in both the years.

The highest total green fodder yield was obtained when cutting at 10 cm from the ground level was followed (114.98 t ha$^{-1}$) during first year and in the third and fourth harvests ground level cutting produced maximum green fodder yield of 17.59 and 16.86 t ha$^{-1}$ respectively in the second year. The green fodder yield was significantly increased by increasing the fertilizer levels in both the years. As the spacing was increased the green fodder yield was found to exhibit a decreasing trend and the higher green fodder yield was recorded by the treatment involving narrow spacing during both years.

The maximum dry fodder yield was obtained when cutting at 10 cm from the ground level was followed (31.35 t ha$^{-1}$) in the first year. In the third harvest ground level cutting produced maximum dry fodder yield of 4.97 t ha$^{-1}$ whereas in the fourth and sixth harvests maximum dry fodder yield was recorded when cutting height of 10 cm was followed during second year. In the second harvest dry fodder yield was significantly influenced by nutrient levels whereas in all other harvests $N_2$ and $N_3$ was found to be on a par in first year.

With regard to DMP, during first year sixth harvest recorded highest DMP of 216.70 g plant$^{-1}$ with $C_2$ whereas in second year, third harvest recorded highest DMP of 163.71 g plant$^{-1}$ with $C_1$. The DMP was significantly increased by increasing the fertilizer levels in both the years. $S_3$ registered highest DMP of

183.53, 226.08, 245.77 and 258.52 g plant$^{-1}$ in first, fourth, fifth and sixth harvests respectively in first year and 189.51, 176.02, 214.48, 212.48, 155.17, 178.02 and 186.97 g plant$^{-1}$in first, second, third, fourth, fifth, sixth and seventh harvest respectively in second year.

Among the cutting pattern, $C_2$ (cutting at 10 cm from the ground level) recorded the highest leaf area index during the first and second year. The highest RGR was recorded by $C_2$ in first year and $C_1$ in second year. CGR and NAR was the highest in ground level cutting in second year. The regeneration percentage and RGR were found to be the highest in $S_3$ in both the years. The highest CGR of 4.78 g m$^{-2}$ day$^{-1}$ was observed by $S_1$ between first and second harvest and 3.92 g m$^{-2}$ day$^{-1}$ by $S_2$ between fourth and fifth harvest during first year.

$C_2$ recorded the highest crude protein content and lowest crude fibre content in both the years. The crude protein content was not influenced by spacing treatments both in first and second year. The crude fibre content was unaffected by spacing treatments in the first year whereas lowest crude fibre content (28.82 %) was recorded by $S_1$ and it was on a par with $S_3$ (29.19 %). The highest nutrient dose recorded highest crude protein content and least crude fibre content.

The uptake of all nutrients were the highest for $C_2$ in the first year and $C_1$ and $C_2$ were found to be on a par in the second year except in nitrogen uptake. Among the nutrient levels, $N_3$ recorded the highest uptake of nutrients. The uptake of nutrients was highest for $S_1$ in both the years.

The net income and B: C ratio were the highest for $C_2$ in both the years. Among the nutrient levels, $N_3$ recorded the highest net income. The net income and B: C ratio were not significantly influenced by spacing treatments in first year whereas $S_1$ recorded highest net income and B: C ratio in second year.

Major findings of the investigation- 2 are as follows.

Under partial shaded condition among the cutting pattern, $C_2$ recorded the highest plant height and $C_1$ recorded the highest number of tillers plant$^{-1}$ and leaf area index during the first and second year. $S_1$ recorded highest plant height in second and fourth harvests whereas $S_2$ recorded highest plant height in third harvest in first year and $S_1$ recorded highest plant height in third, fifth and sixth harvests whereas $S_2$ recorded highest plant height in fourth harvest in second year.

The regeneration percentage and RGR were the highest when 10 cm cutting height was followed in the first year. Ground level cutting registered highest RGR and cutting at 10 cm cutting height recorded highest CGR in second year. The regeneration percentage, RGR, CGR and NAR were the highest when 60 cm x 40 cm spacing was followed in both years.

The total green fodder yield was the highest in $S_1$ which was on a par with $S_2$ in first year and $S_1$ was found to be significantly superior to $S_2$ and $S_3$ in the second year. The total green fodder yield was the highest for $C_2$ in the first year whereas in the second year $C_1$ and $C_2$ was found to be on a par. The total green fodder yield was the highest in $S_1$ which was on a par with $S_2$ in first year and $S_1$ was found to be significantly superior to $S_2$ and $S_3$ in the second year.

$C_2$ recorded the highest crude protein content in the first year and in the second year $C_1$ and $C_2$ was found to be on a par in all the harvests except final harvest. The crude fibre content was the lowest when cutting at 10 cm from the ground level was followed in both the years. The crude protein content was highest in $S_3$ in second harvest and $S_1$ in fifth harvest in the first year. The crude fibre content was unaffected by spacing treatments in both first and second year.

The uptake of nutrients was highest for $C_2$ in the first year and $C_1$ and $C_2$ were found to be on a par in the second year except in nitrogen uptake. The uptake of nutrients was highest for $S_1$ in both the years.

The net income and B: C ratio were the highest for $C_2$ in both the years. Highest B: C ratio was recorded by $S_3$ in first year whereas net income and B: C ratio remains non significant in the second year.

Based on this study, it can be concluded that under open condition planting palisade grass at a spacing of 60 cm x 30 cm, with a nutrient dose of 300: 75: 75 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ and harvesting the grass at a cutting height of 10 cm from the ground level can be recommended for obtaining highest fodder yield, crude protein content, net income, B: C ratio and lowest crude fibre content. Similarly in a partial shaded coconut garden of 40 per cent shade, planting palisade grass at a spacing of 60 cm x 20 cm with a nutrient dose of 250: 62.5: 62.5 kg N: $P_2O_5$: $K_2O$ $ha^{-1}$ and harvesting the grass at a height of 10 cm from the ground level resulted in the highest fodder yield, crude protein content, net income, B: C ratio and lowest crude fibre content.

**Future Line of Work**

Studies may be conducted to find out the effect of continuous intercropping of palisade grass on coconut productivity and also the effect of intercropping of palisade grass with legumes on coconut productivity needs to be investigated.

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# 7. REFERENCES


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# APPENDICES

## Appendix – I

**Weather parameters during the cropping period (January 2014 to May 2015)**

| Month and year | Temperature (°C) | | RH (%) | | Bright sunshine hours | Rainfall (mm) | Number of rainy days | Evaporation (mm $day^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | | | | |
| January, 2014 | 30.61 | 21.53 | 93.41 | 73.64 | 8.8 | 28.5 | 2 | 3.2 |
| February, 2014 | 31.33 | 22.32 | 92.35 | 69.46 | 9.3 | 21.0 | 3 | 4.0 |
| March, 2014 | 32.43 | 22.88 | 91.90 | 66.54 | 9.9 | 31.5 | 2 | 4.3 |
| April, 2014 | 32.40 | 24.47 | 91.20 | 73.60 | 9.0 | 115 | 9 | 3.0 |
| May, 2014 | 31.88 | 24.73 | 90.03 | 78.45 | 8.7 | 280.4 | 11 | 3.4 |
| June, 2014 | 30.76 | 25.21 | 92.46 | 79.16 | 9.0 | 88.0 | 10 | 3.3 |
| July, 2014 | 29.99 | 24.30 | 91.90 | 77.50 | 9.2 | 104.2 | 9 | 3.6 |
| August, 2014 | 29.50 | 23.74 | 90.70 | 81.20 | 8.6 | 551.5 | 16 | 5.1 |
| September, 2014 | 30.20 | 24.19 | 90.80 | 78.96 | 8.8 | 219.4 | 10 | 3.8 |
| October, 2014 | 30.52 | 23.82 | 86.93 | 82.40 | 7.9 | 230.2 | 12 | 3.7 |
| November, 2014 | 30.18 | 23.38 | 93.46 | 77.23 | 7.7 | 137.3 | 11 | 1.7 |
| December, 2014 | 31.2 | 23.25 | 94.30 | 78.30 | 7.9 | 133.5 | 5 | 2.5 |
| January, 2015 | 30.61 | 21.56 | 93.87 | 65.0 | 9.16 | 8.0 | 2 | 3.0 |
| February, 2015 | 31.53 | 22.34 | 91.78 | 64.71 | 9.35 | 0 | 0 | 4.1 |
| March, 2015 | 32.42 | 23.65 | 89.93 | 67.12 | 9.26 | 56.1 | 4 | 4.2 |
| April, 2015 | 32.74 | 24.48 | 92.0 | 75.00 | 8.82 | 182.6 | 9 | 4.0 |
| May, 2015 | 32.14 | 25.31 | 90.71 | 83.29 | 8.21 | 406.0 | 8 | 3.4 |

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## Appendix – II

**Weather parameters during the cropping period (June 2015 to May 2016)**

| Month and year | Temperature ($^{o}C$) | | RH (%) | | Bright sunshine hours | Rainfall (mm) | Number of rainy days | Evaporation (mm $day^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | | | | |
| June, 2015 | 31.43 | 24.47 | 90.97 | 82.97 | 8.80 | 346.9 | 19 | 3.9 |
| July, 2015 | 31.31 | 24.6 | 89.10 | 79.87 | 9.61 | 53.5 | 5 | 4.0 |
| August, 2015 | 31.68 | 24.57 | 89.52 | 76.42 | 9.55 | 80.2 | 4 | 4.2 |
| September, 2015 | 31.41 | 24.40 | 91.40 | 83.77 | 8.59 | 289.8 | 15 | 4.5 |
| October, 2015 | 31.29 | 24.03 | 92.45 | 80.54 | 8.04 | 399.1 | 19 | 3.8 |
| November, 2015 | 31.54 | 23.79 | 92.70 | 79.57 | 7.75 | 254.1 | 18 | 3.6 |
| December, 2015 | 31.48 | 23.38 | 93.94 | 83.16 | 9.16 | 259.3 | 11 | 3.4 |
| January, 2016 | 32.52 | 22.64 | 91.40 | 72.50 | 7.87 | 0.4 | 0 | 4.2 |
| February, 2016 | 32.91 | 23.17 | 92.50 | 73.30 | 9.14 | 43.6 | 1 | 4.5 |
| March, 2016 | 34.40 | 24.64 | 90.20 | 68.50 | 8.67 | 1.9 | 0 | 3.8 |
| April, 2016 | 35.29 | 26.62 | 90.83 | 77.03 | 8.82 | 22.6 | 0 | 3.6 |
| May, 2016 | 33.81 | 25.42 | 89.00 | 77.00 | 7.34 | 463.3 | 13 | 3.4 |

# PRODUCTION PACKAGE OF PALISADE GRASS

## (*Brachiaria brizantha* (Hochst. ex A. Rich.) Stapf.)

*by*

**SHARU S. R.**
**(2013-21-104)**

**ABSTRACT**

**of the thesis submitted in partial fulfilment of the requirements for the degree of**

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# ABSTRACT

The experiment entitled "Production package of palisade grass (*Brachiaria brizantha* (Hochst. ex A. Rich) Stapf.)" was conducted at the Instructional farm, College of Agriculture, Vellayani, Kerala for a period of two years from 2014-16. The main objectives were to standardise the nutrient requirement, spacing and cutting pattern of palisade grass under open and partial shaded condition and to work out the economics of cultivation.

The investigation was conducted as two separate experiments, one in open condition and another under partial shaded condition in coconut garden. Both the experiments were laid out in randomized block design with three replications. The treatments consisted of two cutting patterns, $C_1$ (cutting at ground level) and $C_2$ (cutting at 10 cm from the ground level) three nutrient levels, $N_1$ (200: 50: 50 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$), $N_2$ (250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$) and $N_3$ (300: 75: 75 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$) and three spacings, $S_1$ (60 cm x 30 cm), $S_2$ (60 cm x 40 cm) and $S_3$ (60 cm x 60 cm) in open condition. Under the partial shaded condition the treatments consisted of two cutting patterns, $C_1$ (cutting at ground level) and $C_2$ (cutting at 10 cm from the ground level), three nutrient levels, $N_1$ (150: 32.5: 32.5 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$, $N_2$ (200: 50: 50 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$) and $N_3$ (250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ ha$^{-1}$) and three spacings, $S_1$ (60 cm x 20 cm), $S_2$ (60 cm x 30 cm) and $S_3$ (60 cm x 40 cm). Farmyard manure @ 10 t ha$^{-1}$ was uniformly applied to all plots. Entire dose of phosphorus and potassium were applied as basal, nitrogen was top dressed in equal splits after each harvest.

The results indicated that the cutting pattern, nutrient levels and spacing had significant effect on the growth, yield, physiological and quality parameters, uptake of nutrients, available nutrient status and economics of cultivation of palisade grass both under open and shaded conditions.

Among the cutting pattern, $C_2$ (cutting at 10 cm height from the ground level) recorded the highest plant height and $C_1$ (cutting at ground level) recorded the highest number of tillers plant$^{-1}$ and leaf area index during first and second year under both open and shaded conditions. Under open condition the highest RGR was recorded by $C_2$ in first year and $C_1$ in second year. CGR and NAR was the highest in ground level cutting in second year while under partial shaded condition the regeneration percentage and RGR were the highest when 10 cm cutting height was followed in the first year and in the second year ground level cutting registered highest RGR and cutting at 10 cm cutting height recorded highest CGR.

The total green and dry fodder yield, net returns and B: C ratio were the highest for $C_2$ in first and second years, under both the situations. The crude fibre content was the lowest in $C_2$ in first and second years under both the situations. The uptake of nutrients were the highest in $C_2$ in first year under both open and shade conditions whereas, only nitrogen uptake was significant in $C_2$ in second year under both conditions.

Among the nutrient levels, $N_3$ recorded the highest growth and yield attributes, crude protein content, uptake of nutrients, net returns and B: C ratio in first and second years both under open and partial shaded condition.

Among the tested spacings, $S_1$ recorded the highest plant height, leaf area index, total green fodder and dry fodder yield and uptake of nutrients whereas, $S_3$ registered the highest number of tillers plant$^{-1}$ in both the years under open as well as partial shaded conditions. The net returns and B: C ratio were the highest in $S_1$ in second year under open condition whereas, these were the highest in $S_3$ in first year under shade condition. The highest crude protein content was recorded in $S_1$ (fifth harvest) and $S_3$ (second harvest) in first year under shade condition. The lowest crude fibre content was recorded in $S_1$ in second year under open condition.

Pooled analysis of two years data indicated that palisade grass cultivated at a spacing of 60 cm x 30 cm, with a nutrient recommendation of 300: 75: 75 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ and harvesting at a height of 10 cm from ground level was the best method for obtaining maximum fodder yield and profit under open condition. Under partial shaded condition a narrow spacing of 60 cm x 20 cm with a nutrient recommendation of 250: 62.5: 62.5 kg N, $P_2O_5$ and $K_2O$ $ha^{-1}$ and harvesting at 10 cm height from the ground level can be recommended for realising higher fodder yield, fodder quality and profit from palisade grass cultivation.

## സംഗ്രഹം

പാലിസെഡ് ഗ്രാസിന്റെ ശാസ്ത്രീയ കൃഷിക്ക് ശുപാർശ ചെയ്യേണ്ട പോഷക മൂലകങ്ങളുടെ അളവ്, ചെടികൾ തമ്മിലുള്ള അകലം വിളവെടുപ്പ് രീതി എന്നിവ തുറസ്സായ സ്ഥലത്തും, ഭാഗികമായി തണലുള്ള തെങ്ങിൻതോപ്പിലും നിശ്ചയിക്കുന്നതിന് വേണ്ടി 2014 മുതൽ 2016 വരെയുള്ള കാലയളവിൽ രണ്ടു പരീക്ഷണങ്ങൾ വെള്ളയാണി കാർഷിക കോളേജിലെ അഗ്രോണമി വിഭാഗത്തിൽ നടത്തുകയുണ്ടായി.

തുറസ്സായ സ്ഥലത്ത് കൃഷിചെയ്യുന്ന ആദ്യ പരീക്ഷണത്തിൽ പോഷക മൂലകങ്ങളുടെ അളവ് നിശ്ചയിക്കുന്നതിന് മൂന്ന് തോതും (200: 50: 50, 250: 62.5: 62.5, 300: 75: 75 kg N $P_2O_5$, $K_2O$ $ha^{-1}$), ചെടികൾ തമ്മിലുള്ള അകലം നിശ്ചയിക്കുന്നതിന് മൂന്ന് തോതും (60 x 30, 60 x 40, 60 സെ.മീ x 60 സെ.മീ), രണ്ടു വിളവെടുപ്പ് രീതിയും (തറനിരപ്പിൽ വിളവെടുക്കുന്ന രീതി, തറനിരപ്പിൽ നിന്നും 10 സെ.മീ ഉയരത്തിൽ വിളവെടുക്കുന്നരീതി) പരീക്ഷണത്തിൽ ഉൾപ്പെടുത്തി. പ്രസ്തുത പഠനത്തിൽ മെച്ചപ്പെട്ട വിളവിനും, ഗുണനിലവാരത്തിനും, അറ്റാദായത്തിനും 300: 75: 75 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$ എന്നീ പോഷക മൂലകങ്ങൾ നൽകി 60 സെ.മീ x 30 സെ.മീ. അകലത്തിൽ തറനിരപ്പിൽ നിന്നും 10 സെ.മീ ഉയരത്തിൽ വിളവെടുക്കുന്ന രീതി ഉത്തമമായി കണ്ടു.

ഭാഗീകമായി തണലുള്ള തെങ്ങിൻതോപ്പിൽ നടത്തിയ പരീക്ഷണത്തിൽ പോഷകമൂലകങ്ങൾക്ക് മൂന്ന് തോത് (150: 37.5: 37.5, 200: 50: 50, 250: 62.5: 62.5 kg N $P_2O_5$ $K_2O$ $ha^{-1}$) ചെടിയുടെ അകലത്തിന് മൂന്ന് തോത് (60 x 20, 60 x 30, 60 സെ.മീ x 40 സെ.മീ) എന്നിവ കൂടാതെ രണ്ടു വിളവെടുപ്പ് രീതിയും (തറനിരപ്പിൽ വിള വെടുക്കുന്ന രീതി, തറനിരപ്പിൽ നിന്നും 10 സെ.മീ ഉയരത്തിൽ വിളവെടുക്കുന്ന രീതി) ഉൾപ്പെടുത്തി. പോഷകമൂലകങ്ങൾ 250: 62.5: 62.5 kg N $P_2O_5$ $K_2O$ $ha^{-1}$ എന്ന തോതിലും, 60 സെ.മീ x 20 സെ.മീ അകലത്തിലും, തറനിരപ്പിൽ നിന്നും 10 സെ.മീ ഉയരത്തിൽ വിളവെടുപ്പ് നടത്തുന്നതിലും നിന്ന് നല്ല വിളവ്, ഉയർന്ന ഗുണനിലവാരം, വർദ്ധിച്ച അറ്റാദായം എന്നിവ ലഭിച്ചതായി കണ്ടു.