NUTRITIONAL REQUIREMENT OF 'NENDRAN' BANANA UNDER RICE FIELDS.

BY

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THESIS
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DECLARATION

I hereby declare that this thesis entitled "Nutritional requirement of 'Nendran' banana under Rice fields" is a bonafide record of research work done by me during the course of research and that 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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Date 27/6/88

CERTIFICATE

Certified this thesis entitled 'Nutritional requirement of 'Nendran' banana under Rice fields' is a record of research work done independently by Smt.GEETHA V. NAIR under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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INTRODUCTION

Banana, the 'Queen of tropical fruits' is one of the most widely grown fruit crops of India. The importance of growing bananas in a tropical country like India, needs no emphasis, as it plays a vital role not only in the internal trade, but also in the international trade. Because of its export potentialities, food value and status as a fruit of common man, the area under this crop is increasing year after year.

India ranks second in banana production among the various banana producing countries of the world, with an acreage of 2.7 lakh hectares under the crop. It accounts for about 20 per cent of area under fruit crops in India.

Banana is one of the most important fruit crops of Kerala and the State ranks first in acreage accounting for an area of about 51, 420 hectares and a production of 331.19 thousand tonnes (Anon., 1987). Important varieties of banana grown in Kerala are Palayankodan, Nendran, Robusta, Red banana, Monthan and others.

Among these varieties, 'Nendran' is the most popular commercial variety of banana in Kerala, occupying nearly 30 per cent of the total area under banana.

Eventhough, Kerala ranks first in area under banana, the total production of banana in Kerala is less compared to other States in India. One of the important reasons for this situation is the poor management practices followed by the farmers. Systematic cultivation of banana is not done in homesteads of Kerala and correct manure schedule has not been standardised for different zones and different types of soil. At present, a general manurial schedule is recommended for the State, without considering the nutritional status of the soil.

For any crop the quantity and frequency of application of nutrients play a great role in determining the production of dry matter, which ultimately contributes towards the yield of the crop. Hence the present study was carried out mainly to confirm whether the increased dose of nutrients and increased number of split applications could produce any significant influence with regard to the growth and yield of bananas.

The objectives of the study are as given below.

1. To make a suitable manurial recommendation for 'Nendran' bananas grown in rice fields.

2. To study the effect of split application of nutrients on the growth and yield of Nendran bananas, under irrigated conditions in rice fallows.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

1. Role of major nutrients

The effect of nitrogen, phosphorus and potassium individually and in combinations, on the growth and yield of banana cultivars have been reported by many workers.

Various experiments conducted in India and abroad showed that remarkable yield improvement in banana could be brought about by judicious and regular manuring. The three major nutrients, nitrogen, phosphorus and potassium are required in large quantities by banana plant.

Studies on the individual effect of phosphorus on the growth and yield of bananas are very few in India.

Bananas respond very well to the application of nitrogen. Studies conducted at Poona region indicated the significance of nitrogen application on growth and yield of bananas. Under such conditions nitrogen application was found to be highly beneficial, but application of phosphorus and potassium were not found to be effective (Gandhi, 1951). Negative response to phosphorus and potassium was reported in heavy clayey soils (Gopalan Nair, 1953).

Importance of nitrogen on growth and yield of bananas has been further confirmed by Martin prevel (1969), Venkatesam *et al.* (1965) Ramaswami and Muthukrishnan (1973), Arunachalam (1972), Valsamma Mathew (1980) and Hernandez (1985).

It was also reported that nitrogen influence the quality attributes, time of shooting and period of maturity of the crop, in addition to the yield (Croucher and Mitchell, 1940; Stein Hausen, 1957; Butler, 1960; Jagirdar *et al.* 1963; Kohli *et al.* 1984).

Beneficial affects of potassium in banana nutrition has been reported by many workers. Wood (1939) recorded an increase in yield in bananas by the application of farm yard manure and potash. Increase in bunch weight has been reported by application of potassium (Hewitt and Osborne, 1962). Twyford (1967) found that the amount of potash was always higher among the nutrients analysed. The potash content was between 2.2 and 4.6 times higher than nitrogen content and critical manuring could be done on 4:1:14 ratio of N, P and K. Marked increase in bunch weight was noticed by Decunha and Fraga (1963) by the application of potassium in sandy soils. Positive influence of potassium on yield and quality of bunches has been further stressed by Vadivel (1976) and Sheela (1982).

Combined effects of N, P and K have been very well studied in bananas. Fawcett (1921) revealed that higher levels of nitrogen and potassium are required for optimum growth and yield of bananas. Summerville (1944) observed for the Dwarf Cavendish bananas grown on red basaltic soils of Queensland, that there was considerably greater response to nitrogen and potassium when applied together than when they were applied separately. Figueroa Escobar (1962) reported remarkable yield improvement in bananas by application of N and K_2O in the ratio 1:2. The results of a study in 'Robusta' banana indicated that application of 160 g of N in combination with 240 g K_2O per plant gave an additional yield of 35.2 tonnes per hectare (Champion et al. 1958). Investigations by Bhangoo et al. (1962) in Honduras indicated significant response to application of phosphorus and potassium, in conjunction with nitrogen, in improving the average bunch weight of 'Giant Cavendish' banana. Little or no response was obtained with the use of nitrogen alone.

In a trial conducted by Lin et al.(1962) individual application of nitrogen, phosphorus and potassium failed to influence growth and yields, while NPK at the rate of 200:100:300 kg. N: P_2O_5: K_2O per acre helped to maximise the yield. The effect of nitrogen and phosphorus in increasing bunch weight of bananas has been stressed by Randhawa et al. (1973), which was further confirmed by Sundar Singh (1972).

Shanmugam and Velayutham (1972) reviewed fertilizer recommendations of banana in different states of India and found that a dose of 225 g each of N, P and K per plant per year was the best recommendation for Kerala soils. Trials conducted at Banana Research Station, Kannara, pointed out that about 191 g nitrogen and 300 g potassium, when applied in 2 equal split doses increased the yield of 'Nendran' bananas in Kerala.

2. Nutrients on growth and development

The correlation between bunch weight and leaf area was reported by Croucher and Mitchell (1940) and Summerville (1944). Correlation between pseudostem height and circumference and yield was documented by several workers.

Increase in yield could be secured in banana by the application of nitrogen in soils which were rich in available P_2O_5 and K_2O (Croucher and Mitchell, 1940). According to Stein Hausen (1957), nitrogen promoted vegetative growth including longitudinal growth of petiole. Promotive effect was noticed on sprouting of corm bits also. Reduction in the rate of leaf production and size of leaves produced were noted in bananas due to deficiency of nitrogen (Murray, 1959). Suckering was also reduced by low levels of nitrogen. Baruah and Mohan (1985) reported highest rate of suckering with 330 g N per plant and lowest rate with zero g nitrogen per plant. Low rate of leaf production was noticed by

Butler (1960) in bananas with reduction, in levels of nitrogen. This was further proved by Battikah and Khalidy (1962). Arunachalam (1972) and Shanmugam and Velayutham (1972) reported reduction in the number of leaves produced with lower levels of nitrogen. Height and girth of pseudo-stem was significantly increased with higher levels of nitrogen (Ashok Kumar, 1977; Valsamma Mathew, 1980). Anjorin and Obigbesan (1983) reported that application of N at higher levels (400 g/plant) retarded the plant height and girth in bananas.

Phosphorus requirement of banana was much less compared to N and K as reported by Norris and Ayyar (1942). Martin Prevel (1964), Turner (1969), Jauhari et al. (1974) and Vadivel (1976). Summerville (1944) stated that whilst in the very early stages of growth significant increase were associated with the presence of added potash, no differences were found later.

Brzesowsky and Van Biesen (1962) opioned that treatment with 60:64:450 lb/acre NPK, produced significantly more leaves than treatment with 60:64: 150 and 120:64:150 lb/acre. Influence of K_2O in enhancing sucker production was reported by Jambulingam et al. (1975). Effect of K_2O on 'Fairyman' bananas was studied by Yang and Pao (1962) and the results showed that area, length, width and number of leaves are not affected significantly by potash. Potassium starvation significantly reduced the leaf size, longivity, total leaf area, pseudostem height and circumferance in bananas (Lahav, 1972).

Pseudostem growth was greatly increased by potassium, as reported by Chu (1960) and Sheela (1982). According to Yang and Pao (1962) height of the plant was not significantly influenced by increased doses of potash.

3. Effect of nutrients on flowering

In Ducken fields Croucher and Mitchell (1940) observed earliness of flowering by two months due to application of nitrogen. Shooting was hastened upto 20% by nitrogen. This was in confirmity with the studies done by Stein-Hausen (1957), Simmonds (1959) and Kohli *et al.* (1984). The duration of the crop was significantly increased by application of nitrogen (Valsamma Mathew, 1980). Singh *et al.* (1977) observed that higher levels of NPK (150 g N, 90 g P_2O_5, 170 g K_2O per plant per year) significantly shortened the time taken to flowering.

4. Effect of nutrients on yield and yield attributes

A positive correlation exists between the applied nutrients and yield, as reported by many workers.

Bowman and Eastwood (1940) obtained increased yields due to application of nitrogen. This was later on supported by Bhan and Majumdar (1956), Simmonds (1959), Butler (1960) and Jagirdar (1963). All the yield attributing characters and ultimately the yield were improved in bananas by the application of nitrogen (Venkatesam et al. 1965; and Arunachalam et al., 1976). Ramaswami and Muthukrishnan (1973) obtained best result with 170 g N per plant per year which increased the length and girth of fruit at harvest. Gopimony et al. (1979) studied the effect of top-dressing with urea at flower-initiation in Zanzibar variety of 'Nendran'. They found that additional dose of 500 g urea in five equal splits of 100 g each at one week interval, during 5th month of planting resulted in an increase in bunch weight and number of fingers per bunch. Split application of nitrogen at 30 and 150 days after planting recorded maximum bunch weight (Nambiar et al., 1979). Effect of nitrogen nutrition in rainfed 'Palayankodan' was reported by Valsamma Mathew (1980). In this study optimum and economic doses of N were worked out as 204.6 g and 96 g per plant per year respectively. In trials conducted with the variety 'Giant Cavendish', number of hands, fruit number and yield of bunches were increased by application of nitrogen, the best rate of nitrogen being N at 100 g per plant per year.

Fruit length and weight were not significantly affected by nitrogen application (Hernandez et al. 1981)

Trials conducted in bananas by Valmayar et al. (1965) with various combinations of N, P and K revealed that there was response with the application of nitrogen. The role of nitrogen as the critical nutrient in determining the yield was further supported by Nambisan et al. (1981). In'Poovan' variety of banana best results were obtained with 100 g nitrogen per plant for plant crop and 200 g for the ratoon. For the variety 'Vayalvazhai' (ABB) 100 g nitrogen was sufficient for both crops (Nanjan et al. 1981). Yield increase was obtained in 'Giant Governor' bananas with increasing levels of nitrogen upto 240 g per plant per year. (Chattopadhyay et al. 1981). Kohli et al. (1984) reported that maximum dry matter production and yield were observed in 'Robusta' banana with 150 - 300 g nitrogen per plant per year.

Foliar application of nitrogen enhanced the yield in bananas as reported by Ashok Kumar (1977) and Sharma (1984). Individual effect of phosphorus in improving the yield of bananas was not much significant (Valmayar et al. 1965; Nambisan et al.1981). Jagirdar and Ansari (1966) reported that

'Basrai' variety of banana receiving 96 lb per acre of K_2SO_4 alone, gave the highest yield in terms of bunch weight, number of fingers per unit area and highest monetary returns per lb of fertilizers applied. Beneficial effect of potassium on yield of bunches has been confirmed by many workers (Osborne and Hewitt, 1963; Moreau and Robin, 1972; Sheela, 1982; Turner and Barkus, 1982; Langenegger and Smith, 1986).

Increased dose of potassium exerted a favourable effect on nearly every feature of fruit growth and quality as reported by Yang and Pao (1962). Average weights of fingers increased due to potash application by 15-27 per cent during first year and by 27-48 per cent in second year. Thickness and weight of peel, length and girth of fruits etc. were also increased.

In a trial conducted by Venkatarayeppa et al. (1978) fruit volume and weight were remarkably increased by spraying potassium dihydrogen phosphate (2% solution) to the whole plant. Among the six levels (100 - 600 g K_2O per plant) of potassium tried by Obiefuna (1984), K_2O at 300 g per plant per year was found to be the optimum dose with respect to increase of yield. But 750 g K_2O per plant per year was found to produce the highest yield in 'Giant Cavendish' bananas (Garita and Jaramillo, 1984).

Increased yields were obtained by application of N, P and K in combination in bananas. Shangoo *et al.* (1962) found out that a 350-160-180 formulation of N, P_2O_5 and K_2O greatly increased yields, bunch weight and number of hands per bunches. According to Veeraraghavan (1972), significant increase in the number and weight of fruits in 'Nendran' banana was obtained with 228 g N, 228 g P_2O_5 and 456 g K_2O per plant per year. A dose of 180 g N, 155 g P_2O_5 and 186.75 g K_2O per plant per year was the best recommendation for 'Robusta' bananas (Kohli *et al.* 1976). 'Basrai' bananas produced maximum yield in Uttar Pradesh with 150 g N, 90 g P_2O_5 and 170 g K_2O per plant per year (Singh *et al.*, 1977). Pillai *et al.* (1977) found that optimum dose of N, P_2O_5 and K_2O giving maximum yield was 191 g N, 115 g P_2O_5 and 301 g K_2O per plant per year in 'Nendran' bananas. Plants receiving 100 kg N, 40 kg P_2O_5 and 400 kg K_2O per acre produced heaviest bunches in 'Robusta' bananas (Pillai and Khadar, 1981).

4. Effect of nutrients on fruit quality

Preharvest conditions including mineral nutrition reflected on the quality of final products in all crops.

It was observed that nitrogen nutrition had positive effect on soluble solids and titrablo acidity and adverse effect on the weight and solid to acid ratio of Pineapple fruit (Reuther and Smith, 1952; Smith, 1967; Kefford and Chandler, 1970). Desai and Phadnis (1979) reported that in Cheema sahebi grapes, TSS, acidity, sugar and TSS/acid ratio were better with lower levels of nitrogen. Total reducing sugar content was increased significantly by nitrogen application (Chattopadhyay et al. 1980). Similar results were obtained in rainfed 'Palayankodan' bananas, studied by Valsamma Mathew (1980).

In an experiment by Ho (1968 b) in Taiwan increasing supplies of K_2O increased the number of bunches, rind thickness, finger length and circumference. Increased dose of K_2O improved the fruit conditions as observed after 20 days of storage. According to Koen (1976) optimum yield of high quality fruits were obtained with an annual application of 370 g potassium-Ammonium Nitrate along with 450 g KCl per plant. Yield and fruit quality was lowest with higher rate of application or when the latter treatment was supplemented with 250 g magnesium sulphate.

Studies conducted by Venkatarayappa et al. (1978) on the effect of post shooting application of potassium dihydrogen phosphate revealed that the treatments significantly increased the volume and weight of fruits. Total soluble solids contents of 'Robusta' increased with an increase in level of K_2O application (upto 300 g per plant). Reducing, non-reducing and total sugar contents also increased with increasing rates of K_2O. While acidity was decreased, sugar-acid ratio was enhanced. Fruit ascorbic acid content was also increased with higher levels of potash (Vadivel and Shanmugavelu, 1978). Sheela (1982) also obtained beneficial effects on TSS, reducing sugars, total sugars, sugar acid ratio and acidity with higher doses of potash.

Singh *et al.* (1974) studied the effect of nutrients on fruit quality of 'Robusta' banana and reported an appreciable improvement in fruit qualities with different K combinations. But Teotia *et al.* (1972) failed to get any marked effect on the quality of fruits as effected by the different levels of N, P and K in bananas variety 'Cavendish'.

3. Deficiency of nutrients

Deficiency of any of the 3 major nutrients would seriously impair the growth and development of banana and ultimately result in the reduction of yield of bunches.

Murray (1959) and Wardlaw (1961) reported that characteristic symptoms of nitrogen deficiency were slow growth, development of yellowish green colour of lamina and more or less deep reddish finger or pigmentation in petiole. Total deficiency of nitrogen would effect the growth beyond flowering (Charpentier and Martin Prevel, 1965). A considerable reduction in yield and quality invariably occurred if differentiation coincided with a period of nitrogen deficiensy.

Pale green leaves and Pink petioles were produced by nitrogen deficiency in 'Williams' bananas (Lahav et al. 1981).

Severe phosphate deficiency has been tentatively identified in Dominica (Simmonds, 1952). Bananas planted on a highly phosphate deficient soil after satisfactory establishment, stopped growing and many plants subsequently died. Cessation of growth was accompanied by bad leaf colour coupled with severe marginal scorching and shrinkage of older leaves, poor root development, rotting of base of corm and occurrence of stained vasculars in centre of the corm.

In Jamaica similar situation was occurred with respect to potash deficiency (Simmonds and Hutchinson, 1953). Even though satisfactory early growth were there, after a time the older leaves turned yellow at tip and distal margins and yellowing rapidly spreaded in proximal direction until whole leaf has withered.

Occurrence of premature yellowing was reported in 8 to 10 month old 'Lacatan' bananas due to low K supply, in dry soils (Hasselo, 1961). On Chinchina series soils, K_2O at 200 or 400 kg per hectare controlled premature yellowing (Garcia et al. 1980). Murray (1960) observed that visual deficiency symptoms of K occurred at levels considerably lower than those at which growth was reduced. In a trial with banana on K deficient soils, pre-planting application of K increased the yield by upto 17.5% (Information bulletin, Citrus and subtropical Fruit Research Institute).

6. Effect of split application

Time of application of fertilizer is an important factor in determining the yield of the crop (Summerville, 1944). He reported that the whole quantity of fertilisers should be applied during the early stages of growth. The importance of split application of fertilizer has been pointed out in earlier periods by Alexandrowitz (1955), Dugain (1959), Ho (1968) and Leigh (1969). Nitrogenous fertilizers were applied in 2 to 12 instalments by Dugain and he has reported that fractional application of nitrogen was more beneficial than frequent application in large quantities. Veeraraghavan (1972) recommended 228 g N, 228 g P_2O_5 and 456 g K_2O / year for 'Nendran' banana during 2nd and 4th month after planting in two equal splits.

Veerannah *et al.*(1976) studied the nutrient uptake in 'Poovan' and 'Robusta' bananas and reported that nitrogen and potassium were absorbed more in pre-flowering stages in 'Robusta'. They found a continuous and steady uptake of nitrogen and potassium and quantities were almost equal before and after flowering in the case of 'Poovan'.

For 'Palayankodan' variety a dose of 160-200 g N, 160-200 g P_2O_5 and 320-400 g K_2O per plant per year was recommended to be applied in 2 equal splits at 2nd and 4th month after planting (Anon, 1986).

The highest yield in rainfed bananas was recorded by Osborne and Hewitt (1963) when N was applied in 3 splits in an year. Leigh (1969) also supported this type of split application. Marques and Monteiro (1971) recommended at least 200 kg N, 50-150 kg P_2O_5 and 100-160 kg K_2O per hectare, applied in three to four splits in Mozambique as mineral fertilizers or compost.

Three split applications of K_2O at first, third and fifth month after planting were tried, along with nitrogen, in Tamil Nadu. The results of the study revealed that split application was beneficial in increasing yield of bunches. But fertilizers did not help to increase yield if applied after six months of planting. Three split applications of 900 kg N, 480 kg P_2O_5 and 480 kg K_2O per hectare increased the yield to a greater extent in 'Dwarf Cavendish' bananas (Sharma and Roy, 1973). The importance of application of fertilizers in three splits was stressed by Nambiar _et al._ (1979). This study recommended the application of fertilizers in three equal splits at 30, 60 and 150 days after planting.

Different levels of split applications were recommended to different nutrients by Ho (1968). He recommended 5 split applications of nitrogen, two split applications of phosphorus and three split applications of potassium for the maximisation of yield.

Effect of potassium applications during the floral initiation stages was studied by Obiefuna (1984). Six levels of K_2O (100 to 600 g per plant) as muriate of potash (zero K_2O as control) were applied to plantain at growth stages ranging from 15th to 22nd leaf emergence. K_2O at 300 g per plant applied at 19/20th leaf stage (four to five months after planting) produced highest yield. Potash application beyond 20th leaf stage (five months after planting) was not effective in increasing the yield. Highest yield of plantain associated with heavy application of K_2O, two to three months after planting, could be achieved by timely application of small quantities of K_2O at 19/20th leaf stage when it requires more for its floral initiation.

According to Rajeevan (1985) yield could be improved by 17% in 'Palayankodan' variety by suitably spliting the recommended dose of fertilizers. It has been suggested that for 'Nendran', application of fertilizers in six split doses will be beneficial to improve finger size and bunch weight (Anon., 1966).

Gopimony et al. (1979) recommended application of an additional dose of 500 g urea in five equal splits at one week interval during fifth month of planting for obtaining higher yields.

In a trial conducted by Sharma (1984) with 'Basrai' bananas 250-500 g N was applied to soil in split dose of half the rate applied to soil and half as foliar spray. Plant height pseudostem girth, bunch weight and number of fruits were found greater in plants receiving 187.5 N per plant applied in twelve sprays at two weeks interval starting from October - November. Earlier flowering was also reported by this treatment.

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation was undertaken with the objective of making a suitable fertilizer recommendation for the 'Nendran' bananas grown under irrigated conditions in rice fallows. The materials and methods used for the study are detailed below.

1. Location

The field experiment was conducted in the rice fallow of the Instructional Farm, attached to the College of Agriculture, Vellayani. The experimental site was located at an altitude of 29 M above the mean-sea level and at a latitude of 8.5° N and longitude of 76.9° E. The soil of the experimental field was clay loam.

Chemical properties of the soil were studied and the results are presented in Table 1. The chemical characters of soil from an upland field near the experimental site and wet land soil from a farmer's field in which bananas were grown are also presented in this table, for comparative purposes.

Table 1. Chemical properties of soil from experimental field, farmer's field and upland field

Characters	Experimental field	Farmer's field	Upland field
Total Nitrogen (%)	0.074	0.092	0.041
Available P_2O_5 (kg/ha)	12.5	16	55
Available K_2O (kg/ha)	206	176	115
Total CaO(%)	0.037	0.032	0.17
pH	5.3	5.2	4.9

2. Climate

The experimental site enjoyed a humid tropical climate and received a good amount of rainfall by way of South-west and North-east monsoons. The data on various weather parameters (monthly rainfall, mean-maximum and minimum temperatures and relative humidity) during the cropping period (November 1985 to November 1986) are presented in Appendix I. The mean maximum and minimum temperatures during the cropping period were 34.2°C and 21.2°C respectively. Total rainfall received during the period was 1489.1 mm. Maximum rainfall was received during the month of August. During planting time about 449.8 mm of rainfall was received. Irrigation was given to the crop at fortnightly intervals with 200 lt of water per plant.

3. Cultivar

The cultivar selected for the study was 'Nendran' coming under the subgroup 'plantain' with 'AAB' genome. This is a popular cultivar of banana having good fruit qualities. Nendran is mainly grown as an irrigated crop in Kerala.

4. Preparation of planting material

Suckers of uniform size and age (3 months old) were selected and pseudostems were cut each at a length of about 15-25 cm from the corm. The rhizome were smeared with cow-dung slurry and ash, dried in sun for 3-4 days and stored in shade upto 15 days before planting.

5. Field preparation and planting

Raised beds were taken with proper channels all around and pits of size 50 cm^3 were dug on these beds at a spacing of 2 m x 2 m. Wood ash at the rate of two kilograms and lime at the rate of 1 kg were applied to each pit. 25 gms of phorate 10% G was applied to each pit before planting as a prophylatic measure against rhizome weevil and aphids.

Suckers were planted upright in the centre of pits with 5 cm of pseudostem remaining above the soil level. Planting was done on 18th November, 1985. Uniform cultural and crop management practices were adopted during the cropping period.

6. Experimental design and layout

The experiment was laid out in 3^3 confounded factorial design with two replications. The higher order interactions NK^2S and NK^2S^2 were partially confounded in replication 1 and 2 respectively. Four controls were tested against the treatments in order to compare the different levels of split applications in treatments and controls.

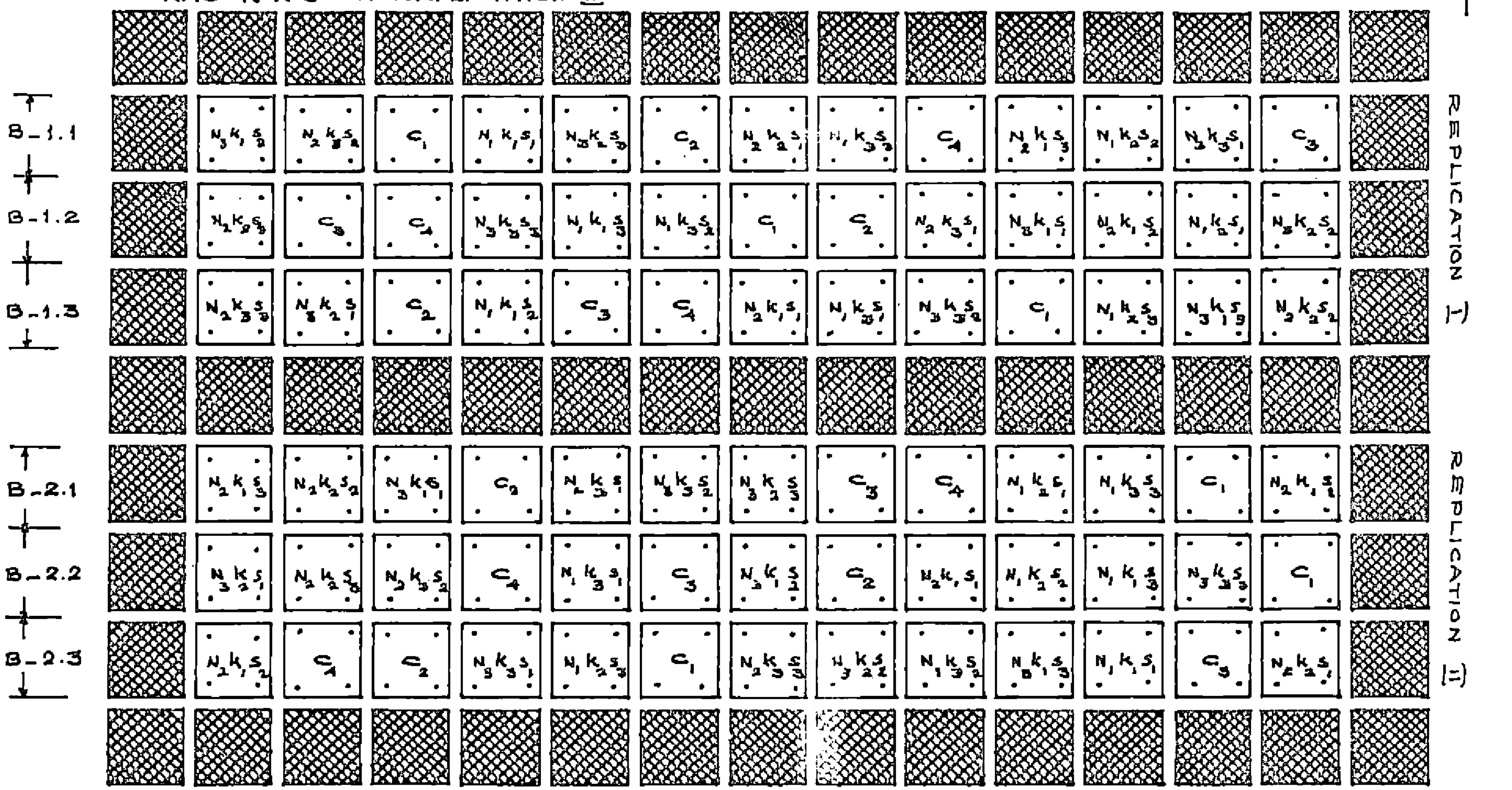
The details of layout are as follows:

Total number of treatments	: 27
Number of controls	: 4
Number of replications	: 2
Number of blocks	: 6
Number of plots per block	: 13 (9 treatments + 4 controls)
Spacing	: 2 m x 2 m
Number of plants per plot	: 4

Treatments

Treatments consisted of combinations of three levels of nitrogen, three levels of potassium and three levels of split applications.

FIG. I LAY-OUT PLAN - 3^3+4 FACTORIAL EXPERIMENT CONFOUNDING NK^2S IN REPLICATION I AND NK^2S^2 IN REPLICATION II



TREATMENTS

N_1 - 200 g N / PLANT / YEAR
N_2 - 300 g N / PLANT / YEAR
N_3 - 400 g N / PLANT / YEAR
K_1 - 300 g K_2O / PLANT / YEAR
K_2 - 450 g K_2O / PLANT / YEAR
K_3 - 600 g K_2O / PLANT / YEAR

S_1 - 4 SPLIT APPLICATIONS
S_2 - 6 SPLIT APPLICATIONS
S_3 - 8 SPLIT APPLICATIONS

▩ BOARDER PLANTS
• TREATED PLANTS

CONTROLS

C_1 - PACKAGE OF PRACTICES DOSE IN 2 SPLITS.
C_2 - PACKAGE OF PRACTICES DOSE IN 4 SPLITS.
C_3 - PACKAGE OF PRACTICES DOSE IN 6 SPLITS.
C_4 - PACKAGE OF PRACTICES DOSE IN 8 SPLITS.

Levels of nitrogen

1. N_1 — 200 gram per plant per year
2. N_2 — 300 gram per plant per year
3. N_3 — 400 gram per plant per year

Levels of potassium

1. K_1 — 300 gram per plant per year
2. K_2 — 450 gram per plant per year
3. K_3 — 600 gram per plant per year

N and K_2O were applied in 4, 6 and 8 splits as given below

4 splits - Four equal splits at first, second, third and fourth month after planting.

6 splits - Six equal splits at first, second, third, fourth, fifth and sixth month after planting.

8 splits - Eight equal splits at first, second, third, fourth, fifth, sixth, seventh and eighth month after planting.

In all the treatments P_2O_5 was applied at a rate of 100 gm per plant per year and this whole quantity of P_2O_5 was applied one month after planting.

The details about controls are given below:

Control-1

The dose as per recommendation of package of practices 1982 (190:115:300 g, N: P_2O_5 : K_2O per plant per year).

This was applied in two equal splits - second and fourth month after planting.

Control-2

N and K_2O recommended as per package of practices were applied in four equal splits at first, second, third and fourth month after planting. P_2O_5 was applied one month after planting.

Control-3

N and K_2O recommended as per package of practices were applied in six equal splits at first, second, third, fourth fifth and sixth month after planting. P_2O_5 was applied one month after planting.

Control-4

N and K_2O recommended as per package of practices were applied in eight equal splits at first, second, third, fourth, fifth, sixth, seventh and eighth month after planting. P_2O_5 was applied one month after planting.

Cowdung was applied one month after planting at the rate of 10 kg per pit, in all the treated and control plots.

Nutrients N, P_2O_5 and K_2O were applied as urea (46.0% N), Superphosphate (16.0% P_2O_5) and muriate of potash (60.0% K_2O).

7. Observations

I. Morphological characters

1. Weight of planting material

Weight of each sucker was recorded at planting time.

2. Height of pseudostem

Height of pseudostem was measured from the base of the plant to the axil of youngest leaf and recorded in Centimeters.

3. Number of leaves

Total number of leaves produced by plant upto each fertilizer application was recorded, at monthly intervals till shooting.

4. Length of lamina

This was measured from the base of the lamina to the tip and recorded in Centimeters.

5. Width of lamina

Lamina width was measured at the broadest point in the middle region and recorded in Centimeters.

6. Total leaf area

This was computed using the formula,

Leaf area = length x breadth x 0.8 (Murray, 1960).

7. Number of days taken for the sprouting of the rhizome were calculated.

8. Total number of days taken for flowering and harvest were computed separately.

9. Sucker production

Mean number of days taken for first sucker emergence were recorded from each plant. Number of suckers at the time of shooting and harvest were also recorded. However the suckers were not allowed to emerge until shooting. After shooting two healthy suckers per plant were retained.

10. Bunch characters

Bunches were harvested when they were fully mature indicated by the disappearance of angles, round full. (Simmonds, 1959).

The following observations were made on bunch characters.

a) Weight of bunch

Weight of bunch including the portion of peduncle upto the first scar (exposed outside the plant) was recorded in Kilograms.

b) Length of bunch

This was measured from the point of attachment of first hand to that of the last hand and expressed in Centimeters.

c) Number of hands and fingers per bunch

The total number of hands and total number of fingers in each bunch were noted.

d) Mean weight of finger

The middle fruit in the top row of the second hand (from the base of the bunch) was selected as the representative finger (Gottreich *et al.* 1964) for finding out the mean finger weight, girth and length of finger. The weight of this representative finger was recorded as the mean finger weight.

e) Girth and length of finger

Girth was measured at the middle portion and length from the portion of attachment to the top using fine thread and scale.

f) Dry weight

The whole mature finger was dried in oven at 70°C until two consecutive weights agreed as adopted by Sheela (1982).

II. Qualitative analysis

a) Total soluble solids

The fruit from well ripe bunches were used for the analysis of TSS. The middle finger in the top row of second hand, was selected as the representative fruit. Samples were taken from each fruit, from 3 portions viz. top, middle and bottom and these samples were pooled and macerated in a waring blender. Triplicate samples from these were used for the analysis of total soluble solids (TSS) which was found out using a pocket refractometer and expressed as percentage.

b) Starch content

The mature finger (except the peel) was dried at 70°C in oven, powdered and this was used for the analysis of starch (AOAC, 1965) and values expressed as percentage of dry weight of fruits.

12. Statistical analysis

The experimental data were analysed statistically by applying the technique of analysis of variance for confounded factorial experiment and significance was tested by 'F' test. (Cochran and Cox, 1965). LSD was used for comparing levels of significant main effects and first order interactions. In cases where the second order interactions (N x K x S) were found to be significant, the critical difference was calculated by using the Tukey's Q test (Snedecor and Cochran, 1967). Quadratic response surface of the form

$Y = a + bN + cN^2 + dK + eK^2 + fNK$ was tried to estimate optimum and economic doses of nutrients.

RESULTS

RESULTS

The results of the present study are prescribed under the following titles.

1. Height of pseudostem

Observations on mean height of pseudostem at monthly intervals from second month of planting to eighth month of planting are given in Tables 2.1 and 2.2 . Analyses of variance of the data are given in Appendix II.

Effect of nitrogen was found to be statistically significant during the 2nd, 3rd, 4th and 5th month of planting. During this period the lowest nitrogen level was found to produce significantly taller plants than those under the other two nitrogen levels.

Potassium did not exert any significant influence on the mean height of pseudostem during the entire growth period. The response to split application was significant at earlier stages of growth of the crop (upto fifth month of planting) and thereafter it failed to shew statistical significance. Application of fertilizers in 8 splits produced relatively taller plants. These plants were significantly taller than those produced under 4 split applications. In general, an increase in the number of splits was

Table 2.1 Height of pseudostem during fertilizer application (cm)
(from 2nd month to 8th month of planting)

Main effects/ Interactions	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
N_{200}	101.44	169.91	245.93	317.16	341.17	341.41	341.48
N_{300}	83.43	147.46	225.29	299.17	331.19	336.46	336.54
N_{400}	90.89	149.08	216.38	299.28	325.67	335.96	335.96
N	Sg	Sg	Sg	Sg	NSg	NSg	NSg
K_{300}	91.89	154.87	231.56	305.67	329.02	331.61	331.67
K_{450}	94.96	159.67	228.46	306.11	336.35	340.24	340.24
K_{600}	88.91	151.91	227.58	303.83	332.67	339.95	340.08
	NSg	NSg	NSg	NSg	NSg	NSg	NSg
S_4	83.35	145.05	216.70	293.66	330.18	332.98	332.98
S_6	94.13	158.05	233.14	308.50	333.92	340.29	340.29
S_8	98.29	163.35	237.77	313.44	333.93	334.56	334.56
	Sg	Sg	Sg	Sg	NSg	NSg	NSg
SE ±	3.67	5.28	5.55	5.38	4.96	3.72	3.17
CD (0.05)	10.47	15.06	15.81	15.35	NSg	NSg	NSg
N_{200} K_{300}	101.14	161.53	243.79	318.33	334.58	334.66	334.66
N_{200} K_{450}	105.90	180.99	252.83	312.16	341.38	341.38	341.38
N_{200} K_{600}	97.30	167.20	241.16	316.00	342.55	348.20	348.41
N_{300} K_{300}	87.62	149.29	235.13	301.50	328.88	328.88	329.75
N_{300} K_{450}	85.08	150.75	227.50	302.33	324.54	326.20	333.37
N_{300} K_{600}	77.58	142.32	213.25	293.66	340.16	342.25	345.29
N_{400} K_{300}	86.91	153.79	215.75	297.16	323.60	325.28	326.40
N_{400} K_{450}	93.89	147.[illegible]	205.06	298.83	340.12	342.21	347.96
N_{400} K_{600}	91.87	146.20	228.31	301.83	310.29	329.37	333.45
	NSg	NSg	NSg	NSg	NSg	NSg	NSg
N_{200} S_4	96.59	166.91	243.45	309.83	343.35	344.09	344.30
N_{200} S_6	102.33	168.95	250.91	322.00	346.54	346.54	346.54
N_{200} S_8	105.41	173.86	243.41	319.66	333.62	333.62	333.62
N_{300} S_4	77.70	133.61	224.71	294.16	326.16	328.88	336.41
N_{300} S_6	85.70	161.36	222.13	298.00	332.00	335.12	335.12
N_{300} S_8	86.79	157.39	229.04	305.33	335.21	342.29	342.29
N_{400} S_4	75.76	134.64	181.93	227.00	321.04	325.28	333.12
N_{400} S_6	94.25	53.83	227.35	305.50	323.01	347.21	347.21
N_{400} S_8	100.66	158.79	240.84	315.33	322.95	329.37	333.17
	NSg	NSg	Sg	NSg	NSg	NSg	NSg
K_{300} S_4	83.10	146.95	226.25	299.83	326.33	327.88	329.87
K_{300} S_6	90.58	150.64	210.85	296.00	334.21	337.26	344.38
K_{300} S_8	76.37	137.58	213.00	285.56	330.01	333.79	339.58
K_{450} S_4	96.79	153.32	236.84	309.50	335.18	335.18	335.18
K_{450} S_6	93.16	163.66	236.30	309.00	339.25	340.29	340.29
K_{450} S_8	92.42	157.15	228.26	307.00	327.33	345.41	346.91
K_{600} S_4	95.79	166.34	233.58	307.66	325.55	325.76	325.76
K_{600} S_6	101.12	164.70	238.25	313.33	335.58	337.25	337.25
K_{600} S_8	97.95	161.00	241.46	319.33	340.66	340.66	340.66
	NSg	NSg	NSg	NSg	NSg	NSg	NSg
SE ±	6.36	9.15	9.61	9.33	8.60	6.45	5.49
CD (0.05)	NSg	NSg	27.39	NSg	NSg	NSg	NSg

N - Nitrogen (g/plant) K - Potassium (g/plant) S - Split application
Sg - Significant NSg - Not significant

FIG. 2.1 HEIGHT OF PSEUDOSTEM (cm) AS INFLUENCED BY DIFFERENT LEVELS OF NITROGEN (FROM 2nd MONTH UP TO 8th MONTH AFTER PLANTING)

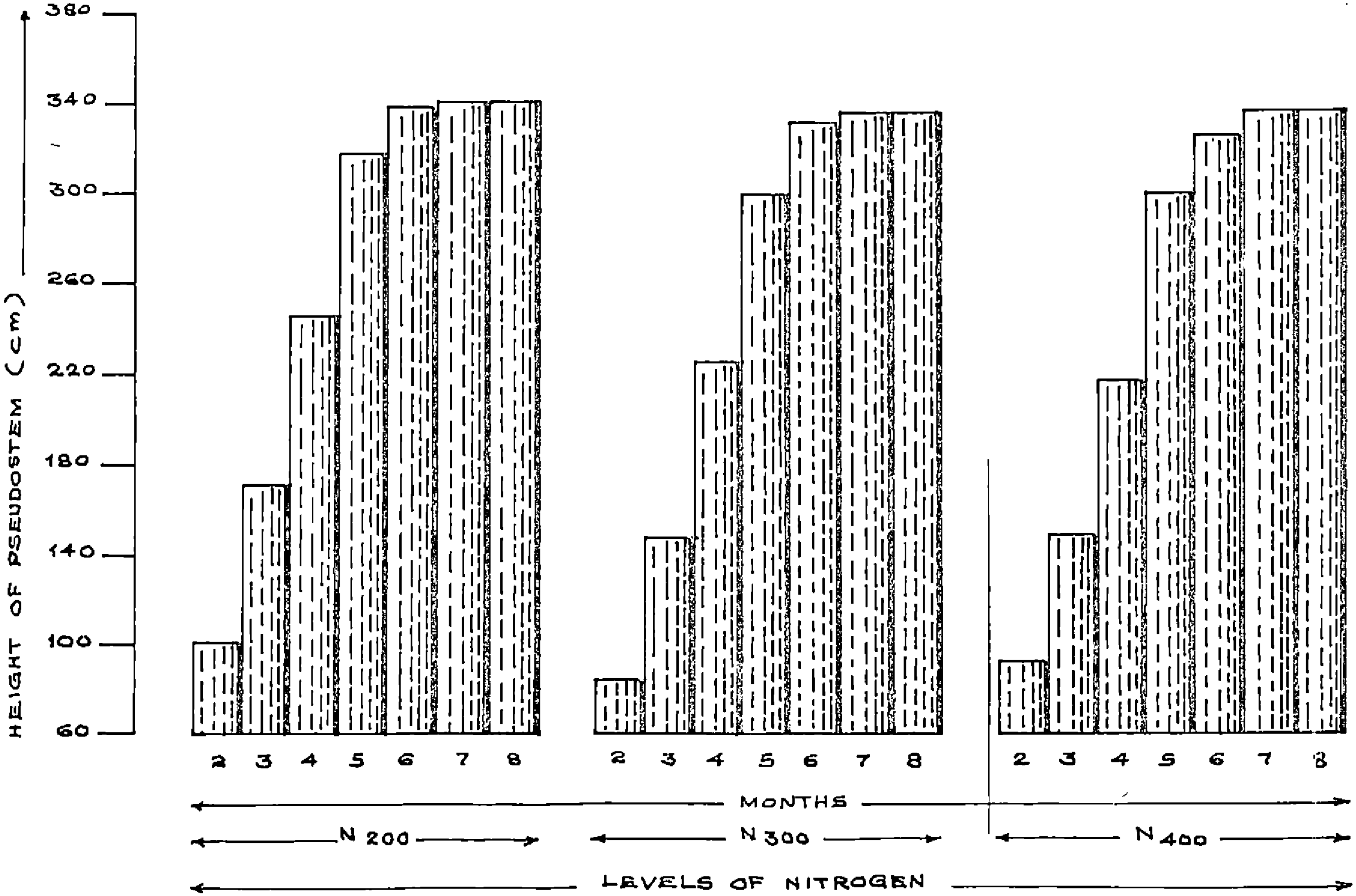


FIG.2.1 HEIGHT OF PSEUDOSTEM (cm) AS INFLUENCED BY DIFFERENT LEVELS OF POTASSIUM (FROM 2nd MONTH UP TO 8th MONTH AFTER PLANTING)

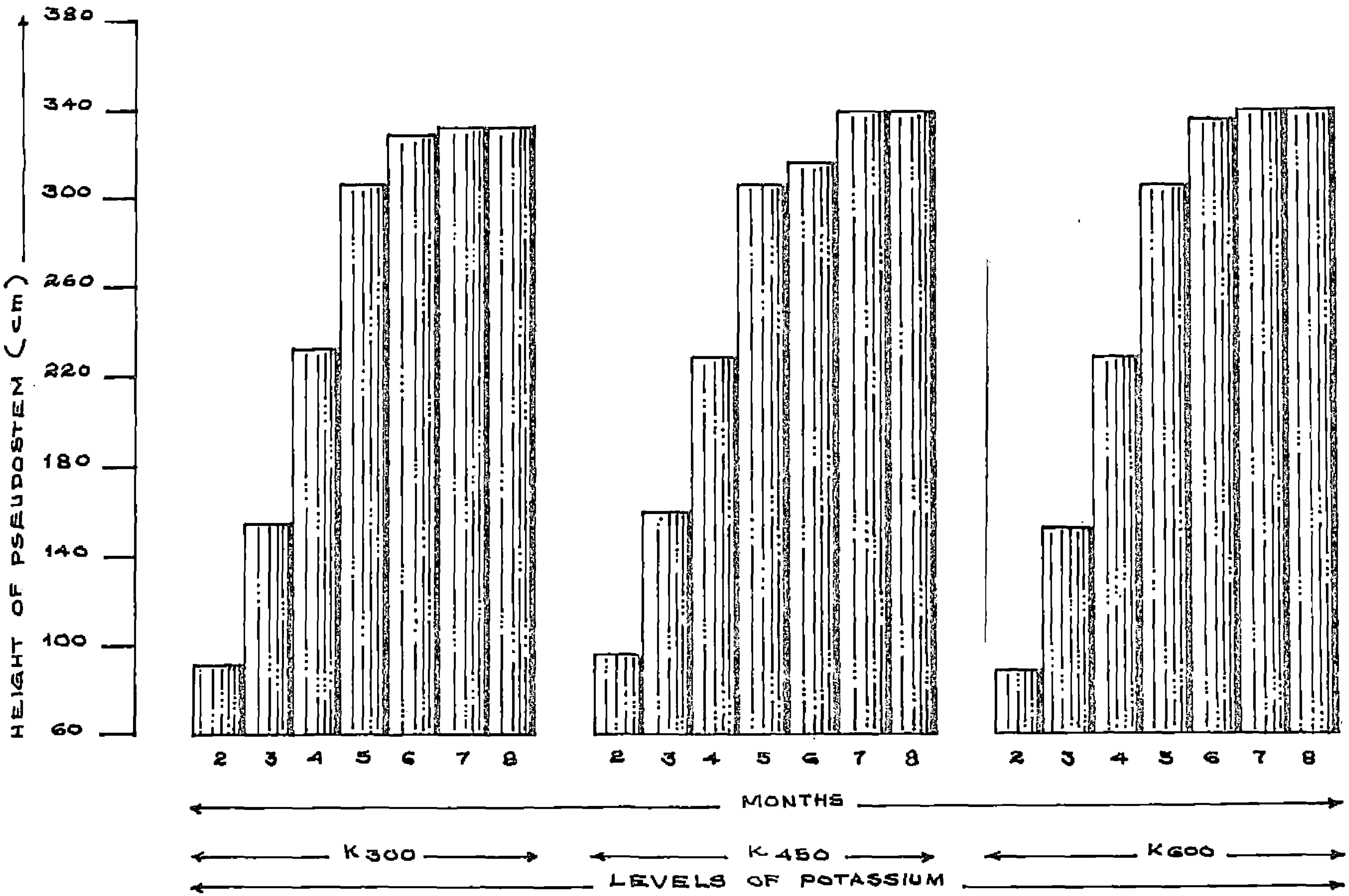


FIG. 2.3 HEIGHT OF PSEUDOSTEM (cm) AS INFLUENCED BY DIFFERENT SPLIT APPLICATIONS (FROM 2nd MONTH UP TO 8th MONTH AFTER PLANTING)

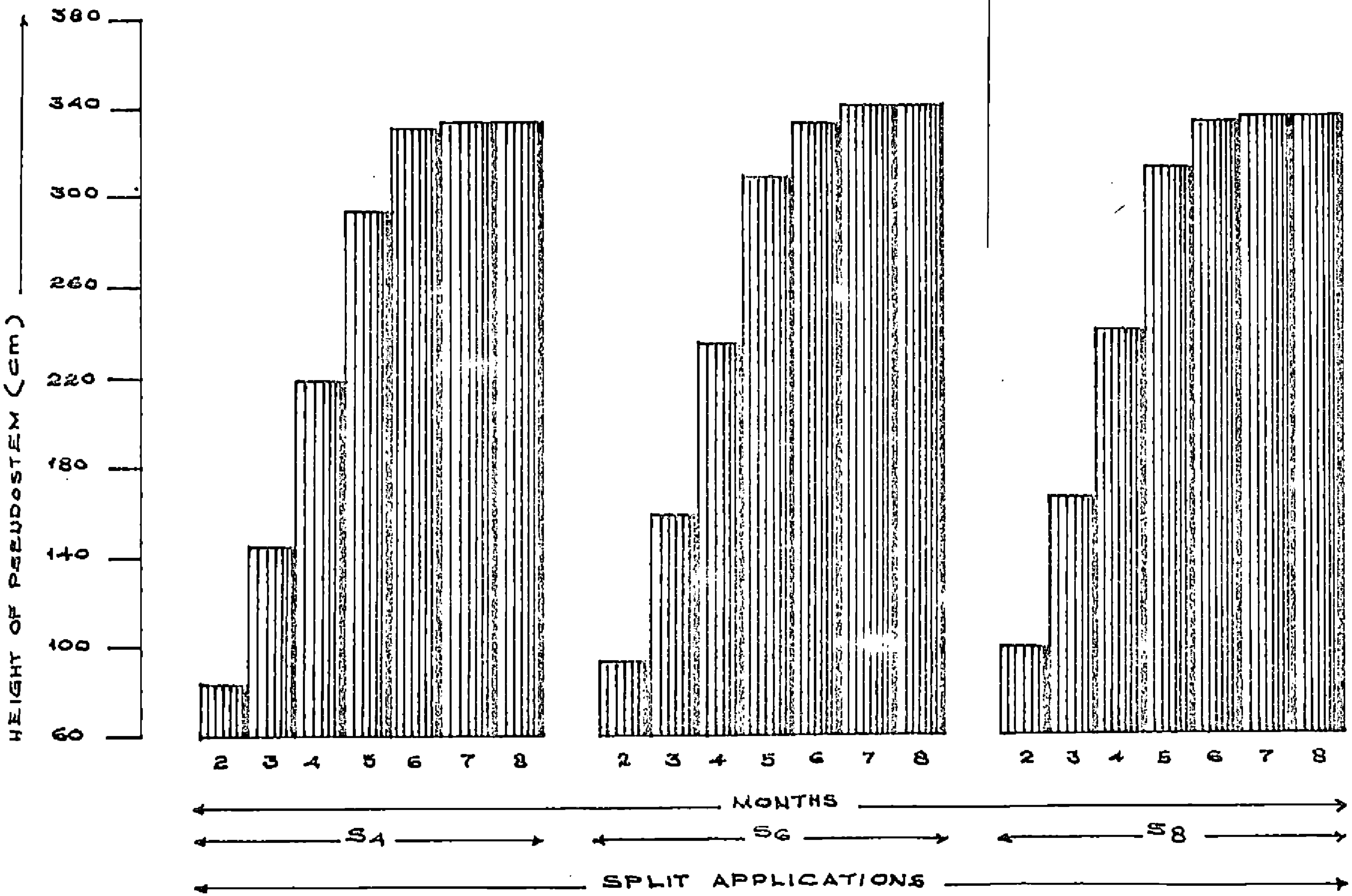


Table 2.2 Height of pseudostem during fertilizer application (cm)
(from 2nd month to 8th month of planting)

Treatment combinations	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
$N_{200}\ K_{300}\ S_4$	96.05	153.12	223.38	302.50	326.75	327.00	327.00
$N_{200}\ K_{300}\ S_6$	103.86	149.60	253.75	323.50	342.50	342.50	342.50
$N_{200}\ K_{300}\ S_8$	103.50	181.88	244.25	329.00	335.50	335.50	335.50
$N_{200}\ K_{450}\ S_4$	108.35	186.63	268.50	315.50	334.13	334.13	334.13
$N_{200}\ K_{450}\ S_6$	104.73	188.88	252.00	323.50	334.13	334.13	334.13
$N_{200}\ K_{450}\ S_8$	104.63	167.48	238.00	312.50	331.88	331.88	331.88
$N_{200}\ K_{600}\ S_4$	85.38	161.00	228.50	311.50	345.18	347.12	347.12
$N_{200}\ K_{600}\ S_6$	98.40	168.37	247.00	319.00	363.00	363.00	363.00
$N_{200}\ K_{600}\ S_8$	108.13	172.25	248.00	317.50	334.50	334.50	334.50
$N_{300}\ K_{300}\ S_4$	84.75	142.10	254.50	309.50	331.50	331.50	331.50
$N_{300}\ K_{300}\ S_6$	95.00	156.63	227.65	299.50	329.00	329.00	329.00
$N_{300}\ K_{300}\ S_8$	83.13	149.15	224.25	295.50	326.15	326.15	326.15
$N_{300}\ K_{450}\ S_4$	81.86	131.00	213.15	287.50	306.00	306.00	306.00
$N_{300}\ K_{450}\ S_6$	81.13	149.13	228.25	298.00	331.13	331.13	331.13
$N_{300}\ K_{450}\ S_8$	92.25	172.15	241.12	321.50	336.60	341.50	341.50
$N_{300}\ K_{600}\ S_4$	66.50	127.75	206.50	285.50	341.00	341.00	341.00
$N_{300}\ K_{600}\ S_6$	81.25	148.35	211.50	296.50	336.50	340.75	340.75
$N_{300}\ K_{600}\ S_8$	85.00	150.88	221.75	299.00	343.00	343.00	343.00
$N_{400}\ K_{300}\ S_4$	68.50	145.63	190.88	287.50	220.75	325.15	325.15
$N_{400}\ K_{300}\ S_6$	91.50	153.75	224.13	305.50	334.05	334.05	334.05
$N_{400}\ K_{300}\ S_8$	100.75	162.00	232.25	298.50	316.00	316.65	316.65
$N_{400}\ K_{450}\ S_4$	81.54	134.30	250.93	285.00	238.50	347.50	347.50
$N_{400}\ K_{450}\ S_6$	93.65	163.00	228.65	305.50	352.50	355.63	355.63
$N_{400}\ K_{450}\ S_8$	106.50	154.50	235.63	306.00	338.38	338.38	338.38
$N_{400}\ K_{600}\ S_4$	77.25	124.00	204.00	258.00	303.88	311.13	311.13
$N_{400}\ K_{600}\ S_6$	97.63	154.75	226.30	305.50	332.50	332.50	332.50
$N_{400}\ K_{600}\ S_8$	100.75	159.88	254.65	341.50	344.50	334.50	334.50
SE 1 ±	11.03	15.85	16.65	15.66	14.90	11.18	9.52
CD 1(0.05)	NSg	NSg	NSg	NSg	NSg	NSg	NSg
C 1	72.92	130.95	204.91	283.00	330.40	332.83	332.83
C 2	96.10	157.05	231.20	298.30	324.50	331.42	331.42
C 3	108.80	171.98	251.03	315.50	333.37	333.37	333.37
C 4	101.20	154.20	231.58	306.80	329.85	335.50	335.50
SE 2 ±	6.36	9.14	9.61	9.59	8.60	6.45	5.49
CD 2(0.05)	18.16	26.11	27.41	27.36	NSg	NSg	NSg

N - Nitrogen (g/ plant) K - Potassium (g/plant) S- Split application C - Control
NSg - Not significant

CD 1 - Critical difference for the comparison of treatment combinations

CD 2 - Critical difference for the comparison among different controls found to result in an increase in the height of pseudostem.

Nitrogen exerted a positive influence on the split application of nutrients, with respect to increase in plant height at fourth month of planting.

The control treatments did not show any significant difference among themselves from the sixth to eighth month of planting. But during the period from 2nd month of planting to the 5th month of planting, 2 splits were found to produce dwarfer plants than the plants produced under the other split applications.

2. Number of leaves produced per plant upto the time of each fertilizer application

Data on the average number of leaves per plant upto the time of each fertilizer application are presented in Tables 3.1 and 3.2. Analyses of variance of the data are given in Appendix III. Number of leaves per plant were not significantly affected by different levels of nitrogen during first fertilizer application. From second month onwards till fifth month of fertilizer application, number of leaves per plant were significantly increased by the application of 200 g N per plant. The effect of N on the number of leaves per plant was not significant from sixth month onwards.

Table 3.1 Cumulative number of leaves per plant upto the time of fertilizer application (at monthly intervals from 1st to 8th month of planting)

Main effects/ Interactions	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
N_{200}	3.70 (1.92)	11.87 (3.44)	17.26 (4.15)	22.82 (4.77)	27.98 (5.29)	29.32 (5.41)	29.49 (5.43)	29.49 (5.43)
N_{300}	3.37 (1.83)	10.75 (3.28)	16.69 (4.01)	21.53 (4.64)	27.04 (5.20)	29.38 (5.42)	29.55 (5.43)	29.55 (5.43)
N_{400}	3.52 (1.87)	11.14 (3.33)	16.09 (4.01)	21.25 (4.61)	26.93 (5.18)	29.15 (5.39)	29.43 (5.42)	29.43 (5.42)
	NSg	Sg	Sg	Sg	Sg	NSg	NSg	NSg
K_{300}	3.52 (1.87)	11.19 (3.34)	16.74 (4.09)	22.03 (4.69)	27.59 (5.25)	29.43 (5.42)	29.43 (5.42)	29.43 (5.42)
K_{450}	3.48 (1.86)	11.48 (3.38)	16.48 (4.05)	21.98 (4.68)	26.98 (5.19)	29.27 (5.41)	29.49 (5.43)	29.49 (5.43)
K_{600}	3.59 (1.89)	11.08 (3.32)	16.20 (4.02)	21.58 (4.64)	27.37 (5.23)	29.15 (5.39)	29.55 (5.43)	29.55 (5.43)
	NSg	NSg	NSg	NSg	NSg	NSg	NSg	NSg
S_4	3.70 (1.92)	11.08 (3.28)	15.92 (3.99)	21.25 (4.61)	26.70 (5.16)	29.43 (5.42)	29.71 (5.45)	29.71 (5.45)
S_6	3.41 (1.84)	11.38 (3.37)	16.42 (4.08)	21.86 (4.67)	27.48 (5.24)	29.10 (5.39)	29.21 (5.40)	29.21 (5.40)
S_8	3.48 (1.86)	11.54 (3.39)	17.09 (4.13)	22.48 (4.74)	27.77 (5.26)	29.32 (5.41)	29.54 (5.44)	29.54 (5.44)
SE ±	NSg (0.03)	Sg (0.03)	Sg (0.03)	Sg (0.03)	Sg (0.02)	NSg (0.01)	NSg (0.01)	NSg (0.01)
CD (0.05)	NSg	(0.08)	(0.09)	(0.09)	(0.06)	NSg	NSg	NSg
N_{200} K_{300}	3.65 (1.91)	11.81 (3.43)	17.48 (4.18)	22.82 (4.77)	28.32 (5.32)	29.32 (5.41)	29.32 (5.41)	29.32 (5.41)
N_{200} K_{450}	3.48 (1.86)	11.97 (3.46)	17.31 (4.16)	23.32 (4.82)	27.31 (5.22)	29.16 (5.40)	29.32 (5.41)	29.32 (5.41)
N_{200} K_{600}	4.00 (2.00)	11.47 (3.43)	16.99 (4.12)	22.32 (4.72)	28.32 (5.32)	29.49 (5.43)	29.82 (5.46)	29.82 (5.46)
N_{300} K_{300}	3.48 (1.87)	11.14 (3.34)	16.81 (4.05)	22.15 (4.71)	27.65 (5.26)	29.66 (5.45)	29.66 (5.45)	29.66 (5.45)
N_{300} K_{450}	3.48 (1.87)	10.82 (3.29)	15.65 (3.96)	22.15 (4.59)	26.48 (5.15)	28.99 (5.38)	29.66 (5.45)	29.66 (5.45)
N_{300} K_{600}	3.15 (1.77)	10.31 (3.21)	15.65 (3.96)	21.31 (4.62)	26.99 (5.15)	29.49 (5.49)	29.40 (5.48)	29.40 (5.40)
N_{400} K_{300}	3.45 (1.86)	10.63 (3.26)	15.97 (3.99)	21.14 (4.59)	26.81 (5.17)	29.32 (5.42)	29.32 (5.42)	29.32 (5.42)
N_{400} K_{450}	3.48 (1.87)	11.77 (3.43)	16.32 (4.04)	21.49 (4.64)	27.16 (5.21)	29.66 (5.45)	29.66 (5.45)	29.66 (5.45)
N_{400} K_{600}	3.65 (1.91)	11.12 (3.34)	15.98 (3.99)	21.13 (4.59)	26.82 (5.18)	28.49 (5.34)	29.16 (5.40)	29.16 (5.40)
	NSg	NSg	NSg	NSg	NSg	NSg	NSg	NSg
N_{200} S_4	3.82 (1.95)	11.31 (3.36)	16.99 (4.12)	22.49 (4.74)	27.32 (5.22)	29.82 (5.46)	30.16 (5.49)	30.16 (5.49)
N_{200} S_6	3.65 (1.91)	12.15 (3.48)	16.99 (4.42)	22.49 (4.74)	28.16 (5.31)	28.74 (5.36)	28.74 (5.36)	28.74 (5.36)
N_{200} S_8	3.65 (1.91)	12.15 (3.48)	17.82 (4.32)	23.49 (4.85)	28.49 (5.34)	29.33 (5.42)	29.33 (5.42)	29.33 (5.42)
N_{300} S_4	3.31 (1.82)	10.31 (3.21)	15.65 (3.96)	21.15 (4.54)	26.98 (5.19)	29.66 (5.40)	29.66 (5.45)	29.66 (5.45)
N_{300} S_6	3.48 (1.87)	10.82 (3.28)	15.81 (3.97)	21.48 (4.63)	26.97 (5.19)	29.16 (5.40)	29.16 (5.40)	29.16 (5.40)
N_{300} S_8	3.31 (1.82)	11.14 (3.33)	16.81 (4.10)	21.98 (4.68)	27.16 (5.21)	29.65 (5.41)	29.66 (5.45)	29.66 (5.45)
N_{400} S_4	4.00 (2.00)	11.30 (3.28)	15.14 (3.89)	19.79 (4.44)	26.81 (5.17)	28.82 (5.36)	29.32 (5.41)	29.32 (5.41)
N_{400} S_6	3.09 (1.76)	11.30 (3.33)	16.48 (4.06)	21.64 (4.65)	26.18 (5.21)	29.33 (5.41)	29.33 (5.41)	29.33 (5.41)
N_{400} S_8	3.48 (1.86)	11.32 (3.36)	16.66 (4.08)	21.99 (4.68)	26.81 (5.17)	29.32 (5.41)	29.69 (5.44)	29.69 (5.44)
	NSg	NSg	NSg	NSg	NSg	NSg	NSg	NSg
K_{300} S_4	3.65 (1.91)	10.64 (3.26)	15.97 (3.99)	21.34 (4.61)	27.14 (5.21)	29.99 (5.47)	29.99 (5.47)	29.99 (5.47)
K_{300} S_6	3.82 (1.95)	11.14 (3.33)	16.31 (4.03)	21.64 (4.65)	26.16 (5.11)	29.49 (5.43)	29.66 (5.45)	29.66 (5.45)
K_{300} S_8	3.65 (1.91)	10.63 (3.26)	15.47 (3.93)	20.80 (4.56)	26.81 (5.17)	28.82 (5.36)	29.47 (5.43)	29.49 (5.43)
K_{450} S_4	3.45 (1.85)	11.30 (3.36)	16.81 (4.10)	22.30 (4.72)	27.82 (5.27)	28.99 (5.38)	28.99 (5.38)	28.99 (5.38)
K_{450} S_6	3.15 (1.77)	11.64 (3.41)	16.31 (4.03)	21.98 (4.68)	27.31 (5.22)	28.99 (5.38)	28.99 (5.38)	28.99 (5.38)
K_{450} S_8	3.65 (1.91)	11.30 (3.36)	16.65 (4.08)	21.31 (4.61)	27.31 (5.22)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
K_{600} S_4	3.48 (1.86)	11.64 (3.41)	17.47 (4.18)	22.76 (4.74)	27.82 (5.27)	29.32 (5.41)	29.32 (5.41)	29.32 (5.41)
K_{600} S_6	3.46 (1.86)	11.65 (3.41)	16.81 (4.10)	22.30 (4.72)	27.49 (5.24)	29.32 (5.41)	29.66 (5.44)	29.66 (5.44)
K_{600} S_8	3.46 (1.86)	11.32 (3.36)	16.41 (4.05)	22.66 (4.76)	27.99 (5.29)	29.32 (5.41)	29.66 (5.44)	29.66 (5.44)
SE ±	NSg (0.054)	NSg (0.053)	NSg (0.059)	NSg (0.058)	NSg (0.039)	NSg (0.030)	NSg (0.032)	NSg (0.032)
CD (0.05)	NSg	NSg	NSg	NSg	NSg	NSg	NSg	NSg

N – Nitrogen (g/plant) K – Potassium (g/plant) S– Split application

Sg– Significant NSg– Not significant

Transformed values are given in brackets.

Table 3.2 Cumulative number of leaves per plant upto the time of each fertilizer application (at monthly intervals from 1st to 8th month of planting)

Treatment combinations	1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
N_{200} K_{300} S_4	3.48 (1.18)	11.00 (3.31)	16.98 (4.12)	21.98 (4.68)	27.99 (5.29)	30.49 (5.52)	30.49 (5.52)	30.49 (5.52)
N_{200} K_{300} S_6	4.00 (2.00)	11.97 (3.46)	16.98 (4.12)	22.98 (4.79)	27.99 (5.29)	28.49 (5.33)	28.49 (5.33)	28.49 (5.33)
N_{200} K_{300} S_8	3.48 (1.86)	12.49 (3.53)	18.49 (4.30)	23.49 (4.84)	28.99 (5.38)	28.99 (5.38)	28.99 (5.38)	28.99 (5.38)
N_{200} K_{450} S_4	4.00 (2.00)	11.97 (3.46)	17.49 (4.18)	23.00 (4.79)	26.00 (5.09)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{200} K_{450} S_6	3.00 (1.73)	11.97 (3.46)	16.98 (4.12)	22.98 (4.73)	27.99 (5.29)	28.49 (5.33)	28.99 (5.38)	28.99 (5.38)
N_{200} K_{450} S_8	3.48 (1.86)	11.97 (3.46)	17.46 (4.17)	24.00 (4.89)	27.99 (5.29)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{200} K_{600} S_4	4.00 (2.00)	10.97 (3.31)	16.49 (4.06)	22.44 (4.74)	28.00 (5.29)	29.49 (5.43)	30.49 (5.52)	30.49 (5.52)
N_{200} K_{600} S_6	4.00 (2.00)	12.49 (3.52)	16.98 (4.12)	21.49 (4.63)	28.48 (5.33)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{200} K_{600} S_8	4.00 (2.00)	12.00 (3.46)	17.49 (4.18)	22.98 (4.79)	28.49 (5.33)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{300} K_{300} S_4	3.48 (1.86)	10.69 (3.39)	16.49 (4.06)	21.96 (4.68)	27.99 (5.29)	29.99 (5.47)	29.99 (5.47)	29.99 (5.47)
N_{300} K_{300} S_6	3.46 (1.86)	10.97 (3.51)	16.46 (4.05)	22.47 (4.74)	27.99 (5.29)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{300} K_{450} S_4	3.48 (1.86)	10.00 (3.16)	15.69 (3.93)	20.98 (4.98)	26.00 (5.09)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{300} K_{450} S_6	3.46 ([illegible])	11.00 (3.31)	15.49 (3.93)	21.00 (4.58)	26.47 (5.41)	29.00 (5.38)	29.00 (5.38)	29.00 (5.38)
N_{300} K_{450} S_8	[illegible] (1.86)	11.44 (3.39)	16.49 (4.06)	21.44 (4.63)	26.99 (5.19)	28.49 (5.33)	29.49 (5.43)	29.49 (5.43)
N_{300} K_{600} S_4	3.00 (1.73)	10.49 (3.23)	14.98 (3.87)	20.49 (4.52)	26.99 (5.19)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{300} K_{600} S_6	3.48 (1.86)	10.49 (3.23)	15.49 (3.93)	20.98 (4.58)	26.46 (5.38)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{300} K_{600} S_8	3.00 (1.73)	10.97 (3.31)	16.49 (4.06)	22.49 (4.74)	27.49 (5.24)	29.99 (5.47)	29.99 (5.47)	29.99 (5.47)
N_{400} K_{300} S_4	4.00 (2.00)	9.49 (3.08)	14.49 (3.80)	20.00 (4.47)	25.49 (5.04)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{400} K_{300} S_6	2.91 (1.70)	10.97 (3.31)	15.98 (4.12)	21.47 (4.63)	27.47 (5.24)	29.00 (5.38)	29.00 (5.38)	29.00 (5.38)
N_{400} K_{300} S_8	3.48 (1.86)	11.49 (3.59)	16.49 (4.06)	21.98 (4.58)	27.49 (5.24)	29.48 (5.42)	29.48 (5.42)	29.48 (5.42)
N_{400} K_{450} S_4	4.00 (2.00)	11.49 (3.39)	16.98 (3.99)	20.98 (4.58)	26.49 (5.14)	29.49 (5.43)	30.00 (5.47)	30.00 (5.47)
N_{400} K_{450} S_6	3.00 (1.73)	11.97 (3.46)	16.49 (4.06)	21.96 (4.68)	27.49 (5.24)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{400} K_{450} S_8	3.48 (1.86)	11.44 (3.39)	16.49 (4.06)	21.49 (4.63)	27.49 (5.24)	30.00 (5.47)	30.00 (5.47)	30.00 (5.47)
N_{400} K_{600} S_4	4.00 (2.00)	11.49 (3.39)	14.98 (3.87)	21.47 (4.63)	25.47 (5.04)	28.49 (5.33)	28.49 (5.33)	28.49 (5.33)
N_{400} K_{600} S_6	3.48 (1.86)	10.97 (3.31)	15.98 (3.99)	21.47 (4.63)	27.00 (5.19)	29.49 (5.43)	29.49 (5.43)	29.49 (5.43)
N_{400} K_{600} S_8	3.46 (1.86)	11.00 (3.31)	17.00 (4.12)	22.49 (4.74)	28.00 (5.29)	28.49 (5.33)	28.49 (5.33)	28.49 (5.33)
SE 1±	(0.094)	(0.093)	(0.102)	(0.101)	(0.062)	(0.053)	(0.053)	(0.053)
CD 1(0.05)	NSg	NSg	NSg	NSg	NSg	NSg	NSg	NSg
C 1	3.97 (1.99)	10.24 (3.20)	15.00 (3.87)	20.47 (4.52)	26.32 (5.13)	29.32 (5.41)	29.32 (5.41)	29.32 (5.41)
C 2	3.97 (1.99)	10.56 (3.25)	15.14 (4.01)	21.29 (4.61)	26.99 (5.19)	28.66 (5.35)	28.66 (5.35)	28.66 (5.35)
C 3	3.65 (1.91)	11.66 (3.41)	17.32 (4.16)	22.98 (4.74)	27.48 (5.24)	29.15 (5.39)	29.15 (5.39)	29.15 (5.39)
C 4	4.00 (2.00)	11.31 (3.36)	16.33 (4.04)	22.31 (4.72)	27.82 (5.27)	28.99 (5.38)	28.99 (5.38)	28.99 (5.38)
SE 2±	(0.054)	(0.053)	(0.059)	(0.058)	(0.039)	(0.030)	(0.032)	(0.032)
CD 2 (0.05)	NSg	(0.152)	(0.168)	(0.166)	(0.112)	NSg	NSg	NSg

N - Nitrogen (g/plant) K - Potassium (g/plant) S - Split application C - Control

NSg- Not significant

CD 1 - Critical difference for comparison of treatment combinations

CD 2 - Critical difference for comparison among different controls

Transformed values are given in brackets

The effect of potassium on the number of leaves per plant was not at all significant during the entire period of growth. Split applications did not exert any influence on the number of leaves per plant during first fertilizer application. Eight splits produced plants with more number of leaves and was significantly different from the application of nutrients in 4 splits, during 2nd, 3rd, 4th and 5th month of fertilizer application. From 6th month onwards effect of split application was not significant. None of the interactions was significant for the whole period of the crop growth among the control and treated plots. Application of nutrients in 2 splits resulted in the significant reduction in the number of leaves in control during 2nd, 3rd, 4th and 5th months of planting. Split application had no significant influence in the number of leaves per plant during 1st, 6th, 7th and 8th month of planting.

3. Leaf area

The mean values on leaf area at 2nd, 3rd and 4th month of planting are presented in Tables 4.1 and 4.2. The related analyses of variance of the data are given in Appendix IV.

Analysis of the date showed that nitrogen and potassium had not exerted any significant effect on leaf area at 2nd, 3rd and 4th month of planting. Split applications significantly

Table 4.1 Leaf area at 2nd, 3rd and 4th month of planting (cm^2)

Main effects/ Interactions	Leaf area (cm^2)		
	2nd month	3rd month	4th month
N_{200}	1590.34	3578.06	6131.50
N_{300}	1486.49	3400.49	5975.85
N_{400}	1511.04	3379.81	5820.26
	NSg	NSg	NSg
K_{300}	1530.33	3511.42	5970.96
K_{450}	1576.31	3521.49	5931.94
K_{600}	1481.22	3325.46	6024.67
	NSg	NSg	NSg
S_4	1459.95	3274.02	5648.86
S_6	1529.08	3506.21	6154.71
S_8	1598.89	3578.16	6124.05
	NSg	NSg	Sg
SE ±	64.960	121.769	150.970
CD (0.05)	NSg	NSg	430.212
N_{200} K_{300}	1615.58	3676.30	6072.41
N_{200} K_{450}	1643.60	3652.30	6177.31
N_{200} K_{600}	1511.85	3405.60	6194.78
N_{300} K_{300}	1549.93	3391.26	6126.34
N_{300} K_{450}	1568.68	3599.94	5925.26
N_{300} K_{600}	1340.85	3210.27	5875.97
N_{400} K_{300}	1425.49	3666.72	5714.15
N_{400} K_{450}	1516.65	3312.23	5743.35
N_{400} K_{600}	1590.96	3360.50	6003.27
	NSg	NSg	NSg
N_{200} S_4	1551.50	3487.07	5972.26
N_{200} S_6	1553.69	3611.58	6445.43
N_{200} S_8	1666.43	3635.55	5976.81
N_{300} S_4	1370.22	3290.77	5881.90
N_{300} S_6	1521.10	3418.56	5866.45
N_{300} S_8	1568.13	3492.13	6179.20
N_{400} S_4	1458.12	3044.20	5092.41
N_{400} S_6	1512.87	3488.46	6152.23
N_{400} S_8	1562.12	3666.78	6216.12
	NSg	NSg	NSg
K_{300} S_4	1410.38	3271.18	5564.79
K_{300} S_6	1567.52	3248.95	5569.60
K_{300} S_8	1421.93	3201.90	5812.18
K_{450} S_4	1610.76	3650.08	6187.20
K_{450} S_6	1492.77	3525.70	6166.10
K_{450} S_8	1483.55	3342.87	6110.80
K_{600} S_4	1569.86	3513.01	6160.90
K_{600} S_6	1688.65	3789.81	6060.21
K_{600} S_8	1538.18	3431.63	6151.02
	NSg	NSg	NSg
SE±	112.514	210.910	261.488
CD (0.05)	NSg	NSg	NSg

N - Nitrogen (g/plant) K - Potassium (g/plant) S- Split application

Sg- Significant NSg- Not significant

Table 4.2 Leaf Area at 2nd, 3rd and 4th month of planting (cm^2)

Treatment Combinations	2nd month	3rd month	4th month
N_{200} K_{300} S_4	1523.00	3712.90	5868.17
N_{200} K_{300} S_6	1625.95	3848.35	6265.00
N_{200} K_{300} S_8	1697.77	3467.65	6084.05
N_{200} K_{450} S_4	1695.20	3571.90	5969.40
N_{200} K_{450} S_6	1601.25	3590.40	6722.77
$N_{200}K_{450}$ S_8	1634.35	3794.60	5689.80
N_{200} K_{600} S_4	1436.30	3176.40	6079.20
N_{200} K_{600} S_6	1432.07	3396.00	6348.52
N_{200} K_{600} S_8	1667.17	3644.40	6156.60
N_{300} K_{300} S_4	1374.85	3162.60	5828.20
N_{300} K_{300} S_6	1532.23	3488.30	6302.92
N_{300} K_{300} S_8	1742.70	3522.90	6247.90
N_{300} K_{450} S_4	1508.65	3391.47	5736.75
N_{300} K_{450} S_6	1575.30	3640.50	5708.30
N_{300} K_{450} S_8	1622.10	3767.85	6330.67
N_{300} K_{600} S_4	1227.15	3318.25	6080.75
N_{300} K_{600} S_6	1455.80	3126.90	5588.15
N_{300} K_{600} S_8	1339.60	3185.65	5959.02
N_{400} K_{300} S_4	1333.30	3238.06	4998.00
N_{400} K_{300} S_6	1674.08	3613.60	5993.70
N_{400} K_{300} S_8	1269.10	3548.50	6150.75
$N_{400}K_{450}$ S_4	1438.70	2783.50	5002.65
N_{400} K_{450} S_6	1301.75	3346.20	6067.25
$N_{400}K_{450}$ S_8	1609.50	3827.00	6160.17
N_{400} K_{600} S_4	1602.35	3111.05	5276.60
N_{400} K_{600} S_6	1562.78	3505.60	6395.75
$N_{400}K_{600}$ S_8	1607.75	3464.85	6337.45
SE 1 $\pm$	194.88	365.30	452.91
CD 1 (0.05)	NS	NS	NS
C 1	1386.40	2890.70	5480.58
C 2	1594.96	3496.36	6227.80
C 3	1610.96	3555.35	6426.32
C 4	1574.73	3569.81	6237.68
SE 2 $\pm$	112.50	110.91	261.48
CD 2 (0.05)	NS	601.31	745.51

N - Nitrogen (g/plant) P- Potassium (g/plant) S-Split application

C - Control NS- Not significant

CD 1- Critical difference for the comparison of treatment combinations

CD 2- Critical difference for the comparison among different controls.

influenced the leaf area only during 4th month of planting. During this period, there was a significant reduction in leaf area by the application of nutrients in 4 splits. None of the interaction effects was found to be significant on leaf area during the entire period of observation. The effect of split application was not significant in control treatments, at 2nd month of planting. But during the later stages of growth the application of nutrients in two splits significantly reduced the leaf area.

4. Number of suckers per plant at flowering

Data on mean number of suckers per plant at flowering are given in Tables 5.1(a) and 5.2(a). Analyses of variance data are presented in Appendix V(a).

The result of analysis revealed that the nutrients, N and K_2O had a significant bearing on the number of suckers produced at flowering. Application of N at 400 g per plant significantly reduced the number of suckers produced at flowering. Maximum number of suckers at flowering was observed when 600 g K_2O per plant was applied, however this increase was not statistically significant over K_2O at 450 g per plant.

Table 5.1(a) to (c). Number of suckers per plant at flowering, harvest and cumulative number of leaves per plant at flowering

Main effects/ Interactions	5.1(a) No. of suckers per plant at flowering	5.1(b) No. of suckers per plant at harvest	5.1(c) No. of leaves per plant at flowering
N_{200}	6.78 (2.60)	7.07 (2.66)	29.54 (5.44)
N_{300}	6.35 (2.52)	6.64 (2.57)	29.54 (5.44)
N_{400}	5.75 (2.39)	6.31 (2.51)	29.44 (5.42)
	S§	NS§	NS§
K_{300}	5.85 (2.42)	6.35 (2.52)	29.43 (5.42)
K_{450}	6.41 (2.53)	6.80 (2.60)	29.49 (5.43)
K_{600}	6.63 (2.57)	6.86 (2.62)	29.66 (5.45)
	S§	NS§	NS§
S_4	6.64 (2.57)	6.66 (2.58)	29.74 (5.46)
S_6	6.24 (2.49)	6.64 (2.57)	29.27 (5.41)
S_8	6.01 (2.45)	6.68 (2.58)	29.54 (5.42)
	NS§	NS§	NS§
SE ±	(0.020)	(0.042)	(0.013)
CD(0.05)	(0.117)	NS§	NS§
N_{200} K_{300}	6.64 (2.57)	6.78 (2.60)	29.32 (5.41)
N_{200} K_{450}	6.49 (2.54)	7.14 (2.67)	29.32 (5.41)
N_{200} K_{600}	7.30 (2.70)	7.30 (2.70)	29.99 (5.47)
N_{300} K_{300}	5.47 (2.33)	5.98 (2.44)	29.66 (5.45)
N_{300} K_{450}	7.14 (2.67)	7.31 (2.70)	29.33 (5.41)
N_{300} K_{600}	6.49 (2.54)	6.65 (2.58)	29.66 (5.45)
N_{400} K_{300}	5.48 (2.34)	6.29 (2.50)	29.60 (5.45)
N_{400} K_{450}	5.64 (2.37)	5.98 (2.44)	29.32 (5.41)
N_{400} K_{600}	6.14 (2.47)	6.65 (2.58)	29.32 (5.41)
	NS§	NS§	NS§
N_{200} S_4	6.98 (2.64)	7.12 (2.66)	29.32 (5.41)
N_{200} S_6	6.81 (2.61)	6.81 (2.61)	30.16 (5.39)
N_{200} S_8	6.62 (2.57)	7.30 (2.70)	29.32 (5.41)
N_{300} S_4	6.63 (2.57)	6.85 (2.61)	29.66 (5.44)
N_{300} S_6	5.88 (2.54)	6.32 (2.60)	29.33 (5.41)
N_{300} S_8	5.97 (2.44)	6.31 (2.51)	29.66 (5.44)
N_{400} S_4	6.31 (2.51)	6.32 (2.51)	29.44 (5.43)
N_{400} S_6	5.48 (2.34)	6.32 (2.51)	29.33 (5.41)
N_{400} S_8	5.48 (2.34)	6.46 (2.54)	29.65 (5.44)
	NS§	NS§	NS§
K_{300} S_4	6.29 (2.50)	6.29 (2.50)	29.99 (5.47)
K_{300} S_6	6.80 (2.60)	6.94 (2.63)	29.66 (5.44)
K_{300} S_8	6.94 (2.61)	6.95 (2.61)	29.44 (5.42)
K_{450} S_4	5.79 (2.40)	6.32 (2.51)	29.65 (5.44)
K_{450} S_6	6.64 (2.57)	6.97 (2.64)	29.16 (5.40)
K_{450} S_8	6.29 (2.50)	6.64 (2.57)	29.66 (5.45)
K_{600} S_4	5.48 (2.25)	6.43 (2.53)	29.32 (5.41)
K_{600} S_6	5.81 (2.41)	6.49 (2.54)	29.88 (5.46)
K_{600} S_8	6.79 (2.60)	7.14 (2.67)	29.77 (5.45)
	NS§	NS§	NS§
SE ±	(0.013)	(0.073)	(0.030)
CD(0.05)	NS§	NS§	NS§

N – Nitrogen (g/plant) K – Potassium (g/plant) S– Split application

S§– Significant NS§– Not significant

Transformed values are given in brackets.

Table 5.2(a) to (c) Number of suckers per plant at flowering, harvest and cumulative number of leaves per plant at flowering

Treatment combinations	5.2(a) No. of suckers per plant at flowering	5.2(b) No. of suckers per plant at harvest	5.2(c) Cumulative number of leaves per plant at flowering
N_{200} K_{300} S_4	6.96 (2.63)	6.96 (2.63)	30.49 (5.52)
N_{200} K_{300} S_6	7.59 (2.64)	7.59 (2.64)	28.49 (5.33)
N_{200} K_{300} S_8	5.99 (2.44)	7.49 (2.73)	28.99 (5.38)
N_{200} K_{450} S_4	7.00 (2.64)	8.00 (2.82)	29.49 (5.43)
N_{200} K_{450} S_6	6.49 (2.54)	7.00 (2.64)	28.99 (5.38)
N_{200} K_{450} S_8	5.99 (2.44)	6.49 (2.55)	28.49 (5.38)
N_{200} K_{600} S_4	7.00 (2.64)	7.00 (2.64)	30.49 (5.52)
N_{200} K_{600} S_6	6.96 (2.63)	6.96 (2.63)	29.99 (5.47)
N_{200} K_{600} S_8	7.96 (2.82)	7.96 (2.82)	29.49 (5.43)
N_{300} K_{300} S_4	5.95 (2.44)	6.44 (2.54)	29.99 (5.47)
N_{300} K_{300} S_6	5.48 (2.34)	5.99 (2.44)	29.49 (5.43)
N_{300} K_{300} S_8	5.00 (2.23)	5.48 (2.34)	29.99 (5.43)
N_{300} K_{450} S_4	7.49 (2.73)	[illegible].49 ([illegible].73)	29.44 (5.43)
N_{300} K_{450} S_6	7.49 (2.73)	8.00 (2.82)	29.00 (5.38)
N_{300} K_{450} S_8	6.49 (2.54)	6.49 (2.54)	29.44 (5.43)
N_{300} K_{600} S_4	6.69 (2.58)	6.49 (2.54)	29.49 (5.43)
N_{300} K_{600} S_6	6.49 (2.54)	6.49 (2.54)	29.49 (5.49)
N_{300} K_{600} S_8	6.49 (2.54)	7.00 (2.64)	29.99 (5.47)
N_{400} K_{300} S_4	5.99 (2.44)	5.99 (2.44)	29.44 (5.43)
N_{400} K_{300} S_6	5.00 (2.23)	6.49 (2.54)	29.00 (5.38)
N_{400} K_{300} S_8	5.48 (2.34)	6.41 (2.53)	29.48 (5.42)
N_{400} K_{450} S_4	5.95 (2.44)	5.95 (2.44)	30.00 (5.47)
N_{400} K_{450} S_6	5.99 (2.44)	5.99 (2.44)	29.49 ([illegible])
N_{400} K_{450} S_8	5.00 (2.23)	6.49 (2.54)	30.00 (5.47)
N_{400} K_{600} S_4	7.00 (2.64)	7.00 (2.64)	28.99 (5.38)
N_{400} K_{600} S_6	5.99 (2.44)	6.49 (2.54)	29.49 (5.43)
N_{400} K_{600} S_8	5.97 (2.44)	6.49 (2.54)	29.49 (5.43)
SE 1±	(0.123)	(0.127)	(0.164)
CD 1 (0.05)	NS§	NS§	NS§
C 1	5.32 (2.30)	5.64 (2.37)	29.66 (5.44)
C 2	7.30 (2.70)	7.64 (2.76)	29.16 (5.40)
C 3	5.97 (2.44)	6.98 (2.64)	29.31 (5.41)
C 4	5.81 (2.41)	6.81 (2.61)	29.16 (5.40)
SE 2±	(0.071)	(0.073)	(0.095)
CD 2(0.05)	(0.203)	(0.209)	NS§

N - Nitrogen (g/plant) K - Potassium (g/Plant) S- Split application C - Control

NS§ - Not significant

CD 1 -Critical difference for comparison of treatment combinations

CD 2- Critical difference for comparison among different controls

Transformed values are given in brackets

No significant effect on the number of suckers produced was noticed in the case of split applications studied in this experiment.

Interaction effects were not found to be significant for this character. Application of nutrients in 4 splits for control treatments significantly enhanced the production of suckers at flowering.

5. Number of suckers per plant at harvest

The mean values on the number of suckers at harvest are presented in Tables 5.1(b) and 5.2(b). Analyses of variance of the data are scheduled in Appendix V(b). None of the main effects and interaction effects were found to influence significantly the number of suckers produced per plant at harvest. In control treatments, application of nutrients in 2 splits, significantly reduced the number of suckers at harvest.

6. Number of leaves produced per plant upto the time of flowering

The observations on the mean number of leaves per plant upto the time of flowering are presented in Table 5.1(c) and analyses of variance of the data in Appendix V(c).

The results of analysis of the data revealed that there were no significant differences in the number of leaves produced per plant upto the time of flowering, either due to individual effects of nutrients or due to their interactions.

7. Number of days taken for germination of rhizome

The observations on the number of days taken for germination of rhizome were subjected to statistical analysis and the mean values are presented in Tables 6.1(a) and 6.2(a). Analyses of variance of the data are given in Appendix VI(a).

None of the main effects and the interaction effects was found to be statistically significant on this character.

8. Number of days taken for first sucker emergence

The mean values on the number of days taken for the first sucker emergence are furnished in Tables 6.1(b) and 6.2(b). Analyses of variance of the data are given in Appendix VI(b).

Different levels of nitrogen, potassium, split applications and their interactions failed to produce any significant effect on the number of days taken for the emergence of first sucker.

Table 6.1(a) to (d). Number of days taken for sprouting of rhizome, first sucker emergence, flowering and harvest

Main effects/ Interactions	6.1(a) No. of days taken for sprouting of rhizome	6.1(b) No. of days taken for first sucker emergence	6.1(c) No. of days taken for flowering	6.1(d) No. of days taken for harvest
N_{200}	20.62 (4.54)	134.30 (11.58)	182.23 (13.49)	272.15 (16.49)
N_{300}	22.06 (4.69)	134.30 (11.85)	189.36 (13.76)	286.20 (16.91)
N_{400}	21.64 (4.65)	140.46 (11.98)	188.82 (13.77)	287.06 (16.94)
	NSg	NSg	NSg	Sg
K_{300}	21.58 (4.64)	141.79 (11.90)	187.72 (13.70)	281.91 (16.79)
K_{450}	21.54 (4.64)	131.66 (11.47)	186.92 (13.77)	278.48 (16.68)
K_{600}	21.14 (4.59)	145.08 (12.04)	188.00 (13.73)	284.75 (16.87)
	NSg	NSg	NSg	NSg
S_4	20.91 (4.57)	136.89 (11.70)	191.86 (13.85)	286.81 (16.93)
S_6	21.63 (4.65)	145.80 (12.07)	187.74 (13.70)	283.24 (16.83)
S_8	21.78 (4.66)	135.76 (11.65)	181.75 (13.48)	275.13 (16.58)
	NSg	NSg	Sg	Sg
SE ±	(0.058)	(0.203)	(0.097)	(0.093)
CD(0.05)	NSg	NSg	0.279	0.267
N_{200} K_{300}	20.97 (4.57)	143.10 (11.90)	184.16 (13.57)	269.11 (16.40)
N_{200} K_{450}	29.93 (4.46)	128.11 (11.31)	179.03 (13.38)	265.73 (16.30)
N_{200} K_{600}	20.97 (4.57)	131.90 (11.48)	181.54 (13.54)	279.54 (16.72)
N_{300} K_{300}	22.83 (4.77)	138.93 (11.78)	186.59 (13.65)	282.38 (16.80)
N_{300} K_{450}	22.41 (4.73)	136.95 (11.70)	188.78 (13.73)	286.90 (16.93)
N_{300} K_{600}	20.97 (4.57)	144.38 (12.01)	192.75 (13.88)	283.34 (17.01)
N_{400} K_{300}	20.97 (4.57)	143.36 (11.97)	192.48 (13.87)	294.52 (17.16)
N_{400} K_{450}	22.48 (4.74)	130.00 (11.40)	188.96 (13.74)	283.63 (16.82)
N_{400} K_{600}	21.48 (4.63)	158.35 (12.58)	187.78 (13.70)	283.70 (16.84)
	NSg	NSg	NSg	NSg
N_{200} S_4	19.93 (4.46)	130.01 (11.40)	187.45 (13.69)	276.83 (16.63)
N_{200} S_6	21.48 (4.63)	145.61 (12.06)	181.76 (13.48)	272.78 (16.51)
N_{200} S_8	20.47 (4.52)	127.62 (11.29)	177.55 (13.32)	266.40 (16.32)
N_{300} S_4	21.37 (4.62)	133.39 (11.54)	190.68 (13.80)	289.[illegible] (17.[illegible])
N_{300} S_6	21.93 (4.68)	146.24 (12.09)	190.30 (13.79)	286.23 (16.91)
N_{300} S_8	22.91 (4.78)	141.96 (11.91)	187.12 (13.67)	282.57 (16.80)
N_{400} S_4	21.48 (4.64)	147.63 (12.15)	214.76 (14.65)	293.90 (17.14)
N_{400} S_6	21.48 (4.63)	145.56 (12.06)	191.23 (13.82)	290.89 (17.05)
N_{400} S_8	21.99 (4.69)	137.90 (11.74)	180.63 (13.44)	277.55 (16.62)
	NSg	NSg	NSg	NSg
K_{300} S_4	20.39 (4.51)	134.70 (11.60)	193.46 (13.90)	290.78 (17.95)
K_{300} S_6	21.37 (4.62)	130.43 (11.42)	192.98 (13.89)	277.10 (16.64)
K_{300} S_8	20.97 (4.57)	144.32 (12.01)	197.36 (14.04)	292.61 (17.10)
K_{450} S_4	21.96 (4.68)	142.29 (11.92)	188.57 (13.73)	283.60 (16.84)
K_{450} S_6	21.45 (4.63)	136.06 (11.66)	187.74 (13.70)	289.21 (17.01)
K_{450} S_8	21.49 (4.63)	159.57 (12.63)	186.91 (13.67)	289.21 (17.01)
K_{600} S_4	22.42 (4.73)	148.54 (12.18)	181.24 (13.46)	276.05 (16.64)
K_{600} S_6	21.96 (4.68)	128.55 (11.33)	184.07 (13.56)	274.71 (16.57)
K_{600} S_8	20.97 (4.57)	130.62 (11.42)	179.94 (13.41)	272.65 (16.52)
	NSg	NSg	NSg	NSg
SE ±	(0.101)	(0.351)	(0.169)	(0.162)
CD (0.05)	NSg	NSg	NSg	NSg

N - Nitrogen (g/plant) K - Potassium (g/ plant) S- Split application

Sg- Significant NSg- Not significant

Transformed values are given in brackets.

Table 6.2. Number of days taken for sprouting of rhizome, 1st sucker emergence, (a to d) flowering and harvest

Treatment Combinations	6.2(a) No. of days taken for sprouting of rhizome	6.2(b) No. of days taken for 1st sucker emergence	6.2(c) No. of days taken for flowering	6.2(d) No. of days taken for harvest
$N_{200} K_{300} S_4$	20.47 (4.52)	132.48 (11.51)	194.84 (13.95)	286.82 (16.93)
$N_{200} K_{300} S_6$	22.00 (4.69)	139.30 (11.80)	186.00 (13.63)	262.92 (16.21)
$N_{200} K_{300} S_8$	20.47 (4.52)	158.12 (12.47)	172.00 (13.19)	257.99 (16.06)
$N_{200} K_{450} S_4$	18.88 (4.34)	127.57 (11.29)	175.85 (13.26)	263.95 (16.24)
$N_{200} K_{450} S_6$	20.47 (4.52)	139.82 (11.82)	178.44 (13.35)	264.43 (16.26)
$N_{200} K_{450} S_8$	20.47 (4.52)	117.45 (10.83)	182.83 (13.52)	268.84 (16.39)
$N_{200} K_{600} S_4$	20.49 (4.52)	130.00 (11.40)	191.95 (13.85)	279.99 (16.73)
$N_{200} K_{600} S_6$	22.00 (4.69)	158.12 (12.57)	180.88 (13.46)	291.43 (16.07)
$N_{200} K_{600} S_8$	20.47 (4.52)	109.81 (10.47)	177.94 (13.33)	272.49 (16.50)
$N_{300} K_{300} S_4$	20.62 (4.50)	128.36 (11.32)	182.83 (13.52)	279.84 (16.72)
$N_{300} K_{300} S_6$	23.47 (4.82)	139.82 (11.82)	187.99 (13.71)	279.48 (16.71)
$N_{300} K_{300} S_8$	24.90 (4.99)	148.99 (12.20)	188.96 (13.74)	267.85 (16.96)
$N_{300} K_{450} S_4$	21.89 (4.67)	133.77 (11.56)	188.96 (13.74)	286.42 (16.92)
$N_{300} K_{450} S_6$	21.89 ([illegible])	138.46 (11.76)	190.96 (13.81)	290.91 (17.05)
$N_{300} K_{450} S_8$	[illegible] (4.64)	138.64 (11.77)	186.62 (13.65)	283.42 (16.83)
$N_{300} K_{600} S_4$	22.00 (4.69)	137.99 (11.74)	200.44 (14.15)	303.49 (17.12)
$N_{300} K_{600} S_6$	20.47 (4.52)	160.97 (12.68)	191.45 (13.85)	288.36 (16.99)
$N_{300} K_{600} S_8$	20.47 (4.52)	138.36 (11.76)	186.00 (13.63)	276.69 (16.62)
$N_{400} K_{300} S_4$	20.47 (4.52)	143.47 (11.97)	202.99 (14.24)	306.28 (17.49)
$N_{400} K_{300} S_6$	20.47 (4.52)	147.83 (12.15)	191.74 (13.84)	298.87 (16.99)
$N_{400} K_{300} S_8$	22.00 (4.69)	136.85 (11.78)	182.98 (13.52)	281.36 (15.59)
$N_{400} K_{450} S_4$	23.47 (4.84)	130.00 (11.40)	189.97 (13.78)	295.98 (16.77)
$N_{400} K_{450} S_6$	22.00 (4.69)	130.00 (11.40)	194.00 (13.92)	271.99 (17.20)
$N_{400} K_{450} S_8$	22.00 (4.69)	130.00 (11.40)	182.98 (13.52)	294.98 (16.49)
$N_{400} K_{600} S_4$	20.47 (4.69)	130.07 (11.40)	199.75 (14.13)	287.85 (17.16)
$N_{400} K_{600} S_6$	22.00 (4.69)	159.63 (12.6[illegible])	189.99 (13.77)	268.99 (16.9[illegible])
$N_{400} K_{600} S_8$	22.00 (4.69)	145.08 (12.04)	175.97 (13.26)	299.46 (16.40)
SE 1 ±	(0.175)	(0.608)	(0.293)	(0.281)
CD 1 (0.05)	NS§	NS§	NS§	NS§
C 1	21.00 (4.58)	148.00 (12.16)	205.92 (14.35)	297.09 (17.23)
C 2	20.96 (4.56)	132.13 (11.49)	192.10 (13.86)	285.62 (16.90)
C 3	20.98 (4.58)	148.01 (12.16)	186.95 (13.67)	282.03 (16.79)
C 4	21.49 (4.63)	126.38 (11.24)	206.96 (13.37)	286.11 (16.91)
SE 2 ±	(0.102)	(0.351)	(0.169)	(0.162)
CD 2 (0.05)	NS§	NS§	(0.483)	NS§

N – Nitrogen (g/plant) K – Potassium (g/plant) S – Split application C– Control

NS§ – Not significant

CD 1 – Critical difference for comparison of treatment combinations

CD 2– Critical difference for comparison among different controls.

Transformed values are given in brackets.

9. Number of days taken for flowering

The mean number of days taken for flowering are given in Tables 6.1(c) and 6.2(c) and analyses of variance of the data on this character are given in Appendix VI(c).

The results showed that the effect of split application alone was significant with respect to this character. Eight split applications significantly reduced the number of days taken for flowering.

Interaction effects were not found to be statistically significant. Among controls, application of nutrients in 4 and 6 splits resulted in the shortening of the flowering period, but statistically these split applications were found on par with each other.

10. Number of days taken for harvest

Observations on mean number of days for harvest are presented in Tables 6.1(d) and 6.2(d). The related data on analyses of variance are presented in Appendix VI(d).

Analysis of the data showed that the application of nitrogen and split applications significantly influenced number of days for harvest. Number of days for harvest were significantly reduced when lowest dose of nitrogen (N at 200 g per plant) was applied. Eight split applications also resulted in the significant reduction of number of days for harvest.

Interaction effects were not found to be statistically significant. Different levels of split applications failed to show any significant difference among themselves in control treatment.

11. Bunch characters

a) Bunch weight

Data on mean weight of bunches at maturity are given in Tables 7.1 and 7.2. Analyses of variance of the data are presented in Appendix VII.

It was observed that nitrogen could not influence the bunch weight significantly. Potassium exerted a significant influence on the bunch weight with K_2O at 600 g per plant producing maximum bunch weight of 11.64 kg and this was significantly different from the effect of K_2O at 300 g per plant. K_2O at 450 g per plant produced bunches with average weight of 11.189 kg, which was statistically on par with K_2O at 600 g per plant. From the table 7.3 it was clear that K_2O showed a significant linear response even when it was applied in varying split doses. Although 6 split applications were found to be significantly superior to 4 split applications, it was on par with 8 split applications.

Table 7.1 Weight of bunches at maturity (kg)

Main effects/ Interactions	Weight of bunches(kg)	Main effects/ Interactions	Weight of bunches(kg)
N_{200}	10.96	N_{200} S_4	10.66
N_{300}	11.15	N_{200} S_6	11.12
N_{400}	11.03	N_{200} S_8	11.10
	NS9	N_{300} S_4	10.76
K_{300}	10.32	N_{300} S_6	11.68
K_{450}	11.18	N_{300} S_8	10.99
K_{600}	11.64	N_{400} S_4	10.66
	S9	N_{400} S_6	11.30
S_4	10.69	N_{400} S_8	11.05
S_6	11.39		NS9
S_8	11.05	K_{300} S_4	10.00
	S9	K_{300} S_6	10.85
SE ±	0.173	K_{300} S_8	11.23
CD(0.05)	0.494	K_{450} S_4	10.64
N_{200} K_{300}	10.38	K_{450} S_6	11.56
N_{200} K_{450}	11.33	K_{450} S_8	11.98
N_{200} K_{600}	11.17	K_{600} S_4	10.32
N_{300} K_{300}	10.83	K_{600} S_6	11.14
N_{300} K_{450}	11.30	K_{600} S_8	11.70
N_{300} K_{600}	11.32		NS9
N_{400} K_{300}	9.75	SE ±	0.300
N_{400} K_{450}	10.93	CD (0.05)	0.856
N_{400} K_{600}	12.02		
	S9		

N - Nitrogen (g/plant) K - Potassium (g/Plant) S- Split application

S9- Significant NS9- Not significant

FIG. 3·1 EFFECT OF DIFFERENT LEVELS OF NITROGEN, POTASSIUM AND DIFFERENT SPLIT APPLICATIONS (IN TREATMENTS AND CONTROLS) ON THE WEIGHT OF BUNCHES AT MATURITY

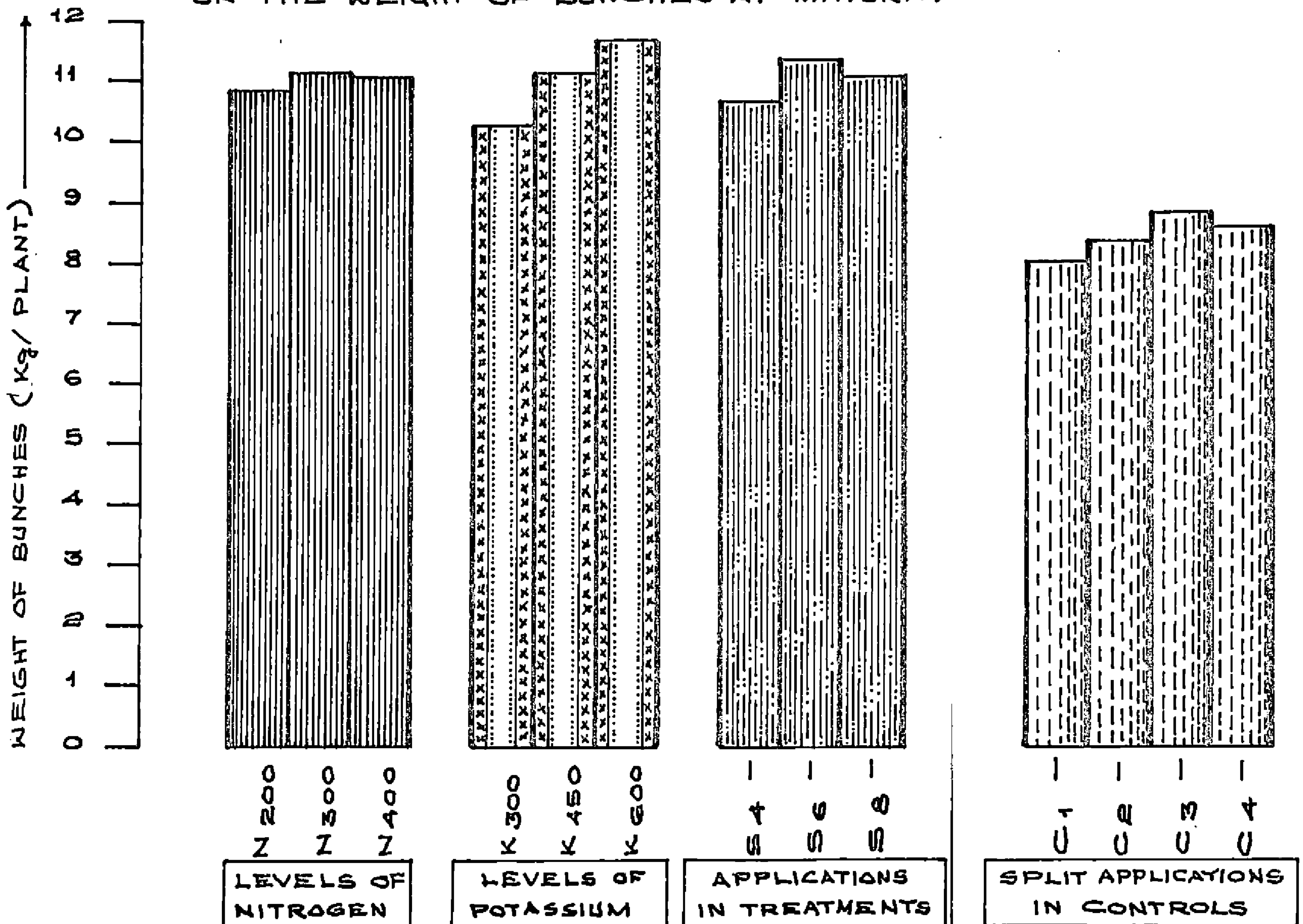


FIG. 3.2 EFFECT OF DIFFERENT COMBINATIONS OF NITROGEN AND POTASSIUM ON THE WEIGHT OF BUNCHES AT MATURITY

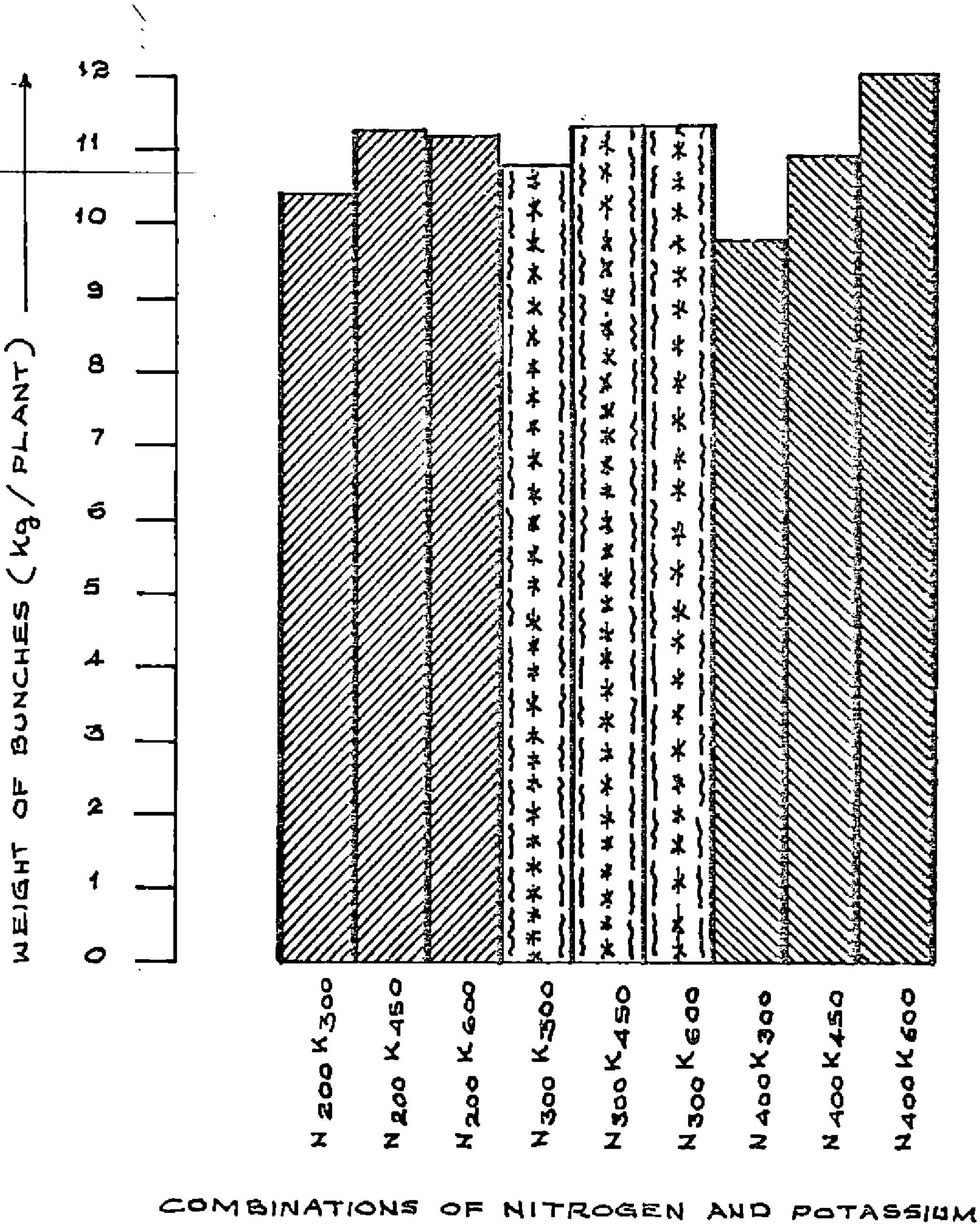


Table 7.2 Weight of bunches at maturity (kg)

Treatment Combinations	Weight of bunches (kg)	Treatment Combinations	Weight of bunches(kg)
$N_{200} K_{300} S_4$	9.95	$N_{400} K_{300} S_4$	9.60
$N_{200} K_{300} S_6$	10.57	$N_{400} K_{300} S_6$	9.75
$N_{200} K_{300} S_8$	10.61	$N_{400} K_{300} S_8$	9.69
$N_{200} K_{450} S_4$	11.07	$N_{400} K_{450} S_4$	10.50
$N_{200} K_{450} S_6$	11.50	$N_{400} K_{450} S_6$	11.45
$N_{200} K_{450} S_8$	11.43	$N_{400} K_{450} S_8$	10.85
$N_{200} K_{600} S_4$	10.95	$N_{400} K_{600} S_4$	11.90
$N_{200} K_{600} S_6$	11.30	$N_{400} K_{600} S_6$	12.95
$N_{200} K_{600} S_8$	11.28	$N_{400} K_{600} S_8$	12.42
$N_{300} K_{300} S_4$	10.45	SE 1 ±	0.520
$N_{300} K_{300} S_6$	11.60	CD 1(0.05)	NS
$N_{300} K_{300} S_8$	10.45	C 1	8.11
$N_{300} K_{450} S_4$	11.00	C 2	8.46
$N_{300} K_{450} S_6$	11.75	C 3	8.91
$N_{300} K_{450} S_8$	11.15	C 4	8.70
$N_{300} K_{600} S_4$	10.85	SE 2 ±	0.300
$N_{300} K_{600} S_6$	11.71	CD 2 (0.05)	NS
$N_{300} K_{600} S_8$	11.40		

N - Nitrogen (g/ plant) K - Potassium (g/plant)

S - Split application G - Control

NS - Not significant

CD 1 - Critical difference for the comparison of treatment combinations

CD 2 - Critical difference for the comparison among different controls

Table 7.3 Response Analysis of potassium to different split applications

Number of splits	Source	df	SS	MSS	F
4	KL	1	4.563	4.563	8.45
	KQ	1	0.235	0.235	0.43
6	KL	1	5.427	5.427	10.05
	KQ	1	0.255	0.255	0.47
8	KL	1	5.713	5.713	10.57
	KQ	1	0.071	0.071	0.131
	Error	45	24.38	0.54	-

* Significant at 0.05 level

KL - Linear response of potassium

KQ - Quadratic response of potassium.

Interactions of N and K_2O were found to be statistically significant. NK combinations with 400 g N and 600 g K_2O which produced bunches having average weight of 12.03 kg was found significantly superior to all other 8 combinations of N and K_2O. Combinations of N and K_2O with 400 g N and 300 g K_2O produced bunches having lowest yield (average weight of 9.75 kg) and was on par with NK combination having 300 g N and 300 g K_2O.

As the second order interaction was not significant, no logical comparison could be made between the combinations of levels of N, K_2O and split applications. However 400 g N and 600 g K_2O combined with 6 split applications produced bunches having maximum weight of 12.95 kg. Treatment combination with N 400, K 300 and split applications produced bunches having lowest yield (Average weight of 9.6 kg).

From the table 7.2 it can be seen that treated plots were significantly different from control plots and they out yielded control plots appreciably. In controls the different levels of split applications failed to produce any significant difference among themselves with regard to bunch weight.

response surface models of the form $Y = a+bN+cN^2+dK+eK^2+fNK$, was tried to estimate optimum and economic doses of nutrients. The estimated equations are presented below -

S_1 $Y = 8.593262-0.001567\ N-0.0000184\ N^2 + 0.00752\ K$
$-0.0000144\ K^2 + 0.00030008\ NK\ (R^2 = 77.55\%)$

S_2 $Y = 8.8525 + 0.00868\ N-0.000043\ N^2 + 0.002208\ K$
$-0.0000112\ K^2 + 0.000041\ NK\ (R^2 = 78.10\%)$

S_3 $Y = 12.8257 -0.0192\ N + 0.000008\ N^2 + 0.000066\ K$
$-0.000006\ K^2 + 0.00003\ NK\ (R^2 = 87.91\%)$

Although the coefficient of determination of the equations were relatively high, they failed to indicate optimum levels of nutrients within the range covered in the experiment. This may be due to the linearity in the response obtained in the case of potassium.

b) Number of hands per bunch

The data on the mean number of hands per bunch are given in Tables 8.1(a) and 8.2(a). Analyses of variance data are presented in Appendix VIII(a). The number of hands per bunch were not significantly influenced by different levels of N, K_2O and split applications. Interaction effects were also not found to be significant. Among control treatments, number of hands per bunch were significantly increased by application of nutrients in 6 and 8 splits.

c) Number of fingers per bunch

Tables 8.1(b) and 9.2(b) present the mean data on the number of fingers per bunch and Appendix VIII(b) present the data on analyses of variance. Analysis of the data showed that different levels of potassium alone could produce significant differences in the number of fingers per bunch. K_2O at 600 g per plant produced more number of fingers (48.32) and was significantly different from K_2O at 300 g per plant which produced 44.36 fingers on an average. Interaction effects were not found to be significant on this character. Among control treatments 2 split applications produced significantly lesser number of fingers per bunch.

d) Length of bunch at maturity

Tables 9.1(a) and 9.2(a) show the mean data on length of bunches at maturity and Appendix IX (a) present data on analysis of variance on this character.

The results of analysis revealed that different levels of N, K_2O split applications and their interactions did not influence the bunch length, significantly.

Table 8.1(a) & (b). Number of hands and fingers per bunch at maturity

Main effects/ Interactions	8.1(a) No. of hands per bunch	8.1(b) No. of fingers per bunch
N_{200}	5.48 (2.34)	47.64 (6.90)
N_{300}	5.26 (2.29)	46.83 (6.84)
N_{400}	5.16 (2.27)	45.99 (6.78)
	NSg	NSg
K_{300}	5.16 (2.27)	44.36 (6.66)
K_{450}	5.37 (2.31)	47.82 (6.91)
K_{600}	5.37 (2.31)	48.32 (6.95)
	NSg	Sg
S_4	5.37 (2.31)	45.33 (6.73)
S_6	5.37 (2.31)	48.13 (6.93)
S_8	5.16 (2.27)	47.01 (6.85)
	NSg	NSg
SE ±	(0.029)	(0.069)
CD(0.05)	NSg	0.198
N_{200} K_{300}	5.32 (2.30)	45.08 (6.71)
N_{200} K_{450}	5.65 (2.37)	47.30 (6.87)
N_{200} K_{600}	5.48 (2.34)	50.62 (7.11)
N_{300} K_{300}	5.16 (2.27)	43.78 (6.76)
N_{300} K_{450}	5.16 (2.27)	48.27 (6.94)
N_{300} K_{600}	5.48 (2.34)	46.45 (6.81)
N_{400} K_{300}	5.00 (2.23)	42.26 (6.90)
N_{400} K_{450}	5.32 (2.30)	47.89 (6.92)
N_{400} K_{600}	5.18 (2.41)	47.37 (6.88)
	NSg	NSg
N_{200} S_4	5.18 (2.41)	47.37 (6.88)
N_{200} S_6	5.48 (2.34)	48.48 (6.96)
N_{200} S_8	5.18 (2.27)	47.07 (6.86)

(Contd ...)

Interactions	8.1(a)	8.1(b)
N_{300} S_4	5.18 (2.77)	45.98 (6.78)
N_{300} S_6	5.48 (2.34)	41.94 (6.47)
N_{300} S_8	5.18 (2.27)	45.92 (6.77)
N_{400} S_4	5.18 (2.27)	41.42 (6.43)
N_{400} S_6	5.18 (2.27)	47.31 (6.87)
N_{400} S_8	5.18 (2.27)	48.02 (6.93)
	NSg	NSg
K_{300} S_4	5.18 (2.27)	42.30 (6.50)
K_{300} S_6	5.48 (2.34)	45.60 (6.75)
K_{300} S_8	5.48 (2.34)	48.20 (6.94)
K_{450} S_4	5.32 (2.30)	47.64 (6.90)
K_{450} S_6	5.67 (2.37)	48.27 (6.94)
K_{450} S_8	5.16 (2.27)	48.49 (6.96)
K_{600} S_4	5.00 (2.23)	43.24 (6.57)
K_{600} S_6	5.00 (2.23)	49.63 (7.04)
K_{600} S_8	5.48 (2.34)	48.26 (6.94)
	NSg	NSg
SE ±	(0.042)	(0.120)
CD(0.05)	NSg	NSg

N- Nitrogen (g/ plant) K - Potassium(g/plant) S- Split application

Sg- Significant   NSg- Not significant

Transformed values are given in brackets

Table 8.2(a) & (b). Number of hands and fingers per bunch at maturity

Treatment combinations	8.2(a) No. of hands/bunch	8.2(b) No. of fingers/bunch
$N_{200} K_{300} S_4$	5.48 (2.34)	42.49 (6.51)
$N_{200} K_{300} S_6$	5.48 (2.34)	47.99 (6.92)
$N_{200} K_{300} S_8$	5.00 (2.23)	44.86 (6.69)
$N_{200} K_{450} S_4$	5.99 (2.44)	45.97 (6.78)
$N_{200} K_{450} S_6$	5.99 (2.44)	48.49 (6.96)
$N_{200} K_{450} S_8$	5.00 (2.23)	47.46 (6.88)
$N_{200} K_{600} S_4$	5.99 (2.44)	53.99 (7.34)
$N_{200} K_{600} S_6$	5.00 (2.23)	48.99 (6.99)
$N_{200} K_{600} S_8$	5.48 (2.34)	48.45 (6.99)
$N_{300} K_{300} S_4$	5.00 (2.23)	44.99 (6.70)
$N_{300} K_{300} S_6$	5.48 (2.34)	49.49 (7.03)
$N_{300} K_{300} S_8$	5.00 (2.23)	42.99 (6.55)
$N_{300} K_{450} S_4$	5.00 (2.23)	47.49 (6.89)
$N_{300} K_{450} S_6$	5.48 (2.34)	46.86 (6.84)
$N_{300} K_{450} S_8$	5.00 (2.23)	50.48 (7.10)
$N_{300} K_{600} S_4$	5.48 (2.34)	45.48 (6.74)
$N_{300} K_{600} S_6$	5.48 (2.34)	49.49 (7.03)
$N_{300} K_{600} S_8$	5.48 (2.34)	44.46 (6.66)
$N_{400} K_{300} S_4$	5.00 (2.23)	39.49 (6.28)
$N_{400} K_{300} S_6$	5.00 (2.23)	45.48 (6.74)
$N_{400} K_{300} S_8$	5.00 (2.23)	41.90 (6.47)
$N_{400} K_{450} S_4$	5.48 (2.34)	43.38 (6.58)
$N_{400} K_{450} S_6$	5.48 (2.34)	49.48 (7.03)
$N_{400} K_{450} S_8$	5.00 (2.23)	50.99 (7.14)
$N_{400} K_{600} S_4$	5.00 (2.23)	45.38 (6.73)
$N_{400} K_{600} S_6$	5.00 (2.23)	49.49 (7.03)
$N_{400} K_{600} S_8$	5.48 (2.34)	51.49 (7.17)
SE 1 ±	(0.073)	(0.208)
CD 1(0.05)	NS§	NS§
C 1	5.32 (2.30)	31.14 (5.58)
C 2	5.32 (2.30)	35.53 (5.96)
C 3	5.48 (2.34)	39.63 (6.29)
C 4	5.48 (2.34)	35.61 (5.96)
SE 2 ±	(0.042)	(0.120)
CD 2(0.05)	NS§	(0.363)

N- Nitrogen (g/plant) K - Potassium(g/plant) S-Split application
C - Control NS§ - Not significant

CD 1- Critical difference for comparison of treatment combinations

CD 2- Critical difference for comparison among different controls

Transformed values are given in brackets

e) Finger length at maturity

Mean values on finger length at maturity are furnished in Table 9.1(b) and 9.2(b). Analyses of variance data are presented in Appendix IX (b). Finger length was significantly influenced by nitrogen alone. N at 200 g per plant produced fingers which are significantly longer than (27.66 cm) those produced under other two levels of N.

Interaction of N and split application was found to be statistically significant. Maximum finger length of 28.95 cm was obtained when 200 g N was combined with 4 split applications. This combination was significantly different from all other combinations of nitrogen and split application except the combination with N at 400 g and 8 split applications. Among control treatments different levels of split application failed to produce any significant difference among themselves.

f) Finger girth at maturity

The observations on mean girth of fingers at maturity are furnished in Table 9.1(c) and 9.2(c). The related analyses of variance of the data are given in Appendix IX(c).

None of the main effects and interaction effects were found to be statistically significant with respect to

Table 9.1(a) to (g). Length of bunches, finger characters and quality aspects

Main effects/ Interactions	9.1(a) Length of bunch(cm)	9.1(b) Finger length(cm)	9.1(c) Finger girth (cm)	9.1(d) Finger weight (gm)	9.1(e) Dryweight of finger(g)	9.1(f) Starch content of fingers(%)	9.1(g) TSS content of ripe fruits(%)
N_{200}	37.13	26.66	13.98	199.63	54.70	70.21	16.90
N_{300}	35.37	25.80	14.16	205.08	59.66	74.55	17.79
N_{400}	34.86	26.44	14.09	204.89	60.43	71.49	16.59
	NS	S	NS	NS	S	NS	S
K_{300}	34.38	26.70	14.11	197.43	58.29	73.51	17.39
K_{450}	36.81	26.56	14.12	205.20	58.46	69.03	17.03
K_{600}	36.17	26.64	14.00	206.97	58.94	73.79	16.87
	NS	NS	NS	NS	NS	NS	NS
S_4	35.85	26.77	13.92	201.40	57.40	73.07	17.33
S_6	35.88	26.41	14.17	203.57	59.12	73.07	16.78
S_8	35.64	26.37	14.17	204.63	58.27	25.66	17.18
	NS	NS	NS	NS	NS	NS	NS
SE±	0.846	0.344	0.117	3.322	1.563	1.498	0.278
CD(0.05)	NS	0.981	NS	NS	4.455	NS	0.794
N_{200} K_{300}	35.32	27.56	14.15	194.93	63.29	22.40	17.43
N_{200} K_{450}	39.20	27.68	14.28	204.34	58.70	66.84	16.55
N_{200} K_{600}	36.89	27.73	13.50	194.61	52.10	71.39	16.73
N_{300} K_{300}	33.92	26.13	14.08	202.77	61.28	75.40	18.33
N_{300} K_{450}	35.49	25.95	14.08	202.55	58.61	71.03	17.91
N_{300} K_{600}	36.20	25.33	14.33	208.92	69.10	77.23	17.13
N_{400} K_{300}	33.41	26.40	14.09	194.60	60.30	72.72	16.41
N_{400} K_{450}	35.75	26.06	14.09	202.70	58.09	69.20	16.62
N_{400} K_{600}	34.92	26.87	14.91	217.38	62.90	72.51	16.75
	NS	NS	NS	NS	NS	NS	NS
N_{200} S_4	37.15	28.95	13.82	198.41	52.77	70.80	17.25
N_{200} S_6	37.36	27.21	14.05	198.63	54.80	67.05	17.10
N_{200} S_8	36.91	26.81	14.06	201.85	56.51	72.76	16.36
N_{300} S_4	36.00	25.55	14.08	201.12	59.81	76.17	17.66
N_{300} S_6	35.58	25.98	14.36	205.76	58.79	75.11	17.28
N_{300} S_8	34.53	25.88	14.07	208.36	60.39	72.38	18.43
N_{400} S_4	34.40	25.81	13.85	204.62	59.63	72.24	17.08
N_{400} S_6	34.72	26.20	14.10	206.33	63.76	74.05	16.95
N_{400} S_8	35.42	27.32	14.33	203.68	57.90	68.17	16.75
	NS	NS	S	NS	NS	NS	NS
K_{300} S_4	33.52	26.68	13.84	199.43	57.94	77.08	17.83
K_{300} S_6	37.45	26.48	14.12	206.95	59.97	70.24	17.16
K_{300} S_8	36.55	27.15	13.80	197.82	54.80	71.90	17.00
K_{450} S_4	35.31	26.25	14.10	191.09	56.96	74.52	17.00
K_{450} S_6	35.80	26.73	14.33	207.93	59.42	68.13	16.79
K_{450} S_8	34.52	26.41	14.09	211.70	60.97	73.57	16.55
K_{600} S_4	34.32	27.16	14.39	201.78	59.96	68.92	17.34
K_{600} S_6	35.18	26.48	13.92	200.71	56.00	68.73	17.13
K_{600} S_8	37.41	26.37	14.13	211.40	58.84	75.66	17.06
	NS	NS	NS	NS	NS	NS	NS
SE ±	1.466	0.596	0.202	5.754	2.707	2.595	0.482
CD (0.05)	NS	1.699	NS	NS	NS	NS	NS

N – Nitrogen (g/ plant) K – Potassium (g/plant) S – Split application

S – significant NS – Not significant

Table 9.2(a) to (g). Length of bunches, finger characters and quality aspects at maturity

Treatment Combinations	9.2(a) Length of bunches (cm)	9.2(b) Finger length (cm)	9.2(c) Finger girth (cm)	9.2(d) Weight of finger (gm)	9.2(e) Dryweight of finger (gm)	9.2(f) Starch content of finger (%)	9.2(g) TSS content of ripe fruit(%)
N_{200} K_{300} S_4	33.62	30.00	13.77	197.65	49.42	79.32	17.50
N_{200} K_{300} S_6	34.62	25.95	13.90	189.30	53.50	64.47	18.00
N_{200} K_{300} S_8	37.71	26.75	14.80	187.85	56.95	73.40	16.80
N_{200} K_{450} S_4	40.00	27.55	14.46	213.30	62.65	68.95	16.75
N_{200} K_{450} S_6	42.20	28.45	14.50	205.75	57.40	66.00	15.50
N_{200} K_{450} S_8	35.40	27.05	13.90	250.00	56.05	65.57	16.40
N_{200} K_{600} S_4	37.85	29.30	13.25	184.30	46.25	64.15	17.50
N_{200} K_{600} S_6	35.20	27.25	13.75	200.85	53.52	70.70	16.80
N_{200} K_{600} S_8	37.62	26.65	13.50	198.70	56.55	79.32	16.90
N_{300} K_{300} S_4	34.50	25.05	13.75	195.25	59.65	74.25	19.00
N_{300} K_{300} S_6	35.27	27.45	14.25	204.32	59.25	82.50	17.25
N_{300} K_{300} S_8	32.00	25.90	14.20	208.75	64.95	89.47	18.75
N_{300} K_{450} S_4	34.75	26.50	14.25	201.75	60.25	73.43	17.50
N_{300} K_{450} S_6	36.60	25.90	14.50	216.75	60.37	66.25	17.75
N_{300} K_{450} S_8	35.12	25.45	13.50	192.15	55.10	73.42	18.50
N_{300} K_{600} S_4	38.75	25.10	14.25	206.37	59.55	80.85	16.50
N_{300} K_{600} S_6	34.87	24.60	14.35	196.21	56.75	76.60	16.85
N_{300} K_{600} S_8	36.47	26.30	14.40	220.20	61.02	74.25	18.05
N_{400} K_{300} S_4	32.45	25.00	14.00	205.40	64.75	77.67	17.00
N_{400} K_{300} S_6	36.05	25.35	14.15	179.65	58.15	76.60	15.75
N_{400} K_{300} S_8	33.25	28.85	14.22	198.75	58.00	63.90	16.50
N_{400} K_{450} S_4	37.62	25.40	13.65	205.81	57.02	68.35	17.25
N_{400} K_{450} S_6	34.62	25.40	14.00	201.30	60.50	72.15	16.12
N_{400} K_{450} S_8	35.02	26.95	14.37	201.00	56.75	67.20	16.50
N_{400} K_{600} S_4	33.12	27.05	13.90	202.80	57.12	70.70	17.00
N_{400} K_{600} S_6	33.50	27.40	14.17	238.05	72.65	73.42	16.00
N_{400} K_{600} S_8	38.15	26.17	14.50	211.30	58.95	73.42	17.25
SE 1±	2.539	1.032	0.351	9.967	4.690	4.495	0.836
CD 1(0.05)	NS§	NS§	NS§	NS§	NS§	NS§	NS§
C 1	34.02	25.35	14.00	197.43	60.12	73.77	18.03
C 2	34.82	26.50	14.31	198.26	60.70	73.42	16.95
C 3	36.88	26.35	14.21	188.76	56.86	73.15	17.00
C 4	36.80	26.50	14.45	203.75	58.17	66.64	16.87
SE 2 ±	1.466	0.596	0.202	5.754	2.707	2.595	0.482
CD 2	NS§	NS§	NS§	NS§	NS§	NS§	NS§

N - Nitrogen (g/plant) K - Potassium (g/plant) S- Split application C - Control

NS§- Not significant

CD 1 - Critical difference for the comparison of treatment combinations

CD 2- Critical difference for the comparison among different controls.

above character. Among control treatments, application of nutrients in different splits did not produce any significant difference in the finger girth at maturity.

g) Finger weight at maturity

Data on the mean weight of fingers at maturity are given in Tables 9.1(d) and 9.2(d). Analyses of variance of the data are given in Appendix IX(d).

The results of analysis of the data revealed that none of the main effects and interaction effects produced statistically significant response on this character, in treated as well as in control plots.

h) Dry weight of fingers at maturity

Mean values on this character are presented in Tables 9.1(e) and 9.2(e). Analyses of variance of the data are given in Appendix IX(e).

It was observed that N at 200 g per plant produced fingers with significantly lesser dry weight when compared to other two levels of N. Potassium and split application had no significant effect on the dry weight of fingers. Interaction effects were also not found to be significant on this character.

i) Starch content of mature fingers

Tables 9.1(f) and 9.2(f) presents the mean values on the starch content of mature fingers and Appendix IX(f) presents the data on analyses of variance of this character.

Individual effects and interaction effects were not found to be statistically significant on the starch content of fingers in treated plots and control plots.

j) TSS content of ripe fruits

Mean values on TSS content of ripe fruits are furnished in Tables 9.1(g) and 9.2(g). Analyses of variance data are presented in Appendix IX(g). There was significant response to different dose of N on TSS content of ripe fruits. TSS content of fruits significantly increased when 300 g N per plant was applied. K_2O and split applications did not influence the TSS content of fruits significantly. Interaction effects were also not found to be significant on this character.

Among control treatments also different split applications had not produced any significant effect on the TSS content of ripe fruits.

Economics of crop cultivation

The data on the economics of crop cultivation is furnished in Table 10. The data revealed that there was marked difference in the net income obtained from treated and control plots. Treatment combination with 400 g nitrogen, 600 g potassium and 6 split applications recorded the highest net income of Rs.41,109/- per ha followed by treatment combination with 400 g nitrogen, 600 g potassium and 8 split applications, yielding a net income of Rs.35,084/- per ha.

Least value of net return was noted in control-4 which registered the net profit of Rs.11,504/- per ha.

Highest value for the cost-benefit ratio (1.73) was obtained in the treatment combination N_{400} K_{600} S_6 while the lowest value (1.20) was recorded by control-4.

Table 10. Effect of different combinations of N, K and Split applications on the economics of cultivation (per ha)

Treatment combinations	Cost of cultivation excluding the cost of fertilizers and split application charges (Rs./ha)	Cost of fertilizers and split application charges (Rs./ha)	Total cost (Rs./ha)	Yield of bunches kg/ha	Total income Rs./ha	Net income Rs./ha	Cost-benefit ratio
$N_{200} K_{300} S_4$	40966	9075	50041	24875	74625	24584	1.49
$N_{200} K_{300} S_6$	40966	11275	52241	26425	79275	27034	1.51
$N_{200} K_{300} S_8$	40966	13325	54291	26525	79575	25284	1.46
$N_{200} K_{450} S_4$	40966	9950	50916	27700	83100	32184	1.62
$N_{200} K_{450} S_6$	40966	12000	52966	28750	86250	33284	1.63
$N_{200} K_{450} S_8$	40966	14050	55016	28575	85725	30709	1.55
$N_{200} K_{600} S_4$	40966	10700	51666	27375	82125	30459	1.58
$N_{200} K_{600} S_6$	40966	12750	53716	28250	84750	31034	1.57
$N_{200} K_{600} S_8$	40966	14800	55766	28200	84600	28834	1.52
$N_{300} K_{300} S_4$	40966	10375	51341	26100	78300	26959	1.52
$N_{300} K_{300} S_6$	40966	12425	53391	29000	87000	33609	1.62
$N_{300} K_{300} S_8$	40966	14475	55441	26100	78300	22859	1.41
$N_{300} K_{450} S_4$	40966	11100	52066	27500	82500	30434	1.62
$N_{300} K_{450} S_6$	40966	13150	54116	29375	88125	27509	1.49
$N_{300} K_{450} S_8$	40966	15200	56116	27875	83625	27459	1.54
$N_{300} K_{600} S_4$	40966	11850	52816	27125	81375	28559	1.53
$N_{300} K_{600} S_6$	40966	13900	54866	29275	87825	32959	1.61
$N_{300} K_{600} S_8$	40966	15950	56916	28500	85500	28584	1.52
$N_{400} K_{300} S_4$	40966	11500	52466	24000	72000	19534	1.37
$N_{400} K_{300} S_6$	40966	13550	54516	24375	73125	18609	1.34
$N_{400} K_{300} S_8$	40966	15600	56566	24725	74175	17609	1.31
$N_{400} K_{450} S_4$	40966	12250	53216	26250	18750	25534	1.47
$N_{400} K_{450} S_6$	40966	14300	55266	28625	35875	30609	1.55
$N_{400} K_{450} S_8$	40966	16350	52316	26450	81375	29059	1.55
$N_{400} K_{600} S_4$	40966	14250	55216	29750	89250	34034	1.61
$N_{400} K_{600} S_6$	40966	15050	56016	32375	97125	41109	1.73
$N_{400} K_{600} S_8$	40966	17100	58066	31050	93150	35084	1.60
C_1	40966	7250	48046	20275	60825	12779	1.26
C_2	40966	9300	50096	21150	63450	13354	1.26
C_3	40966	11350	52146	22275	66825	14679	1.28
C_4	40966	13400	54196	21750	65250	11054	1.20

<u>Labour charges</u>

Man - Rs.28 per day

Woman - Rs.26 per day

<u>Cost of fertilizers</u>

Urea - Rs.2.12 per kg

Super phosphate - Rs.0.85 per kg

Muriate of potash- Rs.1.19 per kg.

DISCUSSION

DISCUSSION

Present recommendation of the fertilizer application for 'Nendran' bananas in Packages of practices (Anon., 1986) is to apply the prescribed dose of fertilizers (190:115:300 g N, P_2O_5 and K_2O per plant per year respectively) in 6 splits for the maximisation of bunch weight and grade of fruits. Banana being a gross feeder, requires heavy manuring for its growth and fruiting. It is estimated that an average crop of banana removes 300 kg N, 80 kg P_2O_5 and 800 kg K_2O from a hectare of land (Veeraraghavan, 1972).

Several reports are available indicating the greater requirement of nitrogen and potassium for bananas. Hence a revision of the present recommendation of nutrients is necessary for improving the banana production in the State.

Apart from the proper dosage of nutrients, the schedule of application of nutrients also play an important role in the improvement of yield in bananas. Hence in this experiment, higher doses of nitrogen and potassium are tried along with different levels of split applications in order to find out the optimum dose and frequency of application of nutrients in 'Nendran' bananas. The results of the studies are discussed hereunder.

1. Height of pseudostem

From the data presented in Tables 2.1 and 2.2 it could be observed that 200 g N per plant per year produced significantly taller plants during 2nd, 3rd, 4th and 5th month after planting (Fig.2.1). Thereafter, the effect of nitrogen was not found to be significant on this character. Nitrogen which accounts for the vegetative growth of the plant might have been absorbed and utilized more by the plant during pre-flowering stage of the crop. Veerannah *et al.* (1976) reported that nitrogen and potassium are absorbed more in pre-flowering stages in Robusta bananas. Maximum pseudostem height was reported by the application of 180 g N per plant per year (Kohli *et al.* (1976). Anjorin and Obigbesan (1983) reported that higher levels of nitrogen (upto 400 g per plant per year) significantly reduced the height, girth and weight of pseudostem in bananas.

The effect of potassium was not found to be significant on the pseudostem height during the entire period of growth of the crop (Fig.2.2). Reports of Yang and Pao (1962) is also in conformity with the present finding on the effect of K_2O on the pseudostem height in bananas.

Split application markedly increased the plant height upto fifth month of planting,(Fig.2.3) which indicates the fact that most of the vegetative growth of the crop has been completed before fifth month of planting.

Summerville (1944), Veeraraghavan (1970), Pillai *et al.* (1977) and Valsamma Mathew (1980) also supported this aspect by pointing out the fact that the fertilizer application should be completed before the plant comes to reproductive period. Increase in pseudostem height of bananas due to split application of nutrients has been reported by Shattikah and Khalidy (1962), Nambiar *et al.*(1979), Rajeevan (1985).

Interaction effects were not found to be significant on the pseudostem height of bananas.

2. Number of leaves produced by the plant upto the time of each fertilizer application

The analysis of the data on the number of leaves produced by the plant at the time of each fertilizer application (Tables 3.1 and 3.2) revealed that application of nitrogen at the rate of 200 g per plant per year significantly increased the number of leaves produced by the plant from second month after planting upto the fifth month. During this period a significant reduction in the number of leaves produced was observed with higher levels of nitrogen. From sixth month onwards the effect of nitrogen was not significant on this character. This threws light on the fact that the vegetative growth of the crop has been completed before sixth month of planting, and hence the nitrogenous fertilizers, which accounts for the vegetative growth should be applied in optimum quantities before this period. Nitrogen, though contributes much towards the vegetative growth, can cause deformities, when given in excess quantities. In the present study the reduction in the number of leaves produced with higher levels of nitrogen, may be due to the excess supply of nitrogen given to the plant, over and above its requirement. Promotive effect of nitrogen was observed on pseudostem height, girth and number of leaves with 170 g nitrogen per plant per year (Arunachalam, 1972; Kohli et al. 1976).

As in the case of pseudostem height, here also, the effect of potassium was not found to be significant on the number of leaves produced at all the stages of growth. Venkatesam et al. (1965) also obtained similar results on the variety 'Karpoorachakarakeli'. Findings of Yang and Pao (1962), Sheela (1982) are also in agreement with the results obtained in this study.

Split application increased the number of leaves produced by the plant from second month upto fifth month after planting. Four split applications produced plants with less number of leaves in treated plots while lesser number of leaves have been produced by two split applications in the case of controls. Increase in the number of leaves produced with increased number of split application has been reported by Battikah and Khalidy (1962), Rajeevan (1985).

Interaction effects were not found to be significant on the number of leaves produced by the plant during different months of fertilizer application.

3. Leaf area

The leaf area of plants were observed for three months from the second month of planting. Analysis of the data on this character (Tables 4.1 and 4.2) showed that leaf area was not significantly affected by different levels of nitrogen and potassium. Similar responses were observed by Yang and Pao (1962), Sheela (1982) with different levels of K_2O tried. Leaf area was markedly increased by increased number of split applications at fourth month of planting. During the earlier periods, the quantity of nutrients received by the crop may be inadequate to produce leaves with more leaf area. Contradictory results were reported in this aspect by the study conducted by Rajeevan (1985) which showed that leaf area was not influenced significantly by different split applications. However increase in leaf area by split application of nutrients has been reported by Battikah and Khalidy (1962).

4. Number of suckers at flowering and harvest

From the results presented in Tables 5.1(a), 5.2(a), 5.1(b) and 5.2(b), it could be seen that N and K_2O had significant effect on the number of suckers produced at flowering. N at 400 g per plant significantly reduced the number of suckers produced. But higher levels of K_2O produced more number of suckers per plant. Contradictory to the above result, none of the main effects or interaction effects influenced the total number of suckers produced at harvest. Highest rate of suckering was reported with 330 g N per plant per year and lowest rate with zero g nitrogen per plant per year, by Baruah and Mohan (1985). Effect of K_2O in enhancing sucker production was reported by Jambulingam et al. (1975). However Vadivel (1976) observed that sucker production was not influenced by different levels of K_2O.

5. Number of leaves produced per plant upto the time of flowering

Results of analysis of the data presented in Tables 5.1(c) and 5.2(c) revealed that there was no significant difference in the number of leaves produced per plant upto the time of flowering, either due to individual effects of nutrients or due to their interactions. Twenty nine leaves were produced by most of the plant upto the time of flowering in treatments as well as in control plots. From this it is assumed that quantity of nutrients supplied and its frequency of application had no influence on this character which is controlled physiologically in bananas.

6. Number of days taken for first sucker emergence, flowering and harvest

Analyses of the data presented in Tables 6.1(b) and 6.2(b) pointed out that number of days taken for first sucker emergence is not affected by different levels of nitrogen, potassium and split applications. Slight variations found in the number of days taken for first sucker emergence in different treatments may be due to the slight difference in age and size of suckers planted initially as mother plants.

From the results presented in Tables 6.1(c) and 6.2(c) it could be observed that N and K_2O could not markedly influence the number of days taken for shooting. Eventhough the effect of nitrogen was not significant, the data showed that higher levels of nitrogen increased the time taken for shooting compared to lower levels of nitrogen. This may be due to the supra optimal levels of nitrogen diverting carbohydrate into vegetative growth and lowering the levels of other nutrients in the vegetative tissue (Black, 1965). Studies conducted by Valsamma Mathew (1980) also showed similar results with respect to the effect of nitrogen on the time taken for shooting.

Plant which received eight split applications took minimum number of days for flowering. The positive response of split application in hastening shooting has been reported by Sharma (1984), Rajeevan (1985).

Time required for establishment of plant and difference in age and size of suckers would have also contributed to this factor.

Analysis of the data in the tables 6.1(d) and 6.2(d) showed that nitrogen at 200 g per plant per year markedly reduced the total number of days taken for harvest. Time taken for flowering was also reduced by the lower levels of nitrogen (200 g N), compared to the other two higher levels of nitrogen. This may be one of the reasons for the reduction in the total number of days taken for harvest with lower levels of nitrogen (200 g N).

Potassium did not influence the time taken for harvest significantly. As in the case of time taken for shooting, here also eight split application significantly reduced the total number of days taken for harvest of the crop.

7. Weight of bunches at maturity

Data on the mean weight of bunches at maturity (Tables 7.1 and 7.2) showed that bunch weight was not markedly influenced by different levels of nitrogen. Yield of bunches slightly increased with 300 g N per plant and then a showed a decrease when 400 g nitrogen per plant per year was applied (Fig.3.1). From the analysis of the data on the vegetative characters, yield and yield attributes, it could be observed that nitrogen at the level of 200 g per plant was effective in improving the characters, such as pseudostem height, number of leaves, sucker production, finger length etc. In most of the studies the recommendation of nitrogen given was less than 200 g per plant per year, for optimum production of bunches (Kohli *et al.* 1976; Arunachalam, 1972; Ramaswami and Muthukrishnan, 1974b; Pillai *et al.* 1977). Hence in this study also insignificant response of nitrogen may be due to the excess quantity of nitrogen supplied. Jagirdar *et al.* (1963) reported that higher levels of nitrogen did not help to increase yield, but help to improve grade of fruits. In trials conducted by Langenegger and Smith (1986) with seven levels of N and K_2O, beneficial effect was found on yield with different levels of K_2O, but nitrogen was found to produce no significant effect on yield. Rao (1978) reported that banana respond to nitrogen, but beyond a certain level, the benefits are not proportional. Excess nitrogen fertilizers beyond optimum limit will be utilised for vegetative growth.

Significant positive influence on bunch weight was noticed with K_2O at 600 g per plant per year, producing maximum bunch weight of 11.64 kg. From table 7.3 it is clear that response of potassium on bunch weight is linear and it could be presumed that optimum level of K_2O probably lies above the range covered in the experiment. Hence further studies using higher doses of K_2O could be undertaken to determine the economic dose of K_2O. Increase in yield due to K_2O application has been reported by various workers (Yang and Pao, 1962; Decunha and Fraga, 1963; Osborne and Hewitt, 1963; Moreau and Robin, 1972; Garcia et al., 1980; Lahav et al. 1981; Sheela 1982). The effect of split application was found to be statistically significant on the bunch weight of banana. Six split applications although recorded maximum bunch weight of 11.3 kg, it was not statistically different from 8 split applications, which recorded the bunch weight of 11.05 kg. Significant positive response of split application on yield of banana has been reported by many workers (Alexandrowitz, 1955; Dugain, 1959; Ho, 1968; Leigh, 1969; Osborne and Hewitt, 1963; Marques and Monteiro, 1971; Lacovilha, 1973; Sharma and Roy 1973; Nambiar et al. 1979; Gopimony et al. 1979; Obiefuna, 1984; Sharma, 1984; Rajeevan, 1985).

Sharma and Roy (1973) reported that fertilizers did not help to increase yield, if applied after 6 months of planting.

Eventhough the individual effect of N_2 on bunch weight was not significant, it could produce significant positive response in combination with potassium. It is also interesting to note that highest levels of N (N at 400 g per plant) when combined with highest level of K_2O (K_2O at 600 g per plant) produced bunches with maximum weight (12.02 kg) and this was significantly superior to other 8 combinations of N and K_2O (Fig.3.2). Vegetative characters, finger length and such other characters were maximum with lowest level of N (200 g N) per plant. While highest level of N (400 g N) when combined with highest level of K_2O could produce remarkable improvement on yield of bananas. It is important to note that lowest yield was recorded when 400 g N was combined with 300 g K_2O (lowest level of K_2O). Hence it is clear that N alone could not produce yield improvement in bananas, but a combination of N and K in correct proportion is necessary for manipulating the yield as reported by several workers (Croucher and Mitchell, 1940; Summerville, 1944; Bhangoo <u>et al.</u> 1962) Norris and Ayyar (1942) reported that plants require larger quantity of K_2O and moderate quantity of nitrogen for optimum growth. Figueroa Escobar (1962) obtained best results with N and K_2O application in the ratio 1:2. Lin <u>et al.</u> (1962)

and Melin (1970) also stressed the importance of combined application of N and K. The effect of nitrogen in presence of phosphorus and potassium in increasing the number of bunches and fingers and enhancing the weight of bunches has been reported by Sundar Singh (1972).

Eventhough the combined effect of nitrogen, potash and split application was not found to be significant, a dose of 400 g N, 600 g K_2O combined with six split application may be recommended as the best treatment of the experiment.

In control the different split applications failed to produce any significant difference among themselves. This may be due to the inadequate quantity of nutrients supplied to them. However, all the treated plants out-yielded the control plants and hence it is evident that higher doses of nutrients would be necessary than the existing recommended dose, for Nendran bananas and this higher dose when supplemented in six splits can improve the yield in Nendran bananas.

8. Number of hands per bunch

Analyses of the data in Tables 8.1(a) and 8.2(a) showed that number of hands per bunch was not significantly influenced by different levels of N, K_2O and split applications. Similar results were obtained with nitrogen in a study conducted by Valsamma Mathew (1980). Likewise K_2O also produced similar response on the number of hands per bunch in the experiment conducted by Vadivel (1976) and Langenegger and Smith (1986).

In the present study lowest level of nitrogen (200 g N per plant) produced more number of hands while highest level of potassium (600 g K_2O per plant) produced more number of hands compared to the other two lowest levels of potassium. Increase in number of hands produced due to potash application was reported by Yang and Pao (1962) and Bhangoo *et al.* (1962).

Similar response of split application on number of hands per bunch as seen in the present study was reported earlier by Rajeevan (1985).

9. Number of fingers per bunch

Analysis of the data on the mean number of fingers per bunch (Tables 8.1(b) and 8.2(b) revealed that nitrogen had no significant influence on the number of fingers per bunch at maturity. However, more number of fingers were produced with 200 g N per plant. Valsamma Mathew (1980) also had observed similar results with regard to this character.

Higher levels of K_2O markedly increased the number of fingers per bunch. K_2O at 600 g per plant produced an average number of 48.32 fingers. Production of more number of fingers at highest level of K_2O might have contributed towards the production of bunches with maximum weight, when K_2O was applied at highest dose. Vijayaraghava Kumar (1981) based on his statistical studies of the influence of biometric characters on yield in banana reported that number of fingers is having the maximum direct effect in culinary varieties of banana. The direct influence of number of fingers on yield improvement of 'Nendran' bananas has been reported by Kurian et al. (1985) in a study conducted at Banana Research Station, Kannara. Reports by Jagirdar and Ansari (1966) and Sheela (1982) are also in conformity with the above results.

Split application produced no significant influence in the number of fingers per bunch at maturity. It is also probable that this character is influenced more by the quantity of fertilizers upto a certain level than the time of application. Interaction effects were not found to be significant.

10. Length of bunches at maturity

Analyses of the data in tables 9.1(a) and 9.2(a) showed that different levels of N, K_2O, split applications and their interactions could not influence the length of bunches at maturity.

11. Finger length at maturity

Analysis of the data in Tables 9.1(b) and 9.2(b) revealed that finger length was significantly increased by application of N at 200 g per plant per year. Increase in length of fruit by the application of N upto 170 g per plant per year was reported by Ramaswami and Muthukrishnan (1973). In a trial conducted by Fernendez *et al.* (1980) nitrogen content in fruit pulp was found negatively correlated with fruit length and weight suggesting excessive nitrogen nutrition. Hernandez *et al.* (1981) observed that beyond 150 g N per plant no significant response could be noticed in variables like fruit length, girth, weight of bunch etc. Main effect of K_2O and split application were not found significant on the finger length at maturity.

This response of K_2O is in line with findings of Vadivel (1976) and Sheela (1982). Rajeevan (1985) found no marked response on finger length with different levels of split applications.

Interaction of nitrogen and split application was found significant, in increasing length of fingers. Maximum finger length of 28.95 cm was obtained when 200 g nitrogen was applied in 4 splits. Hence it is obvious that a reasonable dose of nitrogen, when applied in different fractions is effective rather than frequent application in large quantities. When nitrogen was applied in splits the length of fruits was increased from 26.6 to 28.95 cm.

12. Girth of finger at maturity

From the results presented in Tables 9.1(c) and 9.2(c) it was observed that none of the main effects of interaction effects significantly influenced the girth of fingers at maturity. Girth of the fruits were not affected significantly by different levels of nitrogen as observed by Hernandez *et al.* (1981). Similar effects were observed with different levels of K_2O (Vadivel, 1978) and different split applications (Rajeevan 1985)

13. Weight of finger at maturity

Tables 9.1(d) and 9.2(d) showed that weight of fruits were not significantly affected by different levels of N and K_2O and split applications.

14. Dry weight and starch content of fingers at maturity

Mean values on these characters are presented in Tables 9.1(e), 9.2(e), 9.1(f) and 9.2.(f). Nitrogen at 200 g per plant per year produced fingers with significantly lesser dry weights, while K_2O and split applications had no significant influence on this character. None of the main effects of interraction effects were found to influence the starch content of fingers at maturity.

15. TSS content of ripe fruits

Analyses of the data on Tables 9.1(g) and 9.2(g) revealed that TSS content was influenced by different levels of nitrogen only. TSS content was increased significantly when 300 g N was applied. Thereafter a decrease in TSS content was observed with increasing levels of nitrogen by Kefford and Chandler (1970) in pineapple and Valsamma Mathew (1980) in 'Palayankodan' bananas. Medium dose of nitrogen showed maximum percentage of TSS as reported by Nijjar and Chand (1969) in 'Anab-e-shahi' grapes.

Quality aspects were not significantly influenced by different split applications in 'Palayankodan' variety of bananas (Rajeevan, 1985).

Economics of crop cultivation

The data on the economics of crop cultivation(Table 10) revealed that treatment combination with 400 g nitrogen, 600 g potassium and 6 split applications was the best treatment which gave a net profit of Rs.41,109/- per ha. Same nutrient combination with 8 split applications ranked the second, according the net profit of Rs.35,084/- per ha. The data clearly points out that eventhough the cost of cultivation may be raised to a certain level by these treatments, the returns from the crop is also enhanced by these treatments in a proportionate manner.

When the treatment combination with 400 g nitrogen 600 g potassium and 6 split applications was tried, yield increase of about 10,625 kg per ha. was noticed over the presently recommended dose(C_4).

Hence it could be evident that higher dose of nutrients than the presently recommended Package of practices dose is needed for 'Nendran' banana and this quantity when applied in 6 splits can make remarkable yield improvement in this crop.

Thus 400 g nitrogen, 600 g potassium and 6 split applications may be recommended as the economic dose for yield improvement of 'Nendran' banana grown in Rice fallows.

SUMMARY

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An experiment was conducted at the Instructional farm, College of Agriculture, Vellayani from November 1986 to November 1987 to find out a suitable manurial recommendation for 'Nendran' bananas grown in rice fields and to study the effect of split application on the growth and yield of Nendran bananas, under irrigated condition in rice fallows. The trial was conducted as $3^3 + 4$ factorial experiment, with two replications, confounding NK^2S in replication I and NK^2S^2 in replication II. Three levels of nitrogen (200, 300 and 400 g per plant per year), three levels of potassium (300, 450 and 600 g per plant per year) and three split application (4, 6 and 8 splits) were tried in different combinations. A uniform dose of 100 g P_2O_5 per plant per year was applied to all the treated plots. There were four controls in the experiment in which the fertilizer doze as per the recommendation of package of practices (190 : 115 : 300 g, N, P_2O_5, K_2O per plant per year) were applied in 2, 4, 6 and 8 splits. The results of the study are summarised below.

1. Height of pseudostem and total number of leaves were more with lowest level of nitrogen (200 g N per plant per year) from second month to fifth month of planting. Thereafter the effect of nitrogen was not significant. Effect of potassium was not found significant at all stages of growth. 6 & 8 split applications produced relatively taller plants. But more number of leaves were produced by 8 split applications.

2. Leaf area was affected by split applications alone at 4th month of planting during which the leaf area was increased by 6 and 8 split applications which were found on par with each other.

3. Nitrogen and potassium alone influenced the total number of suckers at flowering, while this character was not influenced by different split applications. The two higher levels of potassium produced more number of suckers at flowering, but sucker production was reduced with highest level of nitrogen applied. The number of suckers produced at harvest remained unaltered with different levels of nitrogen, potassium and different split applications.

4. No significant difference was found in the number of leaves produced upto the time of flowering, either due to individual effects of nutrients, split applications or due to their interaction effects.

5. Neither the individual effects of nitrogen, potassium or split applications nor their interactions were significant on the number of days taken for sprouting of rhizome and first sucker emergence.

6. Split application alone produced significant differences in the number of days taken for shooting, which was reduced when nutrients were applied in eight splits.

7. Time taken for harvest was significantly reduced when 200 g nitrogen was applied, though this was not at all influenced by different levels of potassium. This period was shortened by application of nutrients in eight splits.

8. The response of nitrogen was not at all significant in increasing the weight of bunches at maturity, but the bunch weight showed a significant linear increase with different levels of potassium applied. Increased

number of split applications also enhanced the bunch weight at maturity, though the split application at higher levels were found on par with each other.

9. Interaction of nitrogen and potassium was found significant on the weight of bunches at maturity, with 400 g nitrogen, combined with 600 g potassium producing bunches having maximum weight of 12.02 kg. Among the treatment combinations 400 g nitrogen and 600 g potassium applied in six splits was the best combination, eventhough the superiority of this against the other treatments was not statistically significant. Number of hands were not significantly affected by different levels of nitrogen, potassium and split applications or their interactions.

10. Potassium alone could produce significant differences in the number of finger produced per bunch, with 600 g K_2O producing 48.32 fingers on an average which was found on par with 450 g K_2O producing 47.82 fingers on an average.

11. Neither the main effects of nitrogen, potassium and split applications nor their interactions were significant on the length of bunches at maturity.

12. In the case of finger length at maturity, nitrogen alone had significant effect, recording maximum finger length of 26.66 cm with 200 g N, per plant per year. Interaction of N x S was also found significant, with 200 g N and 4 split applications producing, maximum finger length of 28.95 cm at maturity.

13. Finger girth and finger weight were not markedly influenced by different levels of nitrogen, potassium and different split applications.

14. Dry weight of fingers were affected significantly by different levels of nitrogen alone. Lowest level of nitrogen (200 g) significantly reduced the dry weight of mature fingers.

15. Different levels of nitrogen, potassium and different split applications did not influence the starch content of mature fingers.

16. Nitrogen at 300 g per plant per year increased the TSS content of ripe fruits, which was not affected by different levels of potassium and split applications.

17. Maximum net profit of Rs. 41,109/- per hectare was obtained with the treatment - combination having 400 g N, 600 g K_2O and 6 split applications. Cost benefit ratio also showed maximum value (1.73) for the above treatment combination.

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* Originals not seen.

APPENDICES

APPENDIX I

Weather data for the period from November 1985 to November 1986

Month	Temperature (^oC)		Relative humidity %	Total rainfall mm
	Maximum	Minimum		
1985 November	29.80	23.20	79.00	449.80
December	30.90	23.20	77.56	110.80
1986 January	32.50	21.80	75.00	21.60
February	32.50	21.20	76.00	86.00
March	31.80	21.20	70.60	8.60
April	34.50	24.40	73.00	125.30
May	33.74	23.50	73.00	132.00
June	31.18	22.50	76.00	224.30
July	31.04	22.80	79.00	94.40
August	30.30	22.30	74.00	449.30
September	30.30	23.40	74.00	102.40
October	30.80	22.60	74.00	80.20
November	30.63	21.30	74.00	183.40

Appendix II

Abstract of analyses of variance table on mean height of pseudostem (at monthly intervals from 2nd to 8th month of Planting)

Source	df	Mean sum of squares						
		2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
Blocks	5	255.17	1649.57*	584.40	2651.80*	857.20	605.80*	464.60*
Nitrogen(N)	2	1474.98*	2821.06*	4136.31*	1932.00*	1112.00	415.25	187.75
Potassium (K)	2	164.21	275.93	78.87	26.25	242.00	555.50	771.75
Split application (S)	2	1069.57*	1594.37*	2205.87*	1907.00*	24.25	267.75	175.25
N x K	4	94.03	273.90	849.37	76.37	1018.75	490.62	288.62
K x S	4	107.50	92.50	271.18	267.87	213.50	50.87	64.62
N x S	4	168.07	187.46	186.37*	457.50	279.75	208.87	115.12
N x K x S	8	177.37	263.59	781.14	192.78	565.50	227.90	210.90
NKS	2	120.92	234.00	1109.62	1.00	649.50	204.50	101.25
NK^2S+	2	2.21	24.25	505.06	36.00	611.87	534.25	409.25
NKS^2	2	100.50	202.31	746.62	36.00	565.25	86.50	150.25
NK^2S^2+	2	485.71	593.78	763.25	667.37	399.37	86.37	182.62
T Vs C	1	166.12*	63.62	3.00	305.00*	47.00	512.00*	477.00*
Error	45	434.42	503.00	554.44	522.85	444.03	250.00	181.26

* Significant at 0.05 level
\+ Confounded effects

T - Treatment
C - Control

Appendix III

Abstract of analyses of variance table for the number of leaves per plant at the time of fertilizer application (from 1st to 8th month of planting)

Source	df	Mean sum of squares @							
		1st month	2nd month	3rd month	4th month	5th month	6th month	7th month	8th month
Blocks	5	0.0383	0.0706*	0.0754*	0.0781*	0.0417*	0.0023	0.0021	0.0022
Nitrogen (N)	2	0.0359	0.1264*	0.1231*	0.0420*	0.0550*	0.0020	0.0003	0.0003
Potassium (K)	2	0.0040	0.0164	0.0202	0.0120	0.0156	0.0029	0.0003	0.0003
Split application (S)	2	0.0294	0.0623*	0.0944*	0.0778*	0.0502*	0.0040	0.0096	0.0096
N x K	4	0.0223	0.0222	0.0123	0.1358	0.0119	0.0117	0.0059	0.0059
K x S	4	0.0136	0.0002	0.0086	0.0101	0.0032	0.0083	0.0041	0.0041
N x S	4	0.0298	0.0021	0.0134	0.0124	0.0119	0.0081	0.0062	0.0062
N x K x S	8	0.0165	0.0380	0.0183	0.0111	0.0121	0.0078	0.0034	0.0034
NKS	2	0.0127	0.0361	0.0031	0.0023	0.0037	0.0068	0.0031	0.0031
NK^2S+	2	0.0026	0.0299	0.0278	0.0013	0.0010	0.0001	0.0010	0.0010
NKS^2	2	0.0040	0.0395	0.0057	0.0025	0.0046	0.0009	0.0015	0.0015
NK^2S^2+	2	0.0466	0.0464	0.0366	0.0383	0.0391	0.0235	0.0081	0.0081
T vs C	1	0.1500	0.0090	0.0233	0.0021	0.0041	0.0090	0.0300	0.0244
Error	45	0.0178	0.0171	0.0209	0.0204	0.0093	0.0057	0.0063	0.0061

* Significant at 0.05 level   T - Treatment   C - control
\+ Confounded effects
@ Data are transformed using the square root transformation.

Appendix IV

Abstract of analyses of variance Table for Leaf area (at monthly intervals from 2nd to 4th month of planting)

Source	df	Mean sum of squares		
		2nd month	3rd month	4th month
Blocks	5	118000	392320	835942
Nitrogen (N)	2	53028	213760	436224
Potassium (K)	2	40700	219328	39232
Split application (S)	2	86876	454752	1448128*
N x K	4	62694	90512	120448
K x S	4	30978	90656	54336
N x S	4	9784	86768	785888
N x K x S	8	19223	163244	250392
NKS	2	3776	9184	78976
NK^2S^+	2	8350	291616	583968
NKS^2	2	34136	13568	257216
NK^2S^{2+}	2	30630	338608	81408
T vs C	1	2784	126464	24064
Error	45	75956*	266899*	410258*

* Significant at 0.05 level

\+ Confounded effects

T - Treatment

C - Control

Appendix VI (a) to (d)

Abstract of analyses of variance table on number of days for sprouting of rhizome, first sucker emergence, flowering and harvest

Source	df	Mean sum of squares @			
		(a) No. of days for sprouting of rhizome	(b) No. of days for 1st sucker emergence	(c) No. of days for flowering	(d) No. of days for harvest
Blocks	5	0.0864	0.9322	0.5810*	0.7175*
Nitrogen (N)	2	0.1162	0.7355	0.4331	1.1538*
Potassium (K)	2	0.0139	1.5959	0.0439*	0.1572
Split application (S)	2	0.0435	0.9555	0.6245	0.5737*
N x K	4	0.0593	0.6938	0.0725	0.2451
K x S	4	0.5234	0.9465	0.1594	0.2287
N x S	4	0.0234	0.4107	0.0942	0.0505
N x K x S	8	0.0443	0.5258	0.0708	0.0938
NKS	2	0.0413	0.1000	0.0336	0.1728
NK^2S +	2	0.0050	1.3605	0.0390	0.0495
NKS^2	2	0.0813	0.5058	0.1259	0.0625
NK^2S^2 +	2	0.0495	0.1368	0.1198	0.0905
T vs C	1	0.0264	0.0673	1.1777	1.2187
Error	45	0.0613	0.7402	0.1728	0.1587

* Significant at 0.05 level

T - Treatment

C - Control

\+ Confounded effects

@ Data are transformed using square root transformation.

Appendix V (a) to (c)

Abstract of analyses of variance table for Number of suckers at flowering, Number of suckers at harvest and Number of leaves at flowering

Source	df	Mean sum of squares @		
		(a) No. of suckers at flowering	(b) No. of suckers at harvest	(c) No. of leaves at flowering
Blocks	5	0.0105	0.0207	0.0042
Nitrogen (N)	2	0.2003*	0.0997	0.0000
Potassium (K)	2	0.1167*	0.0537	0.0018
Split application (S)	2	0.0701	0.0004	0.0098
N x K	4	0.0624	0.0438	0.0059
K x S	4	0.0299	0.0155	0.0040
N x S	4	0.0112	0.0187	0.0042
N x K x S	8	0.0367	0.0236	0.0039
NKS	2	0.0422	0.0431	0.0023
NK^2S+	2	0.0165	0.0108	0.0018
NKS^2	2	0.0001	0.0871	0.0003
NK^2S^2+	2	0.0881	0.0512	0.0114
T vs C	1	0.0315	0.0040	0.0083
Error	45	0.0305	0.0322	0.0054

* Significant at 0.05 level

T - Treatment C - Control

+ Confounded effects

@ Data are transformed using square root transformation.

Appendix VII

Analysis of variance table on weight of bunches at Maturity

Source	df	SS	MSS	F
Blocks	5	1.9746	0.3949	0.7288
Nitrogen (N)	2	0.3154	0.1577	0.2911
Potassium (K)	2	6.1928	8.0964	14.9427*
K - linear (KL)	1	15.6680	15.1668	28.9180*
K - Quadratic(KQ)	1	0.5230	0.5250	0.9689
Split application (S)	2	4.4238	2.2119	4.0823*
N x K	4	9.3955	2.3488	4.3350*
K x S	4	0.0708	0.0177	0.0326
N x S	4	0.7114	0.1778	0.3282
N x K x S	8	3.0087	0.0376	0.0664
NKS	2	0.4746	0.2373	0.4379
NK^2S^+	2	0.0678	0.0339	0.0626
NKS^2	2	0.0454	0.0027	0.0419
NK^2S^{2+}	2	0.4208	1.2104	2.2340
T vs C	1	103.8467	103.8467	56.2671*
Error	45	24.3823	0.5418	-

* Significant at 0.05 level

\+ Confounded effects

T = Treatment C- Control.

Appendix VIII (a) and (b)

Abstract of analyses of variance table on Number of hands and number of fingers

Source	df	Mean sum of square @ (a) No. of hands	(b) No. of fingers
Blocks	5	0.0038	0.0945
Nitrogen (N)	2	0.0235	0.0660
Potassium (K)	2	0.0135	0.4517*
Split application (S)	2	0.0135	0.1914
N x K	4	0.0058	0.0989
K x S	4	0.0185	0.1065
N x S	4	0.0134	0.0880
N x K x S	8	0.0046	0.0520
NKS	2	0.0008	0.0498
NK^2S +	2	0.0061	0.0107
NKS^2	2	0.0059	0.0532
NK^2S^2 +	2	0.0067	0.0986
T vs C	1	0.0078	11.1965*
Error	45	0.0108	0.0873

* Significant at 0.05 level T - Treatment

\+ Confounded effects C - Control

@ Data are transformed using square root transformation.

Appendix IX (a) to (g)

finger characters

Abstract of analyses of variance table on length of bunches and quality aspects of fingers at maturity

Source	df	Mean sum of squares @						
		(a) Length of bunches	(b) Finger length	(c) Finger girth	(d) Weight of finger	(e) Dry weight of finger	(f) Starch content of finger	(g) TSS content of ripe fruit
Blocks	5	15.36	1.80	0.05	320.95	17.36	175.00*	1.58
Nitrogen (N)	2	25.56	15.98*	0.15	172.62	174.39*	89.89	6.95*
Potassium (K)	2	28.49	0.08	0.07	463.75	0.82	125.78	1.29
Split application (S)	2	0.31	0.43	0.35	49.12	13.21	17.42	1.47
N x K	4	5.52	1.00	0.59	414.56	60.15	5.33	1.20
K x S	4	14.99	1.04	0.27	304.62	49.10	57.76	0.15
N x S	4	2.60	5.63*	0.14	32.31	22.25	55.25	1.96
N x K x S	8	6.61	3.56	0.31	401.45	33.15	30.25	1.36
NKS	2	3.38	3.24	0.35	320.62	19.91	4.31	0.12
NK^2S+	2	2.24	1.70	0.43	18.93	13.21	47.96	2.78
NKS^2	2	9.42	4.36	0.33	91.75	1.07	57.48	0.71
NK^2S^2+	2	11.40	4.96	0.12	10174.50	54.80	11.25	1.83
T vs C	1	0.44	3.00*	0.43	795.25*	8.18*	1.87*	0.23
Error	45	12.89	2.13	0.24	198.71	43.99	40.42	1.39

* Significant at 0.05 level T - Treatment C - Control

\+ Confounded effects

@ Data are transformed using square root transformation

NUTRITIONAL REQUIREMENT OF 'NENDRAN' BANANA UNDER RICE FIELDS

BY

GEETHA V. NAIR

ABSTRACT OF THE THESIS
SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENT FOR THE DEGREE OF
MASTER OF SCIENCE IN HORTICULTURE
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ABSTRACT

An experiment was conducted at the College of Agriculture, Vellayani during 1986-87 to study the effect of 3 levels each of nitrogen (200, 300 and 400 g per plant per year), potassium (300, 450 and 600 g per plant per year) and three split applications (4,6 and 8 splits) on the growth yield and quality of 'Nendran' grown in rice fallows. A minimum dose of 100 g P_2O_5 per plant per year was given to all treatments except the controls.

The experiment was laid out as $3^3 + 4$ partially confounded factorial experiment with two replications, confounding NK^2S in replication I and NK^2S^2 in replication II respectively. Fertilizer dose as per package of practices recommendation (190 : 115 : 300 g N: P_2O_5: K_2O per plant per year) was applied in 2, 4, 6 and 8 splits to control plants (4 controls).

The results of the study revealed that height of pseudostem and number of leaves were increased with lowest level of nitrogen (200 g N). Leaf area was markedly influenced by split application alone with higher levels of split applications producing plants having more leaf area, during 4th month of planting.

Suckers produced at flowering were more with higher levels of potassium while sucker production was reduced with higher levels of nitrogen.

Time taken for flowering and harvest was reduced when the nutrients were applied in eight splits.

Different levels of nitrogen produced insignificant response to weight of bunches at maturity. But bunch weight showed a significant linear increase with increase in levels of potassium, recording maximum bunch weight of 11.64 kg with 600 g K_2O per plant. Eventhough the individual effect of nitrogen was not significant, highest level of nitrogen (400 g N) when combined with highest level of potassium (600 g K_2O) recorded maximum bunch weight (12.02 kg) compared to other eight combinations of N and K.

Among the different levels of splits, six split application of nutrients was found to produce best result with regard to weight of bunches at maturity. Similar response was found with potassium and split application of nutrients, in the case of number of fingers also. Length of fingers was increased with 200 g N per plant, while girth and weight of fingers were not markedly affected by different levels of nitrogen, potassium and split applications.

Dry weight of fingers was increased with the highest level of nitrogen (200 g N). Fruit with the maximum TSS percentage were produced under medium dose of nitrogen (300 g N).

All the treated plants outyielded the control plants and gave higher values of net return.

Plants which received the treatment combination with 400 g N and 600 g K_2O applied in 6 splits, gave maximum net profit (Rs.41,109/ per hectare) and the highest value for cost-benefit ratio (1.73). Least value of net return(Rs.11,054/- per hectare) and cost benefit ratio (1.20) were obtained when the dose as per the recommendation of the package of practices was applied in 8 splits (C_4).