VARIETAL SUITABILITY AND CROP GEOMETRY OF BABY CORN (*Zea mays* L.) IN COCONUT GARDEN

by

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THESIS

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2

DECLARATION

I, hereby declare that this thesis entitled **"Varietal suitability and crop geometry of baby corn (*Zea mays* L.) in coconut garden"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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Dona Scaria

CONTENTS

LIST OF TABLES

9

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

B:C Ratio	Benefit cost ratio
CD (0.05)	Critical difference at 5 per cent level
cm	Centimeter
cm^2	Centimeter square
DAE	Days after emergence
DAS	Days after sowing
dS m^{-1}	Deci Siemens per metre
EC	Electrical conductivity
E	East
et al.	Co- workers/ co- authors
Fig.	Figure
FYM	Farmyard manure
g	Gram
g m^{-2}	Gram per square metre
ha	Hectare
ha^{-1}	Per hectare
i.e.	that is
K	Potassium
KAU	Kerala Agricultural University
kg	Kilogram
kg ha^{-1}	Kilogram per hectare
K_2O	Potash
LAI	Leaf area index
m	Metre
m^{-2}	per square metre
mg	milli gram
mg g^{-1}	milli gram per gram

MOP	Muriate of potash
nos.	Numbers
N	Nitrogen
N	North
NS	Not significant
OC	Organic carbon
P	Phosphorus
P_2O_5	Phosphate
plant $^{-1}$	per plant
POP	Package of practicess
pH	Negative logarithm of hydrogen ion concentration
RBD	Randomized Block Design
RH	Relative humidity
S	Significant
SEm	Standard error of mean
TNAU	Tamil Nadu Agricultural University
t	Tonnes
t ha^{-1}	Tonnes per hectare
viz.	Namely
₹ kg^{-1}	Rupees per kilogram

LIST OF SYMBOLS

%	Per cent
^{0}C	Degree Celcius
@	At the rate of
₹	Rupees
'	Minutes
"	Seconds

Introduction

1. INTRODUCTION

Kerala the 'land of coconuts' is blessed with an abundance of natural resources. However, 'cultivable land' - the most precious resource of nature has become scarce in the State. The average size of operational holding in the State which was 0.27 ha in 2005-06 got diminished to 0.22 ha in 2010-11 (GOK, 2013) which is also the lowest in the country as against the all India average of 1.16 ha (GOI, 2014). Coconut is the major crop of the State and majority of coconut growers are marginal farmers who are currently exposed to economic risks and uncertainties owing to the frequent price fluctuations of the produce. Further more, the productivity of coconut in the State had remained almost stable over past few decades with only slight improvement in the current decade while being still lower than the average productivity in the neighbouring States like Tamil Nadu, Andhra Pradesh and Karnataka (KSPB, 2013). This constrained situation necessitates the need for diversification of holdings to fetch maximum returns from unit area.

Coconut palm as a mono crop at recommended spacing of 7.5 m x 7.5 m does not fully utilize the available resources such as land space, aerial space, water and nutrients. The palm has a typical adventitious root system and about 74 per cent of the roots are within 2 m lateral distance and 82 per cent are confined to 30 to 120 cm depth of soil (Kushwah *et al.*, 1973). As a result, the palms of more than 20 years utilize only 22.3 per cent of land area while the average utilisation of space by the canopy is about 30 per cent which allows the penetration of sufficient light to the ground to support the growth of intercrops (Nelliat *et al.*, 1974). Hence, there exists ample scope to exploit these resources through the integration of several species of seasonal, annual, and perennial intercrop components in coconut garden for enhancing income and employment opportunities.

Maize (*Zea mays* L.) is the third most important food grain crop in the world after wheat and rice, and also an agronomically versatile crop. In India it is consumed as human food, animal feed, poultry feed and used for making industrial products. It is a unique crop, which can be used at any stage of its growth and has very big market potential. With the advent of science and technology, rise in standard of living and supply of rice and wheat through public distribution system, there has been a change in traditional usage of mature maize grain as food to increased consumption of green ears as food (Thavaprakaash *et al.*, 2005a). Though maize is not being cultivated in Kerala, maize products like fresh cobs, corn starch, corn flakes, baby corn, sweet corn, *etc.* are being widely consumed by the people, especially in urban and suburban areas.

Baby corn is the young finger like unfertilized cob with 1-3 cm emerged silk, preferably harvested within 1-3 days of silk emergence in maize, usually within 65-75 DAS. The baby corn is a speciality corn which has recently gained consumer preference among the urban population. The nutritional quality of baby corn is at par or even superior to some of the seasonal vegetables, it being one of the richest sources of phosphorus and fibre. The sweet, succulent and delicious baby corn is a part of several preparations like soups, salads and Chinese foods. It has great potential both for internal consumption as well as for export round the year as 3-4 crops of baby corn can be taken in one year. The possibility of introducing baby corn as a suitable intercrop in coconut gardens in homesteads in all seasons has been demonstrated successfully by Krishi Vigyan Kendra, Ernakulam (KVK, 2014).

Generally, maize varieties and hybrids developed are being cultivated as baby corn, but at present, corn hybrids are also specially bred for the purpose of baby corn. The authentic studies on the varietal suitability of baby corn in coconut based cropping system of Kerala are however meagre.

Crop geometry is an important factor for the efficient utilization of soil resources and also to harvest maximum possible solar radiation to achieve higher yield. Though the spacing requirement of grain and fodder corn has been standardised, information on optimum crop geometry for baby corn production especially under intercropping situation is lacking (Thavaprakaash and Velayudham, 2008).

Hence the present study was carried out to fulfill the following objectives:

- To investigate the feasibility of baby corn as an intercrop in coconut gardens.
- To assess the effect of varieties and spacings on its growth and productivity.
- To work out the economics of baby corn cultivation.

Review of Literature

2. REVIEW OF LITERATURE

Maize (*Zea mays* L.) is one of the most versatile and emerging crops having wider adaptability under varied agro-climatic conditions. It is classified into different groups or types based on the endosperm of kernels among which baby corn is grown for vegetable purpose. Baby corn is a unique cereal in which the milky tender cob is used as fresh vegetable and is also consumed as such as a natural food. This novel crop has recently gained consumer preference especially in and around urban and periurban areas.

Since baby corn cultivation has gained importance only recently, varieties or hybrids suitable for cultivation in different agroclimatic zones are lacking. Moreover, great variation has been reported among baby corn varieties in morphological, yield and yield attributing factors while studying the varietal suitability of the crop in different agro climatic conditions. Planting geometry plays an important role in determining the yield potential of baby corn in various growing situations. When land resource are scarce in a State like Kerala having low per capita land availability, coconut gardens offer a good opportunity for baby corn cultivation. Coconut gardens are predominant in the uplands of Kerala and palm interspaces can accommodate many rows of corn depending on the planting distance of coconut.

In this chapter, a detailed review of research work done on the suitability of corn as an intercrop in coconut garden, the effect of varieties and spacing of baby corn on growth, yield, quality attributes and the profitability have been presented.

2.1 SUITABILITY OF CORN AS INTERCROP IN COCONUT GARDEN

The coconut gardens offer ample scope to accommodate corn as an intercrop where the land resource is scarce. Corn, which is an annual or short season cereal crop, can be intercropped in coconut as the interspaces between coconut rows can accommodate about 6-9 rows of corn depending on the spacing of coconut. The crop is however best planted at least 2 meters away from the base of trees for getting higher yield and returns (PCA, 2004).

Maize is an intercrop recommended in coconut gardens of Kerala (KAU, 2011). Baby corn is a remunerative crop suitable for cultivation as sole crop as well as intercrop. The Central Plantation Crops Research Institute (CPCRI) in 2012 has reported the usefulness of intercropping high value crops such as baby corn, sweet corn, brinjal, pumpkin, black pepper, banana *etc.* under high density cropping system in coconut gardens. The KVK Ernakulam has also suggested that maize is a suitable crop for intercropping in coconut gardens and could be successfully cultivated as baby corn (KVK, 2014).

2.2 VARIETAL EFFECT OF BABY CORN

There are baby corn hybrids which are specially bred for the purpose of baby corn production, but many short season varieties of dent and sweet corn can also be grown as baby corn. Begna *et al.* (1997) demonstrated that non-leafy, shorter cultivars of maize performed better under higher plant densities. The influence of leafiness on tolerance to high densities has also been asserted by Sangoi and Salvador (1998) in maize. According to Dass *et al.* (2008) short duration, prolific, single cross maize hybrid with medium height should be selected for growing as baby corn.

2.2.1 Effect of Varieties on Growth and Growth Attributes

The growth and growth attributes vary with varieties of baby corn. Sukanya *et al.* (1999) reported that upto 45 days after sowing, the baby corn variety YBC-705 recorded significantly higher growth attributes, where as 45 days after sowing, the variety ITC-ZENECA performed better.

While comparing different baby corn varieties, total dry weight at 18 days after emergence was found to be the highest with the baby corn variety SW 2 followed by KKU 922, Baby corn no1, SRC 6, G 5414, KU no 1 and SSW respectively. However at 34 days after emergence the results showed another trend, that the highest total dry weight was recorded with Baby corn no 1 followed by SSW, KU no 1, SW 2, G 5414, SRC 6, CMB and KKU 992. At the final harvest, total dry weight was however similar in all the cultivars. The mean values of number of days for 50 per cent tasseling of each cultivar were 46, 43, 42, 46, 44, 38, 46 and 49 days for KU no 1, SW 2, SRC 6, Baby corn no 1, G 5414, KKU 992, CMB and SSW respectively (Kasikranan *et al.,* 2001).

According to Rani *et al.* (2011) the baby corn variety VL-78 produced highest dry matter content at 30 and 45 Days after sowing (DAS), however the varieties did not show any significant difference in plant height and number of leaves plant^{-1} at 45 DAS. The cv. HIM 129 and VL-78 took minimum number of days to initiate baby corn harvest, while Madhuri and Moti took more days for harvest.

Kheibari *et al.* (2012) reported that the baby corn variety KSC 704 recorded highest number of leaves and plant height followed by KSC 600 and KSC 403. The number of days to tasseling was significantly higher with KSC 600 and KSC 704 followed by KSC 403. Partokazemi *et al.* (2012) pointed out that the corn varieties, (L.cv.sc 370, L.cv.sc 500, L.cv.sc 540) significantly varied in growth and growth attributes and the highest number of leaves and plant height were recorded by the variety L.cv.sc 540.

According to Ramachandrudu *et al.* (2013) among the baby corn varieties tested, the variety G-5406 produced tallest plants with higher number of leaves while lower height and lesser number of leaves were noticed in the variety VL-42. Varieties Golden Baby, COBC-1 and VLBC-1 were found to be at par with one another in case of plant height. Summer season hastened maturity while *Rabi* season delayed it in all the varieties. The variety VL-42 matured earlier than other varieties, while the variety Mridula was late in maturity.

Sobhana *et al.* (2013) reported that better growth in terms of leaf area and dry matter production with early cob initiation and more cobs per plant was observed in the baby corn hybrid HM 4 compared to the variety PEHM 2.

Asaduzzaman *et al.* (2014) anlysed the effect of four baby corn varieties *viz.,* Hybrid baby corn-271, BARI sweet corn-1, BARI Khoibhutta and Shuvra on growth and growth attributes. They reported that, the plant height was significantly different among the varieties at all growth stages. The variety Shuvra produced the tallest plants and BARI sweet corn-1 produced the shortest plants. Days to first tasseling of different baby corn varieties also differed significantly. Minimum days were required both for tasseling and silking in Khoibhutta which was statistically similar to BARI sweet corn-1 while maximum days were taken by Hybrid baby corn-271. Dry matter accumulation plant^{-1} also varied significantly among the varieties at all the growth periods. The variety Shuvra produced the highest dry matter at all stages of growth except at 80 days after emergence (DAE), while variety Khoibhutta recorded the lowest dry matter accumulation at all growth stages. At 80 DAE, Hybrid baby corn-271 was found to be superior in dry matter production. The variety Shuvra produced the highest LAI while the lowest was recorded by BARI sweet corn-1 at all growth stages except at 20 DAE.

Kumar *et al.* (2015) evaluated six baby corn varieties *viz.,* FH-3438, VL Baby Corn, Vivek Hybrid-17, HIM-129, Parkash and HM-4 and found that the variety Parkash produced taller plants compared to all the varieties, while HIM-129 produced shorter plants than others.

According to Singh *et al.* (2015) the baby corn variety HM 4 recorded significantly higher indices of the growth attributes *viz.,* number of leaves per plant, leaf length, plant dry weight, crop growth rate, days to tasseling and days to silking compared to VL Baby Corn-1. Lopes *et al.* (2016) studied four corn varieties and reported that the variety PC 0402 had the highest plant height compared to the varieties BRS Angela, PC 0404, BR 106 and IPR 114.

2.2.2 Effect of Varieties on Yield Attributes and Yield

Performance of baby corn varieties was found to be varying with respect to yield contributing characters and yield according to their genetic potential. According to Sukanya *et al.* (1999), higher baby corn yield was recorded with the variety YBC-705 compared to ITC-ZENECA and C-6. The variety ITC-ZENECA however recorded significantly higher green fodder yield compared to the variety YBC-705 and produced on a par yields with the variety C-6.

As reported by Kasikranan *et al.* (2001), the highest cob weight was recorded by the baby corn cultivar CMB followed by KKU 992 while the cob: corn ratio was the highest with the variety SSW followed by SW 2. The variety G 5414 was found to produce the highest commercial fresh baby corn weight followed by the varieties KU no 1 and Baby corn no 1. The study also concluded that, the best four baby corn cultivars were KKU 992, G 5414, SW 2 and CMB in Oxic soils.

Rodrigues *et al.* (2003) studied the effects of 21 single crosses and 13 inbred lines of baby corn genotypes on yield and its components. The results showed that the hybrids 27A x 29B and 27A X 31B recorded the highest husked and dehusked yield of baby corn. As reported by Najeeb *et al.* (2011), the variety 114-2 x 187-2 recorded the highest cob weight with husk and without husk, cob diameter, cob yield and green fodder yield compared to varieties PS-78 and PS-79, while the average length of the cob was being higher with the variety PS-79.

Rani *et al.* (2011) observed significant genotypic differences in baby corn with regard to yield attributing characters indicating the presence of enough genetic variability among the varieties. The variety cv. VL-78 produced more number of cobs $plant^{-1}$ and cobs ha^{-1} and higher baby corn yield which was significantly greater by 8.1 per cent, 23.8 per cent and 30.4 per cent over HIM-129, Madhuri and Moti respectively. The variety Madhuri however recorded highest cob weight over HIM-129 and cob length over VL-78 and HIM-129. The variety Moti followed by Madhuri recorded significantly more de-husked cob length compared to VL-78 and HIM-129.

Kheibari *et al.* (2012) reported that the stover yield was highest with the baby corn cultivar KSC 704 followed by KSC 600 and KSC 403, however, the total cob yield was significantly higher with KSC 403. Partokazemi *et al.* (2012) pointed out that among the corn varieties, L.cv.sc 370, L.cv.sc 500 and L.cv.sc 540, the highest grain yield, biological yield, harvest index, 1000 seeds weight, ear length and number of grains per row were observed in the variety L.cv.sc 540.

In an investigation conducted by Ramachandrudu *et al.* (2013) in baby corn cultivars, the dehusked cob diameter was found to be maximum in *Rabi* season while it was minimum in *Kharif* season. The highest and lowest dehusked cob diameter was observed in baby corn varieties Mridula and COBC-1 respectively. Dehusked cob length was higher in *Rabi* and lower in *Kharif* season. Cobs produced by Madhuri followed by Golden Baby were longer than the cobs produced by varieties G-5406, VLBC-1, Mridula and COBC-1. Cob weight recorded in the variety Mridula was the highest while it was the lowest in VLBC-1. Among the varieties, dehusked cob weight was the highest in Golden baby and the lowest in COBC-1. The ratio of dehusked cob weight to green cob weight was found to be higher in *Kharif* season, whereas it was lower in *Rabi* season. Dehusked cob weight to green cob weight ratio and number of cobs per plant recorded were highest in the variety VLBC-1 while lowest in the variety Mridula. The cob yield was the highest in the variety Golden baby and lowest in

COBC-1. The fodder yield was however highest in variety Mridula and lowest in variety Madhuri.

Sobhana *et al.* (2013) reported that the baby corn hybrid HM 4 proved superiority over the baby corn hybrid PEHM 2 in terms of baby corn yield with husk, marketable cob yield and green fodder yield.

Asaduzzaman *et al.* (2014) anlysed the effect of four baby corn varieties *viz.,* Hybrid baby corn-271, BARI sweet corn-1, BARI Khoibhutta and Shuvra on yield attributes and yield. The number of ear plant^{-1} of baby corn varieties differed significantly among the varieties and highest number of cobs plant^{-1} was recorded in Hybrid baby corn-271 and the lowest in variety Shuvra. The cob length also varied significantly with variety Shuvra producing the longest cob and BARI sweet corn-1 producing the shortest cob. Significantly higher marketable cob yield was obtained from BARI sweet corn-1 which was statistically at par with Hybrid baby corn-271 and Khoibhutta and the lowest marketable cob yield was recorded in Shuvra. The cob yield with husk of baby corn was found to be the highest in Hybrid Baby Corn-271 and the lowest in Shuvra. The varieties Khoibhutta and BARI sweet corn-1 produced significantly higher corn yield with husk compared to Hybrid baby corn-271 and Shuvra. Significant difference was observed in case of fodder yield and the highest fodder yield was recorded with the variety Shuvra followed by Hybrid baby corn-271 and was the lowest in BARI sweet corn-1. The highest number of harvests was recorded in variety Khoibhutta while the lowest was recorded in Hybrid Baby Corn-271 which did not vary from Shuvra.

Kumar *et al.* (2015) evaluated six baby corn varieties *viz.,* FH-3438, VL baby corn, Vivek hybrid-17, HIM-129, Parkash and HM-4. The variety Vivek hybrid-17 significantly outyielded all other varieties with respect to baby corn yield with and without husk. The highest marketable cob yield was produced by Vivek hybrid-17 which was significantly higher than all other varieties. This variety also showed 5.1, 9.6, 21.7, 83.3 and 88.9 per cent superiority over VL baby corn, Parkash, HIM-129, FH- 3438 and HM-4, respectively in case of marketable cob yield. Significantly higher green fodder yield was produced by the variety Parkash compared to other varieties. The variety HM-4 had the highest baby corn length and girth. Significantly higher number of baby corn ears per plant was produced by VL baby corn which was also at par with Parkash and Vivek hybrid-17. The variety Parkash recorded more number of baby corn ears per ha than other varieties, except VL baby corn and Vivek hybrid-17 which were at par. The variety Vivek hybrid-17 attained maturity earlier than other varieties.

In another study, the variety HM 4 recorded significantly higher indices of the yield attributes *viz.,* number of cobs per plant, weight of corn with husk, weight of corn without husk, length of corn, corn yield and fodder yield in two years compared to VL Baby Corn-1 (Singh *et al.,* 2015).

Among different Amber pop corn maize cultivars VL-16, VL-41, VL-42, VL-78, VL-88, early duration double cross hybrid VL-42 produced the highest baby corn yield with an average of more than one corn per plant and was the earliest in maturity. The corns of this variety were cylindrical, longer, uniform and more attractive. Composite VL-16 was another suitable variety for baby corn production with potential yield of 1,102 kg ha^{-1} in 49 days (EIRI, 2016).

Lopes *et al.* (2016) analyzed four corn varieties for baby corn yield in Oxysoil and concluded that all yield attributing characters like cob length without and with husk, cob diameter without and with husk and cob weight without and with husk were the highest with the variety PC 0402 and the lowest with BRS Angela compared to the varieties PC 0404, BR 106 and IPR 114. Baby corn yield with husk and marketable cob yield were also the highest with the variety PC 0402 and the lowest with the variety BRS Angela.

2.2.3 Effect of Varieties on Quality Parameters

Varieties of baby corn were reported to be varying their quality parameters like protein, fibre, TSS, ascorbic acid etc. In a study conducted by Shanti *et al.* (2012), the baby corn varieties Vivek-17, Vivek-11 and Baby corn-1 were compared to assess the stover nutritional quality. In this trial, the variety Vivek-17 was found to have the highest crude protein content and the variety Baby corn-1 recorded the highest crude fibre content.

Hooda and Kawatra (2013) reported the superiority of baby corn variety HM-4 in quality parameters. In their study this variety contained 17.96 per cent protein, 2.13 per cent fat, 5.3 per cent ash and 5.89 per cent crude fibre. Total soluble sugars content was 23.43 g 100 g^{-1} while reducing sugar content was 1.96 g 100 g^{-1}. This variety was also found to have 5.43 mg 100 g^{-1} ascorbic acid in the cob. According to Sobhana *et al.* (2013) no significant variation in protein content was noticed between the baby corn hybrids HM 4 and PEHM 2; but the hybrid HM 4 recorded significantly higher value of total soluble sugar than the hybrid PEHM 2.

Dhaka *et al.* (2014) reported that in sweet corn, the highest total soluble solid content was recorded with the variety Sugar-75 compared to the variety Madhuri and was statistically at par with the varieties Misthi and Hi-Brix-51. The total digestible nutrients and protein content of green fodder of the variety Sugar-75 were significantly higher compared to other varieties.

Kumawat *et al.* (2014) concluded that among four sweet corn varieties (Sugar 75, Bajaura sweet corn, Win orange and Priya), the variety Sugar baby recorded significantly higher total soluble sugars and protein content in cob and stover. Lopes *et al.* (2016) reported that the corn variety PC 0402 lost less weight during storage periods as baby corn, followed by the varieties IPR 114 and BR 106. The varieties PC 0402 and BR 106 packed with straw were more suitable in relation to the quality aspects like colour and appearance for trading purposes.

2.2.4 Effect of Varieties on Soil Nutrient Status and Uptake

Nutrient uptake and soil nutrient status were influenced by varieties according to their genetic ability and interaction with environment. Wasonga *et al.* (2008) reported that the open pollinated maize variety Ababari recorded the highest P uptake compared to the varieties Oking and H513 at various experimental sites. As reported by Rani *et al.* (2011), the cultivar VL-78 had highest nitrogen uptake of 20 kg ha^{-1} at 30 and 62 kg ha^{-1} at 45 DAS compared to cultivars like HIM-129, Madhuri and Moti.

In an experiment with two baby corn hybrids HM 4 and PEHM 2, Sobhana *et al.* (2013) reported no significant variation in organic carbon, available N, K and Zn in soil due to variation in hybrids. However the available P content in soil was low in case of HM 4 compared to PEHM 2. The baby corn hybrid HM 4 also had higher values for N, P and K uptake in different plant parts compared to PEHM 2. Dhaka *et al.* (2014) reported that the highest nitrogen and phosphorus content and uptake by sweet corn in grain and fodder were registered by the variety Sugar-75 which were significantly higher than the other varieties (Madhuri, Hi-Brix-51 and Misthi).

Kumawat *et al.* (2014) compared four sweet corn varieties and reported that the variety Sugar 75 recorded higher nitrogen uptake of 103.12 kg ha^{-1} and phosphorus uptake of 18.44 kg ha^{-1} than Bajaura sweet corn, Win orange and Priya. The lowest uptake was recorded with the variety Priya. The available nitrogen and phosphorus content in soil were however not influenced by the varieties in this study.

2.2.5 Effect of Varieties on Net returns and Benefit: Cost Ratio

Varieties of corn are found to be differing in net income and benefit: cost ratio. Najeeb *et al.* (2011) reported that the baby corn variety 114-2 x 187-2 recorded the highest benefit: cost ratio compared to PS-78 and PS-79. Rani *et al.* (2011) evaluated four baby corn cultivars *viz.,* HIM-129, VL-78, Madhuri and Moti. The cultivars VL-78 recorded higher net returns by 14.1 per cent, 34.89 per cent and 84.35.0 per cent more than HIM-129, Madhuri and Moti respectively. The cultivar HIM-129 was the next best one which gave significantly higher net returns of 31485 ₹ ha^{-1} and B:C ratio of 2.3 than Madhuri and Moti.

Shanti *et al.* (2012) analyzed the economics of maize production and found that the gross returns, net returns and B: C ratio were higher in baby corn compared to maize grown for other purposes like grain, fodder or green cobs. In a study by Ramachandrudu *et al.* (2013), the baby corn varieties Golden baby, G-5406 and Mridula provided the higher net returns and benefit: cost ratio which did not vary each other.

Sobhana *et al.* (2013) compared two baby corn hybrids HM 4 and PEHM 2 and concluded that the hybrid HM 4 recorded higher net returns over PEHM 2. According to Dhaka *et al.* (2014), the variety Sugar-75 was the most efficient in realizing highest net returns of 94081 ₹ ha^{-1} and B:C ratio of 4.9 which were significantly higher over other varieties (Madhuri, Hi-Brix-51 and Misthi) in sweet corn.

Singh *et al.* (2015) reported that the baby corn variety HM 4 resulted in maximum gross returns (104504 ₹ ha^{-1}), net returns (81708 ₹ ha^{-1}) and benefit: cost ratio (3.58) over VL baby corn-1. Lopes *et al.* (2016) reported that the corn varieties when grown as baby corn, the highest net income was recorded with the varieties PC 0404 and BRS Angel compared to PC 0402, BR 106 and IPR 114.

2.3 EFFECT OF SPACING IN BABY CORN

The spatial arrangement of plants in general governs the production of leaves and their area which in turn influences the light interception, growth, growth attributes and yield.

Vega *et al.* (2001) reported that maize yield is more affected by variations in plant density due to its low tillering ability and the presence of a brief flowering period compared to other members of the grass family. Plant density is of particular importance in corn, as it does not have tillering capacity to adjust to variation in plant stand. According to Widdicombe and Thelen, (2002) cultivation of plants with desirable density has positive effect on crop yield components, so higher yield will be achieved by optimum plant density.

Singh and Chaudhary (2008) observed that plant density exerts a strong influence on maize growth, because of its competitive effect both on the vegetative and reproductive development. Optimum plant density leads to proper utilization of solar radiation which in turn influences leaf area, interception and utilization of solar radiation and consequently corn dry matter accumulation and biomass production (Moosavi *et al.,* 2012).

2.3.1 Effect of Spacing on Growth and Growth Attributes

The availability of space in the intercropping situation influences efficient interception of radiation energy, root proliferation and growth of above ground biomass. Ayisi and Poswall (1997) suggested that high plant density in maize increases total light interception by the crop canopy, which increases the total dry matter and leaf area index. According to Sukanya *et al.* (1999), LAI was markedly influenced by spacing levels in baby corn. In their study it was observed that plant height was decreasing with the increase in spacing, however the wider spacing of 45 cm x 30 cm recorded significantly higher LAI, dry matter production and extended harvest period as compared to 60 cm x 15 cm and 45 cm x 15 cm spacing levels.

According to Chougule (2003) plant height, number of functional leaves, leaf area and total dry matter production per plant were significantly higher with 60 cm x 20 cm spacing than the closer spacing *viz.* 45 cm x 15 cm, 45 cm x 20 cm and 60 cm x 15 cm in sweet corn. Thavaprakaash *et al.* (2005a) reported that baby corn raised at 60 cm x 19 cm spacing produced taller plants, higher LAI and more dry matter production during late *Rabi* season than 45 cm x 25 cm spacing. In another study, Thavaprakaash *et al.* (2005b) reported that growth characters *viz.,* plant height, LAI and dry matter production in baby corn were significantly higher at 60 cm x 19 cm wider row spacing than 45 cm x 25 cm spacing.

According to Thavaprakaash and Velayudham (2008), the 60 cm x 19 cm spacing of baby corn intercepted more light at 25, 45 and 60 DAS and at harvest compared to 45 cm x 25 cm. Another spacing trial by Kunjir *et al.* (2009) indicated that the spacing of 45 cm x 20 cm recorded significantly higher plant height of sweet corn compared to 60 cm x 20 cm and 75 cm x 20 cm spacing. The broader spacing of 75 cm x 20 cm produced significantly more number of leaves and dry matter per plant than the closer spacing of 45 cm x 20 cm and it was at par with 60 cm x 20 cm spacing.

In a study on forage corn, increase in plant density from 50,000 to 1,40,000 plants ha^{-1} was found to increase the plant height by 15.1 per cent and a plant density of 1,40,000 plants ha^{-1} produced 3.4 times higher LAI compared to that of 50,000 plants ha^{-1} (Moosavi *et al.,* 2012).

Shafi *et al.* (2012) observed an increase in plant height of maize cultivars with increased sowing density. As per Chauhan and Opena (2013), the spacings 50 cm x 20 cm, 50 cm x 30 cm, 75 cm x 20 cm, or 75 cm x 30 cm did not influence the plant height and number of leaves in maize. However, the leaf area and shoot biomass were greatly influenced by the crop geometry and at 4 and 8 weeks after planting, highest leaf area was produced by plants grown at 50 × 20 cm spacing.

According to Rathika *et al.* (2013a), light interception in baby corn was significantly higher at wider row spacing of 75 cm x 16 cm compared to 60 cm x 20 cm. Portes and Melo (2014) reported that in maize, LAI and total dry matter production were significantly higher at a density of 40,000 plants ha^{-1} compared to 26,600, 20,000, 16,000 and 13,300 plants ha^{-1}.

In another study on population density it was reported that plant population of 1,11,111 plants ha^{-1} recorded significantly higher growth attributes *viz.,* plant height and LAI compared to 83,333 plants ha^{-1} in maize (Kumar *et al.,* 2015). According to Nand (2015), maize plants sown at a spacing 60 cm x 20 cm produced higher plant height, number of leaves, LAI and dry matter production compared to 45 cm x 20 cm and 60 cm x 25 cm spacings.

Singh *et al.* (2015) reported that in baby corn, a spacing of 60 cm x 25 cm recorded significantly higher plant height and number of leaves over 45 cm x 25 cm. The spacing 45 cm x 25 cm however resulted in more dry matter accumulation per plant. In another spacing trial by Thakur *et al.* (2015), among different spacing levels (30 cm x 30 cm, 50 cm x 30 cm, 30 cm x 60 cm and 50 cm x 50 cm), the plant height and LAI were significantly higher with the spacing 30 cm x 30 cm followed by 50 cm x 30 cm in sweet corn. However, days to 50 per cent flowering was not influenced by the crop geometry.

Sarwar *et al.* (2016) reported that, among different spacings (75 cm x 25 cm, 75 cm x 20 cm, 60 cm x 25 cm, 65 cm x 20 cm, 50 cm x 25 cm) tried in maize, tallest plants with highest number of leaves and LAI were recorded with 75 cm x 25 cm and short statured plants with lowest number of leaves and the lowest LAI were recorded with 50 cm x 25 cm spacing, though the dry matter production was the highest with the narrow spacing (50 cm x 25 cm). Days to tasseling and silking were significantly influenced by plant spacing and the spacing of 60 cm x 25 cm took lesser days for tasseling; wherein, 75 cm x 20 cm required more days. The spacing 60 cm x 25 cm required minimum days for silking while 50 cm x 25 cm spacing required more number of days.

2.3.2 Effect of Spacing on Yield Attributes and Yield

The effect of crop geometry on yield and yield attributes of baby corn is contradictory. Some studies indicated that yield attributes and yield are positively influenced by wider spacing while some other investigations showed negative influence.

Alessi and Power (1974) reported that crop spaced at 100 cm between rows produced bigger ears plant^{-1} as compared to crop planted at 50 cm row spacing in dry land corn. According to Kotch *et al.* (1995) plant to plant spacing of 10 cm is the best for baby corn production. Thakur *et al.* (1995) evaluated an early composite maize cultivar under different spacing regimes viz., 40 cm x 20 cm, 40 cm x 10 cm, 60 cm x 20 cm, 60 cm x 10 cm and reported that the optimum spacing for baby corn production was 40 cm x 20 cm and for green fodder production was 40 cm x 10 cm.

Thakur *et al.* (1997) observed that at wider spacing of 60 cm x 20 cm, growth and yield attributes in baby corn significantly increased, but could not compensate baby corn yield obtained in narrow spacing. In their study, a plant spacing of 40 cm x 20 cm increased the baby corn yield by 28.2, 11.3 and 9.4 per cent over 60 cm x 20 cm, 60 cm x 10 cm and 40 cm x 10 cm spacing respectively in sandy loam soil of Kullu valley during rainy season.

Sahoo and Panda (1999) reported that the spacing 40 cm x 20 cm appeared to be more advantageous in terms of baby corn yield. According to Sukanya *et al.* (1999), spacing of 45 cm x 30 cm produced the highest baby corn yield as compared to 60 cm x 15 cm and 45 cm x 15 cm, however the green fodder yield was the highest at 45 cm x 15 cm spacing.

According to Thakur *et al.* (2000), the highest baby corn yield was obtained under close spacing (40 cm x 40 cm) since the highest plant density produced more number of cobs ha^{-1}. Ramachandrappa *et al.* (2004) in their field experimentation observed the wider spacing of 45 cm x 30 cm recording higher number of baby ears per plant, husked baby corn length, girth and weight as compared to narrow spacing.

Thavaprakaash *et al.* (2005a) reported that baby corn yield attributes *viz.,* length of cob and corn, diameter of cob and corn and weight of cob and corn; green cob yield and fodder yield were significantly higher at 60 cm x 19 cm wider row spacing than 45 cm x 25 cm spacing level. Thavaprakaash *et al.* (2005b) reported that in both *Kharif* and summer seasons, crop geometry resulted in substantial increase in green cob yield of baby corn with higher yields in the *Kharif.* Baby corn when grown at 60 cm x 19 cm produced higher cob yields over 45 cm x 25 cm spacing. The results of pooled analysis of data also followed the same trend.

Kar *et al.* (2006) pointed out that the spacing of 60 cm x 20 cm significantly increased the number of prime cobs and green-cob yield followed by 45 cm x 30 cm spacing in sweet corn. According to Thavaprakaash and Velayudham (2008), baby corn raised at 60 cm x 19 cm produced higher cob yields and fodder yields over 45 cm x 25 cm spacing.

In a spacing trial conducted by Gosavi and Bhagat (2009) in baby corn, among the spacing levels tried (60 cm x 20cm, 45 cm x 20cm and 30 cm x 20 cm), the spacing 60 cm x 20 cm was at par with 45 cm x 20 cm spacing recording significantly higher values of yield attributing characters like length of baby corn, number of cobs per plant, cob weight with husk and without husk compared to 30 cm x 20 cm spacing. Baby corn yield with and without husk was significantly higher at the spacing 45 cm x 20 cm compared to other spacing levels, but the green fodder production was significantly higher at 30 cm x 20 cm spacing.

Wider spacing of 75 cm x 20 cm in sweet corn recorded significantly higher values for cob length, cob girth and weight of cob than 60 cm x 20 cm and 45 cm x 20 cm spacings (Kunjir *et al.,* 2009). In another study on forage corn, total fresh and dry yield were 83.8 per cent higher under a density of 1,40,000 plants ha^{-1} compared to a density of 50,000 plants ha^{-1} (Moosavi *et al.,* 2012). According to Partokazemi *et al.* (2012), as the planting density increased from 65,000 to 85,000 plants ha^{-1}, the grain yield and biological yield got decreased significantly in corn.

In another spacing trial in baby corn, Chauhan and Opena (2013) reported that among the spacings tried (50 cm x 20 cm, 50 cm x 30 cm, 75 cm x 20 cm, and 75 cm x 30 cm), the highest grain yield was produced by plants grown at narrow spacing. Golada *et al.* (2013) reported the crop spacing 60 cm x 15 cm significantly influencing yield attributes in baby corn and maximum green cob yield, baby corn yield and green fodder yield were recorded at 60 cm x 15 cm spacing compared to 45 cm x 20 cm, 60 cm x 15 cm and 90 cm x 10 cm spacings.

According to Rathika *et al.* (2013b), baby corn grown at wider row (75 cm x 16 cm) spacing produced 7.0 and 6.3 per cent higher cob yield over narrow row (60 cm x 20 cm) spacing during 2006 and 2007 respectively. Pooled analysis of data also showed wider row spacing recording 6.7 per cent higher green cob yield than narrow row spacing. Sobhana *et al.* (2013) reported that the plant density of 83,333 plants ha^{-1} recorded significantly higher baby corn yield with and without husk and fodder yield compared to the plant density of 66,666 plants ha^{-1}.

Dar *et al.* (2014) concluded that baby corn yield and fodder yield were higher in 50 cm x 15 cm crop geometry than all other crop geometry treatments *viz.,* 40 cm x 15 cm, 40 cm x 20 cm, 50 cm x 20 cm, 60 cm x 15 cm and 60 cm x 20 cm.

Sarjamei *et al.* (2014) opined that among the plant densities studied (90,000, 1,20,000 and 1,50,000 plants ha^{-1}) in baby corn, the highest and lowest ear yield were obtained under 1,20,000 and 90,000 plants per hectare. The highest number of ears per plant was produced by 1,20,000 plants per ha^{-1}, but 1,50,000 plants per ha^{-1} produced the highest dehusked ear yield. In another investigation, Sorkhi and Fateh, (2014) reported that among the different plant densities tried for maize (60,000, 70,000, 80,000 and 90,000 plants ha^{-1}), the highest grain yield was recorded with 80,000 plants ha^{-1} while fodder yield was recorded with 90,000 plants ha^{-1}.

Portes and Melo, (2014) reported that in maize, the grain yield at a density of 40,000 plants ha^{-1} was higher than the other densities (26,600, 20,000, 16,000 and 13,300 plants ha^{-1}), though the number of cobs per plant produced were lower. As pointed out by Kumar *et al.* (2015), plant population of 1,11,111 plants ha^{-1} recorded significantly higher grain yield and stover yield compared to 83,333 plants ha^{-1} in maize.

In maize, the spacing of 60 cm x 20 cm was found to significantly increase the cob length, cob girth, cob weight, grains weight per cob and grain yield compared to the spacing of 60 cm x 25 cm or 45 cm x 20 cm (Nand, 2015). The spacing 45 cm x 25 cm recorded significantly higher cob yield and green fodder yield over 60 cm x 25 cm in baby corn (Singh *et al.,* 2015).

According to Thakur *et al.* (2015), fresh kernel weight of sweet corn was significantly higher at 50 cm x 50 cm compared to 30 cm x 30 cm, 50 cm x 30 cm or 30 cm x 60 cm, but was comparable with 60 cm x 30 cm. The spacing 50 cm x 50 cm also recorded significantly higher cob yield and weight of cob with and without cover.

Results of another study indicated that 60 cm x 20 cm spacing recorded higher husked baby corn and dehusked baby corn yield when compared to 45 cm x 20 cm, 45 cm x 30 cm and 60 cm x 30 cm spacings, though the fodder yield recorded was the highest with 45 cm x 20 cm spacing (EIRI, 2016).

Sarwar *et al.* (2016) reported that the number of cobs per plant was not significantly influenced by the crop geometry in maize. The highest cob length was however recorded in 75 cm x 25 cm and the minimum cob length in 50 cm x 25 cm spacing. The highest grain yield was observed in 50 cm x 25 cm spacing followed by 65 cm x 20 cm.

2.3.3 Effect of Spacing on Quality Attributes

The availability of space under different crop geometries influence efficient interception of radiation energy, photosynthetic rate, synthesis of biomass and translocation of photosynthates from source to sink. Sukanya (1997) reported that wider spacing of 45 cm x 30 cm recorded significantly higher protein, reducing sugars and ascorbic acid content compared to 45 cm x 15 cm or 60 cm x 15 cm spacing in baby corn.

Ramchandrappa *et al.* (2004) observed that 45 cm x 30 cm spacing in baby corn recorded the highest values for nutritional parameters *viz.* crude protein, phosphorus, potassium, calcium, sugars, ascorbic acid and crude fibre content than other spacings *viz.* 45 cm x 25 cm and 30 cm x 30 cm. According to Kar *et al.* (2006) the highest protein yield was obtained with 60 cm x 20 cm spacing than other spacings (45 cm x 30 cm, 45 cm x 20 cm or 60 cm x 30 cm) in sweet corn. Thavaprakaash *et al.* (2008) reported that, crop geometry could not influence fodder quality parameters like crude fibre, crude protein, nitrogen free extract and ether extract contents in baby corn.

According to Kunjir *et al.* (2009), wider spacing of 75 cm x 20 cm recorded significantly higher protein and sugar contents than the closer spacing of 60 cm x 20 cm and 45 cm x 20 cm in sweet corn. Das *et al.* (2009) reported that the highest protein content was noticed at 60 cm x 10 cm spacing, while the highest ascorbic acid content was observed at 60 cm x 15 cm. Wider spacing of 60 cm x 20 cm recorded significantly higher protein and sugar content than the narrow spacing in baby corn as reported by Gosavi and Bhagat (2009). The study also indicated that 45 cm x 20 cm and 30 cm x 20 cm spacings were at par with respect to both these quality parameters.

A study on maize crop by Barbieri *et al.* (2013) indicated that a higher leaf chlorophyll content by the plants grown at narrow row spacing (35 cm between rows) compared with conventional spacing of 75 cm between rows.

Sobhana *et al.* (2013) reported a decline in crude protein content of baby corn cob with the increase in plant density from 66,666 plants ha^{-1} to 83,333 plants ha^{-1}. They also noticed that total soluble sugar content was not influenced by the plant densities. Accoring to Dar *et al.* (2014), crop geometry of 60 cm x 20 cm recorded significantly higher crude protein content. At 40 cm x 20 cm spacing, lower crude protein content in baby corn cob, stover, cob husk and tassel were recorded compared to all other crop geometries (40 cm x 20 cm, 50 cm x 15 cm, 50 cm x 20 cm and 60 cm x 15 cm). Acid detergent fibre content of fodder was significantly higher at the wider spacing (60 cm x 20 cm) though no significant effect of crop geometry was found on neutral detergent fibre, hemicellulose content, ash and ether extract content of fodder.

Nand (2015) pointed out that in maize, the spacing of 60 cm x 20 cm significantly increased the protein content and protein yield compared to 60 cm x 25 cm and 45 cm x 20 cm spacings.

2.3.4 Effect of Spacing on Soil Nutrient Status and Uptake

Crop geometry influences plant uptake, soil nutrient relations and other chemical properties positively or negatively. According to Kar *et al.* (2006) the total N uptake by sweet corn was highest at 60 cm x 20 cm (53.62 kg ha^{-1}), though it was on a par with other spacings (45 cm x 30 cm, 45 cm x 20 cm, 60 cm x 20 cm, 60 cm x 30 cm). Kunjir *et al.* (2009) reported that wider spacing of 75 cm x 20 cm recorded significantly higher uptake of nitrogen, phosphorus, potassium compared to closer spacing of 60 cm x 20 cm and 45 cm x 20 cm in sweet corn. Srikanth *et al.* (2009) reported that spacing had significant influence on the N uptake in corn. The spacing 75 cm x 20 cm recorded a higher N (109.6 kg ha^{-1}), P (21.4 kg ha^{-1}) and K (164.6 kg ha^{-1}) uptake over the spacing 60 cm x 20 cm and the wider spacing of 75 cm x 20 cm recorded higher available N (173.1 kg ha^{-1}), P (14.65 kg ha^{-1}) and K (576.4 kg ha^{-1}) status in soil.

According to Aravinth *et al.* (2011), baby corn spaced at 60 cm x 15 cm recorded higher uptake of nitrogen, phosphorus and potassium during *Kharif* and summer 2007 seasons compared to 45 cm x 25 cm spacing. The results of the study by Barbieri *et al.* (2013) in maize indicated a greater N uptake capacity by the plants at narrow row spacing (35 cm between rows) compared with conventional spacing of 75 cm between rows.

Sobhana *et al.* (2013) reported that with increasing plant population of baby corn hybrids from 66,666 plants ha^{-1} to 83,333 plants ha^{-1}, there was significant reduction in contents of available N, P, K and organic carbon in soil. In their experiment, more uptake of P and K by baby corn and total N uptake in stover were found to be associated with a higher plant population of 83,333 plants ha^{-1} than 66,666 plants ha^{-1}. Kumar *et al.* (2015) reported significantly higher nitrogen uptake, phosphorus and potassium uptake with a density of 1,11,111 plants ha^{-1} in baby corn.

Dar *et al.* (2014) pointed out that a higher nitrogen uptake in baby corn cob, stover, cob husk and tassel were observed at spacings 50 cm x 15 cm and 40 cm x 20 cm crop geometry as compared to all other treatments (40 cm x 15 cm, 50 cm x 20 cm, 60 cm x 15 cm and 60 cm x 20 cm) and the lowest total nitrogen uptake (104.77 kg ha^{-1}) was recorded with the spacing 40 cm x 15 cm.

2.3.5 Effect of Spacing on Net Returns and Benefit: Cost Ratio

Economics of corn cultivation was influenced by crop geometry as reported by many researchers. Sahoo and Panda (1999) revealed that the spacing of 40 cm x 20 cm appeared to be more advantageous in terms of benefit: cost ratio in baby corn cultivation. In another study, Kar *et al.* (2006) pointed out that the spacing of 60 cm x 20 cm significantly increased the net returns and benefit : cost ratio followed by that at 45 cm x 30 cm in sweet corn.

According to Das *et al.* (2009), net returns (144900 ₹ ha^{-1}) and benefit: cost ratio (11.32) of baby corn was significantly higher at the spacing of 50 cm x 15 cm. Sobhana *et al.* (2013) reported that the plant density 83,333 plants ha^{-1} recorded higher net returns over a density of 66,666 plants ha^{-1} in baby corn.

Dar *et al.* (2014) reported that the highest net income of 162400 ₹ ha^{-1} and benefit: cost ratio of 2.31 were recorded in planting geometry of 50 cm x 15 cm as compared to other planting geometries (40 cm x 15 cm, 40 cm x 20 cm, 50 cm x 20 cm, 60 cm x 15 cm and 60 cm x 20 cm) in baby corn.

Kumar *et al.* (2015) indicated that a plant population of 1,11,111 plants ha^{-1} recorded significantly higher net returns and benefit cost ratio compared to 83,333 plants ha^{-1} in maize. According to Singh *et al.* (2015), sowing the crop at 45 cm x 25 cm spacing resulted in maximum gross returns (112963 ₹ ha^{-1}), net returns (90148 ₹ ha^{-1}) and benefit: cost ratio (3.95) when compared to 60 cm x 25 cm in baby corn.

Thakur *et al.* (2015) reported that in sweet corn, net income (172513 ₹ ha^{-1}) was significantly higher at 30 cm x 30 cm but the B: C ratio was statistically on a par in all planting geometries (30 cm x 30 cm, 50 cm x 30 cm, 30 cm x 60 cm and 50 cm x 50 cm); though the highest value was obtained with 30 cm x 30 cm spacing.

The review of literature indicated the influence of varietal characters and planting geometry or planting density on growth, yield attributes and yield of speciality maize, 'baby corn'. Various studies also pointed out the effect of variation in cutivars and planting geometry on quality parameters and economics of cultivation of baby corn crop in different growing conditions.

Materials and Methods

3. MATERIALS AND METHODS

The field experiment entitled "Varietal suitability and crop geometry of baby corn (*Zea mays* L.) in coconut garden" was conducted at Coconut Research Station, Balaramapuram during 2015 to study the feasibility of baby corn cultivation as an intercrop in coconut garden and also to assess the effect of varieties and spacings on the growth and productivity of baby corn and to work out the economics. Two crops were raised during summer (March to May) and *Kharif* season (August to October) in 2015. The materials used and methods followed for the research work are presented in this chapter.

3.1 EXPERIMENTAL SITE

The experiment was conducted in the garden land of Coconut Research Station, Balaramapuram in the interspaces of matured coconut palms (53 years old West Coast Tall variety) which is situated at 8° 23' 55.10328" N latitude and 77° 1' 48.9774" E longitude at an altitude of 26 m above mean sea level.

3.1.1 Soil

A composite soil sample was collected from a depth of 0-15 cm and analysed for its physico – chemical properties. The data on physio-chemical properties of the soil are presented in Table 1 and 2. Chemical properties of the soil were rated as per the package of practices recommended by Kerala Agricultural University (KAU, 2011). The soil of the experimental site was red sandy loam, very strongly acidic in reaction, normal in electrical conductivity, high in organic carbon, low in available nitrogen and phosphorus and low in available potassium.

Table 1. Mechanical composition of the soil of the experimental site

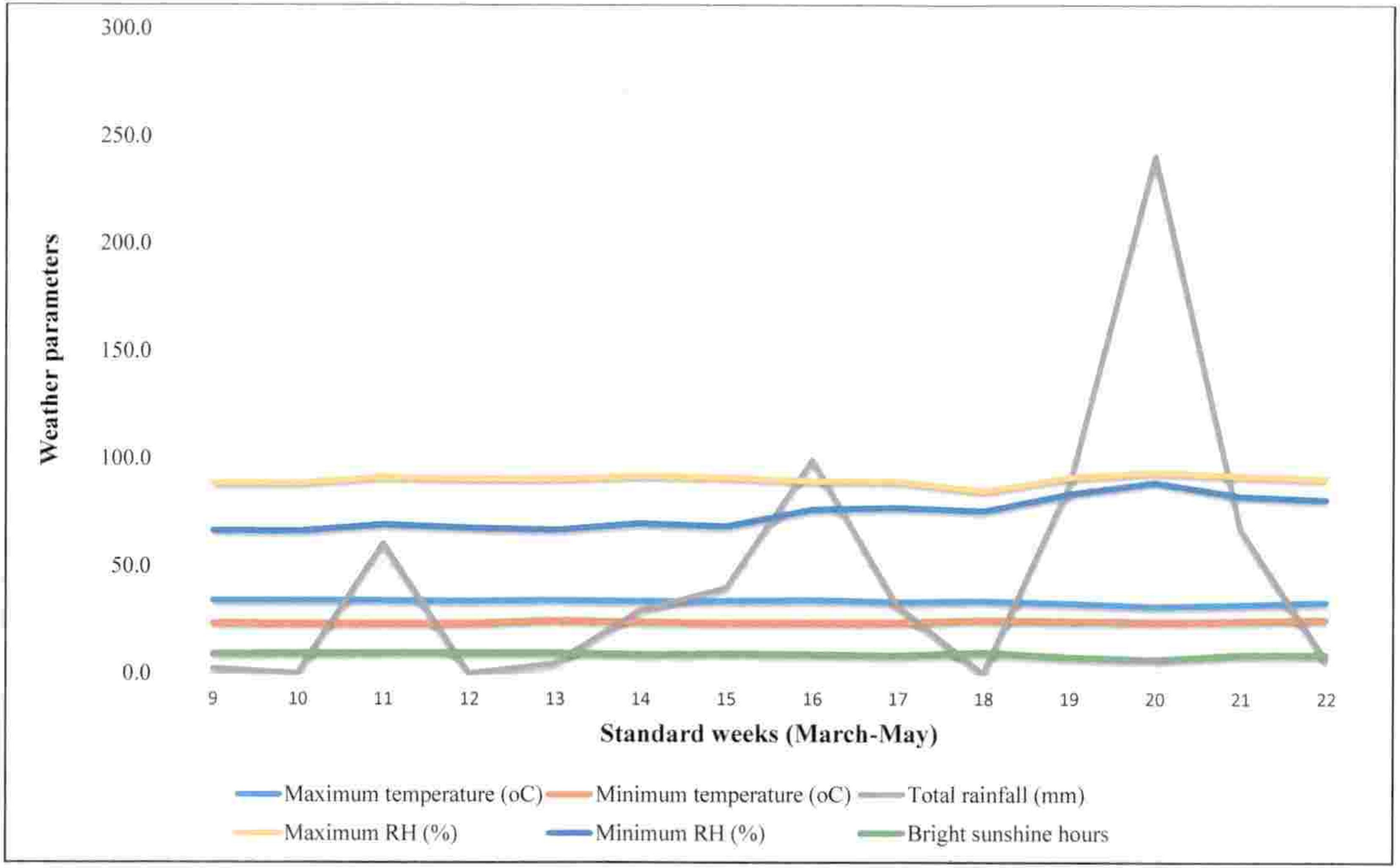
Sl. No.	Fractions	Content (%)	Method used
1	Sand	66.33	Bouyoucos hydrometer method (Bouyoucos, 1962)
2	Silt	18.16	
3	Clay	15.13	

Table 2. Chemical properties of soil of the experimental site

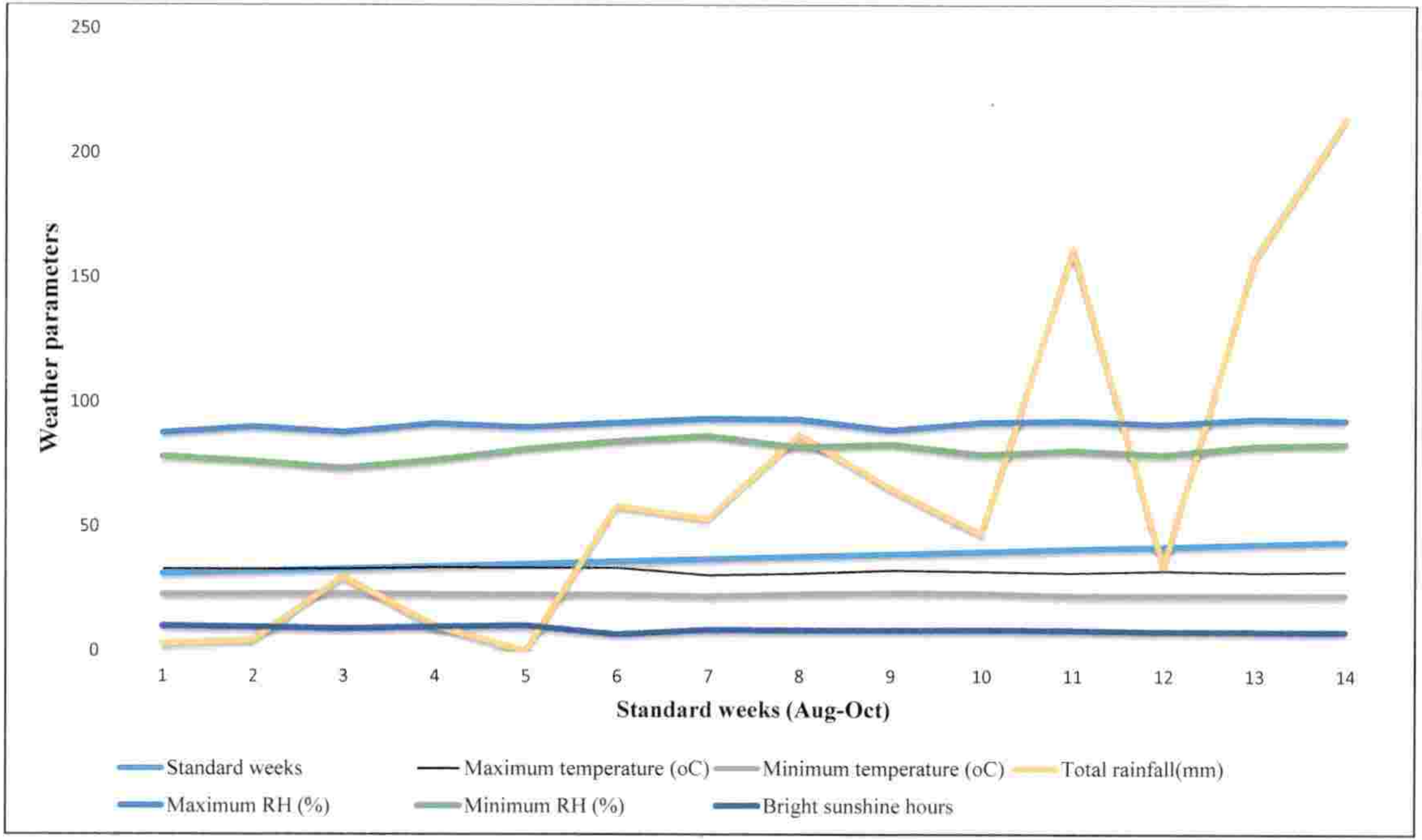
Parameter	Content	Rating	Method used
Soil reaction (pH)	4.6	Very strongly acidic	1:2.5 soil solution ratio using pH meter with glass electrode (Jackson, 1973)
Electrical conductivity (dSm^{-1})	0.10	Normal	Digital conductivity meter (Jackson, 1973)
Organic carbon (%)	2.34	High	Walkley and Black rapid titration method (Jackson, 1973)
Available N ($kg\ ha^{-1}$)	213.25	Low	Alkaline permanganate method (Subbiah and Asija, 1956)
Available P_2O_5 ($kg\ ha^{-1}$)	16.35	Medium	Bray colorimetric method (Jackson, 1973)
Available K_2O ($kg\ ha^{-1}$)	95.76	Low	Ammonium acetate method (Jackson, 1973)

3.1.2 Climate and Season

The experimental site had a warm and humid climate. The first crop of baby corn was raised during the summer season (March - May) and the second crop was raised during the *Kharif* season (August - October) of 2015. The data on weekly mean temperature, relative humidity and rainfall were collected from the Meteorological Observatory of the Coconut Research Station, Balaramapuram. The data are presented in Appendix I and II and graphically illustrated in Fig. 1 and 2.



Weather data during the cropping period in summer (March to May 2015)



Weather data during the cropping period in *Kharif* (August to October 2015)

The mean maximum temperature ranged between 31.4 ^{0}C – 34.2 ^{0}C and mean minimum temperature ranged between 23.2 ^{0}C – 25.2 ^{0}C during the summer season. During the *Kharif* season the mean maximum temperature ranged between 30.5 ^{0}C – 33.6 ^{0}C and mean minimum temperature ranged between 22.2 ^{0}C – 23.5 ^{0}C. The mean maximum relative humidity ranged between 85.1 per cent to 94.0 per cent during summer season and 87.6 per cent to 93.4 per cent during *Kharif* season, while the mean minimum relative humidity ranged between 66.3 per cent to 89.1 per cent and 73.4 per cent to 86.4 per cent during summer and *Kharif* seasons respectively. A total rainfall of 670.0 mm was recorded during the summer crop period and 926.2 mm rainfall was recorded during the *Kharif* crop period.

3.1.3 Previous Cropping History of the Experimental Plot

The field was left uncultivated for few months before the conduct of the experiment and prior to that a bulk crop of banana was grown in the field.

3.2 MATERIALS

3.2.1 Crop and Varieties

Baby corn crop was raised in the interspaces of coconut garden. Three maize varieties Rasi 4212, G 5414 and CO-6 were selected for growing as baby corn. The varietal features are presented in Table 3.

Table 3. Important varietal features

Sl. No	Varietal features	Rasi 4212	G 5414	CO-6
1.	Nature of variety	Maize hybrid	Baby corn hybrid	Maize hybrid
3.	Duration (days)	80-85	50-55	110
4.	Uniformity of cobs	Good	Very good	Good
5.	Type & colour of grains	Semi dent, orange yellow	Uniform sized creamy/ light yellow	Semi dent, orange yellow
6.	Releasing agency	Rasi seeds Pvt. Ltd.	Syngenta Seed Co. Ltd.	TNAU
7.	Cost of seeds (₹ kg^{-1})	130	450	150

3.2.2 Manures and Fertilizers

Well decomposed farm yard manure containing 0.51 per cent N, 0.61 per cent P_2O_5 and 0.31 per cent K_2O was used as the source of organic manure during the first crop period in summer. During the second season (*Kharif*), farm yard manure containing 0.50 per cent N, 0.64 per cent P_2O_5 and 0.31 per cent K_2O was used as manure source. Urea (46 per cent N), Rajphos (20 per cent P_2O_5) and Muriate of potash (60 per cent K_2O) were used as chemical sources of nitrogen, phosphorus and potassium respectively during both the cropping seasons.

3.3 METHODS

3.3.1 Design and Layout

Design : Randomized Block Design

Treatments : 9

Replications : 3

Plot size : 7.2 m x 3.0 m

3.3.1.1 Treatments

Varieties

V_1 : Rasi 4212

V_2 : G 5414

V_3 : CO-6

Spacings

S_1 : 30 cm x 20 cm (1,66,666 plants ha^{-1})

S_2 : 45 cm x 20 cm (1,11,111 plants ha^{-1})

S_3 : 60 cm x 20 cm (83,333 plants ha^{-1})

Treatment combinations

V_1S_1	V_1S_2	V_1S_3
V_2S_1	V_2S_2	V_2S_3
V_3S_1	V_3S_2	V_3S_3

3.3.2 Crop Management

3.3.2.1 Land Preparation

The experimental area was ploughed using a power tiller, levelled and ridges were taken in each plots according to the spacing.

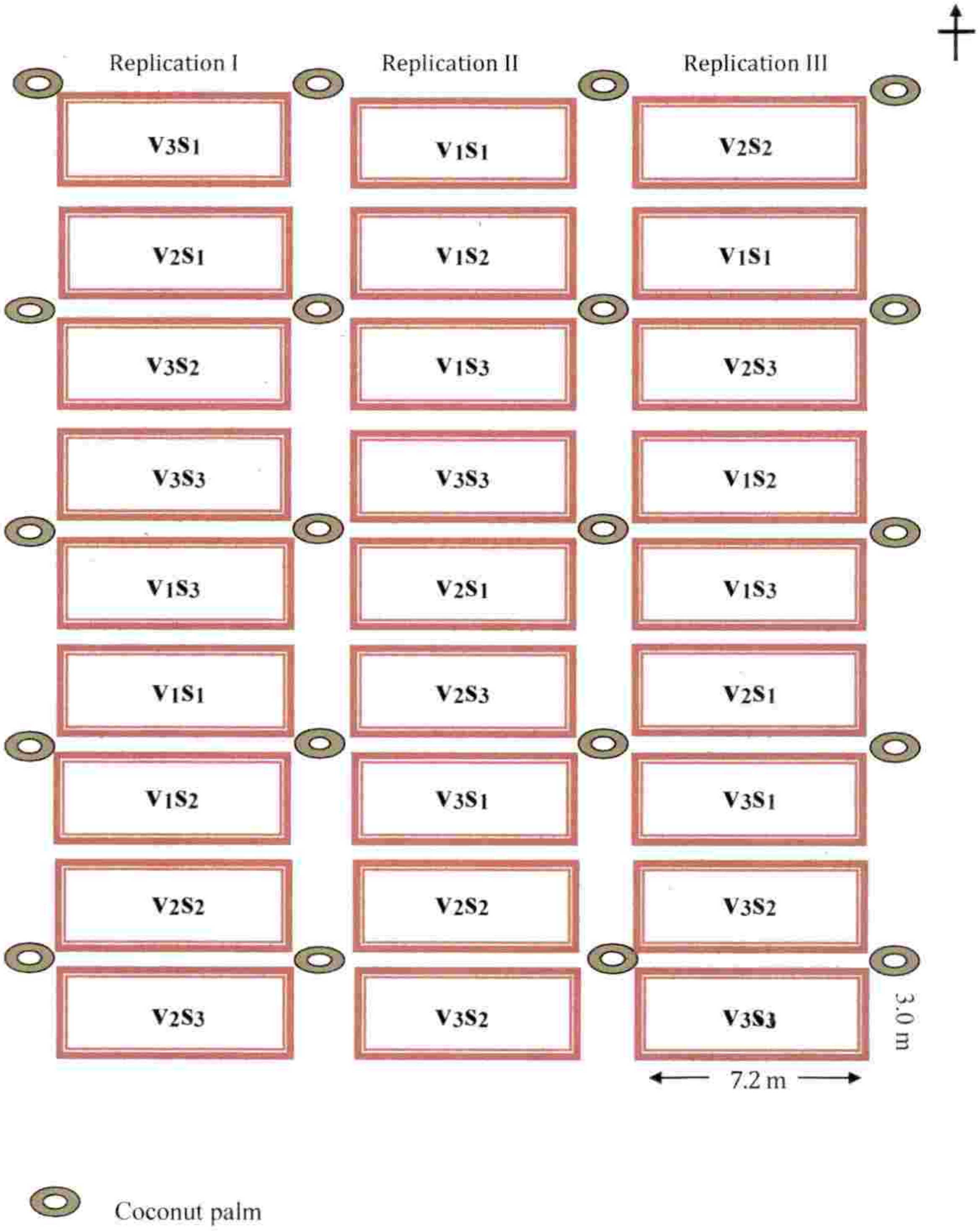


Fig. 3. Layout of field experiment

3.3.2.2 Sowing

Seeds of each variety were dibbled on ridges as per the spacing requirement of treatments.

3.3.2.3 Application of Manures and Fertilizers

Farm yard manure was applied @ 25 t ha^{-1} at the time of final ploughing. The fertilizer recommendation adopted was 135: 65: 45 kg NPK ha^{-1}. Full dose of phosphorus, half of the recommended nitrogen and half of the recommended potassium were applied as basal. The remaining dose of nitrogen and potassium were top dressed on 25^{th} day after planting (DAP).

3.3.2.4 Weeding and Earthing up

Weeding and earthing up was done at 21 and 45 days after sowing (DAS) in each plot.

3.3.2.5 Irrigation

Crop was irrigated on the day of sowing and on third day. Subsequent irrigations were given twice a week. For the summer season crop, irrigation was given more frequently compared to the rainy season crop.

3.3.2.6 De-tasseling

Tassel (male flower) of each plant was removed before pollen shedding at 40-45 DAS, so as to prevent pollination and fertilization of cobs.

3.3.2.7 Harvest

Unfertilized, immature cobs were plucked by hand at about three days after silk emergence.

Plate 1. General view of the experimental field

Plate 2. Field with detasseled corn plants

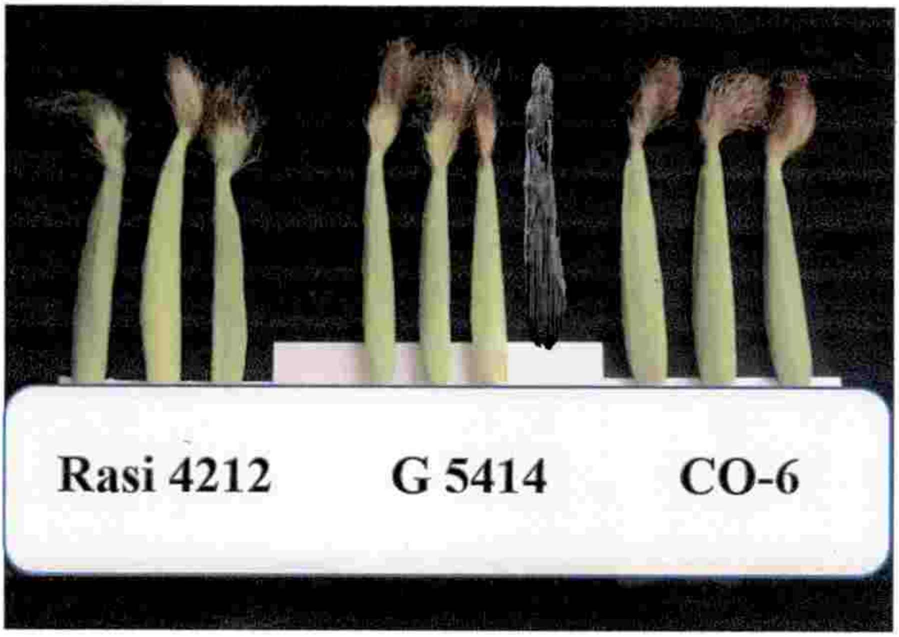


Plate 3. Baby corns of varieties with husk

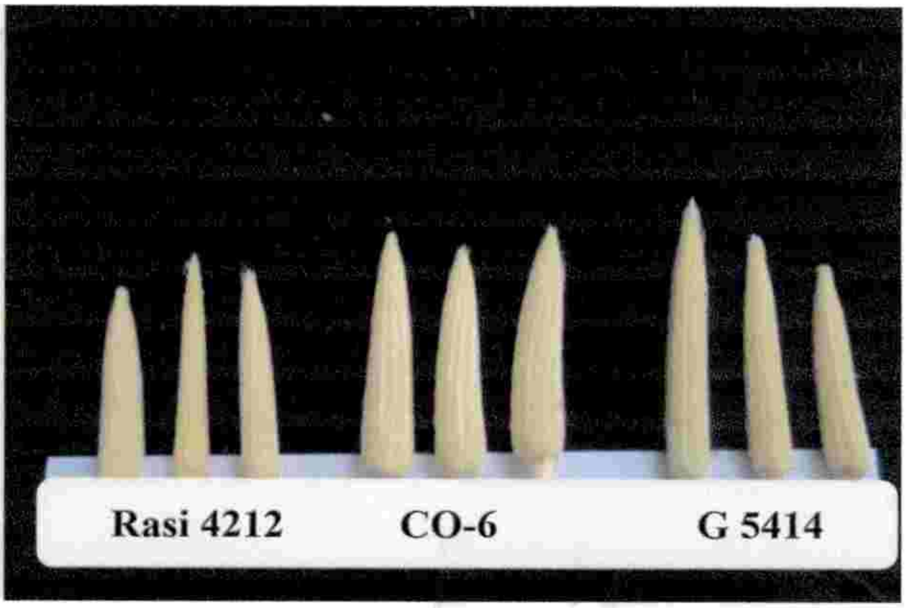


Plate 4. Baby corns of varieties without husk

3.4 OBSERVATIONS

3.4.1 Growth and Growth Attributes

Four representative plants were tagged as observation plants from each plot, excluding the border rows. Observations were recorded from these plants and the average value was calculated.

3.4.1.1 Plant Height

Plant height was measured from the ground level to the collar of the upper most fully opened leaf up to the flowering stage and from ground level up to the base of tassel after flowering at 15 days after emergence (DAE), 30 DAE and 45 DAE and expressed in cm.

3.4.1.2 Leaves per Plant

The number of functional leaves per plant was recorded by counting the fully opened green leaves at 15 DAE, 30 DAE and 45 DAE.

3.4.1.3 Leaf Area Index

Leaf area index was computed at 15 DAE, 30 DAE and 45 DAE, as per the formula suggested by Balakrishnan *et al.* (1987). The length of the fully opened leaf lamina was measured from the base to the tip. Leaf breadth was taken at the widest point of the leaf lamina.

$$\text{LAI} = \frac{L \times B \times N \times K}{\text{Plant spacing (cm)}}$$

L = leaf length (cm)

B = leaf breadth (cm)

N = total number of leaves per plant

K = constant (0.796)

3.4.1.4 Days to 50 per cent Tasseling

The number of days taken from sowing to the day when 50 per cent plants reached the tasseling stage was noted.

3.4.1.5 Days to 50 per cent Silking

The number of days taken from sowing to the day when 50 per cent plants reached silking stage was noted.

3.4.1.6 Days to Maturity

Number of days required by the plant from sowing to the harvestable maturity of the cob as baby corn was noted.

3.4.1.7 Days to Harvest from Tasseling

The number of days taken by the plant from the day of tassel emergence to harvest was noted.

3.4.1.8 Number of Harvests

The number of times the baby cobs were harvested as baby corn from each plot was recorded.

3.4.1.9 Dry Matter Production

Four sample plants were selected randomly and uprooted at harvest. The plants were dried under shade and then oven dried at 60±5°C till a constant weight was obtained and the total dry matter production was expressed as kg ha^{-1}.

3.4.1.10 Light Interception by Crop Canopy

The light interception was measured between 1200 and 1300 hrs of the day using Lux meter HI 97500 as per the procedure outlined by Thavaprakaash and

Velayudham (2008). The incident light above the canopy was measured by holding the sensor above the canopy in each plot. The light transmitted through the canopy was measured by holding the sensor below the row and across the row and the mean value was taken. Observations were taken at 25 and 45 DAS. The percentage of light intercepted by the crop canopies was calculated by the formula,

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

PLI : Percentage of light intercepted

LI : Light incident above the crop canopy

LT : Light transmitted below the crop canopy

3.4.2 Yield Attributes and Yield

Four representative plants were selected from each plot, excluding the border rows and the mean value was calculated.

3.4.2.1 Baby Cobs per Plant

The number of baby corn produced per plant was counted.

3.4.2.2 Baby Cob Length

The length of dehusked baby corn of sample plants was measured from tip to the bottom in cm.

3.4.2.3 Baby Cob Girth

The girth was measured using a thread, at the centre of the dehusked baby cobs of sample plants and the average value was expressed in cm.

3.4.2.4 Baby Cob Weight with Husk

The weight of baby cob (with husk) of sample plants was taken from each plot and the mean was calculated and expressed in gram plant^{-1}.

3.4.2.5 Baby Cob Yield with Husk

The weight of baby corn (with husk) from each plot was recorded in kg and converted to t ha^{-1}.

3.4.2.6 Marketable Baby Cob Yield

The outer two to three layers of husk were removed and the weight was recorded as marketable baby cob yield from each plot and expressed in t ha^{-1}.

3.4.2.7 Baby Cob-Baby Corn Ratio

The ratio of husked baby corn weight to the dehusked baby corn weight was calculated.

3.4.2.8 Green Stover Yield

After harvesting green cobs, the plants were cut immediately from each plot and the fresh weight was recorded in kg and it was converted to t ha^{-1}.

3.4.3 Scoring of Pests and Diseases

The incidence of pests and diseases was noted. However the disease incidence was observed only on few border plants, and hence scoring was not done.

3.5 PLANT ANALYSIS

3.5.1 Plant Analysis

3.5.1.1 Chlorophyll Content

Total chlorophyll content of sample plants were estimated at 25 and 45 DAS by the method described by Sadasivam and Manickam (1996). The value was expressed as mg g^{-1} leaf tissue on fresh weight basis.

3.5.1.2 Crude Protein Content

Crude protein content of baby cob and stover of sample plants were calculated by multiplying the nitrogen content of the plant by the factor 6.25 (Simpson *et al.*,1965).

3.5.1.3 Crude Fibre Content

Crude fibre of baby cob and stover were estimated by the acid- alkali treatment and expressed as percentage as per the procedure outlined by Sadasivam and Manickam (1996).

3.5.1.4 Starch Content

Starch content of baby cobs was estimated using Anthrone reagent following the procedure described by Sadasivam and Manickam (1996).

3.5.1.5 Total Soluble Solids

Total soluble sugar of baby cobs was estimated using hand refractrometer (Shobha *et al.,* 2010).

3.5.1.6 Reducing Sugar

Reducing sugar of baby cobs was estimated using Fehling solutions A and B and expressed as percentage (Sadasivam and Manickam, 1996).

3.5.1.7 Ascorbic Acid

Ascorbic acid content of baby cobs was estimated by titrimetric method (Sadasivam and Manickam, 1996) and expressed as mg 100 g^{-1} on fresh weight basis.

3.5.1.8 Uptake of NPK

Sample plants were cut at harvest, chopped, dried under sun and oven dried at 60±5 °C to a constant weight. Samples were powdered and digested for the nutrient analysis.

3.5.1.8.1 Uptake of Nitrogen

Nitrogen content was estimated by the modified Microkjeldahl method (Jackson, 1973). The uptake was calculated by multiplying the nitrogen content of the sample with the total dry matter production and was expressed as kg ha^{-1}.

3.5.1.8.2 Uptake of Phosphorus

Phosphorus content was determined colorimetrically (Piper, 1966) and the uptake was calculated by multiplying the content with the total dry matter production and expressed as kg ha^{-1}.

3.5.1.8.3 Uptake of Potassium

Potassium content was estimated by flame photometry (Piper, 1966) and the uptake was calculated by multiplying K content with the total dry matter production and was expressed as kg ha^{-1}.

3.5.2 Soil Analysis

A composite soil sample was collected from the site before the experiment and soil samples from each plot were collected after the crop and analysis was done.

3.5.2.1 pH

The pH of the soil samples were determined by preparing soil solution in 1:2.5 ratio and using pH meter with glass electrode (Jackson, 1973).

3.5.2.2 Electrical Conductivity

Conductivity meter was used to determine EC of soil samples and expressed as dSm^{-1} (Jackson, 1973).

3.5.2.3 Organic Carbon

Organic carbon content of soil samples were determined by Walkley and Black rapid titration method (Jackson, 1973) and expressed in percentage.

3.5.2.4 Available Nitrogen

Available nitrogen content in soil was estimated by Alkaline permanganate method (Subbiah and Asija, 1956) and expressed in kg N ha^{-1}.

3.5.2.5 Available Phosphorus

Available phosphorus content in soil was determined by Bray colorimetric method (Jackson, 1973) and expressed in kg P_2O_5 ha^{-1} .

3.5.2.6 Available Potassium

Available potassium content in soil was estimated by Ammonium acetate method (Jackson, 1973), using Flame photometer and expressed in kg K_2O ha^{-1}.

3.6 ECONOMIC ANALYSIS

3.6.1 Net Income

The net returns were calculated by deducting the cost of cultivation from the gross returns.

Net returns (₹) = Gross returns ha^{-1} (₹) – Total cost of cultivation ha^{-1} (₹)

3.6.2 B:C Ratio

$$\text{B:C ratio} = \frac{\text{Gross returns (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

3.7 STATISTICAL ANALYSIS

The data generated from the experiments were subjected to statistical analysis using Analysis of Variance technique (ANOVA) as applied to Randomised Block Design (Panse and Sukhatme, 1985) and the significance was tested using F test (Snedecor and Cohran, 1967). Wherever F values were significant, critical differences were worked out at five per cent and one per cent probability levels. The treatment effect was noted as 'NS' when not significant.

Results

4. RESULTS

The field experiment entitled "Varietal suitability and crop geometry of baby corn (*Zea mays* L.) in coconut garden" was conducted at Coconut Research Station, Balaramapuram during 2015 to study the feasibility of baby corn cultivation as an intercrop in coconut garden. The study aimed to assess the effect of varieties and spacings on the growth and productivity of baby corn and to work out the economics. Two crops were raised during the summer (February - April) and *Kharif* season (August to October) in 2015. The results of the experiment are presented in this chapter.

4.1 GROWTH AND GROWTH ATTRIBUTES

4.1.1 Plant Height

The results on the effect of varieties, spacings and their interactions on plant height are presented in Table 4.

The effect of varieties on plant height was found significant at 15, 30 and 45 DAE during both summer and *Kharif* seasons. In summer, V_3 (CO-6) produced taller plants at all the growth stages (41.29 cm, 99.03 cm and 179.22 cm at 15, 30 and 45 DAE respectively). But in *Kharif* season, plant height was significantly higher with V_1 (Rasi 4212) at 15 DAE (55.02 cm) which was at par with CO-6. At later stages of crop growth, CO-6 recorded significantly higher plant height (96.75 cm and 186.83 cm at 30 and 45 DAE respectively).

Crop geometry did not influence plant height at 15 and 30 DAE in summer and 30 DAE in *Kharif*. At 45 DAE in the summer, S_3 (60 cm x 20 cm) recorded significantly higher plant height over other spacings (162.14 cm), while in *Kharif* S_2 (45 cm x 20 cm) registered higher plant height at 45 DAE (175.44 cm). During both the seasons, plant height was significantly influenced by interaction effects only at 45

Table 4. Effect of varieties, spacings and interactions on plant height in baby corn, cm

Treatments	Plant height					
	Summer			*Kharif*		
	15 DAE	30 DAE	45 DAE	15 DAE	30 DAE	45 DAE
Varieties (V)						
V_1 (Rasi 4212)	36.43	84.85	145.74	55.02	84.51	149.88
V_2 (G 5414)	37.34	91.13	137.05	40.08	93.91	153.96
V_3 (CO-6)	41.29	99.03	179.22	42.92	96.75	186.83
SEm (±)	0.89	2.78	1.11	1.68	2.26	1.28
CD (0.05)	2.68	8.33	3.33	5.05	6.78	3.83
Spacings (S)						
S_1 (30 cm x 20 cm)	38.00	92.60	144.65	47.45	91.45	150.30
S_2 (45 cm x 20 cm)	37.73	91.22	155.23	48.64	87.82	175.44
S_3 (60 cm x 20 cm)	39.33	91.19	162.14	41.93	95.91	164.94
SEm (±)	0.89	2.78	1.11	1.68	2.26	1.28
CD (0.05)	NS	NS	3.33	NS	NS	3.83
Interactions (vs)						
v_1s_1	37.66	84.61	132.87	58.14	86.68	139.22
v_1s_2	37.50	84.59	152.48	59.12	81.23	156.94
v_1s_3	34.12	84.35	151.87	47.81	85.63	153.49
v_2s_1	36.49	85.53	127.27	42.94	85.97	131.44
v_2s_2	36.57	92.70	127.27	40.35	95.15	172.30
v_2s_3	38.98	95.16	156.62	36.95	100.62	158.16
v_3s_1	39.86	106.67	173.80	41.28	101.70	180.24
v_3s_2	39.12	96.37	185.95	46.44	87.08	197.08
v_3s_3	44.88	94.07	177.92	41.05	101.47	183.16
SEm (±)	1.55	4.81	1.92	2.92	3.91	2.22
CD (0.05)	NS	NS	5.77	NS	11.72	6.65

DAE and the combination of CO-6 at 45 cm x 20 cm (v_3s_2) resulted in tallest plants in summer and *Kharif* (185.95 cm and 197.08 cm respectively).

4.1.2 Leaves per Plant

The results on the effect of varieties, spacings and their interactions on number of leaves per plant are given in Table 5.

The variety V_3 (CO-6) recorded the highest number of leaves per plant at all growth stages and was at par with V_2 (G 5414) at 45 DAE during both seasons. Spacing had no effect on number of leaves at 15 and 30 DAE in the summer and 30 DAE in *Kharif* season. At 45 DAE, S_3 (60 cm x 20 cm) recorded significantly higher number of leaves per plant (9.50) over other spacings in summer. However, S_1 (30 cm x 20 cm) resulted in significantly higher number of leaves per plant at 15 DAE (5.31) and S_3 (60 cm x 20 cm) at 45 DAE (9.04) in *Kharif* season.

Interaction of varieties and spacings had significant effect only at 45 DAE in the summer season, recording the highest number of leaves per plant (10.42) with v_3s_3 (CO-6 at 60 cm x 20 cm) followed by v_2s_3 (G-5414 at 60 cm x 20 cm) (9.58). However in *Kharif,* the reverse effect was observed. The interactions v_3s_2 (CO-6 at 45 cm x 20 cm) and v_3s_3 (CO-6 at 60 cm x 20 cm) resulted in higher number of leaves per plant at 15 and 30 DAE (6.08 and 8.50 respectively) and were also on a par with each other.

4.1.3 Leaf Area Index

The leaf area index as influenced by the varieties, spacings and their interactions are presented in Table 6.

Varieties and spacing had significant influence on leaf area index and the variety V_3 (CO-6) recorded the highest leaf area index at all growth stages during both seasons. Leaf area index of 0.65, 1.35 and 4.25 were recorded at 15, 30, and 45 DAE respectively in summer while 0.30, 1.44 and 4.44 were recorded at 15, 30, and 45 DAE respectively in *Kharif* season by the variety V_3 (CO-6). The spacing S_1 (30 cm x 20

Table 5. Effect of varieties, spacings and interactions on leaves per plant in baby corn, nos

Treatments	Leaves per plant					
	Summer			*Kharif*		
	15 DAE	30 DAE	45 DAE	15 DAE	30 DAE	45 DAE
Varieties (V)						
V_1 (Rasi 4212)	4.19	5.64	7.78	4.81	6.09	7.73
V_2 (G 5414)	4.56	6.94	8.61	4.67	7.22	8.70
V_3 (CO-6)	5.31	7.94	8.72	5.47	8.06	8.95
SEm (±)	0.14	0.16	0.12	0.11	0.17	0.20
CD (0.05)	0.42	0.47	0.36	0.34	0.50	0.59
Spacings (S)						
S_1 (30 cm x 20 cm)	4.69	6.64	7.89	5.31	7.08	8.09
S_2 (45 cm x 20 cm)	4.64	7.03	7.72	4.81	7.29	8.26
S_3 (60 cm x 20 cm)	4.72	6.86	9.50	4.83	7.00	9.04
SEm (±)	0.14	0.16	0.12	0.11	0.17	0.20
CD (0.05)	NS	NS	0.36	0.34	NS	0.59
Interactions (vs)						
v_1s_1	4.17	5.67	7.50	4.75	6.17	7.75
v_1s_2	4.33	5.67	7.33	5.17	6.11	7.44
v_1s_3	4.08	5.58	8.50	4.50	6.00	8.00
v_2s_1	4.42	6.58	8.00	4.83	7.08	8.08
v_2s_2	4.50	7.42	8.25	4.67	8.08	8.83
v_2s_3	4.75	6.83	9.58	4.50	6.50	9.19
v_3s_1	5.50	7.67	8.17	4.83	8.00	8.43
v_3s_2	5.08	8.00	7.58	6.08	7.67	8.50
v_3s_3	5.33	8.17	10.42	5.50	8.50	9.92
SEm (±)	0.25	0.28	0.21	0.20	0.29	0.34
CD (0.05)	NS	NS	0.62	0.59	0.86	NS

Table 6. Effect of varieties, spacings and interactions on leaf area index in baby corn

Treatments	Leaf area index					
	Summer			*Kharif*		
	15 DAE	30 DAE	45 DAE	15 DAE	30 DAE	45 DAE
Varieties (V)						
V_1 (Rasi 4212)	0.33	0.74	2.45	0.28	1.07	2.58
V_2 (G 5414)	0.40	0.94	2.41	0.19	0.96	3.82
V_3 (CO-6)	0.65	1.35	4.25	0.30	1.44	4.44
SEm (±)	0.005	0.03	0.05	0.01	0.05	0.16
CD (0.05)	0.014	0.079	0.150	0.039	0.159	0.474
Spacings (S)						
S_1 (30 cm x 20 cm)	0.62	1.17	2.82	0.33	1.33	4.16
S_2 (45 cm x 20 cm)	0.45	0.98	3.29	0.25	1.15	3.55
S_3 (60 cm x 20 cm)	0.31	0.89	3.01	0.19	0.99	3.13
SEm (±)	0.005	0.03	0.05	0.01	0.05	0.16
CD (0.05)	0.014	0.079	0.150	0.039	0.159	0.474
Interactions (vs)						
v_1s_1	0.56	0.81	2.78	0.38	1.30	3.00
v_1s_2	0.26	0.78	2.80	0.30	1.25	2.83
v_1s_3	0.16	0.62	1.78	0.16	0.67	1.92
v_2s_1	0.19	0.90	4.38	0.29	0.93	4.20
v_2s_2	0.60	0.92	3.66	0.17	0.94	3.39
v_2s_3	0.42	1.00	3.89	0.12	1.01	3.88
v_3s_1	1.09	1.80	5.28	0.32	1.78	5.28
v_3s_2	0.49	1.23	3.58	0.29	1.26	4.44
v_3s_3	0.36	1.04	2.64	0.28	1.29	3.59
SEm (±)	0.009	0.04	0.09	0.02	0.09	0.27
CD (0.05)	0.028	0.127	0.258	0.062	0.268	NS

cm) resulted in significantly higher leaf area index at all growth stages during both seasons except at 45 DAE in the summer, wherein the highest leaf area index (3.29) was observed at S_2 (45 cm x 20 cm) spacing.

In summer season, the interaction v_3s_1 (CO-6 at 30 cm x 20 cm) resulted in higher leaf area index at 15 and 30 DAE (1.09 and 1.80 respectively), while at 45 DAE, v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest leaf area index (5.28). However in *Kharif,* v_1s_1 (Rasi 4212 at 30 cm x 20 cm) interaction produced the highest leaf area index at 15 DAE and was at par with v_3s_1 (CO-6 at 30 cm x 20 cm). At 30 DAE, v_3s_1 (CO-6 at 30 cm x 20 cm) resulted in higher leaf area index and at 45 DAE varietal and spacing interaction was not significant.

4.1.4 Days to 50 per cent Tasseling

The results on the effect of varieties, spacings and their interactions on days to 50 per cent tasseling are shown in Table 7.

Varietal differences significantly influenced the number of days taken for 50 per cent tasseling. The variety V_2 (G 5414) and the variety V_3 (CO-6) took more number of days to 50 per cent tasseling in summer and *Kharif* (49.11 days and 49.22 days respectively) and both were at par in performance. The variety V_1 (Rasi 4212) reached 50 per cent tasseling earlier than other varieties (46.22 and 47.33 days in summer and *Kharif* respectively).

Different spacings or interaction effects between varieties and spacings had no effect on days to 50 per cent tasseling during summer and *Kharif* seasons.

4.1.5 Days to 50 per cent Silking

The results on the effect of varieties, spacings and their interactions on days to 50 per cent silking are presented in Table 7.

Varietal variation significantly influenced the days taken for 50 per cent silking. The variety V_3 (CO-6) took higher number of days to 50 per cent silking (50.78 days and 51.56 days in summer and *Kharif* respectively). The variety V_1 (Rasi 4212) attained 50 per cent silking earlier than other varieties in both the seasons.

The effect of spacings or the interaction effects between varieties and spacings on days to 50 per cent tasseling was found to be non significant during both seasons.

4.1.6 Days to Maturity

The results on the effect of varieties, spacings and their interactions on days to maturity are given in Table 7.

Days to crop maturity was significantly influenced only by the different varieties under study. The variety V_3 (CO-6) took higher number of days to maturity in summer and *Kharif* (53.77 days and 55.00 days respectively) which was followed by V_2 (G 5414). The variety V_1 (Rasi 4212) reached maturity earlier than the other two varieties.

4.1.7 Days to Harvest from Tasseling

The results on the effect of varieties, spacings and their interactions on days to harvest from tasseling are presented in Table 8.

The days to harvest from tasseling was influenced by the varieties. During summer and *Kharif* seasons, the variety V_3 (CO-6) recorded higher number of days (5.33 days and 5.78 days respectively) and V_2 (G 5414) recorded the lesser number of days (2.11 days and 3.67 days respectively) to harvest from tasseling.

Spacings or the interaction effects between varieties and spacings had no influence on days to harvest from tasseling.

Table 7. Effect of varieties, spacings and interactions on days to 50 per cent tasseling, days to 50 per cent silking, days to maturity and days to harvest from tasseling in baby corn

Treatments	Days					
	Summer			*Kharif*		
	50 per cent tasseling	50 per cent silking	Maturity	50 per cent tasseling	50 per cent silking	Maturity
Varieties (V)						
V_1 (Rasi 4212)	46.22	48.22	51.22	47.33	49.44	52.00
V_2 (G 5414)	49.11	49.22	52.22	49.11	49.89	52.78
V_3 (CO-6)	48.44	50.78	53.77	49.22	51.56	55.00
SEm (±)	0.70	0.25	0.25	0.25	0.27	0.19
CD (0.05)	2.08	0.76	0.76	0.76	0.81	0.57
Spacings (S)						
S_1 (30 cm x 20 cm)	46.89	49.11	52.11	48.89	50.33	53.44
S_2 (45 cm x 20 cm)	48.56	49.67	52.67	48.33	50.33	53.11
S_3 (60 cm x 20 cm)	48.33	49.44	52.44	48.44	50.22	53.22
SEm (±)	0.70	0.25	0.25	0.25	0.27	0.19
CD (0.05)	NS	NS	NS	NS	NS	NS
Interactions (vs)						
v_1s_1	45.67	47.67	50.67	48.00	50.00	52.33
v_1s_2	47.33	49.33	52.33	47.33	49.67	52.00
v_1s_3	45.67	47.67	50.67	46.67	48.67	51.67
v_2s_1	46.67	49.00	52.00	49.67	50.00	53.33
v_2s_2	50.33	49.33	52.33	49.00	50.00	52.67
v_2s_3	50.33	49.33	52.33	48.67	49.67	52.33
v_3s_1	48.33	50.67	53.67	49.00	51.00	54.67
v_3s_2	48.00	50.33	53.33	48.67	51.33	54.67
v_3s_3	49.00	51.33	54.33	50.00	52.33	55.67
SEm (±)	1.20	0.44	0.44	0.44	0.47	0.32
CD (0.05)	NS	NS	NS	NS	NS	NS

Table 8. Effect of varieties, spacings and interactions on days to harvest from tasseling and number of harvests in baby corn

Treatments	Summer		*Kharif*	
	Days to harvest from tasseling	Number of harvests	Days to harvest from tasseling	Number of harvests
Varieties (V)				
V_1 (Rasi 4212)	5.00	8.56	4.67	8.56
V_2 (G 5414)	2.11	7.89	3.67	7.89
V_3 (CO-6)	5.33	6.89	5.78	6.89
SEm (±)	0.12	0.16	0.16	0.16
CD (0.05)	0.36	0.49	0.49	0.49
Spacings (S)				
S_1 (30 cm x 20 cm)	4.22	7.89	4.56	7.89
S_2 (45 cm x 20 cm)	4.11	7.89	4.78	7.89
S_3 (60 cm x 20 cm)	4.11	7.56	4.78	7.56
SEm (±)	0.12	0.16	0.16	0.16
CD (0.05)	NS	NS	NS	NS
Interactions (vs)				
v_1s_1	5.00	8.33	4.33	8.33
v_1s_2	5.00	8.67	4.67	8.67
v_1s_3	5.00	8.67	5.00	8.67
v_2s_1	2.33	8.00	3.67	8.00
v_2s_2	2.00	8.00	3.67	8.00
v_2s_3	2.00	7.67	3.67	7.67
v_3s_1	5.33	7.33	5.67	7.33
v_3s_2	5.33	7.00	6.00	7.00
v_3s_3	5.33	6.33	5.67	6.33
SEm (±)	0.21	0.28	0.28	0.28
CD (0.05)	NS	NS	NS	NS

4.1.8 Number of Harvests

The results on the effect of varieties, spacings and their interactions on days to harvest from tasseling are shown in Table 8.

Only the varieties influenced the number of harvests significantly and the variety V_1 (Rasi 4212) recorded the highest number of harvests (8.56) during both seasons. The least number of harvests was recorded with V_3 (CO-6).

4.1.9 Dry Matter Production

Dry matter production as influenced by the varieties, spacings and their interactions are indicated in Table 9.

Varieties had significant effect on dry matter production. The variety V_3 (CO-6) recorded significantly higher dry matter production of 14758 kg ha^{-1} and 12221 kg ha^{-1} in summer and *Kharif* respectively and this was at par with V_2 (G 5414) recording a dry matter production of 13486 kg ha^{-1} and 10886 kg ha^{-1} in summer and *Kharif* respectively.

Dry matter production was not influenced by spacing or any of the interactions.

4.1.10 Light Interception by Crop Canopy

Light interception as influenced by the varieties, spacings and their interactions are presented in Table 10.

In summer season, the effect of varieties on light interception by crop canopy was not significant at 30 DAS. However at 45 DAS, V_3 (CO-6) intercepted more light (62.88 per cent) compared to other varieties. In *Kharif*, V_3 (CO-6) intercepted more light at 30 DAS (71.78 per cent) and at 45 DAS, the effect was not significant.

Spacing had no effect on light interception during both seasons. Interaction effect influenced the light interception by crop canopy in summer recording the highest interception with v_3s_1 (CO-6 at 30 cm x 20 cm) at 30 and 45 DAS (73.02 per cent and

Table 9. Effect of varieties, spacings and interactions on dry matter production at harvest in baby corn, kg ha^{-1}

Treatments	Dry matter production	
	Summer	*Kharif*
Varieties (V)		
V_1 (Rasi 4212)	9831	7882
V_2 (G 5414)	13486	10886
V_3 (CO-6)	14758	12221
SEm (±)	516.95	455.05
CD (0.05)	1549.88	1364.30
Spacings (S)		
S_1 (30 cm x 20 cm)	13045	10063
S_2 (45 cm x 20 cm)	13063	11082
S_3 (60 cm x 20 cm)	11968	9844
SEm (±)	516.95	455.05
CD (0.05)	NS	NS
Interactions (vs)		
v_1s_1	10228	7138
v_1s_2	9090	8009
v_1s_3	10176	8500
v_2s_1	14059	11255
v_2s_2	14590	11774
v_2s_3	11810	9630
v_3s_1	14847	11797
v_3s_2	15511	13464
v_3s_3	13918	11403
SEm (±)	895.38	2363.05
CD (0.05)	NS	NS

Table 10. Effect of varieties, spacings and interactions on light interception in baby corn, per cent

Treatments	Light interception by crop canopy			
	Summer		*Kharif*	
	30 DAS	45 DAS	30 DAS	45 DAS
Varieties (V)				
V_1 (Rasi 4212)	61.91	59.06	60.84	61.43
V_2 (G 5414)	65.93	51.90	69.17	69.17
V_3 (CO-6)	62.47	62.88	71.78	71.78
SEm (±)	2.36	2.51	2.65	3.26
CD (0.05)	NS	7.53	7.95	NS
Spacings (S)				
S_1 (30 cm x 20 cm)	63.67	56.30	71.14	71.14
S_2 (45 cm x 20 cm)	66.01	60.29	61.78	62.38
S_3 (60 cm x 20 cm)	60.64	57.24	68.87	68.87
SEm (±)	2.36	2.51	2.65	3.26
CD (0.05)	NS	NS	NS	NS
Interactions (vs)				
v_1s_1	54.07	46.27	61.10	61.10
v_1s_2	64.05	66.48	57.84	59.63
v_1s_3	67.62	64.42	63.57	63.57
v_2s_1	63.91	46.90	79.15	79.15
v_2s_2	65.83	50.30	64.12	64.12
v_2s_3	68.05	58.49	64.23	64.23
v_3s_1	73.02	75.74	73.16	73.16
v_3s_2	68.16	64.10	63.39	63.38
v_3s_3	46.24	48.80	78.80	78.80
SEm (±)	4.09	4.35	4.59	5.64
CD (0.05)	12.28	13.04	NS	NS

75.74 per cent respectively). Interaction effect was however not significant in the *Kharif* season.

4.2 YIELD ATTRIBUTES AND YIELD

4.2.1 Baby Cobs per Plant

The results on the effect of varieties, spacings and their interactions on baby cobs per plant are given in Table 11.

The number of baby cobs per plant was unaffected by varieties, spacings or their interactions during summer and *Kharif* seasons.

4.2.2 Baby Cob Length

The results on the effect of varieties, spacings and their interactions on baby cob length are presented in Table 11.

The variety V_1 (Rasi 4212) produced the longest baby cobs having a length of 11.35 cm and 10.05 cm respectively in summer and *Kharif*. The spacing S_3 (60 cm x 20 cm) recorded significantly higher baby cob length of 10.43 cm and 9.30 cm in summer and *Kharif* respectively. The interaction v_1s_3 (Rasi 4212 at 60 cm x 20 cm) produced the longest baby cobs (12.23 cm) in the summer, followed by v_1s_2 (Rasi 4212 at 45 cm x 20 cm) and v_1s_1 (Rasi 4212 at 30 cm x 20 cm). Interaction had no effect on baby cob length in the *Kharif* season.

4.2.3 Baby Cob Girth

The results on the effect of varieties, spacings and their interactions on baby cob girth are shown in Table 11.

The variety V_3 (CO-6) recorded a baby cob girth of 5.74 cm and the variety V_1 (Rasi 4212) recorded a baby cob girth of 5.14 cm in summer and *Kharif* respectively which were at par in performance.

Table 11. Effect of varieties, spacings and interactions on baby cob length and baby cob girth in baby corn, cm

Treatments	Summer		*Kharif*	
	Baby cob length	Baby cob girth	Baby cob length	Baby cob girth
Varieties (V)				
V_1 (Rasi 4212)	11.35	5.68	10.05	5.14
V_2 (G 5414)	9.85	5.15	8.25	4.42
V_3 (CO-6)	9.19	5.74	8.56	4.77
SEm (±)	0.16	0.08	0.22	0.14
CD (0.05)	0.47	0.25	0.65	0.42
Spacings (S)				
S_1 (30 cm x 20 cm)	9.77	5.46	9.10	4.89
S_2 (45 cm x 20 cm)	10.20	5.67	8.46	4.64
S_3 (60 cm x 20 cm)	10.43	5.44	9.30	4.80
SEm (±)	0.16	0.08	0.22	0.14
CD (0.05)	0.471	NS	NS	NS
Interactions (vs)				
v_1s_1	10.76	5.70	10.02	5.10
v_1s_2	11.05	5.60	9.22	4.89
v_1s_3	12.23	5.76	10.89	5.42
v_2s_1	9.92	5.14	8.57	4.60
v_2s_2	9.83	5.39	7.68	4.40
v_2s_3	9.79	4.93	8.50	4.25
v_3s_1	8.61	5.55	8.72	4.97
v_3s_2	9.72	6.03	8.47	4.62
v_3s_3	9.25	5.63	8.50	4.73
SEm (±)	0.28	0.14	0.37	0.24
CD (0.05)	0.83	NS	NS	NS

Spacings or the interaction effects between varieties and spacings could not influence baby cob girth during both seasons.

4.2.4 Baby Cob Weight with Husk

The results on the effect of varieties, spacings and their interactions on baby cob weight with husk are presented in Table 12.

The variety V_2 (G 5414) produced cobs with significantly higher baby cob weight with husk of 47.01 g cob^{-1} and 35.74 g cob^{-1} in summer and *Kharif* respectively. In summer, the spacing S_2 (45 cm x 20 cm) recorded significantly higher baby cob weight with husk (48.85 g cob^{-1}).

The interaction v_3s_2 (CO-6 at 45 cm x 20 cm) produced baby cobs with significantly higher baby cob weight with husk (56.25 g cob^{-1}) in summer and was at par with v_2s_2 (G-5414 at 45 cm x 20 cm) and v_2s_1 (G-5414 at 60 cm x 20 cm). Different spacings or interaction effects had no significant effect in *Kharif* season.

4.2.5 Baby Cob Yield with Husk

Baby cob yield with husk as influenced by varieties, spacings and their interactions are given in Table 13.

The variety V_2 (G 5414) produced significantly higher baby cob yield with husk (10.97 t ha^{-1} and 9.98 t ha^{-1} in summer and *Kharif* respectively), which was followed by V_3 (CO-6) and V_1 (Rasi 4212). Pooled anlaysis of data also indicated similar trend (10. 47 t ha^{-1} with V_2) and higher yield was obtained in summer season (9.38 t ha^{-1}) compared to *Kharif* season (8.42 t ha^{-1}). The interaction of varieties or spacing with seasons was not significant in terms of baby cob yield with husk.

The spacing S_2 (45 cm x 20 cm) recorded significanlty higher baby cob yield (with husk) of 10.90 t ha^{-1} and 9.63 t ha^{-1} in summer and *Kharif* respectively. Pooled analysis also showed similar results (10.27 t ha^{-1} with S_2).

Table 12. Effect of varieties, spacings and interactions on baby cob weight with husk and baby cob-baby corn ratio in baby corn

Treatments	Summer		*Kharif*	
	Baby cob weight with husk (g cob^{-1})	Baby cob-baby corn ratio	Baby cob weight with husk (g cob^{-1})	Baby cob-baby corn ratio
Varieties (V)				
V_1 (Rasi 4212)	39.71	2.66	30.00	2.76
V_2 (G 5414)	47.01	4.07	35.74	4.47
V_3 (CO-6)	46.32	2.95	30.28	3.05
SEm (±)	1.34	0.07	1.42	0.23
CD (0.05)	4.02	0.22	4.27	0.70
Spacings (S)				
S_1 (30 cm x 20 cm)	39.59	3.01	30.28	3.24
S_2 (45 cm x 20 cm)	48.85	3.46	30.79	3.61
S_3 (60 cm x 20 cm)	44.61	3.21	34.96	3.43
SEm (±)	1.34	0.07	1.42	0.23
CD (0.05)	4.02	0.22	NS	NS
Interactions (vs)				
v_1s_1	38.12	2.60	30.00	2.75
v_1s_2	38.29	2.76	34.87	3.27
v_1s_3	42.73	2.62	42.37	2.26
v_2s_1	41.67	3.56	29.17	4.20
v_2s_2	52.00	4.61	28.33	4.47
v_2s_3	47.37	4.04	32.50	4.74
v_3s_1	38.98	2.86	31.67	2.77
v_3s_2	56.25	3.01	29.17	3.10
v_3s_3	43.74	2.97	30.00	3.29
SEm (±)	2.33	0.13	2.47	0.41
CD (0.05)	6.97	0.38	NS	NS

Table 13. Effect of varieties, spacings and interactions on baby cob yield with husk in baby corn, t ha^{-1}

Treatments	Baby cob yield with husk		
	Summer	*Kharif*	Pooled mean
Varieties (V)			
V_1 (Rasi 4212)	8.24	7.28	7.76
V_2 (G 5414)	10.97	9.98	10.47
V_3 (CO-6)	8.93	8.00	8.46
SEm (±)	0.46	0.48	0.32
CD (0.05)	1.39	1.45	0.93
Spacings (S)			
S_1 (30 cm x 20 cm)	8.20	7.12	7.66
S_2 (45 cm x 20 cm)	10.90	9.63	10.27
S_3 (60 cm x 20 cm)	9.02	8.50	8.76
SEm (±)	0.46	0.48	0.32
CD (0.05)	1.39	1.45	0.93
Interactions (vs)			
v_1s_1	8.05	5.95	7.00
v_1s_2	8.61	7.84	8.22
v_1s_3	8.05	8.04	8.04
v_2s_1	10.37	10.57	10.47
v_2s_2	12.59	9.91	11.24
v_2s_3	9.94	9.45	9.70
v_3s_1	6.18	4.82	5.49
v_3s_2	11.51	11.16	11.33
v_3s_3	9.08	8.02	8.55
SEm (±)	0.80	0.84	0.80
CD (0.05)	NS	2.51	2.29
Seasons			
Y_1 (Summer)	-	-	9.38
Y_2 (*Kharif*)	-	-	8.42
SEm (±)	-	-	0.25
CD (0.05)	-	-	0.76
SEm (±): VY	-	-	0.33
SY	-	-	0.39
VSY	-	-	1.26
CD (0.05): VY	NS	NS	NS
SY	NS	NS	NS
VSY	NS	NS	NS

Baby cob yield with husk was not influenced by the interaction effects in summer season. However in *Kharif* season, the interaction effect v_3s_2 (CO-6 at 45 cm x 20 cm) produced significantly higher baby cob yield with husk (11.16 t ha^{-1}) and was at par with v_2s_1 (G-5414 at 30 cm x 20 cm) producing 10.57 t ha^{-1} and v_2s_2 (G-5414 at 45 cm x 20 cm) producing 9.91 t ha^{-1}. The pooled analysis of data also showed similar trend with respect to interaction effect wherein v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest baby cob yield with husk (11.33 t ha^{-1}).

4.2.6 Marketable Baby Cob Yield

The results on the effect of varieties, spacings and their interactions on marketable baby cob yield are given in Table 14.

The variety V_2 (G 5414) produced significantly higher marketable baby cob yield of 3.67 t ha^{-1} and 3.36 t ha^{-1} in summer and *Kharif* respectively. The variety V_2 (G 5414) was followed by V_3 (CO-6) and v_1 (Rasi 4212) in producing higher marketable baby cob yield.

The spacing S_2 (45 cm x 20 cm) recorded significanlty higher marketable baby cob yield of 3.49 t $ha^{-1}$and 3.24 t ha^{-1} in summer and *Kharif* respectively.

Baby cob yield without husk was influenced by the interactions in both the seasons. The interaction v_3s_2 (CO-6 at 45 cm x 20 cm) produced significantly higher marketable baby cob yield of 4.21 t ha^{-1} and 3.68 t ha^{-1} in summer and *Kharif* respectively. The interactions v_2s_2 (G-5414 at 45 cm x 20 cm) and v_2s_1 (G-5414 at 30 cm x 20 cm) were at par with v_3s_2 (CO-6 at 45 cm x 20 cm) with respect to marketable baby cob yield during both seasons.

4.2.7 Baby Cob-Baby Corn Ratio

Baby cob-baby corn ratio as influenced by varieties, spacings and their interactions are presented in Table 12.

Table 14. Effect of varieties, spacings and interactions on marketable baby cob yield in baby corn, t ha^{-1}

Treatments	Marketable baby cob yield	
	Summer	*Kharif*
Varieties (V)		
V_1 (Rasi 4212)	2.37	2.34
V_2 (G 5414)	3.67	3.36
V_3 (CO-6)	2.74	2.48
SEm (±)	0.16	0.20
CD (0.05)	0.49	0.59
Spacings (S)		
S_1 (30 cm x 20 cm)	2.50	2.27
S_2 (45 cm x 20 cm)	3.49	3.24
S_3 (60 cm x 20 cm)	2.80	2.68
SEm (±)	0.16	0.20
CD (0.05)	0.49	0.59
Interactions (vs)		
v_1s_1	2.26	1.93
v_1s_2	2.15	2.55
v_1s_3	2.72	2.54
v_2s_1	3.52	3.58
v_2s_2	4.10	3.49
v_2s_3	3.40	3.02
v_3s_1	1.71	1.30
v_3s_2	4.21	3.68
v_3s_3	2.30	2.47
SEm (±)	0.29	0.34
CD (0.05)	0.85	1.01

Varietal difference could significantly influence the baby cob-baby corn ratio. The variety V_1 (Rasi 4212) recorded the lowest baby cob-baby corn ratio of 2.66 and 2.76 followed by v_3 (CO-6) recording 2.95 and 3.05 in summer and *Kharif* respectively.

The spacing S_1 (30 cm x 20 cm) recorded the lowest baby cob-baby corn ratio (3.01) in summer season. The interaction v_1s_1 (Rasi 4212 at 30 cm x 20 cm) resulted in lowest baby cob-baby corn (2.60) and was at par with v_1s_3 (Rasi 4212 at 60 cm x 20 cm) and v_1s_2 (Rasi 4212 at 45 cm x 20 cm) recording a baby cob-baby corn of 2.62 and 2.76 respectively. The spacing or the interaction effect had no significant influence on baby cob-baby corn ratio in *Kharif* season.

4.2.8 Green Stover Yield

Green stover yield as influenced by varieties, spacings and their interactions are presented in Table 15.

Green stover yield was significantly influenced by the varieties. The variety V_3 (CO-6) produced significantly higher fodder yield (19.39 t ha^{-1} and 17.86 t ha^{-1}) followed by V_2 (G 5414) producing 16.08 t ha^{-1} and 14.35 t ha^{-1} green stover yield in summer and *Kharif* respectively. Pooled analysis of the data also indicated similar results wherein the highest green stover production was recorded by V_3 (18.62 t ha^{-1}) followed by V_2 (15.21 t ha^{-1}). Pooled analysis of data also showed that higher green stover yield was recorded in summer (15.68 t ha^{-1}) compared to *Kharif* season (14.11 t ha^{-1}). The interaction of varieties or spacing with seasons did not show any significant effect in terms of green stover yield. Spacings or interaction effects had no significant influence on green stover production in both the seasons.

4.3 SCORING OF PESTS AND DISEASES

No pest incidence was observed during both the seasons, however leaf blight was noticed in few border plants of variety Rasi 4212 in the *Kharif* season. Since the

Table 15. Effect of varieties, spacings and interactions on green stover yield in baby corn, t ha^{-1}

Treatments	Green stover yield		
	Summer	*Kharif*	Pooled mean
Varieties (V)			
V_1 (Rasi 4212)	11.58	10.13	10.85
V_2 (G 5414)	16.08	14.35	15.21
V_3 (CO-6)	19.39	17.86	18.62
SEm (±)	0.92	0.76	0.60
CD (0.05)	2.76	2.26	1.70
Spacings (S)			
S_1 (30 cm x 20 cm)	16.95	14.18	15.57
S_2 (45 cm x 20 cm)	15.41	14.89	15.15
S_3 (60 cm x 20 cm)	14.68	13.26	13.97
SEm (±)	0.92	0.76	0.60
CD (0.05)	NS	NS	NS
Interactions (vs)			
v_1s_1	12.35	9.03	10.69
v_1s_2	10.13	10.29	10.21
v_1s_3	12.26	11.07	11.66
v_2s_1	17.38	14.70	16.04
v_2s_2	16.97	16.00	16.49
v_2s_3	13.89	12.35	13.12
v_3s_1	21.14	18.82	19.98
v_3s_2	19.14	18.39	18.76
v_3s_3	17.90	16.36	17.13
SEm (±)	1.59	1.31	1.45
CD (0.05)	NS	NS	NS
Seasons			
Y_1 (Summer)	-	-	15.68
Y_2 (*Kharif*)	-	-	14.11
SEm (±)	-	-	0.46
CD (0.05)	-	-	1.39
SEm (±): VY	-	-	0.14
SY	-	-	1.13
VSY	-	-	0.17
CD (0.05): VY	NS	NS	NS
SY	NS	NS	NS
VSY	NS	NS	NS

infection was noticed below economic threshold level no control measures were adopted.

4.4 PLANT ANALYSIS

4.4.1 Chlorophyll Content

The results on the effect of varieties, spacings and their interactions on chlorophyll content are presented in Table 16.

Chlorophyll content was significantly higher in the variety V_1 (Rasi 4212) which recorded a content of 0.30 mg g^{-1} leaf tissue at 25 DAS, while at 45 DAS no significant effect was seen in summer season. Chlorophyll content of leaf tissues was not influenced by varieties in *Kharif* season.

The spacing S_1 (30 cm x 20 cm) and S_2 (45 cm x 20 cm) resulted in significantly higher chlorophyll content of 0.20 mg g^{-1} leaf tissue at 25 DAS while the S_1 (30 cm x 20 cm) spacing produced higher chlorophyll content of 0.38 mg g^{-1} leaf tissue at 45 DAS in summer also. But the S_1 (30 cm x 20 cm) or S_2 (45 cm x 20 cm) could produce significantly higher chlorophyll content of 0.86 and 0.81 mg g^{-1} leaf tissue at 25 DAS only in *Kharif* which also did not vary each other.

The interaction v_1s_2 (Rasi 4212 at 45 cm x 20 cm) and v_1s_1 (Rasi 4212 at 30 cm x 20 cm) recorded higher chlorophyll content of 0.40 mg g^{-1} leaf tissue and 0.53 mg g^{-1} leaf tissue at 25 and 45 DAS respectively in summer. In *Kharif* season at 25 DAS, significantly higher chlorophyll content of 0.95 mg g^{-1} leaf tissue was recorded with the interaction v_1s_1 (Rasi 4212 at 30 cm x 20 cm).

4.4.2 Crude Protein Content

The results on the effect of varieties, spacings and their interactions on crude protein content of baby cob and stover are shown in Table 17.

Table 16. Effect of varieties, spacings and interactions on chlorophyll content in baby corn, mg g^{-1} leaf tissue

Treatments	Chlorophyll content			
	Summer		*Kharif*	
	25 DAS	45 DAS	25 DAS	45 DAS
Varieties (V)				
V_1 (Rasi 4212)	0.30	0.33	0.78	0.79
V_2 (G 5414)	0.13	0.31	0.82	0.76
V_3 (CO-6)	0.10	0.30	0.82	0.71
SEm (±)	0.008	0.01	0.02	0.06
CD (0.05)	0.024	NS	NS	NS
Spacings (S)				
S_1 (30 cm x 20 cm)	0.20	0.38	0.86	0.78
S_2 (45 cm x 20 cm)	0.20	0.25	0.81	0.74
S_3 (60 cm x 20 cm)	0.14	0.31	0.75	0.74
SEm (±)	0.008	0.01	0.02	0.06
CD (0.05)	0.024	0.034	0.060	NS
Interactions (vs)				
v_1s_1	0.36	0.53	0.95	0.85
v_1s_2	0.40	0.25	0.75	0.71
v_1s_3	0.15	0.20	0.65	0.81
v_2s_1	0.13	0.30	0.83	0.89
v_2s_2	0.14	0.27	0.86	0.70
v_2s_3	0.13	0.35	0.78	0.68
v_3s_1	0.10	0.31	0.80	0.59
v_3s_2	0.07	0.23	0.83	0.81
v_3s_3	0.15	0.37	0.83	0.72
SEm (±)	0.01	0.02	0.03	0.11
CD (0.05)	0.046	0.067	0.104	NS

In the summer, crude protein contents of baby cob and stover were unaffected by varieties. But in *Kharif*, significantly higher crude protein content of 11.53 per cent in baby cob was recorded by V_1 (Rasi 4212) and the variety V_2 (G 5414) recorded the highest crude protein content of 6.11 per cent in stover.

Spacing had significant effect on baby cob crude protein content with the highest value (10.25 per cent) recorded with S_3 (60 cm x 20 cm) and this was at par with S_2 (45 cm x 20 cm) in summer season. Stover crude protein content was not influenced by spacing in the summer season. In *Kharif*, the baby cob crude protein was not influenced by spacing while the highest stover crude protein content of 5.90 per cent was recorded at S_1 (30 cm x 20 cm) which was at par with S_3 (60 cm x 20 cm) recording 5.68 per cent.

Interactions did not influence stover crude protein content in summer, however the baby cob crude protein content was significantly higher (11.67 per cent) with v_3s_2 (CO-6 at 45 cm x 20 cm) and this was at par with v_2s_2 (G 5414 at 45 cm x 20 cm) and v_3s_3 (CO-6 at 60 cm x 20 cm) recording a content of 10.80 per cent. The interactions, v_1s_1 (Rasi 4212 at 30 cm x 20 cm) and v_3s_1 (CO-6 at 30 cm x 20 cm) registered significantly higher baby cob crude protein content (13.09 per cent) and stover crude protein content (6.76 per cent) in *Kharif* season.

4.4.3 Crude Fibre Content

The results on the effect of varieties, spacings and their interactions on crude fibre content of baby cob and stover are given in Table 18.

The crude fibre content of baby cob was only influenced by varieties and the highest content (9.27 per cent) was recorded with V_3 (CO-6) in summer. Crude fibre content was significantly higher with V_2 (G 5414) recording 8.89 per cent and 33.94 per cent respectively in baby cob and stover in *Kharif* season.

Table 17. Effect of varieties, spacings and interactions on crude protein content in baby corn, per cent

Treatments	Crude protein content			
	Summer		*Kharif*	
	Cob	Stover	Cob	Stover
Varieties (V)				
V_1 (Rasi 4212)	9.32	5.42	11.53	4.80
V_2 (G 5414)	9.80	5.03	10.48	6.11
V_3 (CO-6)	10.02	5.97	10.93	6.07
SEm (±)	0.26	0.37	0.16	0.09
CD (0.05)	NS	NS	0.47	0.28
Spacings (S)				
S_1 (30 cm x 20 cm)	8.68	5.48	11.11	5.90
S_2 (45 cm x 20 cm)	10.21	5.95	11.14	5.37
S_3 (60 cm x 20 cm)	10.25	4.98	10.68	5.68
SEm (±)	0.26	0.37	0.16	0.09
CD (0.05)	0.79	NS	NS	0.28
Interactions (vs)				
v_1s_1	9.53	4.40	13.09	4.43
v_1s_2	8.17	6.42	10.62	4.68
v_1s_3	10.27	5.44	10.89	5.23
v_2s_1	8.90	5.29	10.19	6.50
v_2s_2	10.80	5.96	9.93	6.02
v_2s_3	9.70	3.83	11.32	5.80
v_3s_1	7.60	6.75	10.06	6.76
v_3s_2	11.67	5.48	12.89	5.46
v_3s_3	10.80	5.67	9.83	5.99
SEm (±)	0.46	0.64	0.28	0.16
CD (0.05)	1.38	NS	0.83	0.49

Table 18. Effect of varieties, spacings and interactions on crude fibre content in baby corn, per cent

Treatments	Crude fibre content			
	Summer		*Kharif*	
	Cob	Stover	Cob	Stover
Varieties (V)				
V_1 (Rasi 4212)	7.94	31.72	5.01	32.50
V_2 (G 5414)	8.12	30.25	8.89	33.94
V_3 (CO-6)	9.27	33.94	5.41	28.83
SEm (±)	0.33	1.24	0.30	1.27
CD (0.05)	0.99	NS	0.90	3.82
Spacings (S)				
S_1 (30 cm x 20 cm)	8.10	31.52	6.23	33.39
S_2 (45 cm x 20 cm)	8.46	33.89	6.52	30.89
S_3 (60 cm x 20 cm)	8.78	30.50	6.56	30.99
SEm (±)	0.33	1.24	0.30	1.27
CD (0.05)	NS	NS	NS	NS
Interactions (vs)				
v_1s_1	7.33	31.00	4.37	34.17
v_1s_2	7.83	34.17	4.67	30.00
v_1s_3	8.67	30.00	6.00	33.33
v_2s_1	7.76	31.75	9.33	33.50
v_2s_2	8.17	30.00	8.30	34.67
v_2s_3	8.43	29.00	9.03	33.64
v_3s_1	9.21	31.82	5.00	32.50
v_3s_2	9.38	37.50	6.60	28.00
v_3s_3	9.23	32.50	4.63	26.00
SEm (±)	0.57	2.15	0.52	2.21
CD (0.05)	NS	NS	1.56	NS

Spacing had no significant effect on crude fibre content during both seasons. Interaction effects also had no influence on crude fibre content of baby cob and stover in summer and on crude fibre content of stover in *Kharif.* However, the interaction effect v_2s_1 (G 5414 at 30 cm x 20 cm) was found to produce significantly higher baby cob crude fibre content (9.33 per cent).

4.4.4 Starch Content

The results on the effect of varieties, spacings and their interactions on starch content in baby corn cob are presented in Table 19.

Starch content was not significantly influenced by varieties, spacings or their interactions during both seasons.

4.4.5 Total Soluble Solids

The results on the effect of varieties, spacings and their interactions on total soluble solids in baby corn cob are presented in Table 20.

Total soluble solids was not significantly influenced by varieties, spacings or their interactions in general with the exception of varietal effect in the summer season. The variety V_1 (Rasi 4212) recorded numerically the highest total soluble solids (9.67 ^{0} Brix) which was at par with V_3 (CO-6) recording 9.56 ^{0} Brix.

4.4.6 Reducing Sugar

The effect of varieties, spacings and their interactions on reducing sugar in baby corn cob are indicated in Table 19.

Reducing sugar content was not significantly influenced by varieties, spacings or their interactions during both seasons.

Table 19. Effect of varieties, spacings and interactions on starch content and reducing sugar in baby corn, per cent

Treatments	Summer		*Kharif*	
	Starch content	Reducing sugar content	Starch content	Reducing sugar content
Varieties (V)				
V_1 (Rasi 4212)	8.54	3.93	8.47	3.58
V_2 (G 5414)	8.42	4.23	8.63	3.88
V_3 (CO-6)	8.55	4.61	8.57	4.26
SEm (±)	0.11	0.38	0.09	0.38
CD (0.05)	NS	NS	NS	NS
Spacings (S)				
S_1 (30 cm x 20 cm)	8.49	4.59	8.38	4.24
S_2 (45 cm x 20 cm)	8.41	4.12	8.66	3.77
S_3 (60 cm x 20 cm)	8.62	4.06	8.62	3.71
SEm (±)	0.11	0.38	0.09	0.38
CD (0.05)	NS	NS	NS	NS
Interactions (vs)				
v_1s_1	8.57	4.03	8.16	3.68
v_1s_2	8.29	3.92	8.56	3.57
v_1s_3	8.77	3.84	8.69	3.49
v_2s_1	8.43	4.36	8.50	4.01
v_2s_2	8.21	3.74	8.77	3.39
v_2s_3	8.61	4.60	8.61	4.25
v_3s_1	8.46	5.38	8.48	5.03
v_3s_2	8.72	4.71	8.65	4.36
v_3s_3	8.48	3.73	8.58	3.38
SEm (±)	0.18	0.66	0.16	0.66
CD (0.05)	NS	NS	NS	NS

Table 20. Effect of varieties, spacings and interactions on ascorbic acid and total soluble solids in baby corn

Treatments	Summer		*Kharif*	
	Ascorbic acid (mg $100g^{-1}$)	Total soluble solids (^{0} Brix)	Ascorbic acid (mg $100g^{-1}$)	Total soluble solids (^{0} Brix)
Varieties				
V_1 (Rasi 4212)	5.00	9.67	4.32	8.44
V_2 (G 5414)	5.46	8.78	4.48	9.11
V_3 (CO-6)	5.22	9.56	4.72	8.56
SEm (±)	0.45	0.21	0.24	0.36
CD (0.05)	NS	0.64	NS	NS
Spacings (S)				
S_1 (30 cm x 20 cm)	5.01	9.56	4.63	8.67
S_2 (45 cm x 20 cm)	5.41	9.33	4.36	9.33
S_3 (60 cm x 20 cm)	5.26	9.11	4.53	8.11
SEm (±)	0.45	0.21	0.24	0.36
CD (0.05)	NS	NS	NS	NS
Interactions (vs)				
v_1s_1	4.41	9.67	4.58	9.00
v_1s_2	5.17	10.00	4.24	8.67
v_1s_3	5.43	9.33	4.15	7.67
v_2s_1	5.43	9.67	4.48	9.00
v_2s_2	6.23	8.33	4.53	10.00
v_2s_3	4.71	8.33	4.43	8.33
v_3s_1	5.20	9.33	4.83	8.00
v_3s_2	4.82	9.67	4.31	9.33
v_3s_3	5.64	9.67	5.01	8.33
SEm (±)	0.77	0.37	0.40	0.63
CD (0.05)	NS	NS	NS	NS

4.4.7 Ascorbic Acid

The results on the effect of varieties, spacings and their interactions on ascorbic acid content in baby corn cob are given in Table 20.

Varieties, spacings or their interactions had no significant effect on ascorbic acid content during both seasons.

4.4.8 Uptake of NPK

The results on the effect of varieties, spacings and their interactions on uptake of nutrients are shown in Table 21.

4.4.8.1 Uptake of Nitrogen

The variety V_3 (CO-6) resulted in significantly higher nitrogen uptake in summer and *Kharif* (160.80 kg ha^{-1} and 138.28 kg ha^{-1} respectively). The spacing or the interaction effects had significant influence in summer season only, recording the highest uptake of 151.27 kg ha^{-1} with S_2 (45 cm x 20 cm) and 174.75 kg ha^{-1} with v_3s_2 (CO-6 at 45 cm x 20 cm). The interaction v_2s_2 (G 5414 at 45 cm x 20 cm) and v_3s_1 (CO-6 at 30 cm x 20 cm) which recorded a nitrogen uptake of 173.99 kg ha^{-1} and 163.12 kg ha^{-1} respectively were at par with v_3s_2.

4.4.8.2 Uptake of Phosphorus

The varieties V_1 (Rasi 4212) and V_2 (G 5414) resulted in significantly higher phosphorus uptake of 30.67 kg ha^{-1} and 17.87 kg ha^{-1} in summer and *Kharif* respectively. The spacing S_3 (60 cm x 20 cm) recorded higher phosphorus uptake in summer and *Kharif* (28.62 kg ha^{-1} and 23.39 kg ha^{-1} respectively).

The interactions v_3s_3 (CO-6 at 60 cm x 20 cm) and v_1s_3 (Rasi 4212 at 60 cm x 20 cm) recorded significantly higher phosphorus uptake of 33.32 kg ha^{-1} and 26.00 kg ha^{-1} in summer and *Kharif* respectively.

Table 21. Effect of varieties, spacings and interactions on uptake of nitrogen, phosphorus and potassium in baby corn, kg ha^{-1}

Treatments	Uptake of nutrients					
	Summer			*Kharif*		
	N	P	K	N	P	K
Varieties (V)						
V_1 (Rasi 4212)	104.32	30.67	198.73	83.91	13.51	144.51
V_2 (G 5414)	137.33	20.69	245.70	127.62	17.87	237.17
V_3 (CO-6)	160.80	20.51	270.23	138.28	14.67	272.75
SEm (±)	6.10	1.19	13.73	5.40	0.72	16.66
CD (0.05)	18.28	3.56	41.16	16.19	2.15	49.96
Spacings (S)						
S_1 (30 cm x 20 cm)	130.76	25.06	249.68	118.02	11.74	190.25
S_2 (45 cm x 20 cm)	151.27	18.18	235.87	122.98	10.93	215.67
S_3 (60 cm x 20 cm)	120.42	28.62	229.11	108.81	23.39	248.50
SEm (±)	6.10	1.19	13.73	5.40	0.72	16.66
CD (0.05)	18.28	3.56	NS	NS	2.15	NS
Interactions (vs)						
v_1s_1	95.18	29.94	216.93	78.24	6.95	110.81
v_1s_2	105.08	29.65	172.18	82.24	7.58	137.51
v_1s_3	112.71	32.41	207.08	91.26	26.00	185.19
v_2s_1	133.98	29.12	243.34	139.02	16.30	199.33
v_2s_2	173.99	12.81	262.63	131.62	13.40	236.35
v_2s_3	104.00	20.14	231.12	112.21	23.91	275.82
v_3s_1	163.12	16.12	288.77	136.80	11.95	260.61
v_3s_2	174.75	12.08	272.80	155.08	11.81	273.16
v_3s_3	144.53	33.32	249.12	122.96	20.25	284.47
SEm (±)	10.56	2.06	23.78	9.35	1.24	28.86
CD (0.05)	31.67	6.17	NS	NS	3.72	NS

4.4.8.3 Uptake of Potassium

The variety V_3 (CO-6) resulted in significantly higher potassium uptake of 270.23 kg ha^{-1} and 272.75 kg ha^{-1} in summer and *Kharif* respectively. The variety V_2 (G 5414) recorded uptake of potassium at the same level during both seasons. Spacing or the interaction of varieties and spacing had no significant effect on uptake of potassium.

4.5 SOIL ANALYSIS

4.5.1 Soil pH

The results on the effect of varieties, spacings and their interactions on soil pH after experimentation are presented in Table 22.

Soil pH slightly decreased from the initial status (4.6), however it was not influenced significantly by varieties, spacings or their interactions.

4.5.2 Electrical Conductivity

The results on the effect of varieties, spacings and their interactions on electrical conductivity of the soil after the completion of experiment are indicated in Table 22.

Electrical conductivity showed a slight increase towards the completion of experiment. The variety V_3 (CO-6) and the spacing S_3 (60 cm x 20 cm) recorded significantly higher electrical conductivity of 0.15 dSm^{-1} and 0.14 dSm^{-1} respectively in the soil after the experimentation. The interaction effect v_3s_3 (CO-6 at 60 cm x 20 cm) also resulted in higher electrical conductivity of 0.17 dSm^{-1} in the soil after the experiment.

4.5.3 Organic Carbon

The results on the effect of varieties, spacings and their interactions on organic carbon content of soil after the experimentation are presented in Table 22.

Table 22. Effect of varieties, spacings and interactions on soil pH, electrical conductivity and organic carbon content after the experiment in baby corn

Treatments	Soil pH	Electrical conductivity (dSm^{-1})	Organic carbon (per cent)
Varieties (V)			
V_1 (Rasi 4212)	4.13	0.12	0.72
V_2 (G 5414)	4.10	0.14	0.82
V_3 (CO-6)	4.10	0.15	0.61
SEm (±)	0.11	0.002	0.02
CD (0.05)	NS	0.006	0.072
Spacings (S)			
S_1 (30 cm x 20 cm)	4.13	0.14	0.70
S_2 (45 cm x 20 cm)	4.10	0.12	0.65
S_3 (60 cm x 20 cm)	4.10	0.14	0.80
SEm (±)	0.11	0.002	0.02
CD (0.05)	NS	0.006	0.072
Interactions (vs)			
v_1s_1	4.20	0.13	0.73
v_1s_2	4.10	0.12	0.63
v_1s_3	4.10	0.10	0.80
v_2s_1	4.10	0.14	0.76
v_2s_2	4.10	0.13	0.73
v_2s_3	4.10	0.16	0.95
v_3s_1	4.10	0.15	0.61
v_3s_2	4.10	0.11	0.61
v_3s_3	4.10	0.17	0.61
SEm (±)	0.18	0.005	0.04
CD (0.05)	NS	0.015	0.127
Initial status	4.60	0.10	0.98

Organic carbon content in soil showed a slight decrease from an initial status of 0.98 per cent. The variety V_2 (G 5414) and the spacing S_3 (60 cm x 20 cm) recorded significantly higher organic carbon content of 0.82 and 0.80 per cent respectively in the soil. The interaction v_2s_3 (G 5414 at 60 cm x 20 cm) recorded highest organic carbon content (0.95 per cent) among interaction effects.

4.5.4 Available Nutrients in Soil

The results on the effect of varieties, spacings and their interactions on available nutrient status of soil after the experimentation are shown in Table 23.

4.5.4.1 Available Nitrogen in Soil

The available nitrogen content in soil after the experiment was not significantly influenced by varieties, spacings or their interactions.

4.5.4.2 Available Phosphorus in Soil

The available phosphorus content in the soil after the experiment was the highest with the variety V_3 (CO-6) recording a value of 15.52 kg ha^{-1}, followed by V_2 (G 5414) recording a content of 13.16 kg ha^{-1}. Among spacings, S_3 (60 cm x 20 cm) recorded significantly higher available phosphorus content of 15.29 kg ha^{-1} in soil, followed by S_2 (45 cm x 20 cm) recording 12.89 kg ha^{-1}.

The interaction v_3s_3 (CO-6 at 60 cm x 20 cm) recorded the highest available phosphorus content of 18.99 kg ha^{-1} in soil after the experiment, followed by v_3s_2 (CO-6 at 45 cm x 20 cm) and v_2s_3 (G 5414 at 60 cm x 20 cm), recording 15.15 kg ha^{-1} and 14.45 kg ha^{-1} respectively.

4.5.4.3 Available Potassium in Soil

The available potassium content in soil was the highest (78.95 kg ha^{-1}) with the variety V_2 (G 5414), folllowed by V_1 (Rasi 4212) recording 67.84 kg ha^{-1} in soil after the experiment. Among spacings, S_3 (60 cm x 20 cm) recorded significantly higher

Table 23. Effect of varieties, spacings and interactions on soil nutrient status after the experiment in baby corn, kg ha^{-1}

Treatments	Available nutrients in the soil		
	Available N	Available P	Available K
Varieties (V)			
V_1 (Rasi 4212)	252.97	11.24	67.84
V_2 (G 5414)	230.67	13.16	78.95
V_3 (CO-6)	248.09	15.52	52.91
SEm (±)	12.84	0.33	2.30
CD (0.05)	NS	0.99	6.89
Spacings (S)			
S_1 (30 cm x 20 cm)	218.83	11.75	74.97
S_2 (45 cm x 20 cm)	256.46	12.89	77.25
S_3 (60 cm x 20 cm)	256.46	15.29	97.48
SEm (±)	12.84	0.33	2.30
CD (0.05)	NS	0.99	6.89
Interactions (vs)			
v_1s_1	232.07	10.30	49.84
v_1s_2	275.97	10.97	60.51
v_1s_3	250.88	12.43	83.18
v_2s_1	194.43	12.50	98.48
v_2s_2	238.33	12.54	94.08
v_2s_3	259.25	14.45	107.01
v_3s_1	229.97	12.43	44.60
v_3s_2	255.07	15.15	49.17
v_3s_3	259.24	18.99	64.96
SEm (±)	22.23	0.57	3.98
CD (0.05)	NS	1.72	11.93
Initial status	213.25	16.35	95.76

available potassium content of 97.48 kg ha^{-1} in soil, followed by S_2 (45 cm x 20 cm) recording a content of 77.25 kg ha^{-1}.

The interaction effect v_2s_3 (G 5414 at 60 cm x 20 cm) recorded significantly higher available potassium content of 107.01 kg ha^{-1} in soil after the experiment compared to other interactions which was at par with v_2s_1 (G 5414 at 30 cm x 20 cm) recording an available soil potassium content of 98.48 kg ha^{-1}.

4.6 ECONOMIC ANALYSIS

4.6.1 Net Income

The results on the effect of varieties, spacings and their interactions on net income are presented in Table 24.

The variety V_2 (G 5414) registered the highest net income of 133698 ₹ ha^{-1} and 116629 ₹ ha^{-1} among the varieties tested, in summer and *Kharif* respectively, which was followed by the variety V_3 (CO-6) recording a value of 95143 ₹ ha^{-1} and 82991 ₹ ha^{-1} in summer and *Kharif* respectively.

Net income was significantly higher at S_2 (45 cm x 20 cm) spacing in summer and *Kharif* (125839 ₹ ha^{-1} and 114287 ₹ ha^{-1} respectively), followed by S_3 (60 cm x 20 cm) producing a net income of 93513 ₹ ha^{-1} in summer. In *Kharif* season S_3 (60 cm x 20 cm) produced a net income of 87872 ₹ ha^{-1} which did not vary with income produced (114287 ₹ ha^{-1}) by S_2 (45 cm x 20 cm).

In summer season, the interaction v_2s_2 (G 5414 at 45 cm x 20 cm) recorded significantly higher net income (163447 ₹ ha^{-1}), while in *Kharif* season, the v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest net income of 145237 ₹ ha^{-1}. These interactions were also at par in both the seasons.

4.6.2 Benefit: Cost Ratio

The effect of varieties, spacings and their interactions on benefit: cost ratio are presented in Table 25.

The variety V_2 (G 5414) registered the highest benefit: cost ratio of 2.70 and 2.49 in summer and *Kharif* respectively, which was followed by the variety V_3 (CO-6) (2.33 and 2.16 in summer and *Kharif* respectively).

Benefit: cost ratio was higher at S_2 (45 cm x 20 cm) spacing in summer and *Kharif* (2.69 and 2.55 respectively), followed by S_3 (60 cm x 20 cm) recording a value of 2.26 and 2.18 in summer and *Kharif* respectively.

The interaction, v_3s_2 (CO-6 at 45 cm x 20 cm) resulted in the highest benefit: cost ratio of 3.16 and 3.03 respectively in summer season and *Kharif* seasons. However, v_3s_2 was followed by v_2s_2 (G 5414 at 45 cm x 20 cm) which recorded a benefit: cost ratio of 3.08 in summer and v_2s_1 (G 5414 at 30 cm x 20 cm) which recorded a benefit: cost ratio of 2.64 in *Kharif* season.

4.7 SEASONAL EFFECT ON BABY CORN CULTIVATION

The seasonal variation of varieties was noticed among varieties with respect to baby corn yield as indicated in Table 26.

In general yields of all varieties were found to be higher in summer compared to *Kharif* season. In line with this general trend the variety V_2 (G 5414) which was the best yielding variety produced highest baby cob yield with husk of 10.97 t ha^{-1} in summer, but produced only 9.98 t ha^{-1} in *Kharif* season.

The total rainfall recorded during the summer season was 670 mm while it was higher (926.2 mm) in *Kharif* season. The average number of rainy days per standard week was also higher in *Kharif* season (1.5 in summer and 2.9 in *Kharif* respectively). Slight variation in average maximum relative humidity was also noticed between

Table 24. Effect of varieties, spacings and interactions on net returns in baby corn, ₹ ha^{-1}

Treatments	Net returns	
	Summer	*Kharif*
Varieties (V)		
V_1 (Rasi 4212)	71258	66715
V_2 (G 5414)	133698	116629
V_3 (CO-6)	95143	82991
SEm (±)	8190.2	9732.6
CD (0.05)	24555.39	29179.57
Spacings (S)		
S_1 (30 cm x 20 cm)	80746	64176
S_2 (45 cm x 20 cm)	125839	114287
S_3 (60 cm x 20 cm)	93513	87872
SEm (±)	8190.2	9732.6
CD (0.05)	24555.39	29179.57
Interactions (vs)		
v_1s_1	72033	42455
v_1s_2	59843	78083
v_1s_3	81898	79607
v_2s_1	123862	128555
v_2s_2	163447	119542
v_2s_3	113785	101790
v_3s_1	46343	21517
v_3s_2	154228	145237
v_3s_3	84857	82220
SEm (±)	14185.9	16857.3
CD (0.05)	42531.16	50540.50

Table 25. Effect of varieties, spacings and interactions on benefit: cost ratio in baby corn

Treatments	Benefit: cost ratio	
	Summer	*Kharif*
Varieties (V)		
V_1 (Rasi 4212)	1.99	1.93
V_2 (G 5414)	2.70	2.49
V_3 (CO-6)	2.33	2.16
Spacings (S)		
S_1 (30 cm x 20 cm)	2.07	1.84
S_2 (45 cm x 20 cm)	2.69	2.55
S_3 (60 cm x 20 cm)	2.26	2.18
Interactions (vs)		
v_1s_1	2.00	1.59
v_1s_2	1.83	2.08
v_1s_3	2.13	2.10
v_2s_1	2.58	2.64
v_2s_2	3.08	2.52
v_2s_3	2.45	2.30
v_3s_1	1.65	1.30
v_3s_2	3.16	3.03
v_3s_3	2.19	2.15

Table 26. Influence of weather parameters on baby cob yield with husk in summer and *Kharif*

	Baby cob yield with husk (t ha^{-1})	
Varieties	Summer	*Kharif*
V_1 (Rasi 4212)	8.24	7.28
V_2 (G 5414)	10.97	9.98
V_3 (CO-6)	8.93	8.00
SEm (±)	0.46	0.48
CD (0.05)	1.39	1.45
Weather parameters		
Total rainfall (mm)	670.0	926.2
Average number of rainy days/ standard week	1.5	2.9
Average relative humidity (Max) (Per cent)	90.4	91.1
Average relative humidity (Min) (Per cent)	74.4	80.4
Average bright sunshine hours	8.9	8.6

seasons (90.4 per cent in summer and 91.1 per cent in *Kharif*). The average minimum relative humidity also showed variation between summer and *Kharif* seasons (74.4 per cent in summer and 80.4 per cent in *Kharif*). The average bright sunshine hours was also higher (8.9 hrs) in summer compared to *Kharif* (8.6 hrs).

The results of the study indicated the effect of varieties, spacings and their interactions affecting the growth, yield attributes, yield, quality aspects and economics of cultivation of baby corn along with influence on post harvest soil chemical characteristics. The season wise variation in different parameters under the influence of treatments was also noticed in the experiment.

Discussion

5. DISCUSSION

The experiment entitled "Varietal suitability and crop geometry of baby corn (*Zea mays* L.) in coconut garden" was undertaken to study the feasibility of baby corn cultivation as an intercrop in coconut garden, to assess the effect of varieties and spacings on the growth and productivity of baby corn and to work out the economics. The results of the experiment are discussed briefly in this chapter.

5.1 GROWTH AND GROWTH ATTRIBUTES

The results revealed that the growth and growth attributes in general varied more significantly with the varieties, compared to spacings and the interactions between varieties and spacings.

The effect of varieties on plant height was found to be significant at 15, 30 and 45 DAE during both summer and *Kharif* seasons. During both the seasons, the plants were tallest in the variety V_3 (CO-6) at all the stages except at 15 DAE in *Kharif* season wherein V_1 (Rasi 4212) was found significantly superior in plant height. This might be attributed to the genetic variability exhibited by the varieties. Kheibari *et al.* (2012) in baby corn and Partokazemi *et al.* (2012) in maize also reported variation in plant height among varieties.

Crop geometry did not influence plant height at 15 and 30 DAE in summer and at 30 DAE in the *Kharif*. At 45 DAE in the summer, the spacing S_3 (60 cm x 20 cm) recorded significantly higher plant height over other spacings. The higher plant height at wider spacing could be due to better utilization of available nutrients, space and sunshine by each plant. Similar results were obtained by Nand (2015) in corn and Singh *et al.* (2015) in baby corn. However in *Kharif*, the spacing S_2 (45 cm x 20 cm) recorded higher plant height at 15 and 45 DAE. The cloudy weather in *Kharif* season might have enhanced interplant competition for sunlight which might have resulted in stem elongation. Fast rate of stem elongation in plants having competition for light was reported by Aldrich and Kremer (1997) and this effect might have got decreased with increase in the row spacing. Similar results were also reported by Kunjir *et al.* (2009) in sweet corn and Kumar *et al.* (2015) in baby corn.

During both the seasons, plant height was not significantly influenced by interaction effect at 15 and 30 DAE. However at 45 DAE, the interaction of CO-6 at 45 cm x 20 cm (v_3s_2) resulted in the highest plant height in summer and *Kharif* which could be due to the additive effect of main effects. Shafi *et al.* (2012) observed increase in plant height of maize cultivars with increased plant density.

Number of leaves per plant is an important character which governs the LAI and plant photosynthesis. The highest number of leaves per plant was observed in variety V_3 (CO-6) at all growth stages and was at par with V_2 (G 5414) at 45 DAE during both seasons. Since the variety V_3 (CO-6) produced significantly taller plants, the number of leaves produced also might have been positively influenced. Varietal variability in number of leaves produced was reported by Partokazemi *et al.* (2012) in maize, Ramachandrudu *et al.* (2013) and Singh *et al.* (2015) in baby corn.

Since the plant height was significantly higher at the spacing S_3 (60 cm x 20 cm), it recorded significantly higher number of leaves per plant over other spacings at 45 DAE in the summer and *Kharif* season. These results corroborate the findings of Chougule (2003) in sweet corn, Nand (2015) in corn and Singh *et al.* (2015) in baby corn.

On comparing the interaction effects in the summer season, the combination of v_3s_3 (CO-6 at 60 cm x 20 cm) was found to record the highest number of leaves, followed by v_2s_3 (G-5414 at 60 cm x 20 cm). In *Kharif* season, the interactions v_3s_2 (CO-6 at 45 cm x 20 cm) and v_3s_3 (CO-6 at 60 cm x 20 cm) resulted in higher number of leaves per plant. This might be attributed to the manifestation of main effects of varieties and spacings.

The LAI is the main tool for enhancing photosynthetic capacity and assimilates production and the increase or decrease in LAI has a direct effect on plant growth rate.

Varieties and spacing had significant influence on leaf area index. The variety V_3 (CO-6) recorded the highest number of leaves per plant and hence registered the highest leaf area index at all growth stages during both seasons. Shivaranjini (2016) reported the LAI of maize variety CO-6 ranging from 3-4 which is higher in general.

The spacing S_1 (30 cm x 20 cm) resulted in significantly higher leaf area index at all growth stages during both seasons except at 45 DAE in the summer; wherein the highest leaf area index was observed at S_2 (45 cm x 20 cm). The leaf area index is a direct function of leaf area to land space occupied by the plant. Therefore even when the variation in leaf area of individual plant is not profound, LAI is likely to record a higher value when grown at a narrow spacing. According to Thakur *et al.* (2015), increase in LAI with increase in plant density was due to more number of plants per unit area. Increasing plant density is one of the ways of increasing the capture of solar radiation within the canopy and LAI (Moderras *et al.*, 1998) and generally at a optimum plant density, the plants completely use environmental resources (water, air, light and soil) and inter or intra specific competition is minimum. Increase in LAI with increase in plant density was previously reported by Baron *et al.* (2006) in forage corn and Williams (2012) in sweet corn.

In summer season, the interaction v_3s_1 (CO-6 at 30 cm x 20 cm) resulted in higher leaf area index at 15 and 30 DAE, while at 45 DAE, v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest leaf area index. Irrespective of varieties, the combination of the spacing 30 cm x 20 cm with all the three varieties registered higher LAI during both the seasons. The interaction effect of varieties and spacing on LAI seems to be a manifestation of the main effects wherein narrow spacing produced higher LAI.

The days taken for 50 per cent tasseling, 50 per cent silking, days to maturity and the days taken from tasseling to harvest were influenced only by the varieties. In general, the variety V_3 (CO-6) recorded more number of days and V_1 (Rasi 4212) recorded less number of days for 50 per cent tasseling, 50 per cent silking and days to maturity. Since CO-6 is a maize hybrid with duration of 110 days this variety would have taken more number of days to flowering and maturity and Rasi 4212, being an early maturing hybrid with 80-85 days duration would have come to flowering and maturity earlier. The days to harvest from tasseling was also highest for V_3 (CO-6), however V_2 (G 5414) required fewer days than other varieties. In the variety G 5414, 50 per cent silking was observed prior to 50 per cent tasseling and this could be the reason for less number of days taken from tasseling to harvest or maturity. Kasikranan *et al.* (2001), Rani *et al.* (2011) and Kheibari *et al.* (2012) also reported that the days to 50 per cent flowering and days to maturity were different for each varieties of baby corn.

The spacings or the interaction between varieties and spacings had no influence on characters like 50 per cent tasseling, 50 per cent silking, days to maturity and the days from tasseling to harvest. It might be inferred that these characters are purely varietal features and are not influenced by the changes in crop geometry. In agreement with this, Thakur *et al.* (2015) reported that days to 50 per cent flowering was not influenced by the crop geometry in sweet corn.

Dry matter production at harvest was influenced only by varieties as depicted in Fig 4. In general, plant height, number of leaves per plant and LAI were the highest with the variety V_3 (CO-6); hence the total dry matter production was also the highest in this variety. The higher nitrogen uptake recorded in this variety might be another reason for the higher dry matter production compared to other varieties. The variety V_2 (G 5414) was at par in dry matter production with V_3 (CO-6). These varieties could have utilized the available space, nutrients and water more effectively for the production of biomass towards harvest and this would have resulted in more dry matter accumulation. Similar results were reported by Sobhana *et al.* (2013) and Asaduzzaman *et al.* (2014) in baby corn.

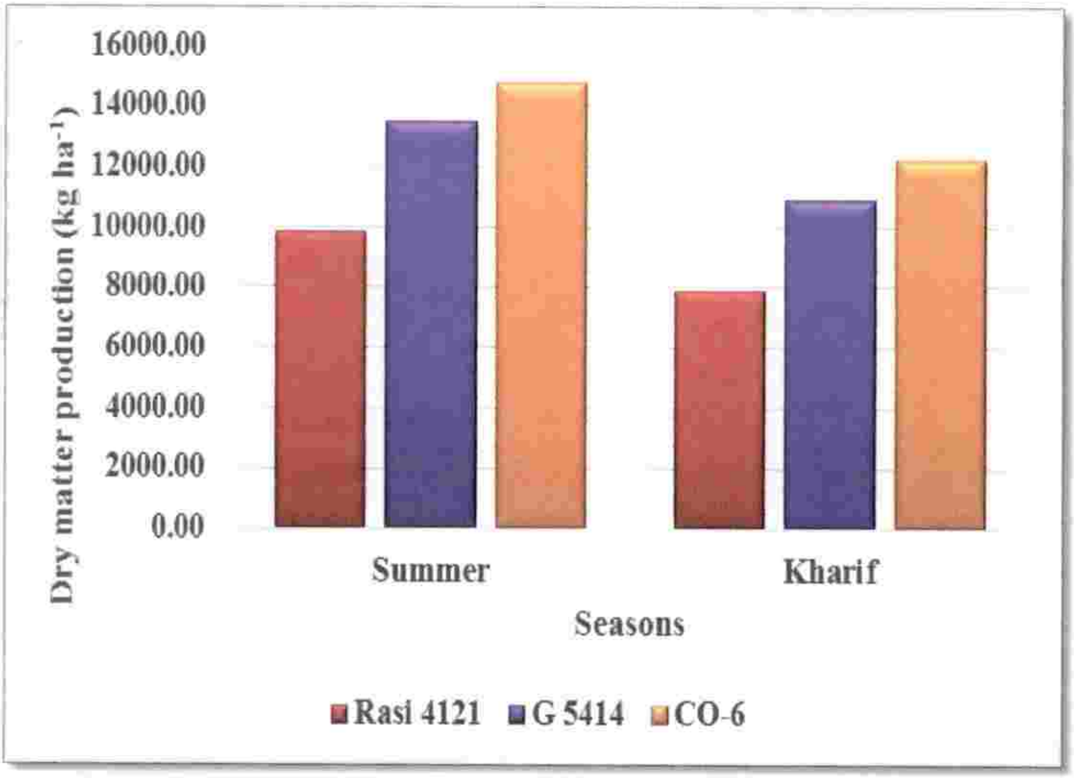


Fig. 4. Effect of varieties on dry matter production

Light interception by the crop canopy plays an important role in enhancing the production and productivity. Among the varieties, V_3 (CO-6) showed higher light interception at different growth stages in both the seasons. The increased growth parameters, especially higher LAI would have helped the plants to harvest the maximum solar radiation (Thavaprakaash and Velayudham, 2008). The inverse relationship between leaf area and light transmission to ground which results in more interception by crop canopy has been reported in corn by Gallo and Daughtry (1986).

Among the interaction effects, v_3s_1 (CO-6 at 30 cm x 20 cm) showed the highest light interception in the summer season. Manifestation of combined effect of higher leaf area index in variety CO-6 and better leaf area index at narrow row spacing (30 cm x 20 cm) might have resulted in higher light interception with respect to their interaction. Ayisi and Poswall (1997) also reported that at high plant density, total light interception by the crop canopy was found to increase.

5.2 YIELD ATTRIBUTES AND YIELD

The results revealed that the yield attributes and yield in general varied significantly with varieties, spacings and their interactions

The number of baby cobs per plant was unaffected by varieties, spacings or their interactions during summer and *Kharif* seasons. This result was however in contradictory with the findings of Gosavi and Bhagat (2009) and Ramachandrappa *et al.* (2004) in baby corn.

Number of harvests was also influenced only by varieties. Particularly V_1 (Rasi 4212) recorded the higher value. The shorter vegetative growth period in Rasi 4212, resulted in attaining maturity earlier than other varieties with more non uniform baby cobs, hence facilitated more number of harvests. The early maturing character of Rasi 4212 with a duration of 80-85 days has been pointed out by RASI SEEDS (2016).

The variety V_1 (Rasi 4212) produced the longest baby cobs in summer and *Kharif* followed by G 5414 and CO-6. The differences in genetic combination of the individual cultivars themselves might be the reason for the variation in length of baby cobs. The spacing S_3 (60 cm x 20 cm) recorded significantly higher baby cob length in summer and *Kharif*. The wider row spacing in general improved the growth attributes like plant height and number of leaves per plant which also might have favoured the cob length in baby corn. The higher photosynthetic area favouring the production of longer cobs per plant was reported by Thavaprakaash *et al.* (2005a) and Gosavi and Bhagat (2009) in baby corn.

The interaction v_1s_3 (Rasi 4212 at 60 cm x 20 cm) produced longest baby cobs in the summer and this could be attributed to the manifestation of combined influence of main effects.

The girth of baby corn cobs varied significantly with varieties. The variety V_3 (CO-6) recorded the highest baby cob girth in summer and the variety V_1 (Rasi 4212) recorded highest baby cob girth in *Kharif* season which were also at par in performance. The variation in the baby cob girth of varieties in different seasons could be considered as an indirect interaction effect of weather parameters on yield attributes surpassing the genetic expression of these traits in the varieties. Yield attribute variation in baby corn especially in dehusked baby cob weight and baby cob girth in different seasons was previously reported by Ramachandrudu *et al.* (2013).

Though the length and girth of baby cob were significantly higher in the variety Rasi 4212, the individual baby cob weight with husk was highest in variety V_2 (G 5414) during both the seasons which might be due to the differences in partitioning of photosynthates within the plant system. According to Asaduzzaman *et al.* (2014), the increased availability of photosynthates might have enhanced the number of flowers resulting in higher number of yield attributes and, greater assimilating surface at reproductive developments results in better green cob formation due to adequate production of metabolites and their translocation towards baby cob.

In summer, the spacing S_2 (45 cm x 20 cm) recorded significantly higher baby cob weight with husk. The plants at lower density would have exploited the natural resources more efficiently, besides responding to externally applied inputs, allocating the photosynthates in a better manner to various plant parts. Ramachandrappa *et al.* (2004) also reported similar results in baby corn.

The interaction v_3s_2 (CO-6 at 45 cm x 20 cm) produced baby cobs with significantly higher husked baby cob weight in summer and was at par with v_2s_2 (G-5414 at 45 cm x 20 cm) and v_2s_1 (G-5414 at 60 cm x 20 cm). With respect to interactions, the variety CO-6 showed superiority when grown at the spacing of 45 cm x 20 cm when compared to G 5414. This might be because of the better growth attributes of CO-6 which might have contributed to the yield parameters. Different spacings or interaction effects had no significant influence on baby cob weight with husk in *Kharif* season.

The variety V_2 (G 5414) produced significantly higher baby cob weight with husk, hence baby cob yield with husk and marketable baby cob yield were also significantly higher for this variety in both seasons. The percentage increase in baby cob yield with husk of the variety G 5414 was 22.8 per cent and 24.75 per cent over the variety CO-6 in summer and *Kharif* seasons respectively. The higher baby cob yield with husk in this variety could be the reason for higher marketable baby cob yield. The pooled anlaysis of baby cob yield with husk also indicated similar trend. Though the total dry matter production was higher with the variety CO-6, the dry matter partitioning to baby cob was higher with the variety G 5414. This could be the reason for increased yield of G 5414, even though the growth attributes recorded were not significantly higher compared with other varieties. Since G 5414 is a baby corn hybrid, its hybrid vigour might have contributed to the higher baby cob yields (Fig 5).

Though the growth attributes were higher for the spacing S_3 (60 cm x 20 cm), the spacing S_2 (45 cm x 20 cm) recorded significantly higher baby cob yield with husk (Fig 6) and marketable baby cob yield in summer and *Kharif* which in turn was confirmed by the pooled analysis of data. This could be attributed to the higher baby cob weight with husk at this spacing. Thakur *et al.* (1995) and Thakur *et al.* (1997) also opined that at wider spacing of 60 cm x 20 cm, growth attributes in baby corn was significantly increased but could not compensate the yield obtained at 45 cm x 20 cm spacing. The percentage of yield increase at 45 cm x 20 cm spacing was 20.84 per cent and 13.3 per cent over the spacing 60 cm x 20 cm in summer and *Kharif* seasons respectively. Gosavi and Bhagat (2009) reported that baby cob yield with husk and marketable baby cob yield were higher at wider spacing in baby corn.

Baby cob yield with husk was not influenced by the interaction effects in summer season. However in *Kharif* season, the interaction effect v_3s_2 (CO-6 at 45 cm x 20 cm) produced significantly higher baby cob yield with husk and was at par with v_2s_2 (G-5414 at 45 cm x 20 cm). The pooled analysis of data also showed similar trend with respect to interaction effect wherein v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest baby cob yield with husk. The higher baby cob weight with husk recorded in this combination resulted in significantly higher baby cob yield also.

Marketable baby cob yield was influenced by the interactions in both the seasons. The interaction effect v_3s_2 (CO-6 at 45 cm x 20 cm) produced significantly higher marketable baby cob yield during both the seasons. The interactions v_2s_2 (G-5414 at 45 cm x 20 cm) and v_2s_1 (G-5414 at 30 cm x 20 cm) were however at par with v_3s_2 (CO-6 at 45 cm x 20 cm) which could also be attributed to the higher baby cob yield with husk.

Varieties significantly influenced the baby cob-baby corn ratio and the variety V_1 (Rasi 4212) recorded lowest baby cob-baby corn ratio followed by V_3 (CO-6) in

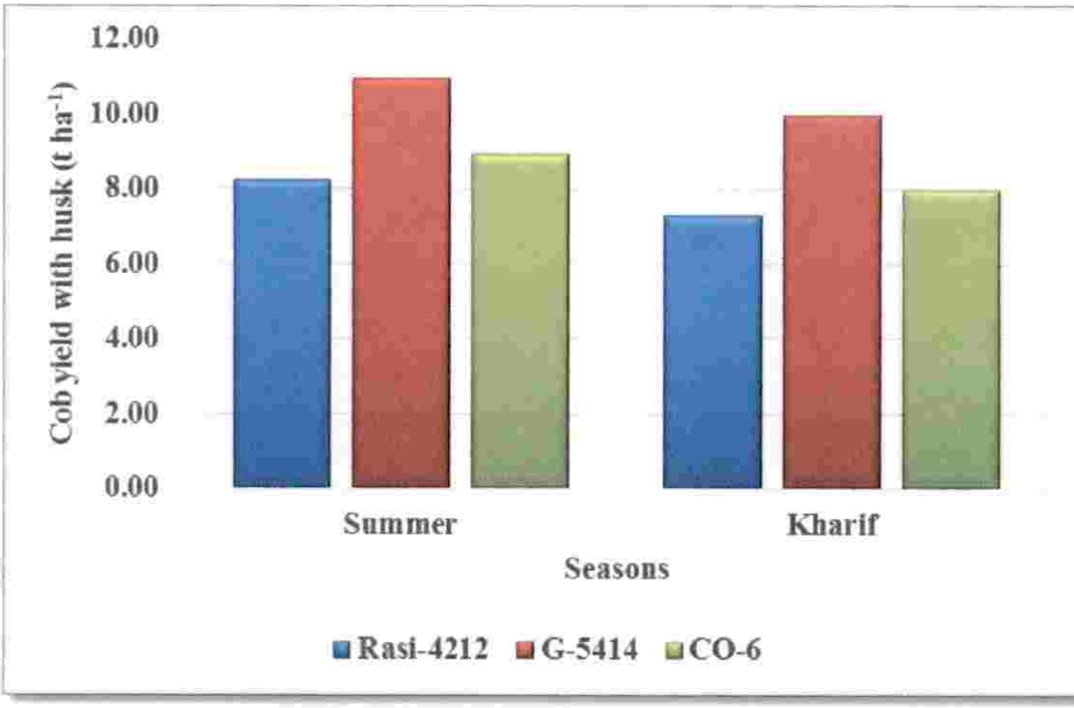


Fig. 5. Effect of varieties on baby cob yield with husk in baby corn

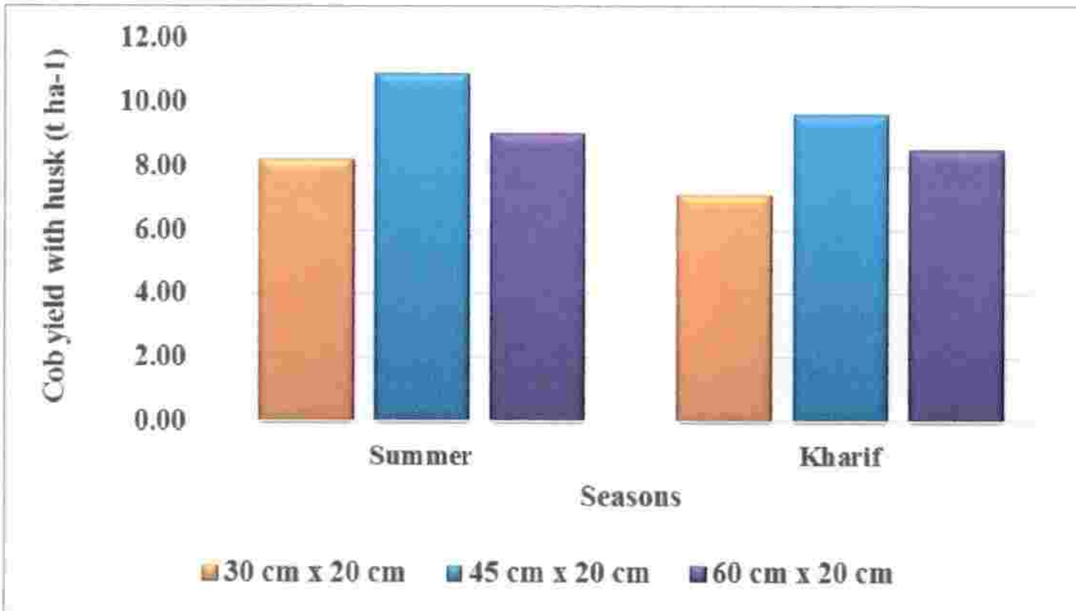


Fig. 6. Effect of spacings on baby cob yield with husk in baby corn

summer and *Kharif*. Varietal variations of baby corn with respect to baby cob-baby corn ratio has been previously reported by Kasikranan *et al.* (2001).

The spacing S_3 (30 cm x 20 cm) recorded the lowest baby cob-baby corn ratio in summer season. Row spacing of 30 cm x 20 cm recorded a significantly higher LAI also in the study. Higher plant densities at narrow row spacing would have improved the leafiness and photosynthesis in plants. As reported by Westgate, (1996) increase in the plant population had substantial effect on LAI and light interception, which was achieved through higher canopy photosynthesis during the season. The higher canopy photosynthesis might have favoured the partitioning of the dry matter towards the economic portion of the baby corn. The interaction v_1s_1 (Rasi 4212 at 30 cm x 20 cm) resulted in the lowest baby cob-baby corn ratio and was at par with v_1s_2 (Rasi 4212 at 45 cm x 20 cm) and v_1s_3 (Rasi 4212 at 60 cm x 20 cm). The spacing or the interaction effect had no significant influence on baby cob-baby corn ratio in *Kharif* season.

Green stover yield was significantly influenced only by the varieties. The variety V_3 (CO-6) produced significantly higher fodder yield followed by V_2 (G 5414) in both the seasons (Fig 7). Pooled analysis of the data also indicated similar results wherein, the highest green stover production was recorded by V_3 followed by V_2. This result was contradictory with respect to baby cob yield with husk wherein, G 5414 was significantly superior in performance. This might be due to the differences in genetic make up of varieties and partitioning of photosynthates between source and sink within the plant system as pointed out by Asaduzzaman *et al.* (2014) in baby corn. Spacing and interactions had no significant influence on green stover production. The maize hybrid CO-6 producing a higher green stover yield of 19 t ha^{-1} in irrigated conditions was reported by Nallathambi *et al.* (2012).

5.3 PLANT ANALYSIS

The chlorophyll is one of the major pigments which governs the photosynthetic rate in a plant system and thereby growth and yield of the crop. Chlorophyll content

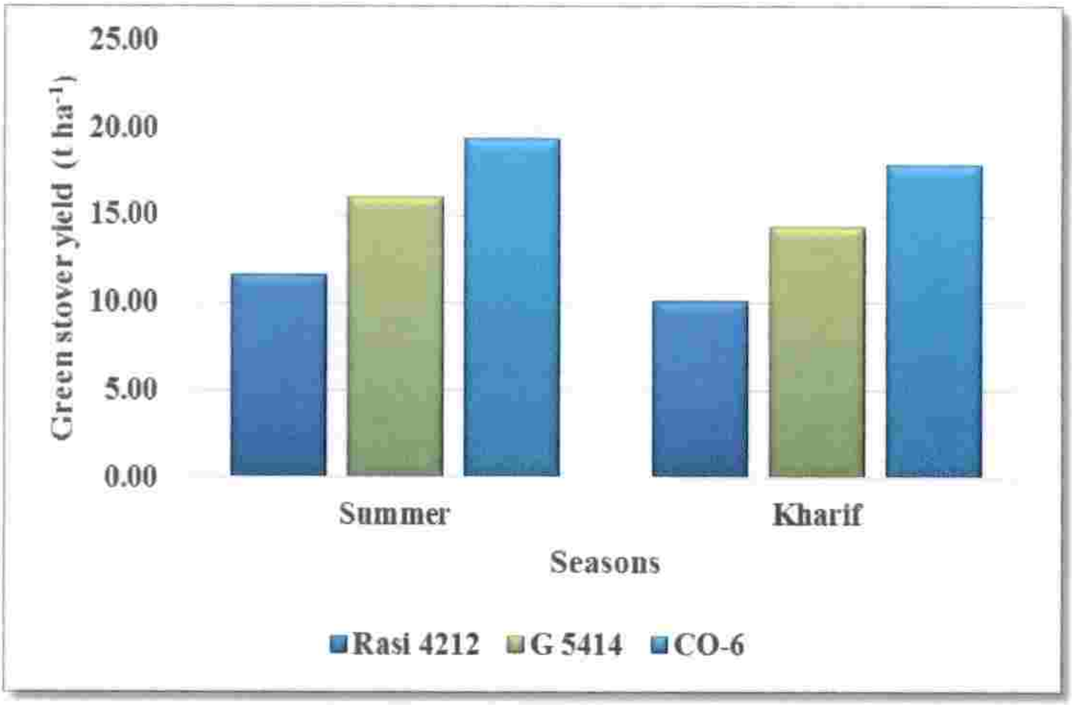


Fig. 7. Effect of varieties on green stover yield

was significantly higher in the variety V_1 (Rasi 4212) at 25 DAS, while at 45 DAS no significant variation was noticed in summer season. The genotypic variation in chlorophyll content of corn cultivars was previously reported by Homayoun *et al.* (2011). The chlorophyll content of varieties did not vary significantly in *Kharif* season.

The spacing S_1 (30 cm x 20 cm) resulted in significantly higher chlorophyll content at 25 DAS and 45 DAS in summer and at 25 DAS only in *Kharif*. The narrow spacing leads to mutual shading in plants. As reported by Clay *et al.* (2009), higher chlorophyll content in shade conditions could be attributed to the upregulation of aminoacid metabolism genes. Higher chlorophyll content of maize at narrow spacing was previously reported by Barbieri *et al.* (2013).

The interaction v_1s_2 (Rasi 4212 at 45 cm x 20 cm) and v_1s_1 (Rasi 4212 at 30 cm x 20 cm) recorded higher chlorophyll content in summer. In *Kharif* season at 25 DAS, significantly higher chlorophyll content was recorded with the interaction v_1s_1 (Rasi 4212 at 30 cm x 20 cm). The main effects functioned complementary to each other on interaction, modifying the interactions with similar trend.

Crude protein content in plants is the main source of protein for animals. In the present study, crude protein content of baby cob and stover were unaffected by varieties in the summer. But in *Kharif*, significantly higher crude protein content in baby cob was recorded by V_1 (Rasi 4212) and the variety V_2 (G 5414) recorded the highest crude protein content in stover. The inherent variation in genetic potential of varieties in utilizing the absorbed nitrogen for the biosynthesis of protein have resulted in variation of crude protein content among varieties. It is a well known fact that nitrogen is a constituent of protein which participates in several biochemical processes for the metabolism of carbohydrate and protein in plant system. Variation in crude protein content among baby corn varieties was reported by Shanti *et al.* (2012).

Spacing had significant effect on baby cob crude protein content with the highest value recorded with S_3 (60 cm x 20 cm) and this was at par with S_2 (45 cm x

20 cm) in summer season which might be attributed to the higher availability of nitrogen to individual plants at wider spacing. Sukanya (1997), Gosavi and Bhagat (2009) and Kunjir *et al.* (2009) also reported that crude protein content was increased at wider spacing in baby corn. However, stover crude protein content was not influenced by spacing in the summer season. Thavaprakaash *et al.* (2008) reported that crude protein content of stover was not inlfuenced by different spacings in baby corn. In *Kharif*, the baby cob crude protein was not influenced by spacing while the spacing S_1 (30 cm x 20 cm) recorded the highest stover crude protein content which was at par with S_3 (60 cm x 20 cm). The higher chlorophyll content recorded at this spacing might have helped in increasing photosynthesis and ultimately protein biosynthesis. More the concentration of chlorophyll, more will be the rate of CO_2 capture as there will be more trapping centres and with increased chlorophyll concentration per unit volume of cells, the rate of photosynthesis also will be increased (Rathore and Jasrai, 2013). Increase in the plant protein production by enhancing the photosynthetic rate was pointed out by Platt and Bassham as early in 1978.

Interactions did not influence stover crude protein content in summer, however the baby cob crude protein content was significantly higher with v_3s_2 (CO-6 at 45 cm x 20 cm) and this was at par with v_2s_2 (G 5414 at 45 cm x 20 cm) and v_3s_3 (CO-6 at 60 cm x 20 cm). The interactions, v_1s_1 (Rasi 4212 at 30 cm x 20 cm) and v_3s_1 (CO-6 at 30 cm x 20 cm) registered significantly higher baby cob crude protein content and stover crude protein content in *Kharif* season which could be a manifestation of main effects in this season.

The crude fibre content is one of the characters which determine the quality of any fodder. On analysing the crude fibre content of baby corn baby cob and stover, it was noticed that only the crude fibre content of baby cob was influenced by varieties wherein, the highest content was recorded with V_3 (CO-6) in summer. In *Kharif* season, crude fibre content was however significantly higher with V_2 (G 5414) in baby cob and stover. The variation in the crude fibre content between the varieties may be because of differences in genetic behaviour of the cultivars tested. Variability in crude fibre of baby corn varieties was reported by Shanti *et al.* (2012).

Spacing had no significant effect on crude fibre content of baby cob and stover during both the seasons which is in agreement with the results reported by Thavaprakaash *et al.* (2008) in baby corn. Interaction effects also had no influence on crude fibre content of baby cob and stover in summer and crude fibre content of stover in *Kharif.* However, the interaction effect v_2s_1 (G 5414 at 30 cm x 20 cm) was found to produce significantly higher baby cob crude fibre content in *Kharif.* The variety G 5414 was superior in crude fibre content of baby cob in *Kharif* season which would have manifested in its interaction effect with spacing.

Starch, reducing sugar and ascorbic acid content were not influenced by varieties, spacings or their interaction effects. Total soluble soilds were also not significantly influenced by varieties, spacings or their interactions in general with the exception of varietal effect in the summer season. The variety V_1 (Rasi 4212) recorded the highest total soluble solids which was at par with V_3 (CO-6). This might be attributed to the genetic differences among the varieties under study. Sobhana *et al.* (2013) pointed out that total soluble solids content was influenced by varietal variations in baby corn. Dhaka *et al.* (2014) also reported that TSS content varied among different varieties of corn.

The variety V_3 (CO-6) had significantly higher nitrogen uptake in summer and *Kharif* and this could be attributed to the higher dry matter production exhibited by this variety. The spacing had significant influence on nitrogen uptake in summer season only, with V_2 (45 cm x 20 cm) recording the highest uptake. The interaction of v_3s_2 (CO-6 at 45 cm x 20 cm) also had significant influence on nitrogen uptake in summer season, though it was at par with v_2s_2 (G 5414 at 45 cm x 20 cm) and v_3s_1 (CO-6 at 30 cm x 20 cm). Though the dry matter production was not significantly influenced by the spacing, a higher value was observed at the spacing 45 cm x 20 cm. This might be the reason for the higher nitrogen uptake by the plants at this spacing. Higher nitrogen uptake with wider spacing in baby corn has been previously reported by Sukanya in 1997 and Thavaprakaash and Velayudham in 2007.

The varieties V_1 (Rasi 4212) and V_2 (G 5414) resulted in significantly higher phosphorus uptake in summer and *Kharif* respectively. The spacing S_3 (60 cm x 20 cm) recorded higher phosphorus uptake in both seasons. The inverse relationship between population density and phosphorus uptake in maize has been reported by Nanjundappa and Manure (2002) which could be the reason for higher phosphorus uptake at wider spacing. Higher phosphorus uptake at wider spacing was reported by Kunjir *et al.* (2009) in sweet corn and Aravinth *et al.* (2011) in baby corn. The interactions v_3s_3 (CO-6 at 60 cm x 20 cm) and v_1s_3 (Rasi 4212 at 60 cm x 20 cm) recorded significantly higher phosphorus uptake in summer and *Kharif* which could be due to the combined influence of the main effects.

The highest potassium uptake was recorded with the variety V_3 (CO-6) in summer and *Kharif* which can be attributed to the higher dry matter production. As reported by Thavaprakaash and Velayudham (2007), generally when the uptake of nitrogen is more, the crop would have a tendency to absorb more P and K as observed in baby corn. During both seasons, the variety V_3 (CO-6) and V_2 (G 5414) had similar potassium uptake which could be attributed to the similar level of dry matter production in these varieties. Spacing or the interaction of varieties and spacing had no significant effect on uptake of potassium. Higher potassium uptake coupled with increased dry matter production in hybrid maize was previously reported by Srikanth *et al.* (2009).

5.4 SOIL ANALYSIS

Soil pH slightly decreased from the initial status, though it was not influenced significantly by varieties, spacings or their interactions. The decrease in pH after two seasons of baby corn cultivation might be attributed to the removal of nutrients especially basic cations during the crop period. According to The *et al.* (2006), when maize was continuously cultivated for three seasons in an acid soil, soil acidity was further increased which was manifested by the decrease in pH by 0.23 unit. This reduction in pH could be attributed to decrease in the exchangeable Ca and Mg which indicated an excessive removal of basic cations by the corn plants. Further more, the rhizosphere acidification by maize roots through the exudation of H^+ ions was repoted by Zhou *et al.* (2009) and this also would have resulted in slight acidification of soil by continuous cultivation of maize.

Electrical conductivity showed a slight increase towards the completion of experiment. The variety V_3 (CO-6) and the spacing S_3 (60 cm x 20 cm) recorded the highest electrical conductivity in the soil after the experimentation. The difference among varieties might be due to the inherent variation in the genetic make up of varieties with respect to uptake of nutrients which would have influenced the electrical conductivity of soil after the experiment. The interaction effect v_3s_3 (CO-6 at 60 cm x 20 cm) recorded higher electrical conductivity in the soil after the experiment. Soil electrical conductivity is a measure of soluble salts, moisture and nutrient contents in soil (Zamir *et al.*, 2016). The wider spacing in general favoured the available nutrient status in the soil and organic matter content which would have reflected in the electrical conductivity of soil.

Organic carbon content in soil showed a slight decrease from an initial status of 0.98 per cent. The variety V_2 (G 5414) and the spacing S_3 (60 cm x 20 cm) recorded significantly higher organic carbon content in the soil while the interaction v_2s_3 (G 5414 at 60 cm x 20 cm) recorded the highest organic carbon content. According to Filho *et al.* (2004) decomposing roots are the main quantitative source of nutrients for microorganisms and the maize root system accumulated substantial amount of carbon in the 0-50 cm soil layer which probably would have resulted from the higher rhizodeposition and root rennovation of maize plants along its crop cycle. With wider spacing, the competition between the plants for the soil factors decreases which would have favoured better root growth and proliferation indirectly contributing to the improvement in the organic matter content of soil due to rhizo deposition. Sobhana *et al.* (2013) reported an increase in soil organic carbon content at wider spacing in baby corn.

The available nitrogen content in soil after the experiment was not significantly influenced by either varieties, spacings or their interactions. Sobhana *et al.* (2013) reported that baby corn varieties did not influence available nitrogen in soil after the experiment.

The available phosphorus content in the soil after the experiment was the highest with the variety V_3 (CO-6), followed by V_2 (G 5414). Among spacings, S_3 (60 cm x 20 cm) recorded significantly higher available phosphorus content in soil, followed by S_2 (45 cm x 20 cm). Srikanth *et al.* (2009) reported that available phosphorus content in soil was the highest at wider spacing in corn. Sobhana *et al.* (2013) also reported variation in soil available phosphorus among different baby corn varieties and this was found to be increasing with increase in spacing. The interaction v_3s_3 (CO-6 at 60 cm x 20 cm) recorded the highest available phosphorus content in soil after the experiment, followed by v_3s_2 (CO-6 at 45 cm x 20 cm) and v_2s_3 (G 5414 at 60 cm x 20 cm). This might be attributed to the manifestation of combined influence of main effects.

The available potassium content in soil was the highest with the variety V_2 (G 5414), followed by V_1 (Rasi 4212) in soil after the experiment. Among spacings, S_3 (60 cm x 20 cm) recorded significantly higher available potassium content in soil, followed by S_2 (45 cm x 20 cm). The increase in post harvest available potassium in soil with decreasing plant density was reported by Srikanth *et al.* (2009) in corn hybrids and Sobhana *et al.* (2013) in baby corn. The interaction effect v_2s_3 (G 5414 at 60 cm x 20 cm) recorded significantly higher available potassium content in soil after the experiment compared to other interactions which was at par with v_2s_1 (G 5414 at 30 cm x 20 cm).

At wider spacing there is an optimum availability of soil moisture, solar radiation and nutrients due to avoidance of mutual competition between plants which would have improved the available phosphorus and potassium content in soil.

5.5 ECONOMIC ANALYSIS

The variety S_2 (G 5414) registered the highest net income among the varieties tested in summer and *Kharif* seasons, which was followed by the variety V_3 (CO-6). This could be attributed to the higher baby corn yield and fodder yield obtained with the variety V_2 (G 5414). The difference in net returns among varieties was previously reported by Najeeb *et al.* (2011), Rani *et al.* (2011) and Ramachandrudu *et al.* (2013) in baby corn. Net income was significantly higher at S_2 (45 cm x 20 cm) spacing in summer and *Kharif*, followed by S_3 (60 cm x 20 cm). Higher net income obtained at S_2 (45 cm x 20 cm) spacing could be attributed to the higher baby corn yield and fodder yield recorded at this moderate spacing. Kumar *et al.* (2015) indicated that at an optimum density, significantly higher net returns in baby corn was obtained. Singh *et al.* (2015) also reported a similar result in baby corn. In summer season, the interaction v_2s_2 (G 5414 at 45 cm x 20 cm) recorded significantly higher net income while in *Kharif* season, v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest net income which could be due to the combined influence of main effects favouring the net income (Fig 8).

The variety V_2 (G 5414) registered the highest benefit: cost ratio in both seasons, which was followed by the variety V_3 (CO-6). The G 5414 variety of baby corn produced higher net income owing to its higher baby corn yield and fodder yield which could have reflected in the benefit: cost ratio. The superiority of G 5414 variety of baby corn with respect to commercial baby corn yield was reported by Kasikranan *et al.* (2011). Researchers like Najeeb *et al.* (2011), Rani *et al.* (2011) and Ramachandrudu *et al.* (2013) also reported varietal variation in benefit: cost ratio of baby corn. The benefit: cost ratio was higher at S_2 (45 cm x 20 cm) spacing in summer and *Kharif*, followed by S_3 (60 cm x 20 cm) which also produced higher baby corn

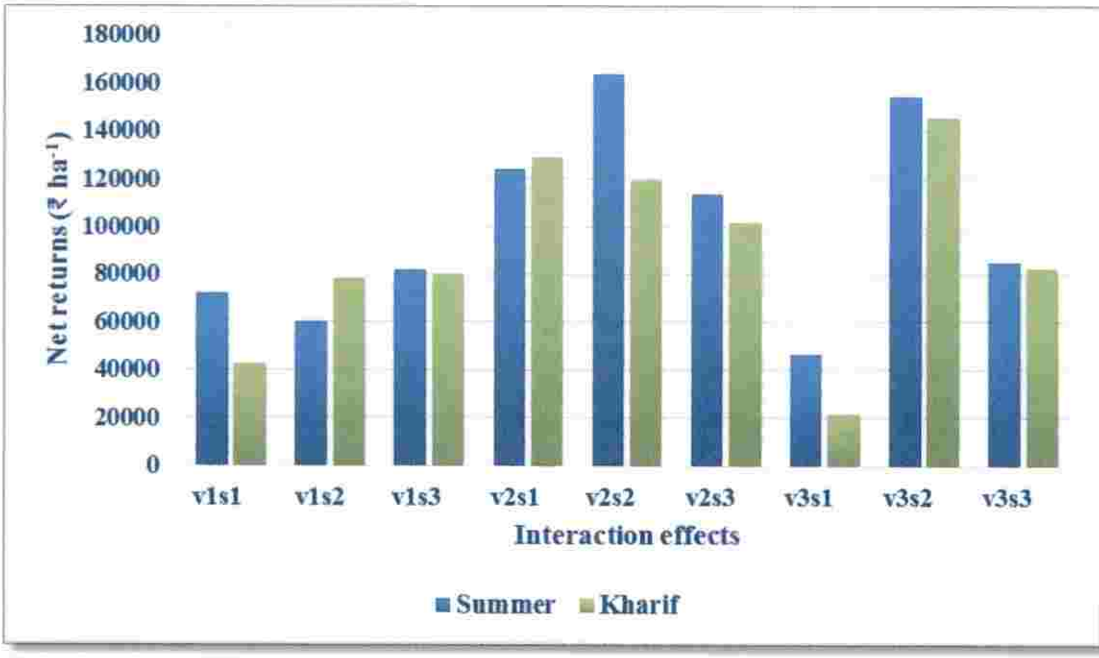


Fig. 8. Interaction effect of varieties and spacings on net returns in baby corn

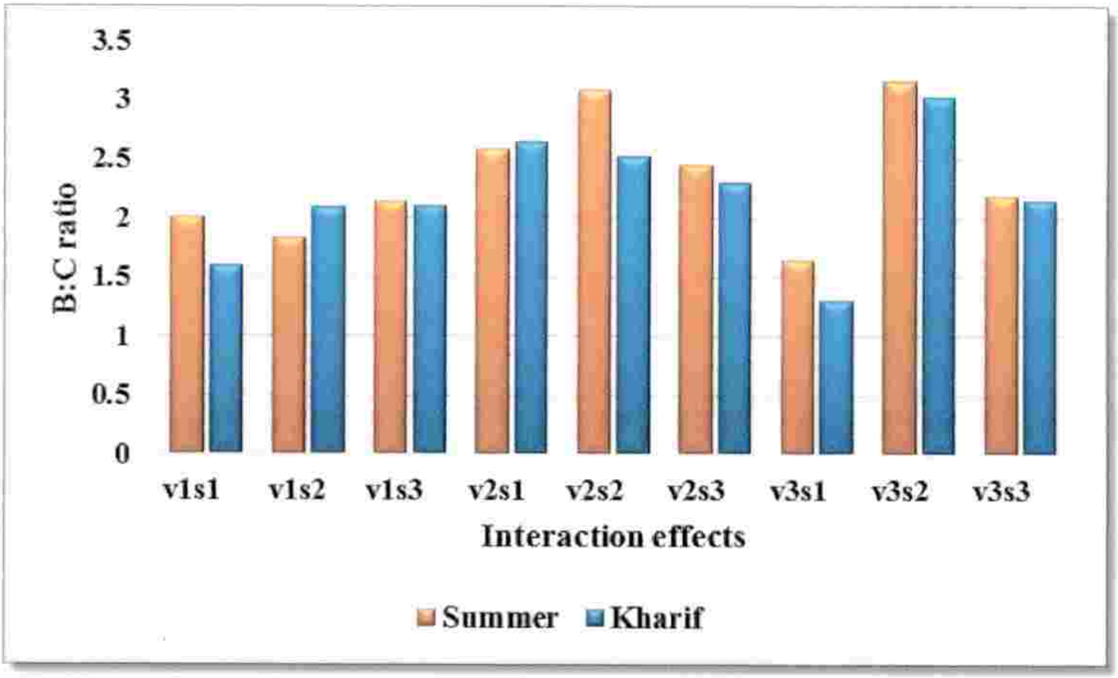


Fig. 9. Interaction effect of varieties and spacings on benefit: cost ratio in baby corn

yield with the highest net income. Kumar *et al.* (2015) indicated that benefit: cost ratio was the highest at an optimum plant density in baby corn. The interaction, v_3s_2 (CO-6 at 45 cm x 20 cm) resulted in the highest benefit: cost ratio in both seasons. However, v_3s_2 was followed by v_2s_2 (G 5414 at 45 cm x 20 cm) in summer and v_2s_1 (G 5414 at 30 cm x 20 cm) in *Kharif* season. The varieties CO-6 or G 5414 when grown at a moderate spacing of 45 cm x 20 cm produced higher baby corn yield which would have reflected in the higher benefit: cost ratio recorded with the interaction effect (Fig 9).

5.6 SEASONAL EFFECT ON BABY CORN CULTIVATION

In general, the yields of baby corn was higher in summer compared to *Kharif* season. On analysing the weather parameters of both seasons, total rainfall was found to be higher in *Kharif* season with continuous showers throughout the season with more number of rainy days per standard week. This would have favoured waterlogging in the field at various stages of crop growth. Maize being a sensitive crop, waterlogging could have affected the baby corn yield negatively. The higher relative humidity prevailed throughout the season might be the reason for the incidence of leaf blight in some of the plants in *Kharif* season. While in summer, rains were good but intermittent in nature providing a dry but moist environment for the better growth of roots and increase in yield. The greater availability of bright sunshine hours might also have improved the photosynthesis in this season as the amount of light determines the photosynthetic rate.

The discussion of the results obtained in this investigation which was carried out in two seasons, suggested that the suitability of baby corn as a viable intercrop in coconut gardens with respect to growth and yield attributes, yield, quality parameters, effect on soil available nutrient status and economics of cultivation. The variety G 5414 and the spacing 45 cm x 20 cm found to be the best among the varieties tested and the spacings tried.

Summary

6. SUMMARY

The field experiment entitled "Varietal suitability and crop geometry of baby corn (*Zea mays* L.) in coconut garden" was conducted at Coconut Research Station, Balaramapuram during 2015 to study the feasibility of baby corn cultivation as an intercrop in coconut garden, to assess the effect of varieties and spacings on the growth and productivity of baby corn and to work out the economics. Two crops were raised during the summer (March to May) and *Kharif* season (August to October) in 2015.

The field experiment was laid out in Randomised Block Design with 9 treatments replicated thrice. The treatments comprised of combinations of three varieties and three spacings. The three varieties were Rasi-4212 (V_1), G-5414 (V_2) and CO-6 (V_3) and the three spacings were 30 cm x 20 cm (S_1), 45 cm x 20 cm (S_2) and 60 cm x 20 cm (S_3).

The results revealed that varieties, spacings and the interaction between varieties and spacings significantly influenced growth and yield of baby corn and the economics of cultivation in coconut garden.

The plant height, number of leaves and leaf area index in general recorded significantly higher values in case of variety V_3 (CO-6). The effect of varieties on plant height was found to be significant at 15, 30 and 45 DAE during both summer and *Kharif* seasons. In the summer season, V_3 (CO-6) produced taller plants at all the growth stages (41.29 cm, 99.03 cm and 179.22 cm at 15, 30 and 45 DAE respectively). But in *Kharif* season, plant height was significantly higher with V_1 (Rasi 4212) at 15 DAE (55.02 cm) and was at par with CO-6. At later stages of crop growth, CO-6 recorded significantly higher plant height (96.75 cm and 186.83 cm at 30 and 45 DAE respectively). The variety V_3 (CO-6) recorded the highest number of leaves per plant and LAI at all growth stages during both seasons and the number of leaves was at par with V_2 (G 5414) at 45 DAE during both the seasons.

Varieties showed variation with respect to the days taken for 50 per cent tasseling, 50 per cent silking, days to maturity and the days to harvest from tasseling. The variety V_2 (G 5414) and the variety V_3 (CO-6) took higher number of days to 50 per cent tasseling in summer and *Kharif* (49.11 days and 49.22 days respectively) and both were at par in performance. The days to 50 per cent silking, days to maturity and the days to harvest from tasseling were also the highest with the variety V_3 (CO-6) during both the seasons, while the variety V_1 (Rasi 4212) was earlier than other varieties in attaining 50 per cent tasseling, 50 per cent silking and maturity and the variety V_2 (G 5414) recorded the lesser number (2.11 days and 3.67 days respectively in summer and *Kharif* seasons) of days to harvest from tasseling.

Varietal variation influenced the number of harvests significantly wherein the variety V_1 (Rasi 4212) recorded the highest number of harvests (8.56) during both seasons while V_3 (CO-6) recorded lesser number of harvests.

Varieties had significant influence on dry matter production and the variety V_3 (CO-6) recorded higher dry matter production (14758 kg ha^{-1} and 12221 kg ha^{-1} in summer and *Kharif* seasons respectively) and this was at par with V_2 (G 5414) producing a dry matter yield of 13486 kg ha^{-1} and 10886 kg ha^{-1} in summer and *Kharif* respectively.

In summer season, the effect of varieties on light interception by crop canopy was not significant at 30 DAS, however at 45 DAS, V_3 (CO-6) intercepted more light (62.88 per cent) compared to other varieties. In *Kharif*, the variety V_3 (CO-6) intercepted more light at 30 DAS (71.78 per cent), and at 45 DAS the effect was however not significant.

The number of baby cobs per plant was unaffected by varietal differences during summer and *Kharif* seasons. The variety V_1 (Rasi 4212) produced the longest baby cobs having 11.35 cm and 10.05 cm length in summer and *Kharif* respectively. The variety V_3 (CO-6) recorded a baby cob girth of 5.74 cm and the variety V_1 (Rasi

4212) recorded a baby cob girth of 5.14 cm in summer and *Kharif* respectively which were at par in performance. However, the variety V_2 (G 5414) produced baby cobs with significantly higher baby cob weight with husk (47.01 g cob^{-1} and 35.74 g cob^{-1} in summer and *Kharif* respectively).

The variety V_2 (G 5414) produced significantly higher baby cob yield with husk of 10.97 t ha^{-1} and 9.98 t ha^{-1} and marketable baby cob yield of 3.67 t ha^{-1} and 3.36 t ha^{-1} in summer and *Kharif* respectively, which was followed by V_3 (CO-6) and v_1 (Rasi 4212). Pooled anlaysis also indicated similar trend in case of baby cob yield with husk (10. 47 t ha^{-1} with V_2).

Varieties significantly influenced the baby cob-baby corn ratio and the variety V_1 (Rasi 4212) recorded the lowest baby cob-baby corn ratio of 2.66 and 2.76 followed by V_3 (CO-6) recording 2.95 and 3.05 in summer and *Kharif* respectively.

Green stover yield was significantly influenced by the varietal variation. The variety V_3 (CO-6) produced significantly higher fodder yield (19.39 t ha^{-1} and 17.86 t ha^{-1} in summer and *Kharif* respectively) followed by V_2 (G 5414) producing 16.08 t ha^{-1} and 14.35 t ha^{-1} green stover yield in summer and *Kharif* respectively. Pooled analysis of the data also indicated similar results wherein the highest green stover production was recorded by V_3 (18.62 t ha^{-1}) followed by V_2 (15.21 t ha^{-1}).

Chlorophyll content was significantly higher in the variety V_1 (Rasi 4212) (0.30 mg g^{-1} leaf tissue) at 25 DAS, while at 45 DAS, no significant effect was seen in summer season. Varieties did not show variation in the chlorophyll content of leaves in *Kharif* season.

In the summer, crude protein contents of baby cob and stover were unaffected by varieties. But in *Kharif*, significantly higher crude protein content of 11.53 per cent in baby cob was recorded by V_1 (Rasi 4212) and the variety V_2 (G 5414) recorded the highest crude protein content of 6.11 per cent in stover.

Only the crude fibre content of baby cob was influenced by varietal difference and V_3 (CO-6) recorded the highest content (9.27 per cent) in summer. Crude fibre content was significantly higher with V_2 (G 5414) recording 8.89 per cent and 33.94 per cent respectively in baby cob and stover in *Kharif* season.

Starch content, reducing sugar and ascorbic acid content were not significantly influenced by varieties during both seasons. Total soluble solids was also not significantly influenced by varieties with the exception of varietal effect in the summer season. The variety V_1 (Rasi 4212) recorded the highest total soluble solids (9.67 ^{0} Brix) which was at par with V_3 (CO-6) recording 9.56 ^{0} Brix.

The variety V_3 (CO-6) resulted in significantly higher nitrogen uptake of 160.80 kg ha^{-1} and 138.28 kg ha^{-1} and potassium uptake of 270.23 kg ha^{-1} and 272.75 kg ha^{-1} in summer and *Kharif* respectively. However, the varieties V_1 (Rasi 4212) and V_2 (G 5414) resulted in significantly higher phosphorus uptake of 30.67 kg ha^{-1} and 17.87 kg ha^{-1} respectively during both the seasons.

Soil pH slightly decreased from the initial status (4.6) though it was not influenced significantly by varietal difference. Electrical conductivity showed a slight increase towards the completion of experiment. The variety V_3 (CO-6) recorded significantly higher electrical conductivity of 0.15 dSm^{-1} in the soil after the experimentation. Organic carbon content in soil showed a slight general decrease from an initial status of 2.34 per cent. The variety V_2 (G 5414) recorded significantly higher organic carbon content of 1.10 per cent in the soil.

The available nitrogen content in soil after the experiment was not significantly influenced by varieties. The available phosphorus content in the soil after the experiment was the highest with variety V_3 (CO-6) recording 15.52 kg ha^{-1}. However, the available potassium content in soil was the highest (128.95 kg ha^{-1}) with the variety V_2 (G 5414) in soil after the experiment.

The variety V_2 (G 5414) registered the highest net income of 133698 ₹ ha^{-1} and 116629 ₹ ha^{-1} and benefit: cost ratio of 2.70 and 2.49 among the varieties tested in summer and *Kharif* respectively, which was followed by the variety V_3 (CO-6).

The crop geometry did not influence most of the growth attributes except plant height, number of leaves and LAI. Though the spacing had no influence on plant height at 15 and 30 DAE in summer and 30 DAE in *Kharif,* at 45 DAE in the summer, the spacing S_3 (60 cm x 20 cm) recorded significantly higher plant height over other spacings (162.14 cm), while in *Kharif* S_2 (45 cm x 20 cm) registered higher plant height at 15 and 45 DAE (48.64 cm and 175.44 cm respectively).

Spacing had no effect on number of leaves at 15 and 30 DAE in the summer and 30 DAE in *Kharif* season. At 45 DAE, S_3 (60 cm x 20 cm) recorded significantly higher number of leaves per plant (9.50) over other spacings in summer. However, S_1 (30 cm x 20 cm) resulted in significantly higher number of leaver per plant at 15 DAE (5.31) and S_3 (60 cm x 20 cm) at 45 DAE (9.04) in *Kharif* season.

The spacing S_1 (30 cm x 20 cm) resulted in significantly higher leaf area index at all growth stages during both seasons except at 45 DAE in the summer; wherein the highest leaf area index was observed at S_2 (45 cm x 20 cm).

Different spacings had no effect on days to 50 per cent tasseling, 50 per cent silking, days to harvest from tasseling, days to maturity and the number of harvests during summer and *Kharif* seasons. Dry matter production and light interception by the crop canopy were also not significantly influenced by the spacings during both seasons.

Among the yield attributes, the number of baby cobs per plant was unaffected by spacing in both the seasons. The spacing S_3 (60 cm x 20 cm) recorded significantly higher baby cob length (10.43 cm and 9.30 cm in summer and *Kharif* respectively). The baby cob girth was however not influenced by spacing during both seasons.

In summer, the spacing S_2 (45 cm x 20 cm) recorded significanlty higher baby cob weight with husk (48.85 g cob^{-1}) while the spacings had no significant effect in *Kharif* season. The spacing S_3 (30 cm x 20 cm) recorded the lowest baby cob-baby corn ratio (3.01) in summer season though spacing had no significant effect on baby cob-baby corn ratio in *Kharif* season.

The spacing S_2 (45 cm x 20 cm) recorded significanlty higher baby cob yield with husk of 10.90 t ha^{-1} and 9.63 t ha^{-1} and marketable baby cob yield of 3.49 t ha^{-1} and 3.24 t ha^{-1} in summer and *Kharif* respectively. Pooled analysis of baby cob yield with husk also showed similar results (10.27 t ha^{-1} with s_2). The spacing had no significant influence on green stover production.

The spacing S_1 (30 cm x 20 cm) resulted in significantly higher chlorophyll content at 25 DAS and 45 DAS in summer and at 25 DAS only in *Kharif*. Spacing had significant effect on baby cob crude protein content also with the highest value (10.25 per cent) recorded with S_3 (60 cm x 20 cm) in summer season. Stover crude protein content was however not influenced by spacing in the summer season. In *Kharif*, the baby cob crude protein was not influenced by spacing while the highest stover crude protein content of 5.90 per cent was recorded at S_1 (30 cm x 20 cm) spacing.

Crude fibre content of baby cob and stover, starch content, reducing sugar, total soluble solids and ascorbic acid content were not significantly influenced by spacings during both seasons.

Spacing had significant influence on uptake of nitrogen in summer season only, recording the highest uptake of 151.27 kg ha^{-1} with S_2 (45 cm x 20 cm). The spacing S_3 (60 cm x 20 cm) recorded higher phosphorus uptake in summer and *Kharif* (28.62 kg ha^{-1} and 23.39 kg ha^{-1} respectively). Spacing had no significant effect on uptake of potassium.

Soil pH was not influenced significantly by the spacings. The spacing S_3 (60 cm x 20 cm) recorded significantly higher electrical conductivity of 0.14 dSm^{-1} and organic carbon content of 1.07 per cent in the soil after the experimentation.

The available nitrogen content in soil after the experiment was not significantly influenced by spacing. However the spacing S_3 (60 cm x 20 cm) recorded significantly higher available phosphorus and potassium content of 15.29 kg ha^{-1} and 97.48 kg ha^{-1} respectively in soil, followed by S_2 (45 cm x 20 cm).

Net income (125839 ₹ ha^{-1} and 114287 ₹ ha^{-1} respectively in summer and *Kharif*) and benefit: cost ratio (2.69 and 2.55 respectively in summer and *Kharif*) were higher at S_2 (45 cm x 20 cm) spacing, followed by S_3 (60 cm x 20 cm).

Among the growth attributes, interaction effects showed significant effect on plant height, number of leaves, LAI and light interception by the crop canopy. However during both the seasons, plant height was not significantly influenced by interaction effects at 15 and 30 DAE and at 45 DAE the interaction effect of CO-6 at 45 cm x 20 cm (v_3s_2) resulted in the highest plant height in summer and *Kharif* (185.95 cm and 197.08 cm respectively).

Interaction of varieties and spacings had significant influence only at 45 DAE in the summer season, recording the highest number of leaves per plant with v_3s_3 (CO-6 at 60 cm x 20 cm). However in *Kharif,* the reverse effect was observed. The interactions v_3s_2 (CO-6 at 45 cm x 20 cm) and v_3s_3 (CO-6 at 60 cm x 20 cm) resulted in higher number of leaves per plant at 15 and 30 DAE (6.08 and 8.50 respectively) and were on a par each other.

In summer season, the interaction v_3s_1 (CO-6 at 30 cm x 20 cm) resulted in higher leaf area index at 15 and 30 DAE (1.09 and 1.80 respectively), while at 45 DAE v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest leaf area index (5.28). However in *Kharif,* v_1s_1 (Rasi 4212 at 30 cm x 20 cm) produced the highest leaf area index at 15 DAE which was at par with v_3s_1 (CO-6 at 30 cm x 20 cm). At 30 DAE, the v_3s_1 (CO-6 at 30 cm x 20 cm) resulted in higher leaf area index and at 45 DAE varietal and spacing interaction was not significant.

Different interaction effects between varieties and spacings had no effect on days to 50 per cent tasseling, 50 per cent silking, days to harvest from tasseling, days to maturity, number of harvests and dry matter production during summer and *Kharif* seasons.

Interaction effect influenced the light interception by crop canopy in summer recording the highest interception with v_3s_1 (CO-6 at 30 cm x 20 cm) at 30 and 45 DAS (73.02 per cent and 75.74 per cent respectively). Interaction effect was not significant for light interception in the *Kharif* season.

The number of baby cobs per plant and baby cob girth were unaffected by the interaction effects during summer and *Kharif* seasons. The interaction v_1s_3 (Rasi 4212 at 60 cm x 20 cm) produced the longest baby cobs (12.23 cm) in summer. Interaction effect had no influence on baby cob length in *Kharif*.

The interaction v_3s_2 (CO-6 at 45 cm x 20 cm) produced baby cobs with significantly higher baby cob weight with husk (56.25 g cob^{-1}) in summer and was at par with v_2s_2 (G-5414 at 45 cm x 20 cm) and v_2s_1 (G-5414 at 60 cm x 20 cm). Different interaction effects had no significant influence on baby cob weight with husk in *Kharif* season. The interaction v_1s_1 (Rasi 4212 at 30 cm x 20 cm) resulted in lowest baby cob-baby corn ratio (2.60) and was at par with v_1s_2 (Rasi 4212 at 45 cm x 20 cm) and v_1s_3 (Rasi 4212 at 60 cm x 20 cm). The interaction effect had no influence on baby cob-baby corn ratio in *Kharif* season.

Baby cob yield with husk was not influenced by the interaction effects in summer season. However in *Kharif* season, the interaction effect v_3s_2 (CO-6 at 45 cm x 20 cm) produced significantly higher baby cob yield with husk (11.16 t ha^{-1}) and was at par with v_2s_1 (G-5414 at 30 cm x 20 cm) producing 10.57 t ha^{-1} and v_2s_2 (G-5414 at 45 cm x 20 cm) producing 9.91 t ha^{-1}. The pooled analysis of data also showed similar trend with respect to interaction effect wherein v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest baby cob yield with husk (11.33 t ha^{-1}).

Baby cob yield without husk was influenced by the interactions in both the seasons. The interaction v_3s_2 (CO-6 at 45 cm x 20 cm) produced significantly higher marketable baby cob yield of 4.21 t ha^{-1} and 3.68 t ha^{-1} in summer and *Kharif* respectively. Interaction effects had no significant influence on green stover production.

The interaction v_1s_2 (Rasi 4212 at 45 cm x 20 cm) and v_1s_1 (Rasi 4212 at 30 cm x 20 cm) recorded higher chlorophyll content (0.40 mg g^{-1} leaf tissue and 0.53 mg g^{-1} leaf tissue at 25 and 45 DAS respectively) in summer. In *Kharif* season at 25 DAS, significantly higher chlorophyll content of 0.95 mg g^{-1} leaf tissue was recorded with the interaction v_1s_1 (Rasi 4212 at 30 cm x 20 cm).

Interactions did not influence stover crude protein content in summer, however the baby cob crude protein content was significantly higher (11.67 per cent) with v_3s_2 (CO-6 at 45 cm x 20 cm) and this was at par with v_2s_2 (G 5414 at 45 cm x 20 cm) and v_3s_3 (CO-6 at 60 cm x 20 cm) recording a content of 10.80 per cent. The interactions, v_1s_1 (Rasi 4212 at 30 cm x 20 cm) registered significantly higher baby cob crude protein content of 13.09 per cent and v_3s_1 (CO-6 at 30 cm x 20 cm) recorded a higher stover crude protein content of 6.76 per cent in *Kharif* season.

Interaction effects also had no influence on crude fibre content of baby cob and stover in summer and on crude fibre content of stover in *Kharif*. The interaction effect v_2s_1 (G 5414 at 30 cm x 20 cm) was however found to produce significantly higher baby cob crude fibre content (9.33 per cent) in *Kharif*. The starch content, reducing sugar, total soluble solids and ascorbic acid content were not significantly influenced by interaction effects during both seasons.

Spacing and varietal interaction effects had significant influence on nitrogen uptake in summer season only and the highest nitrogen uptake of 174.75 kg ha^{-1} was noticed with v_3s_2 (CO-6 at 45 cm x 20 cm) interaction. The interactions v_3s_3 (CO-6 at 60 cm x 20 cm) and v_1s_3 (Rasi 4212 at 60 cm x 20 cm) recorded significantly higher phosphorus uptake of 33.32 kg ha^{-1} and 26.00 kg ha^{-1} in summer and *Kharif* respectively. The interaction of varieties and spacings had no significant effect on uptake of potassium.

Soil pH was not influenced significantly by the interaction of varieties and spacings. The interaction effect v_3s_3 (CO-6 at 60 cm x 20 cm) recorded higher electrical conductivity of 0.17 dSm^{-1} and organic carbon content of 1.81 per cent in the soil after the experiment.

The available nitrogen content in soil after the experiment was not significantly influenced by the interaction of varieties and spacings. The interaction v_3s_3 (CO-6 at 60 cm x 20 cm) recorded the highest available phosphorus content of 18.99 kg ha^{-1} in soil after the experiment, followed by v_3s_2 (CO-6 at 45 cm x 20 cm) and v_2s_3 (G 5414 at 60 cm x 20 cm), recording 15.15 kg ha^{-1} and 14.45 kg ha^{-1} respectively. The interaction effect v_2s_3 (G 5414 at 60 cm x 20 cm) recorded significantly higher available potassium content of 134.29 kg ha^{-1} in soil after the experiment compared to other interactions which was at par with v_2s_1 (G 5414 at 30 cm x 20 cm) recording an available soil potassium content of 130.48 kg ha^{-1}.

In summer season, the interaction v_2s_2 (G 5414 at 45 cm x 20 cm) recorded significantly higher net income (163447 ₹ ha^{-1}), while in *Kharif* season, v_3s_2 (CO-6 at 45 cm x 20 cm) recorded the highest net income of 145237 ₹ ha^{-1}. These interactions were also at par in both the seasons.

The interaction v_3s_2 (CO-6 at 45 cm x 20 cm) resulted in the highest benefit: cost ratio of 3.16 and 3.03 respectively in summer and *Kharif* seasons However, v_3s_2 was followed by v_2s_2 (G 5414 at 45 cm x 20 cm) which recorded a benefit: cost ratio of 3.08 in summer and v_2s_1 (G 5414 at 30 cm x 20 cm) which recorded a benefit: cost ratio of 2.64 in *Kharif* season.

The study revealed that among the varieties tested, G 5414 proved superior and among the spacings 45 cm x 20 cm was significantly superior in both summer and *Kharif* seasons. Investigation of the interaction effect revealed that G 5414 at 45 cm x 20 cm and CO-6 at 45 cm x 20 cm spacing were equally superior in terms of yield and economics. In baby corn cultivation, detasseling is an important operation which is labour intensive. The variety G 5414 exhibited 50 per cent silking prior to tasseling and hence the detasseling before the first harvesting could be avoided. This variety had a better appearance and uniformity compared to CO-6. While comparing the seasons, it was observed that yield was higher in summer in comparison with *Kharif* season. Hence, it could be concluded that baby corn can be profitably intercropped in coconut gardens in summer and *Kharif* seasons. The baby corn hybrid G 5414 at 45 cm x 20 cm spacing was superior with higher baby cob yield with husk, marketable baby cob yield, net income and B:C ratio during both seasons in southern Kerala. The maize variety, CO-6 also performed well in coconut garden during both seasons.

FUTURE LINE OF WORK

- Exploring the possibility of baby corn cultivation in open field conditions.
- Investigating the feasibility of cultivating baby corn as a rainfed crop in homesteads.
- Find out suitable intercrops in baby corn based intercropping systems.

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Varietal suitability and crop geometry of baby corn (*Zea mays* L.) in coconut garden

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ABSTRACT

The experiment entitled "Varietal suitability and crop geometry of baby corn (*Zea mays* L.) in coconut garden" was undertaken at the Coconut Research Station, Balaramapuram, Thiruvananthapuram, during the summer season (March to May) and the *Kharif* season (August to October) of 2015. The main objectives of the study were to understand the feasibility of introducing baby corn as intercrop in coconut garden, to assess the effect of varieties and spacings on its growth and productivity and to work out the economics of cultivation.

The field experiment was laid out in Randomised Block Design with 9 treatments replicated thrice. The treatments comprised of combinations of three varieties and three spacings. The three varieties were Rasi 4212 (V_1), G 5414 (V_2) and CO-6 (V_3) and the three spacings were 30 cm x 20 cm (S_1), 45 cm x 20 cm (S_2) and 60 cm x 20 cm (S_3).

The variety G 5414 recorded significantly higher baby cob weight with husk of 47.01 g cob^{-1} and 35.74 g cob^{-1}, cob yield with husk of 10.97 t ha^{-1} and 9.98 t ha^{-1} and marketable baby cob yield of 3.67 t ha^{-1} and 3.36 t ha^{-1} in summer and *Kharif* respectively. This variety took less number of days from tasseling to harvest (2.11) and recorded the highest net income of ₹ 133698 ha^{-1} and ₹ 116629 ha^{-1} and B:C ratio of 2.70 and 2.49 in summer and *Kharif* seasons respectively. The variety G 5414 was followed by CO-6 in producing higher baby cob yield with husk and marketable baby cob yield.

The growth attributes *viz.,* plant height, number of leaves and leaf area index (LAI) at 15, 30 and 45 days after emergence (DAE), dry matter content and light interception were significantly higher for the variety CO-6. Green stover yield was significantly higher for CO-6 (19.39 t ha^{-1} and 17.86 t ha^{-1} in summer and *Kharif* respectively) followed by G 5414 (16.08 t ha^{-1} and 14.35 t ha^{-1} in summer and *Kharif* respectively).

The study revealed that spacing significantly influenced the growth attributes *viz.,* plant height, number of leaves and LAI. The row spacing of 45 cm x 20 cm recorded the highest baby cob yield with husk of 10.90 t ha^{-1} and 9.63 t ha^{-1}, marketable baby cob yield of 3.49 t ha^{-1} and 3.24 t ha^{-1} along with the highest net

income of ₹ 125839 ha^{-1} and ₹ 114287 ha^{-1} and B:C ratio of 2.69 and 2.55 in summer and *Kharif* respectively. Baby cob weight with husk was significantly higher at 45 cm x 20 cm and baby cob-baby corn ratio was the most desirable at 30 cm x 20 cm in summer.

In summer, the interaction of CO-6 at 45 cm x 20 cm recorded the highest baby cob weight with husk (56.25 g cob^{-1}), marketable baby cob yield (4.21 t ha^{-1}) and B:C ratio (3.16). Net income was the highest with G 5414 at 45 cm x 20 cm and was on a par with CO-6 at 45 cm x 20 cm. In *Kharif*, CO-6 at 45 cm x 20 cm resulted in the highest baby cob yield with husk (11.16 t ha^{-1}), marketable baby cob yield (3.68 t ha^{-1}), net income (₹ 145237 ha^{-1}) and B:C ratio (3.03). The variety G 5414 at 45 cm x 20 cm was on a par with the variety CO-6 at 45 cm x 20 cm with respect to baby cob yield with husk (9.91 t ha^{-1}) and marketable baby cob yield (3.49 t ha^{-1}).

The study revealed that, among the varieties tested, the variety G 5414 was superior and among the spacings, 45 cm x 20 cm was significantly superior in both summer and *Kharif* seasons. The interaction effects revealed that the variety G 5414 at 45 cm x 20 cm and the variety CO-6 at 45 cm x 20 cm were equally superior in terms of yield and economics. In baby corn cultivation, detasseling is an important operation which is labour intensive. The variety G 5414 exhibited 50 per cent silking prior to tasseling and hence the detasseling before first harvesting could be avoided. This variety had a better appearance and uniformity compared to CO-6. In general, the baby corn yield was higher in summer season compared to *Kharif* season.

To conclude, the result of the study indicated that baby corn can be profitably intercropped in coconut gardens in summer and *Kharif* seasons. The baby corn hybrid G 5414 at 45 cm x 20 cm spacing resulted in higher baby cob yield with husk, marketable baby cob yield, net income and B:C ratio during both seasons in southern Kerala. The maize variety CO-6 also performed well in coconut garden during both summer and *Kharif* seasons.

സംഗ്രഹം

'തെങ്ങിൻ തോപ്പിൽ ഇടവിളയായി പിഞ്ചുചോളത്തിന്റെ വിവിധ ഇനങ്ങളുടെ തെരഞ്ഞെടുപ്പും നടീൽ അകലത്തിന്റെ നിർണയവും' എന്ന പേരിൽ ഒരു പഠനം ബാലരാമപുരത്തുള്ള തെങ്ങുഗവേഷണകേന്ദ്രത്തിൽ വെച്ച്, 2015 ലെ വേനൽക്കാലത്തും തുടർന്നുള്ള മഴക്കാലത്തും നടത്തുകയുണ്ടായി. തെങ്ങിൻ തോപ്പിൽ ഇടവിളയായി പിഞ്ചുചോളം എത്രമാത്രം അനുയോജ്യമാണെന്നു മനസ്സിലാക്കുക, വിവിധ ഇനങ്ങൾക്കും നടീൽ അകലത്തിനും പിഞ്ചുചോളത്തിന്റെ വളർച്ചയിലും ഉ□ാദനക്ഷമതയിലും ഉള്ള പങ്കിനെക്കുറിച്ചു പഠിക്കുക, പിഞ്ചുചോളകൃഷിയുടെ സാമ്പത്തിക വശത്തെക്കുറിച്ചു മനസ്സിലാക്കുക എന്നിവയായിരുന്നു ഈ പഠനത്തിന്റെ ലക്ഷ്യങ്ങൾ.

പ്രസ്തുത പഠനത്തിന് റാൻഡമൈസ്ഡ് ബ്ലോക്ക് ഡിസൈൻ എന്ന സ്റ്റാറ്റിസ്റ്റിക്കൽ പഠനരീതിയാണ്അവലംബിച്ചത്. പിഞ്ചുചോളത്തിന്റെ ഉ□ാദനത്തിനായി ചോളത്തിന്റെ മൂന്നിനങ്ങളും (രാസി 4212, ജി 5414, സി ഒ – 6) മൂന്ന് നടീൽ അകലങ്ങളുമായിരുന്നു (30 സെ. മീ. × 20 സെ. മീ., 45 സെ. മീ. × 20 സെ. മീ., 60 സെ. മീ. × 20 സെ. മീ.) പരീക്ഷണത്തിൽ ഉപയോഗിച്ചത്.

രണ്ടു പരീക്ഷണകാലയളവിലും, ജി 5414 എന്ന സങ്കര ഇനത്തിൽപ്പെട്ട പിഞ്ചുചോളം മറ്റ് ഇനങ്ങളേക്കാൾ കൂടുതൽ കതിർ വിളവും സാമ്പത്തികലാഭവും രേഖപ്പെടുത്തുകയുണ്ടായി. അതേ സമയം സി ഒ – 6 എന്ന ഇനത്തിൽ നിന്ന് കൂടുതൽ തീറ്റപ്പുല്ല് ലഭ്യമായി. നടീൽ അകലങ്ങളിൽ, 45 സെ. മീ. × 20 സെ. മീ. അകലത്തിൽ നട്ട പിഞ്ചുചോളങ്ങൾ കൂടുതൽ കതിർ വിളവും സാമ്പത്തികലാഭവും നല്കുകയുണ്ടായി. ഇനങ്ങളുടെയും നടീൽ അകലങ്ങളുടെയും സംയുക്തമായുള്ള അപഗ്രഥനത്തിൽ ജി 5414 എന്ന ഇനവും സി ഒ – 6 എന്ന ഇനവും 45 സെ. മീ. × 20 സെ. മീ. നടീൽ അകലത്തിൽ മികച്ച വിളവും ആദായവും നല്കുന്നതായി കണ്ടു.

തെങ്ങിൻ തോപ്പിൽ ഇടവിളയായി കൃഷി ചെയ്യുമ്പോൾ വേനൽക്കാലത്തും മഴക്കാലത്തും പിഞ്ചുചോളത്തിന്റെ ജി 5414 എന്ന ഇനം 45 സെ. മീ. × 20 സെ. മീ. അകലത്തിൽ നടുന്നത് മികച്ച വിളവും ആദായവും നല്കുമെന്ന് ഈ പഠനത്തിൽ നിന്നു തെളിഞ്ഞു. കൂടാതെ, വേനൽക്കാലമാണ് കൂടുതൽ വിളവു ലഭിക്കാൻ ഉത്തമമെന്നും മനസ്സിലായി.

Appendices

APPENDIX- I

Weather data for the cropping period: Summer

(March 2015 to May 2015)

Standard week	Temperature (°C)		Rainfall (mm)	Relative humidity (%)		Bright sunshine hours
	Maximum	Minimum		Maximum	Minimum	
9	34.1	23.5	2.3	88.7	66.6	9.2
10	34.0	23.2	0.0	88.6	66.3	9.4
11	34.0	23.3	60.5	91.4	69.3	9.6
12	33.7	23.3	0.0	90.7	67.9	9.5
13	34.2	24.7	4.6	90.7	67.0	9.5
14	33.7	24.1	29.5	91.9	70.0	8.9
15	33.8	23.6	40.0	91.4	68.6	9.3
16	34.2	23.5	99.4	89.7	76.5	8.9
17	33.4	23.8	31.5	89.6	77.3	8.4
18	33.8	25.0	0.0	85.1	75.9	9.9
19	32.7	24.5	87.3	91.4	83.6	7.6
20	31.4	24.1	240.8	94.0	89.1	6.5
21	32.3	24.6	67.5	92.1	82.7	8.8
22	33.2	25.2	6.6	90.8	81.0	8.8

APPENDIX- II

Weather data for the cropping period: *Kharif*

(August 2015 to October 2015)

Standard week	Temperature (°C)		Rainfall (mm)	Relative humidity (%)		Bright sunshine hours
	Maximum	Minimum		Maximum	Minimum	
31	32.8	22.7	3.0	87.6	78.1	9.9
32	32.8	22.9	4.2	90.0	76.1	9.5
33	33.0	23.1	29.9	87.9	73.4	8.9
34	33.6	22.9	10.0	91.3	76.7	9.6
35	33.5	22.7	0.0	89.9	81.1	10.2
36	33.4	22.7	58.4	91.7	84.3	6.7
37	30.5	22.2	53.2	93.4	86.4	8.6
38	31.1	23.0	87.0	93.1	81.9	8.3
39	32.5	23.5	65.5	88.9	83.0	8.3
40	32.0	23.3	47.2	91.9	79.0	8.6
41	31.4	22.3	161.8	92.6	80.6	8.3
42	32.3	22.4	34.0	91.1	78.9	7.8
43	31.6	22.6	158.0	93.3	82.4	7.8
44	31.9	22.5	214.0	92.7	83.1	7.7

APPEDINX - III

Average input cost and market price of produce

Items	Cost (₹)
Inputs	
Seed	
Rasi 4212	130 kg^{-1}
G 5414	440 kg^{-1}
CO-6	150 kg^{-1}
Labour wages	
Men	450 day^{-1}
Women	450 day^{-1}
Manures and fertilizers	
Farm yard manure (FYM)	0.80 kg^{-1}
Urea	8 kg^{-1}
Rock phosphate	10 kg^{-1}
Muriate of potash (MOP)	17 kg^{-1}
Produce	
Market price of baby corn	40 kg^{-1}