ORGANIC NUTRITION IN BABY CORN (*Zea mays* L.)

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(2018-11-036)

DEPARTMENT OF AGRONOMY

COLLEGE OF AGRICULTURE

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By

ANUPAMA A

(2018-11-036)

THESIS

Submitted in partial fulfillment of the

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DECLARATION

I, hereby declare that this thesis entitled **"ORGANIC NUTRITION IN BABY CORN (*Zea mays* L.)"** 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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Date : 26 -08- 2020　　　　　　　　　　　　　　　(2018-11-036)

CERTIFICATE

Certified that this thesis entitled **"ORGANIC NUTRITION IN BABY CORN (*Zea mays* L.)"** is a record of research work done independently by Ms. Anupama A (2018-11-036) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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Anupama A

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LIST OF ABBREVIATIONS

Abbreviation	Expansion
%	Per cent
@	At the rate of
^oB	Degree brix
^oC	Degree Celsius
BCR	Benefit -cost ratio
CD	Critical difference
cfu	Colony forming unit
cm	Centimeter
cm^3	Cubic centimetre
DAE	Days after emergence
DAS	Days after sowing
d Sm^{-1}	Deci Siemen per meter
EC	Electrical conductivity
et al.	Co-workers/ co- authors
Fig.	Figure
FYM	Farm yard manure
G	Gram
Ha	Hectare
K	Potassium
KAU	Kerala Agricultural University
kg ha^{-1}	Kg per hectare
LAI	Leaf are index
M	Meter
Max.	Maximum
mg	milli gram
Min.	Minimum
mm	Milli meter
MOP	Muriate of Potash
MRV	Mean rank value
MS	Mean score
N	Nitrogen
NS	Non-significant
P	Phosphorus
pH	Negative logarithm of hydrogen ion concentration
POP	Package of Practices
RBD	Randomized block design
RH	Relative humidity
₹	Indian rupees
SEm	Standard error mean
t ha^{-1}	Tons per hectare
TSS	Total soluble sugar
viz.	Namely

INTRODUCTION

1. INTRODUCTION

Maize is a multi-purpose crop, providing food for humans, animals, livestock and poultry. Diversified uses of maize in the corn starch industry, maize oil processing, specialty corn production and its export potential has contributed to maize demand worldwide in addition to other commercial avenues. Growing maize for vegetable purpose, known as' baby corn,' is contemplated for the diversification and value addition of maize as well as for the development of the food processing industry.

Baby corn is an unfertilized young cob harvested just after two or three days of silk emergence. It is rich in essential fibers and protein and is packed with vital anti oxidants too. This nutrient rich vegetable is very low in calories and starch, and has negligible amount of fat. Baby corn is eaten both raw and cooked while the early harvest of the crop gives nutritious feed for livestock. Improved production technology of baby corn can boost its productivity and help to achieve a higher economic return and high quality product compared to grain maize.

Organic farming is a holistic way of farming and is one of the several approaches suggested to meet the objective of sustainable agriculture. Organic agriculture improves the soil quality by making sufficiently higher amount of nutrients available to the crops by enhanced microbial activity in the soil. Organically produced crops have more demand compared to conventional crops. Organic farming provides higher net profit to farmers compared to conventional farming, mainly due to the premium price of the certified organic produce. Since baby corn is preferred as a raw vegetable or in partially cooked form in soups, salads and Chinese food preparations, nutrient management with organic resources assumes more importance with respect to nutritive value, taste and overall consumer preference.

Vermicompost is a product derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms. It has a strong and diverse microbial and enzymatic function, a fine particulate structure, a good capacity to retain moisture, and contains nutrients such as N, P, K, Ca and Mg in plant-friendly forms (Arancon and Edwards, 2009).

Coir pith compost is an organic manure having favourable effects on soil properties and it facilitates the retention of water in soil and slow release of nutrients. Poultry manure is an organic manure of high quality, which enhances soil structure, nutrient retention, aeration, soil water holding capacity and water infiltration. It was also pointed out that poultry manure supplies P to plants more readily than other sources of organic manure (Garg and Bahle, 2008).

Green manure crops are primarily used to supply nutrients to the subsequent crops and help to increase crop quality and yields. Green manuring build up the soil organic matter and also improves soil physical properties and soil structure. Leguminous green manures fix nitrogen in association with *Rhizobium* bacteria. Besides addition of nitrogen, legumes help in recycling of other nutrients in soil. Use of green manures as alternative to mineral fertilizers is considered as a good agricultural practice.

Good health is considered as an asset in any society and staying healthy through consumption of healthy and quality food is highly relevant in current times. Prospects are higher in organic cultivation of baby corn which is preferred as a raw vegetable in urban areas. However, the influence of organic nutrition in baby corn has not been studied so far in Kerala to make an organic recommendation to the farmers.

With this background, the present study was proposed with the following objectives;

- To investigate the effect of organic nutrition on growth, yield and quality of baby corn.
- To work out the economics of baby corn cultivation.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Organic farming is a holistic way of farming which aims at conserving the natural resources and providing quality food. Organically produced crops have more demand compared to conventional crops owing to the higher nutritive value. Since baby corn is preferred as a raw vegetable or in partially cooked form, nutrient management with organic resources assumes more importance with respect to nutritional quality, taste and overall consumer preference especially in urban areas. In this chapter, a detailed research work done on the effect of different sources of organic nutrition on various aspects of baby corn cultivation are presented.

2.1 EFFECT OF VERMICOMPOST

Vermicompost is a source of nutrition in organic farming and it supplements all essential nutrients besides improving the quality of produce and soil properties.

2.1.1 Effect of vermicompost on growth and growth attributes

Vermicompost has been found to influence the growth habits of maize crop as reported by several researchers. According to Louraduraj (2006), application of 5 t $ha^{-1}$of vermicompost significantly increased the plant height, dry matter accumulation and LAI in maize compared to the application of lower doses. Choudhari and Channappagoudar (2014) reported that application of vermicompost in maize produced a plant height of 148.6 cm and total dry matter content of 160.2 g $plant^{-1}$. Vermicompost application at the rate of 2.5 t ha^{-1} resulted in the highest plant height (201.7 cm), number of leaves per plant (12), leaf area index (3.5) and total dry matter yield in maize (Choudhary and Kumar., 2013). According to Nagavani and Subbian (2014), application of 100 per cent recommended dose of nitrogen through vermicompost in maize has improved the growth attributes like plant height, LAI and dry matter production.

Beneficial effect of vermicompost application in specialty corns have been reported by many researchers. According to Mohammadi *et al*. (2017), different levels of vermicompost had significant effect on plant height and day to 50 per cent silking in sweet corn and significantly higher plant height and minimum days to 50 per cent silking were recorded with the application of vermicompost @ 4.0 t ha^{-1}. Snehaa *et al*. (2017) reported that application of vermicompost @ 5 t ha^{-1} recorded higher values of growth attributes, *viz*., plant height, LAI, DMP in kg ha^{-1} compared to other organic sources such as FYM, farm compost, fish amino acid or oil cakes in baby corn.

2.1.2 Effect of vermicompost on yield attributes and yield

Biomass allocation and productivity in above ground part of maize were the highest (1134 kg ha^{-1} and 459 kg ha^{-1} $month^{-1}$ respectively) in vermicompost treated plots (Roy *et al*., 2010). Vermicompost application resulted in the highest number of cobs (1.6), cob diameter (8.5 cm), cob length (18.4 cm) and yield (4350 kg ha^{-1}) compared to other organic sources in maize (Choudhary and Kumar, 2013). In a study on pop corn, Meena *et al*. (2013) observed that vermicompost, equivalent to 120 kg N ha^{-1} was the best organic source with respect to yield attributes and yield. Sharma and Banik (2014a) reported that vermicompost (@ 10 t ha^{-1}) applied plots of baby corn recorded considerably higher cob (0.717 t ha^{-1}) and green fodder (17.58 t ha^{-1}) yield compared to no vermicompost application. According to Yadav (2015), application of 8 t ha^{-1} of vermicompost produced a biological yield of 6.9 t ha^{-1} in maize. Mohammadi *et al*. (2017) reported that in sweet corn, yield attributes, green cob yield and green fodder yield were influenced significantly by different levels of vermicompost application. In their study, vermicompost application @ 4.0 t ha^{-1} recorded the highest number of cobs per plant, cob length, and cob girth besides producing the highest green cob yield (14151.75 kg ha^{-1}) and green fodder yield (199.79 q ha^{-1}). In an experiment on baby corn, Snehaa *et al*. (2017) pointed out that the application of vermicompost @ 5 t ha^{-1}produced comparable yields with the chemical fertilizer application (RDN 150: 60: 40 kg NPK ha^{-1}).

Contrary results have also been reported by some of the workers on the effect of vermicompost on yield attributes and yield of corn. Saha *et al.* (2007) reported that baby corn yields were poor in vermicompost applied plots compared to other sources of organic nature such as poultry manure and FYM, due to low rates of application. Supply of 100 per cent recommended dose of nutrients through organic sources such as vermicompost producing lower yield was pointed out by Nagavani and Subbian (2014) in hybrid maize.

2.1.3 Nutrient uptake

Ashalatha (2009) reported that the application of vermicompost equivalent to 150 kg N in baby corn has resulted in higher K uptake (62.80 kg ha^{-1}) compared to the application of 150 kg N through chemical fertilizer source or other organic sources such as FYM, poultry manure, leaf manure, sheep manure or neem oil cake. A higher rate of nutrient uptake of N (85 kg ha^{-1}), P (32 kg ha^{-1}) and K (84 kg ha^{-1}) were recorded in maize with vermicompost application as reported by Choudhary and Kumar (2013). Baby corn accumulated significantly higher N (62 kg ha^{-1}), P (10 kg ha^{-1}) and K (75 kg ha^{-1}) when it was grown with vermicompost compared to no vermicompost application (Sharma and Banik, 2014a). Muktamar *et al*. (2017) reported that vermicompost application @ 25 t ha^{-1} supplemented with 100 per cent liquid organic fertilizer registered the highest uptake of N, P, and K, suggesting that the combination was most effective for major nutrient uptake in sweet corn.

2.1.4 Quality of produce and shelf life

. Meena *et al*. (2007) reported that the application of 1.5 t ha^{-1} vermicompost resulted in significantly more protein content in maize as compared with 0.5 and 1.0 t ha^{-1} of vermicompost application. Vermicompost contributed more to concentration of iron, zinc and manganese in baby corn while it did not add to the protein content of cob (Saha *et al*., 2007). Ramesh *et al*. (2008) reported that vermicompost application recorded significantly higher protein content (9.40 per cent) in maize cob as compared to the control (8.58 per cent). Ghosh *et al.* (2013) found that the ascorbic acid, sugar and starch content of sweet corn were increased with increasing dose of vermicompost. Jinjala *et al*. (2016) reported that significantly higher crude protein, vitamin-C and total sugar were recorded in treatment wherein 100 per cent RDN (Recommended dose of nutrients) was supplied through vermicompost in baby corn compared to integrated use of chemical and organic fertilizers.

Studies on influence of vermicompost application on post-harvest quality and shelf life of the produce are meager. According to Mohammed (2008) organically produced tomato fruits using vermicompost had better firmness and higher organoleptic score indicating greater consumer acceptance. Chatterjee *et al*. (2013) observed that application of higher amount of vermicompost along with chemical fertilizers improved the shelf life of tomato fruits.

2.1.5 Soil properties and microbial activity

Vermicompost application has been found to influence the soil physical and biological properties. Application of vermicompost had favourable effects on soil pH, microbial population and soil enzyme activities (Maneswarippa *et al.,* 1999). Jayaprakash *et al.* (2004) reported that application of vermicompost @ 1 t ha^{-1} recorded the highest organic carbon content and increased available NPK in soil and it was found to be significantly superior to FYM (@ 10 t ha^{-1}) treatment and also over no organic treatment in maize based cropping system. Vermicompost application in baby corn has resulted in higher amount of soil available N (246.3 kg ha^{-1}) and K (290 kg ha^{-1}) compared to other organic sources such as FYM, green leaf manure, sheep manure, neem oil cake or poultry manure (Ashalatha, 2009). According to Choudhary and Kumar (2013), chemical parameters like pH, soil organic carbon, available N, P and K were higher after vermicompost application in maize crop compared to other organic sources such as poultry manure, swine manure, FYM or cow dung. Murmu *et al.* (2013) reported that vermicompost based treatments registered lower soil available macronutrients (N, P and K), but higher organic carbon and micronutrient (Fe, Mn, Zn and Cu) as compared to chemical fertilizer treatment at the end of two years cropping system in sweet corn based cropping system. According to Lim *et al*. (2015), vermicompost was found to increase soil fertility in terms of both physical and chemical properties. Physical improvement included better aeration, porosity and bulk density while chemical properties like pH, electrical conductivity and organic carbon content were also enhanced for better plant growth.

Favourable influence of vermicompost on soil microbial activity was reported by many researchers. Sharma and Banik (2014a) observed that vermicompost application in baby corn improved the soil microbial status (basal soil respiration, microbial biomass carbon, microbial quotient, and metabolic quotient) and enzyme activities (urease and acid phosphatase) besides building up soil N, P, K, organic carbon content and CEC. Silva *et al.* (2017) concluded that the two important contributions of vermicompost are increased soil microbial populations and activity, which are key factors in soil nutrient cycling rates, producing substances that influence growth and thus benefiting the maize crop.

2.1.6 Economics of cultivation

Being a costly organic manure, research works generally points out the low economic returns of vermicompost compared to chemical fertilizer application.

According to Ashalatha (2009), vermicompost application equivalent to 150 kg N in baby corn produced the lowest economic returns compared to poultry manure, sheep manure, FYM, green leaf manure or oil cake. Nagavani and Subbian (2014) reported that supplying 100 per cent RDF through vermicompost alone produced lowest economic returns in hybrid maize. In their study, the net returns and benefit-cost ratio produced were ₹ 5061 and 1.14 respectively in the year 2008 and in 2009 values were ₹ 8755 and 1.25, respectively for application of 100 per cent RDF through vermicompost. Application of 100 per cent RDF through chemical fertilizers however produced higher net returns of ₹ 35198 and ₹ 33583 in 2008 and 2009, respectively while the corresponding B:C ratios were 3.02 in 2008 and 2.94 in 2009. In another study on vermicompost application, Jinjala *et al*. (2016) reported that supply of 100 per cent of RDN through vermicompost resulted in the lowest net returns (₹ 86840 ha^{-1}) and benefit-cost ratio (2.86) in baby corn compared to application of RDN only through chemical fertilizers (net returns ₹ 215384 ha^{-1}) or INM practices involving combined application of organic and inorganic sources of nutrients.

2.2 EFFECT OF COIR PITH COMPOST

The coir pith compost is an organic manure having favourable effects on plant growth and soil properties. However, the research works on the influence of coir pith compost in baby corn or maize are meager.

2.2.1 Growth and growth attributes

Suharban *et al*. (1997) conducted a pot culture experiment in bhindi and reported that higher plant height (1.37 m) was observed in coir pith compost treated plants. According to Suja (2001), coir pith compost application increased the vine length, number of leaves, LAI, and biomass of leaf, vine, tuber and whole plant in white yam. Raj (2006) reported that application of enriched coir pith compost produced higher vine length (258.7 cm) and dry matter (1832 kg ha^{-1}) next to vermicompost in slicing cucumber. Dhanya (2011) conducted an experiment on production technology for organic sweet potato and reported that application of coir pith compost at 75 per cent of recommended rate produced the highest number of leaves at 60 DAP. She also reported that coir pith compost application produced a vine length of 80 cm and dry matter yield of 1851.68 kg ha^{-1}.

2.2.2 Yield attributes and yield

Treatment with coir pith compost alone gave the highest yield (5.923 kg per plant) in bhindi (Suharban *et al*., 1997). Kadalli *et al*. (2001) reported that application of coir pith compost @10 t along with recommended dose of NPK fertilizers for maize crop resulted in 12.5 per cent increase in grain yield. Suja (2001) reported that coir pith compost application produced higher tuber weight, tuber length and enhanced tuber yield in white yam. According to Raj (2006) application of enriched coir pith compost in slicing cucumber produced a fruit yield of 15.26 t ha^{-1}. According to Dhanya (2011), number of tubers per plant were higher in plants treated with coir pith compost along with bio inoculants in sweet potato.

2.2.3 Nutrient uptake

Application of coir pith compost resulted in the highest uptake of nitrogen and phosphorus in white yam (Suja, 2001). As reported by Raj (2006), application of enriched coir pith compost in slicing cucumber recorded the N, P and K uptake of 32.41, 22.14 and 49.4 kg ha^{-1}, respectively. Dhanya (2011) reported that N and P uptake were higher with coir pith compost application in sweet potato.

2.2.4 Quality of produce and shelf life

According to Suja (2001), coir pith compost application resulted in significantly higher starch, crude protein and crude fiber content in dioscorea tubers. Raj (2006) reported that fruits of slicing cucumber treated with enriched coir pith compost had the highest keeping quality (7 days), crude protein content (0.36 per cent) and vitamin C content (8.78 mg per 100g fruit). Dhanya (2011) observed that the plants treated with coir pith compost had a higher starch content in sweet potato which was on par with FYM application.

2.2.5 Soil properties and microbial activity

According to Reddy and Reddy (1999), coir pith compost application significantly increased the availability of N, P, K, Fe, Mn and Zn in soil. Raj (2006) reported that enriched coir pith compost application resulted in higher available N (413.23 kg ha^{-1}) and P (197.53 kg ha^{-1}) in soil next to vermicompost application. Kumar *et al*. (2017) observed higher soil microbial activity consequent to the application of coir pith waste along with press mud and litter waste. Ramamoorthy *et al*. (2018) reported that, among various organics evaluated (FYM, composted coir pith and composted calotropis), application of composted coir pith @ 12.5 t ha^{-1} in brinjal significantly improved the post harvest microbial population viz., bacteria (21.71 x 10^{6} g^{-1} soil), fungi (14.61 x 10^{5} g^{-1} soil) and actinomycetes (8.51 x 10^{4} g^{-1} soil) in soil.

2.2.6 Economics of cultivation

Thankamani *et al*. (2005) reported that application of composted coir pith along with $3/4^{th}$ of the recommended dose of leaf mulch produced the highest net income of ₹ 89549 ha^{-1} and benefit-cost ratio of 1.72 in turmeric cultivation. Enriched coir pith compost application in slicing cucumber resulted in a net return of ₹ 2784 ha^{-1} and benefit: cost ratio of 1.03 (Raj, 2006). Dhanya (2011) reported that application of coir pith compost in sweet potato resulted in a benefit: cost ratio of 0.93.

2.3 EFFECT OF POULTRY MANURE

2.3.1 Growth and growth attributes

Ashalatha (2009) reported that the application of poultry manure on N equivalent basis (to supply 150 kg N) in baby corn resulted in higher plant height (147.5 cm), LAI (2.96) and dry matter production (5853 kg ha^{-1}) next to the application of 150 kg N through fertilizer source. Results of the study conducted by Akongwubel *et al*. (2012) in Nigeria indicated that high rates application of poultry manure linearly improved the growth attributes of maize up to the highest rate and the highest plant height, stem diameter and number of leaves per plant were produced with 20 t ha^{-1} of poultry manure. Uwah *et al.* (2014) evaluated the response of animal manures on soil properties, growth and yield of sweet corn and reported that higher plant height (227.3 cm), number of leaves per plant (11.79) and leaf area (2.81 m^2) were obtained with the application of 15 t ha^{-1} of poultry manure. Kumar *et al*. (2018) reported that in baby corn, application of 100 per cent N (150 kg N ha^{-1}) through poultry manure produced significantly higher plant height, leaf area index and dry matter production in comparison to other organic sources like vermicompost, FYM or panchagavya foliar spray.

2.3.2 Yield attributes and yield

Poultry manure as an organic source influence the yield attributes and yield of maize. Khan *et al*. (2008) reported that the treatment with 12 t ha^{-1} of poultry manure resulted in highest cob length (22.5 cm), cob diameter (4.13 cm), 1000 grain weight (246.59 g), and grain yield (5.60 t ha^{-1}) in spring maize. In an experiment conducted in maize by Farhad *et al*. (2009), highest number of grain rows per cob (16), and grains per row (29.1) were recorded with the application of 12 t ha^{-1} of poultry manure. They also reported that the treatment with 12 t ha^{-1} of poultry manure recorded the highest 1000 grain weight (254 g), biological yield (22.2 t ha^{-1}) and grain yield (5.11 t ha^{-1}). Total dry matter yield in sweet corn increased with increasing rate of poultry manure application (Uwah *et al*., 2014). They also reported that poultry manure applied @ 15 t ha^{-1} produced apparently higher unhusked grain ear weight (0.36 kg), dehusked grain ear weight (0.28 kg) and total grain yield (3.77 t ha^{-1}).

Beneficial effect of poultry manure in organic production of baby corn is reported by many researchers. Saha *et al*. (2007) observed that poultry manure application @ 6 t ha^{-1} produced similar baby corn yields compared to the application of higher rates of FYM (10 t ha^{-1}) while it was superior to the vermicompost application. Ashalatha (2009) reported that the application of poultry manure equivalent to 150 kg N in baby corn resulted in higher yield attributing characters like cob length, cob girth, number of cobs per plant and dehusked cob yield next to inorganic fertilizer application. Hekmat and Abraham (2016) reported that in organic production of baby corn, significantly higher cob girth, number of cobs per plant, cob length without husk and cob weight without husk were recorded with the application poultry manure alone at the rate of 4800 kg ha^{-1} compared to the application of FYM, goat manure or their combinations involving poultry manure. Kumar *et al*. (2018) reported that, application of 100 per cent N (150 kg N ha^{-1}) through poultry manure produced the highest cob weight, cob length, and cob girth, green cob and green fodder yield (10920 kg ha^{-1} and 29797 kg ha^{-1}, respectively) in baby corn and was superior to the rest of the organic sources like vermicompost, FYM or panchagavya foliar spray.

2.3.3 Nutrient uptake

Garg and Bahle (2008) reported that the total P uptake by maize increased remarkably by poultry manure addition compared to other organic manures. Poultry manure application in baby corn has lead to higher P uptake (15.07 kg ha^{-1}) by the plants as reported by Ashalatha (2009). Aziz *et al*. (2010) reported that higher shoot phosphorous concentration (8.2 mg g^{-1}) was recorded in maize plants when poultry manure was applied. Hossain *et al.* (2012) reported higher N, P, K content in maize shoot, root and grains compared to control when poultry manure was applied @ 30 t ha^{-1}. Srinivasan *et al*. (2014) noted that when poultry manure was applied in combination with FYM or neem cake, uptake of N, P and K were higher in baby corn.

2.3.4 Quality of produce and shelf life

Pinjari (2007) reported that in sweet corn, phosphorus content in the leaves, stem, grain, cob sheath and cob axis was higher with the application of 100 per cent nitrogen as poultry manure. According to Khan *et al*. (2008), application of 12 t ha^{-1} of poultry manure in spring maize resulted in a protein content of 8.15 per cent. Ashalatha (2009) studied the response of baby corn genotypes to organic manures and reported that the application of poultry manure equivalent of 150 kg N resulted in higher content of Fe and Zn in the produce. She also reported that poultry manure application has improved other quality parameters like protein (14.22 per cent), starch (7.33 per cent) and total sugars (0.421 per cent) in baby corn. Hossain *et al*. (2012) reported that the application of poultry manure @ 30 t ha^{-1} has resulted in higher TSS (26 per cent) and crude protein (5.02 per cent) content compared to control in maize. According to Iqbal *et al*. (2014), application of 100 per cent N through poultry manure in forage maize resulted in a crude protein content of 6.91 per cent. Srinivasan *et al.* (2014) observed significant variation in the protein and ascorbic acid content of baby corn with source of organic manure and the values were higher when poultry manure was applied in combination with neem cake compared to other treatments involving its sole application or combined application with other sources such as FYM or vermicompost.

Limited studies are available on the effect of poultry manure on shelf life of the produce. Ghorbani *et al*. (2008) pointed out that the poultry manure application had a significant impact on crop health, postharvest quality and storage life in tomato and in their study, poultry manure was found to be superior to all other organic manures in terms of storability and final marketable yield after six weeks of storage. In another study, Rajasree and Pillai (2012) reported that the nitrogen nutrition through poultry manure in a greater proportion (2:1 ratio with chemical N) enhanced the shelf life of bitter gourd fruits under normal storage conditions.

2.3.5 Soil properties and microbial activity

According to Ashalatha (2009), poultry manure application (equivalent to 150 kg N) resulted in higher amount of soil available P (27.31 kg ha^{-1}) in an experiment on baby corn. Boateng *et al*. (2006) observed that poultry manure application in maize registered over 53 per cent increase in soil N level from 0.09 per cent to 0.14 per cent, while exchangeable cation content also increased appreciably. Uwah *et al*. (2014) reported that the application of poultry manure in sweet maize increased the soil pH, organic matter content, total N, available P and exchangeable cations (K, Ca and Mg). In their study, increasing the poultry manure rates from 0 to 5, 10 and 15 t ha^{-1}

resulted in corresponding increases in soil organic matter content by 5.1, 22.7 and 30.9 per cent, respectively.

Okur *et al.* (2006) reported that the poultry manure application had a long-term effect on soil enzyme activity and higher soil organic carbon and microbial biomass C were noticed with poultry manure application compared to FYM. Hersztek *et al*. (2018) reported that the application of poultry litter had significant effect on nitrifying bacterial activity in soil and there was a 50 per cent increase in the bacterial activity with the application of 5 t ha^{-1} of poultry litter compared to mineral fertilizers. However, contrary results are reported by Gyapong and Ayisi (2015) that the poultry manure application had no effect on microbial biomass C, N or P in maize-cowpea intercropping system.

2.3.6 Economics of cultivation

Poultry manure application equivalent to 150 kg N ha^{-1}in baby corn resulted in a gross return of ₹ 39272 and benefit-cost ratio of 2.51 which was higher next to the application of chemical fertilizer (Ashalatha, 2009). According to Choudhari and Channappagoudar (2014), use of poultry manure alone as nutrient source in maize produced a gross return of ₹ 27360 and benefit: cost ratio of 1.86. Nagavani and Subbian (2014) reported that the application of 100 per cent RDF through poultry manure produced higher net returns and benefit: cost ratio in the year 2008 (₹ 22483 ha^{-1} and 2.18, respectively) and 2009 (₹ 23145 ha^{-1} and 2.14, respectively) and the values were higher than that obtained with other organic sources such as FYM or vermicompost. In their study, application of 100 per cent RDF through chemical fertilizers however produced the highest net returns of ₹ 35198 ha^{-1} and ₹ 33583 ha^{-1} in 2008 and 2009 respectively, while the corresponding benefit: cost ratios were 3.02 in 2008 and 2.94 in 2009.

2.4 EFFECT OF GREEN MANURING

2.4.1 Growth and growth attributes

Sharma and Behera (2009) studied the nitrogen contribution through green manuring *in situ* with *Sesbania* and dual-purpose legumes in maize- wheat cropping system and reported that the growth and growth attributes of maize were improved by *in situ* green manuring compared with that after fallow and was the highest after *Sesbania* followed by green gram and cowpea. Kar and Ram (2014) reported that green manuring with rice bean produced the highest plant height (175.84 cm) and LAI (3.11) in baby corn compared to no green manuring. Fabunmi and Balogun (2015) studied the response of maize to green manure cowpea and reported that green manure treated pots produced taller plants than control.

2.4.2 Yield attributes and yield

According to Boparai *et al*. (1992), grain yield of maize increased from 13.0 to 24.9 per cent with incorporation of green manure during different cropping seasons. Sakala *et al*. (2003) reported that the maize following green manure crop produced significantly higher yield (2.7 t ha^{-1}) than cropping without green manuring. Turgut *et al*. (2005) observed that the average ear yield of sweet corn was significantly greater in plots receiving green manuring (15127 kg ha^{-1}) than those without green manuring (13826 kg ha^{-1}). Astier *et al*. (2006) reported that the total dry matter yield of maize was higher (7317 kg ha^{-1}) in green manure treated plots. In green manure amended soils, the number of grains per cob and cob yield of maize were higher compared to the control plots (Tejada *et al*., 2008). According to Sharma and Behera (2009), in maize- wheat cropping system both the crops recorded higher grain yield after *in situ* green manuring with *Sesbania* followed by cowpea. Higher baby corn yield (3.12 t ha^{-1}) was obtained in treatments with green manuring compared to treatments without green manuring (Kar and Ram, 2014). As reported by Fabunmi and Balogun (2015), cob girth, grain yield and 100 grain weight of maize were higher in green manure treated plots.

2.4.3 Nutrient uptake

Astier *et al*.(2006) reported that the maize plants receiving green manure treatments had higher nitrogen (56 kg ha^{-1}) and phosphorus (9.5 kg ha^{-1}) uptake compared to without green manure treatments (17.6 kg and 3 kg ha^{-1} nitrogen and phosphorus respectively). Tejada *et al*. (2008) reported that the NPK content in maize was higher in green manure amended plots. According to Sharma and Behera (2009), nitrogen accumulation in maize grain and stover increased significantly after green manuring compared to the fallow. Green manure incorporation increasing the nutrient uptake in maize was reported by Yang *et al*. (2018).

2.4.4 Quality of produce and shelf life

Shehu *et al*. (1998) reported that maize after green manuring had increased crude protein content in leaves (66.2 g kg DM^{-1}) and reduced ash content in stems (5.23 g kg DM^{-1}). In a study conducted by Astier *et al*. (2006), the grain nitrogen concentration in maize plants grown after green manuring was higher (14 g kg^{-1}) than without green manuring (12.3 g kg^{-1}). Tejada *et al*. (2008) observed that the chlorophyll content and grain protein content in maize were higher in green manure amended plots compared to control. In a recent study, Ozturk and Ozer (2019) reported that at the end of 21 days storage period, lower weight loss was observed in tomato fruits of *in situ* green manure–treated (with *Vicia faba*) ungrafted plants compared to control. In their study as compared to the control, greater firmness values were observed in fruits of green manure–treated ungrafted plants during cold storage and which also had lower vitamin C and catechin (phenolic compound) contents than the control.

2.4.5 Soil properties and microbial activity

Boparai *et al*. (1992) reported that green manuring in maize significantly decreased the bulk density of the 25-30 cm soil layer by improving the soil aggregation besides addition of organic matter. They also reported that green manuring in maize increased the organic carbon content of soil to 0.22 per cent after two years of cropping. Shehu *et al*. (1998) observed that green manuring increased the soil organic carbon (0.56 per cent) and total nitrogen content (0.08 per cent) in soil. Hanly and Gregg (2004) studied the effect of green manure on N availability in organic sweet corn and reported that the soil incorporation of green manures significantly influenced soil mineral N levels. In this study, green manure treatments with lupin increased the soil mineral nitrogen levels by 34 per cent in one site and 45 per cent in another site. A study conducted by Randhawa *et al*. (2005) demonstrated that the green manure amendment contributed to an overall increase in soil P availability through enhanced organic P mineralization and the total N (2.66 g kg^{-1}) and organic P (214 mg kg^{-1}) were higher in green manure amended plots compared to unamended plots. Astier *et al.* (2006) reported that green manuring reduced the soil pH and increased the soil available phosphorus (6.26 µg g^{-1}). A study conducted by Tejada *et al*. (2008) to evaluate the effect of different green manures recorded increased soil microbial biomass C and soil respiration consequent to the application of green manures. Significant improvement in available soil nutrients (N, P and K) and organic carbon content due to *in situ* green manuring with sun hemp was reported in maize by Rajashekarappa *et al*. (2013). Dubey *et al*. (2015) concluded that green manuring leads to the addition of organic matter and increase the biological activity in the soil. These crops also improve soil structure and increase the supply of nutrients available to plants. Kar *et al.* (2015) reported that *in situ* green manuring in baby corn cultivation reduced the soil bulk density and increased the porosity appreciably. It was also reported that the incorporation of green manure in summer enhanced the organic carbon content in soil by 24.3 per cent compared to plots without green manuring. In this trial, direct and residual effect of green manure increased the available nitrogen by 1.1 and 1.06 times and available phosphorus by 1.17 and 1.47 times in soil.

2.4.6 Economics of cultivation

Fabunmi and Agbonlahor (2012) concluded that use of cowpea as green manure raised the economic profits from maize production. Rajashekarappa *et al*. (2013) reported that higher net income of ₹ 30098 ha^{-1} and benefit: cost ratio of 2.5 were obtained in maize with *in situ* green manuring of sunhemp. In another study, Sajjad *et al*. (2018) observed that the overall performance of cowpea green manuring in wheat was positive and resulted in a net return of ₹ 10283 ha^{-1}.

2.5 EFFECT OF BIOFERTILIZERS

2.5.1 Growth and growth attributes

PGPR can affect plant growth directly by the synthesis of phytohormones and vitamins, inhibiting plant ethylene synthesis, enhancing stress resistance, improving nutrient uptake, solubilizing inorganic phosphate, and mineralizing organic phosphates (Dobbelaere *et al*., 2003; Lucy *et al*., 2004). In a study carried out to determine the effect of microbial inoculants (biofertilizers) comprising *Azotobacter* sp., *Azospirillum* sp. and phosphate solubilising micro-organism on the growth of maize, Iwuagwu *et al*. (2013) reported that there was significant increase in height, root length, stem diameter, fresh and dry weight of seedlings with the application of the microbial inoculants and suggested that the biofertilizers enhance the growth of maize and as such its usage should be encouraged as it is ecofriendly. Application of PGPR strains significantly increasing the plant height in maize was reported by Kumar *et al*. (2014). Amanullah and Khalid (2015) noted that application of phosphorus solubilizing bacteria in maize produced higher plant height and leaf area. Latha *et al*. (2018) reported that in baby corn, plant height and average number of leaves were the highest with combined inoculation of PGPR and biocontrol agents along with organic formulation and the best among the combination was 50 per cent vermicompost + 50 per cent Jeevamrutha + *Gluconacetobacter diazotrophicus* + *Bacillus megaterium* + *Piriformospora indica*+ *Pseudomonas fluorescens* + *Bacillus subtilis* + *Trichoderma harzianum*. In a recent study, Namitha (2019) reported that baby corn responded well to biofertilizer application (PGPR-1) which significantly increased the plant height at 15 and 45 DAE, leaves per plant at 45 DAE (11.70) and LAI at 30 DAE (2.61) compared to no biofertilizer application.

2.5.2 Yield attributes and yield

Studies conducted by Datta and Banik (1997) suggested the ability of *Azospirillum* to fix atmospheric N and to secrete growth promoting substances and this along with the action of phosphobacteria enhanced the yield attributing characters and yield of baby corn. Thavaprakaash *et al*. (2005) reported that application of 50 per cent RDF through fertilizer along with 50 per cent poultry manure and biofertilizers (*Azospirillum* and phosphobacteria @ 2 kg ha^{-1}) during the late rabi season in baby corn produced longer, thicker and heavier cobs and higher cob yield. Sharma and Banik (2014b) studied the effect of biofertilizers on baby corn and reported that the application of biofertilizers viz. AMF and *Azospirillum* along with 100 per cent RDF had resulted in highest dehusked cob yield (0.77 t ha^{-1}) and green fodder yield (20.23 t ha^{-1}). According to Latha *et al*. (2018), multiple inoculated application of 50 per cent vermicompost + 50 per cent Jeevamrutha +

Gluconacetobacter diazotrophicus + *Bacillus megaterium* + *Piriformospora indica*+ *Pseudomonas fluorescens* + *Bacillus subtilis* + *Trichoderma harzianum* recorded more number of cobs (2.74), cob length with husk (22.45 cm) and without husk (11.43 cm), cob girth with husk (8.50 cm) and without husk (5.89 cm), weight of cobs with husk (79.33 g) and without husk (36.33 g) compared to other triplicate and individual inoculated treatments in baby corn. Namitha (2019) observed that the application of biofertilizer (PGPR- I) had significant influence on the cob weight with husk of baby corn. Significantly higher cob weight with husk (244.33 g per plant and 81.44 g per cob) was obtained with PGPR-1 application (seed treatment and soil application) compared to no biofertilizer application.

2.5.3 Nutrient uptake

Ahmad *et al*. (2008) observed that application of organic compost along with biofertilizer containing PGPR significantly improved the N and P uptake of maize. Kumar *et al*. (2014) reported that PGPR application increased the N uptake in wheat to 73.7 kg ha^{-1} and P uptake to 15.9 kg ha^{-1} compared to control (45.9 kg ha^{-1} and 9.4 kg ha^{-1} of N and P, respectively). The maximum nutrient uptake in baby corn was recorded with the application of biofertilizers viz., AMF and *Azospirillum* along with 100 per cent RDF (Sharma and Banik, 2014b). Joshi (2016) observed that application of 100 per cent NPK along with *Azotobacter* and *Azospirillum* resulted in the highest N, P and K content and uptake in baby corn.

2.5.4 Quality of produce and shelf life

Ullah *et al*. (2013) reported that the seed inoculation of PGPR increased the proline, sugar and chlorophyll content in maize. According to Namitha (2019), application of PGPR I (seed treatment + soil application) in baby corn produced significantly higher reducing sugar content of cob (2.89 per cent) compared to without biofertilizer treatment (2.36 per cent). In this study the PGPR application improved the shelf life and overall organoleptic qualities of cob also when applied along with partial substitution of organic sources.

2.5.5 Soil properties and microbial activity

Jarak *et al*. (2012) reported that the PGPR inoculation caused a proliferation of total microbial number (567.92 x 10^7) in soil including the number of *Azotobacter* (280.89 x 10^2), *Pseudomonas* (105 x 10^6) and aerobic spore forming bacteria (105.04 x 10^6). Combined application of organic manures and PGPR resulted in the highest amount of N, P and K (339.73, 22.33 and 298.66 kg ha^{-1} N, P_2O_5 and K_2O respectively) in soil and also reduced the soil pH and increased the soil organic carbon content (Das and Singh, 2014). Umesha *et al*. (2014) reported that application of RDF along with *Azotobacter chroococcum* + *Bacillus megaterium* + *Pseudomonas fluorescence* + enriched compost increased the available nutrient status of soil (N, P and K) after the harvest of maize crop. According to Ali *et al*. (2015), application of biofertilizer with plant growth promoting bacteria in maize reduced the soil pH, increased the soil available iron and nitrogen and increased the number of microorganisms in rhizosphere.

2.5.6 Economics of cultivation

Singh *et al*. (2018) worked out the economics of cultivation of baby corn and found that the highest net returns of ₹ 97466.66 ha^{-1} and benefit: cost ratio of 2.77 were recorded with application of 100 per cent RDF + phosphate solubilising bacteria compared to the same treatment without biofertilizer (net profit ₹ 79393.34 ha^{-1} and benefit: cost ratio 2.26). Namitha (2019) reported that application of PGPR-I along with 75 per cent RDN + 12.5 per cent N substitution through poultry manure +12.5 per cent N substitution through vermicompost produced the highest net income (₹ 836465 ha^{-1}) compared to the application of same treatment minus PGPR I (₹ 733442 ha^{-1}) in baby corn cultivation.

Investigations done by various researchers indicated the suitability and benefits of different organic nutrient sources such as vermicompost, coir pith compost, poultry manure, green leaf manure and biofertilizers in organic crop production which are relevant in a high value crop like baby corn.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The study entitled “Organic nutrition in baby corn (*Zea mays* L.)” was conducted at College of Agriculture, Vellayani, Thiruvananthapuram during 2018-20 to investigate the effect of organic nutrition on growth, yield and quality of baby corn and to workout the economics of cultivation.

3.1 EXPERIMENTAL SITE

The experiment was conducted in block D of Instructional farm, College of Agriculture Vellayani, Thiruvananthapuram. The experimental site was located at 8°25’45.97716" N latitude and 76°59’22.12368" E longitude and at an altitude of 29 m above the mean sea level.

3.1.1 Soil

Composite soil samples were taken from the field before the experiment and analyzed for its mechanical composition and chemical properties. The soil was sandy clay loam lateritic belonging to the order Oxisol with very strong acidity and medium organic carbon content. The soil was low in available nitrogen, high in available phosphorus and medium in available potassium.

The mechanical composition and chemical properties of soil are given in Table 1 and Table 2 respectively.

Table1. Mechanical composition of soil of the experimental site

Sl. No	Fraction	Content (per cent)	Method used
1.	Sand	47.44	Bouyoucos hydrometer method (Bouyoucos, 1962)
2.	Silt	23.85	
3.	Clay	26.81	

Table 2. Chemical properties of soil of the experimental site

Sl. No	Parameter	Content	Rating	Method used
1.	Soil reaction (pH)	5.21	Strongly acidic	1:2.5 soil solution ratio using pH meter with glass electrode (Jackson, 1973)
2.	Electrical conductivity (d Sm^{-1})	0.26	Safe	Conductimetry Method (Jackson, 1973)
3.	Organic carbon (%)	1.02	Medium	Walkley and Black rapid titration method (Jackson, 1973)
4.	Available N (kg ha^{-1})	268.06	Low	Alkaline permanganate method (Subbiah and Asija, 1956)
5.	Available P (kg ha^{-1})	86.21	High	Bray colorimetric method (Jackson, 1973)
6.	Available K (kg ha^{-1})	223.56	Medium	Ammonium acetate method (Jackson, 1973)

3.1.2 Climate and season

A warm humid climate prevailed over the experimental site. The field experiment was conducted during May to September 2019 and the period also covered the duration for raising and incorporation of green manure cowpea prior to baby corn. The data on standard week wise minimum and maximum temperature, relative humidity, bright sunshine hours and rainfall during the cropping period were collected from the Class B Agromet Observatory of Department of Agricultural Meteorology, College of Agriculture, Vellayani. The weather data are given in Appendix I and graphically represented in Fig 1.

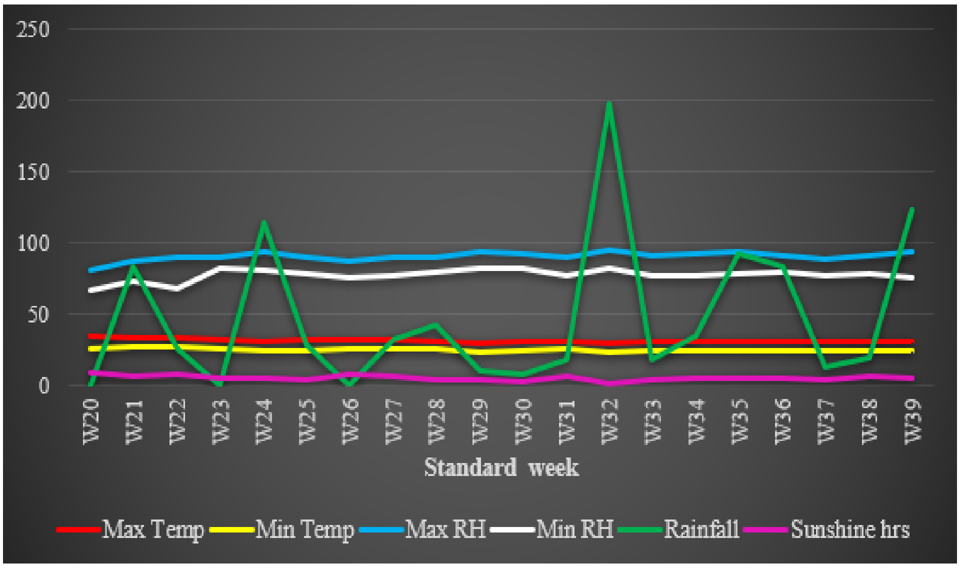

Fig 1. Weather parameters during the period of field experiment

(May 2019- September 2019)

The mean maximum temperature ranged between 30^0C – 34.5^0C and mean minimum temperature ranged between 23.7^0C – 26.7^0C. The mean maximum relative humidity ranged between 81.3 per cent to 94.5 per cent, and mean minimum relative humidity ranged between 66.7 per cent to 82.4 per cent. A total rainfall of 937.70 mm was received during the cropping season.

3.1.3 Previous cropping history of the experimental field

The experimental field was cultivated with banana during the previous season.

3.2 MATERIALS

3.2.1 Crops and variety

The baby corn variety G- 5414 was used for the experiment. The important features of this variety are as follow;

Table 3. Important characters of baby corn variety G- 5414

Parameter	Character
Cob colour	Light yellow
Uniformity of cob	Very good
Maturity (days)	50- 55
Releasing agency	Syngenta Seeds Co. Pvt. Ltd
Cost of seeds (₹ per kg)	625

(Chauhan and Singh, 2012)

The cowpea variety used for green manuring was DC 15 which was released from UAS, Dharwad, having spreading nature and 75-80 days duration.

3.2.2 Manures, fertilizers and biofertilizer

3.2.2.1 Manures

Well decomposed vermicompost, poultry manure and coir pith compost were used as organic sources in the experiment which were applied on N equivalent basis (to supply 135 kg N ha^{-1}) and the quantities were sufficient to supply 65 kg P_2O_5 and 45 kg K_2O per ha also. Cowpea variety DC 15 was used for *in situ* green manuring in the experiment and a quantity of 3.44 t ha^{-1}(on dry weight basis) green matter was incorporated as green manure at 50 per cent flowering stage. The nutrient content of organic manures and green manure are given in Table 4 and the quantity of different organic manures applied on N equivalent basis in the experiment are given in Table 5.

Table 4. Nutrient content of organic manures and green manure, per cent

Sl. No	Organic source	N	P	K
1.	Vermicompost	1.31	1.21	1.55
2.	Poultry manure	1.87	1.08	2.04
3.	Coir pith compost	1.10	0.05	1.01
4.	Green manure cowpea	2.30	0.09	1.90

Table 5. Quantity of organic manures applied, t ha^{-1}

Sl. no	Organic source	Quantity
1.	Vermicompost	7.77
2.	Poultry manure	8.80
3.	Coir pith compost	12.77

3.2.2.2 Fertilizers

Urea (46 per cent N), Rajphos (20 per cent P_2O_5) and Muriate of potash (60 per cent K_2O) were used as sources of chemical fertilizer for N, P and K respectively and were applied only in control plots.

3.2.2.3 Biofertilizers

The biofertilizer PGPR mix 1, which is a consortium of *Azospirillum lipoferum*, *Azotobacter chroococcum*, *Bacillus megaterium* and *Bacillus sporothermodurans* (Gopi *et al*., 2020), supplied from the Department of Agricultural Microbiology, College of Agriculture, Vellayani, was used as per the treatment.

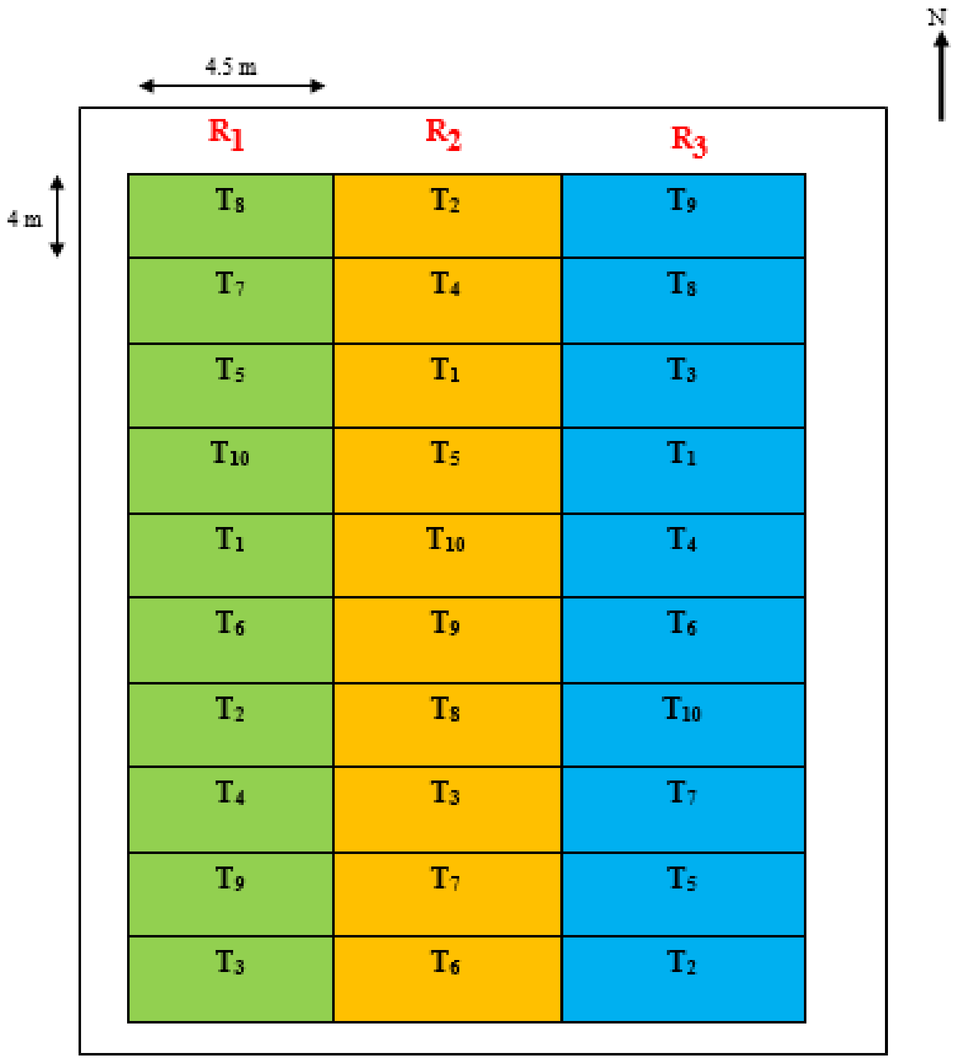

Fig 2. Layout of the experiment

3.3 METHODS

3.3.1 Design and layout

Design	: Randomized Block Design
Treatments	: 10
Replications	: 3
Spacing	: 45 cm x 20 cm
Gross plot size	: 4.5 m x 4.0 m
Net plot size	: 3.15 m x 3.40 m
Variety	: G 5414
Season	: *Kharif* 2019

3.3.1.1 Treatments

T_1 - Vermicompost

T_2 - Coir pith compost

T_3- Poultry manure

T_4 - *In situ* green manuring with cowpea + T_1

T_5- *In situ* green manuring with cowpea + T_2

T_6- *In situ* green manuring with cowpea +T_3

T_7- Vermicompost + PGPR mix I

T_8- Coir pith compost +PGPR mix I

T_9 - Poultry manure + PGPR mix I

T_{10} (control)- NPK@135:65:45 kg ha^{-1} as inorganic fertilisers

3.3.2 Crop management

3.3.2.1 Land preparation

The experimental area was ploughed with a power tiller and brought to a fine tilth with the help of a cultivator. Bunds were taken to separate the area into individual plots. In the individual plots, lime was applied @ 250 kg ha^{-1} at the time of land preparation.

3.3.2.2 Green manuring

Seeds of green manure cowpea was broadcasted uniformly in plots having green manure treatment, 10 days after lime incorporation. Green manure cowpea raised was uprooted and incorporated at 50 per cent flowering stage. A time gap of two weeks was given between green manure incorporation and sowing of baby corn.

3.3.2.3 Application of organic manures

Organic manures (vermicompost, coir pith compost and poultry manure) as per the treatments were applied as basal dose in the plots.

3.3.2.4 Application of biofertilizer

Seeds were moistened and treated with PGPR mix 1 @ 30g kg^{-1} and dried in shade for 15 minutes as per the treatment. Soil application of PGPR mix 1@ 10 g m^{-2} area (mixture of dry cowdung and PGPR mix 1 in 50:1 proportion) was done at the time of sowing and 15 DAS (Days after sowing).

3.3.2.5 Sowing

Ridges were taken 45 cm apart and seeds were sown @ 20 kg ha^{-1}at a spacing of 20 cm between the plants.

3.3.2.6 Weeding and earthing up

Weeding and earthing up were carried out at 21 and 45 DAS in each plot.

3.3.2.7 Irrigation

Irrigation was given on the day of sowing and subsequently as and when required.

3.3.2.8 De-tasseling

The male inflorescence (tassel) was removed from each plant at 40- 45 DAS to avoid pollination and fertilization.

3.3.2.9 Harvest

Small, unfertilized cobs were handpicked at 2- 3 days of silk emergence.

Plate 1. ***In situ*** **green manuring with cowpea**

Plate 2. Green manure incorporation at 50 per cent flowering stage

3.4 OBSERVATIONS

3.4.1 Growth and growth attributes

Five observational plants were selected and tagged from each plot and observations were taken from these plants and average was worked out.

3.4.1.1 Plant height

The plant height was taken from the ground level to the uppermost fully opened leaves upto flowering stage and after flowering stage plant height was recorded from ground level to the basal end of tassel, at 15, 30 and 45 DAE (days after emergence) and was expressed in cm.

3.4.1.2 Leaves per plant

Number of fully opened and functional leaves was counted at 15, 30 and 45 DAE.

3.4.1.3 Leaf area index (LAI)

The length and width of fully opened leaf lamina were taken and the LAI at 15, 30 and 45 DAE were calculated as per the formula suggested by Balakrishnan *et al*. (1987).

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

L= leaf length

B= leaf breadth

N= total number of leaves per plant

K= constant (0.796)

3.4.1.4 Days to 50 per cent tasseling

Number of days were counted when 50 per cent of the plants reached tasseling stage from the date of sowing.

3.4.1.5 Days to 50 per cent silking

Number of days was counted when 50 per cent of plants reached silking stage from the date of sowing.

3.4.1.6 Days to maturity

Number of days taken by the plants to reach the harvestable maturity of the cob was noted.

3.4.1.7 Days to harvest from tasseling

Number of days taken from tassel emergence to reach the harvestable maturity of the cob was noted.

3.4.1.8 Number of harvests

Number of times the cob was harvested from each plot was noted.

3.4.1.9 Dry matter production

The sample plants were uprooted after the final harvest of the cob, shade dried and then oven dried till a constant weight was attained and total DMP (dry matter production) was calculated and expressed in t ha^{-1}.

3.4.2 Yield attributes and yield

Observations were taken from the five selected plants and average was worked out.

3.4.2.1 Cobs per plant

Number of cobs produced per plant was counted and average was expressed as number of cobs per plant.

3.4.2.2 Cob length

Length was measured from base to the tip of the cob after dehusking and expressed in cm.

3.4.2.3 Cob girth

The girth of the dehusked cob was measured using a thread and expressed in cm.

Plate 3. General view of the experimental field

Plate 4. Baby corn at 15 days after emergence

3.4.2.4 Cob weight with husk

Weight of the unhusked cob from the observational plants were measured and the mean was calculated and expressed as g per cob.

3.4.2.5 Cob yield with husk

Total yield of the cob (with husk) obtained from each plot was recorded and expressed as t ha^{-1}.

3.4.2.6 Marketable cob yield

The cobs from the sample plants were dehusked and weight of the corn was recorded and the total marketable cob yield was expressed in t ha^{-1}.

3.4.2.7 Cob- corn ratio

The ratio between weight of the cob (husked) to the weight of the corn (dehusked) was calculated.

3.4.2.8 Green stover yield

The fresh weight of the green stover was taken immediately after harvest of the baby corn by cutting the crop at the ground level and the green stover yield was expressed as t ha^{-1}.

3.4.3 Pest and disease incidence

The plants were observed for the attack of pests and disease incidences.

3.5 PLANT ANALYSIS

3.5.1 Chlorophyll content

The chlorophyll content of fresh leaf sample was estimated using the method suggested by Yoshida *et al*. (1976) at 25 and 45 DAS and expressed in mg g^{-1} of leaf tissue.

3.5.2 Crude protein content

Plate 5. Baby corn at 45 days after emergence

Plate 6. Tasseling in baby corn

The N contents of both cob and stover were estimated and then multiplied by a factor of 6.25 to obtain the crude protein content (Simpson *et al*., 1965) and expressed in percentage.

3.5.3 Starch content

Starch content of the cob was estimated by using Anthrone reagent following the procedure given by Sadasivam and Manickam (1996).

3.5.4 Total soluble sugar

Hand refractometer was used for the measurement of total soluble sugar of the cob (Shobha *et al*., 2010).

3.5.5 Ascorbic acid

Ascorbic acid content of the fresh cob was estimated using the method suggested by Sadasivam and Manickam (1996) and expressed in mg 100 g^{-1} of tissue.

3.5.6 Uptake of nutrients

Baby corn cob, stover and root were dried, powdered and digested for nutrient analysis. Uptake was estimated separately for cob, stover and root and added to get the total uptake.

3.5.6.1 Uptake of N

The N content was analysed by using the modified microckjeldahl method suggested by Jackson (1973). The N content was then multiplied with total dry matter production to obtain the uptake and expressed as kg ha^{-1}.

3.5.6.2 Uptake of P

The P content was analysed by vanadomolybdate phosphoric yellow colour method (Piper, 1966) and the uptake was determined by multiplying it with total dry matter production.

3.5.6.3 Uptake of K

Plate7. Silking in baby corn

Plate 8. Baby corn cob with husk

The K content was analysed by using flame photometer method (Piper, 1966) and the uptake was determined by multiplying it with total dry matter production.

3.6 SOIL ANALYSIS

3.6.1 pH

The pH of the soil sample was found out by diluting with water in the ratio 1:2.5 and analysing using pH meter (Jackson, 1973).

3.6.2 Electrical conductivity

Electrical conductivity of soil sample was found out using conductivity meter (Jackson, 1973).

3.6.3 Organic carbon

Organic carbon content was estimated using Walkley and Black rapid titration method (Jackson, 1973) and expressed in percentage.

3.6.4 Available N

Available N content of soil sample was analysed using alkaline permanganate method suggested by Subbiah and Asija (1956) and expressed in kg ha^{-1}.

3.6.5 Available P

Available P content of soil sample was analysed using alkaline permanganate method suggested by Subbiah and Asija (1956) and expressed in kg ha^{-1}.

3.6.6 Available K

Available K content was estimated by extracting the soil sample with neutral normal ammonium acetate and estimated using flame photometer (Jackson, 1973) and expressed in kg ha^{-1}.

3.7 MICROBIAL COUNT

Population of microbes (bacteria, fungi, actinomycetes, *Azospirillum*, and phosphobacteria) in the soil was estimated using serial dilution technique. Soil samples from different treatments were taken and sieved in a 2 mm mesh. One gram of the soil was suspended in 90 ml sterilised water and serial dilutions of the suspensions were prepared by further dilutions. The medium used for different microorganisms are given in Appendix III. The dilution and plating were done aseptically in a laminar air flow chamber (Herbert, 1990)

3.8 ORGANOLEPTIC STUDY

Organoleptic study was conducted by cooking the cobs with minimum embellishments and rating the qualities using nine point hedonic scale (Appendix II). The cob was salted and kept for 3 minutes and then steam boiled for 5 minutes. The parameters such as appearance, colour, taste, flavor, texture and overall acceptability were rated. The scoring was done at the laboratory of Department of Community Science, College of Agriculture, Vellayani, Thiruvananthapuram by a panel of judges. The judges were requested to evaluate the samples and mark their scores based on their likeness in the score card (Appendix II).

3.9 SHELF LIFE STUDY

To assess the keeping quality of the cobs, the overall visual quality, moisture loss and sensory parameters were analysed on 3rd day and 6th day of storage. The visual quality of the cob with husk on 3rd and 6th day of storage was evaluated using a nine point hedonic scale (Appendix II).

Moisture loss of the cob was estimated using the method of AOAC (1990). To determine the moisture loss, ten gram of the fresh sample was taken and dried in an oven at 105 ^{0}C for 3 hours and cooled in a desiccator. The moisture loss was calculated from the difference in the weight before and after drying and was expressed in per cent.

Moisture (per cent) = $\frac{W1-W2}{W1}$ x 100

Where, w_1 = Weight (g) of the sample before drying

w_2 = Weight (g) of the sample after drying

3.10 ECONOMIC ANALYSIS

Total cost of cultivation, net income and benefit: cost ratio were worked out based on mean values under economic analysis and were not statistically analysed.

3.10.1 Total cost of cultivation

The treatment wise total cost of cultivation was worked out by calculating the cost of inputs and labour and was expressed as ₹ ha^{-1}.

3.10.2 Net income

Cost of cultivation was deducted from gross returns to obtain the net income

Net income (₹ ha^{-1}) = gross returns (₹ ha^{-1}) - cost of cultivation (₹ ha^{-1})

3.10.3 Benefit: cost ratio

The benefit: cost ratio (BCR) was worked out based on variable cost, using the following formula.

$$BCR = \frac{\text{Gross returns } (₹ ha^{-1})}{\text{Cost of cultivation } (₹ ha^{-1})}$$

3.11 STATISTICAL ANALYSIS

Data generated were statistically analysed using analysis of variance technique (ANOVA), suggested by Panse and Sukhatme (1985) as applied to randomised block design. The significance was tested using F test (Snedecor and Cochran, 1967). Critical difference was worked out at 5 per cent level of probability, wherever the treatment differences were found significant. For the organoleptic and shelf life studies, Kruskal Wallis test was adopted to get the mean rank values for all the treatments at 5 per cent level of significance.

RESULTS

4. RESULTS

The study entitled “Organic nutrition in baby corn (*Zea mays* L.)” was carried out during 2018-20 at College of Agriculture, Vellayani, Thiruvananthapuram. The main objective of the study was to investigate the effect of organic nutrition on growth, yield, and quality of baby corn. The results of the study are presented in this chapter.

4.1 GROWTH AND GROWTH ATTRIBUTES

4.1.1 Plant height

Result of the effect of organic nutrition on plant height of baby corn is presented in Table 6.

Plant height varied significantly with different organic sources at 15 and 30 DAE only. The organic nutrition treatment T_9 (application of poultry manure and PGPR mix I) recorded significantly higher plant height of 69.27 cm at 15 DAE which was on par with the plant height recorded with the control (T_{10}- 73.80 cm) wherein N, P and K were applied at the rate of 135:65:45 kg ha^{-1} as chemical fertilizers. Both T_{10} and T_9 were significantly superior to T_7 (63.43 cm) with respect to plant height wherein vermicompost was applied along with PGPR mix I. The treatment T_7 was however on par with T_8 (application of coir pith compost and PGPR mix I), T_1(application of vermicompost), T_6 (*in situ* green manuring with cowpea and application of poultry manure) and T_3 (application of poultry manure) which resulted in a plant height of 61.47 cm, 60.87 cm, 59.97 cm and 59.90 cm, respectively. The treatment T_2 (application of coir pith compost) resulted in lowest value for plant height (48.83 cm) and all other treatments were significantly superior to T_2.

A near similar trend was noticed at 30 DAE. Among different organic nutrition treatments, higher plant height (110.86 cm) was recorded by T_9 (application of poultry manure and PGPR mix I) on par with T_6 and T_3 wherein the T_3 was on par with all other organic treatments. However, the treatment T_{10} (control) recorded the highest plant height of 125.41 cm which was significantly superior to all other treatments.

Table 6. Effect of organic nutrition on plant height, cm

Treatment	Plant height		
	15 DAE	30 DAE	45 DAE
T_1- Vermicompost	60.87	101.87	169.77
T_2- Coir pith compost	48.83	99.82	166.47
T_3 - Poultry manure	59.90	104.06	163.83
T_4 - *In situ* green manuring with cowpea + Vermicompost	55.77	100.96	167.70
T_5 - *In situ* green manuring with cowpea + coir pith compost	55.10	100.96	170.17
T_6 - *In situ* green manuring with cowpea + poultry manure	59.97	109.84	181.53
T_7 -Vermicompost + PGPR mix I	63.43	100.52	165.83
T_8- Coir pith compost +PGPR mix I	61.47	102.41	172.03
T_9 - Poultry manure + PGPR mix I	69.27	110.86	182.63
T_{10} (control) - 135:65:45 kg NPK ha^{-1} as inorganic fertilizers	73.80	125.41	197.24
SEm (±)	1.57	2.70	0.91
CD (0.05)	4.703	8.103	NS

DAE – Days after emergence

4.1.2 Leaves per plant

Result of the effect of application of organic nutrition on leaves per plant in baby corn is given in Table 7. Number of leaves per plant at 30 and 45 DAE varied significantly with the application of organic sources while it was unaffected by the treatments at 15 DAE.

At 30 DAE, the treatment T_9 (application of poultry manure and PGPR mix I) on par with T_6 (*in situ* green manuring with cowpea and poultry manure application) recorded higher number of leaves per plant (8.66) and both these treatments were on par with T_{10} (9.00 leaves per plant). These treatments were however significantly superior to T_8 (7.66), in which coir pith compost and PGPR mix I were applied. The treatment T_8 was however on par with all other treatments (T_1, T_3 and T_7- 7.33, T_2, T_4 and T_5- 7.0) with respect to number of leaves per plant.

At 45 DAE also similar trend was noticed wherein significantly higher number of leaves per plant was recorded with T_9 (11.33) on par with T_6 (10.66) wherein the T_6 was on par with T_3 which in turn on par with T_4, T_5, T_7 and T_8. The number of leaves produced was the lowest in T_2 and T_1 (8.33). The organic nutrition treatments T_9 (application of poultry manure and PGPR mix I) and T_6 (*in situ* green manuring with cowpea and application of poultry manure) did not differ statistically from the control (T_{10}) which produced 11.66 leaves per plant.

Table 7. Effect of organic nutrition on number of leaves per plant

Treatment	Number of leaves per plant		
	15 DAE	30 DAE	45 DAE
T_1- Vermicompost	5.00	7.33	8.33
T_2 -Coir pith compost	4.66	7.00	8.33
T_3 - Poultry manure	5.00	7.33	9.66
T_4 - *In situ* green manuring with cowpea + Vermicompost	4.66	7.00	8.66
T_5 - *In situ* green manuring with cowpea + coir pith compost	4.66	7.00	8.66
T_6 - *In situ* green manuring with cowpea + poultry manure	4.00	8.66	10.66
T_7 -Vermicompost + PGPR mix I	6.00	7.33	9.33
T_8- Coir pith compost +PGPR mix I	4.33	7.66	9.00
T_9 - Poultry manure + PGPR mix I	5.00	8.66	11.33
T_{10} (control) - 135:65:45 kg NPK ha^{-1} as inorganic fertilizers	4.66	9.00	11.66
SEm (±)	0.03	0.27	0.36
CD (0.05)	NS	0.815	1.088

DAE- Days after emergence

4.1.3 Leaf area index (LAI)

Result of the effect of organic nutrition on leaf area index (LAI) of baby corn is detailed in Table 8. The LAI was found to vary significantly with application of organic sources at 30 and 45 DAE only.

As observed in case of other growth attributes, at 30 DAE the organic nutrition treatment T_9 (application of poultry manure and PGPR mix I) produced the highest LAI (3.22) which was on par with the LAI produced with T_6 (*in situ* green manuring of cowpea and application of poultry manure-3.14) and control treatment (T_{10} - LAI 3.21). These treatments were significantly superior to T_3 (2.46), in which poultry manure was applied. The T_3 was however on par with T_7 (2.24), T_8 (2.24), T_4 (2.18), T_5 (2.12) and T_1 (2.01). The treatment T_2 in which coir pith compost was applied recorded the lowest LAI of 1.44.

At 45 DAE, the organic nutrition treatment (T_9) produced higher LAI (5.42) which was on par with T_{10} (5.97) and T_6(*in situ* green manuring of cowpea and application of poultry manure-5.09) and the T_6 in turn was on par with T_7 (4.77) which was significantly superior to all other treatments.

Table 8. Effect of organic nutrition on leaf area index

Treatment	LAI		
	15 DAE	30 DAE	45 DAE
T_1 - Vermicompost	0.59	2.01	3.44
T_2 -Coir pith compost	0.59	1.44	3.29
T_3 - Poultry manure	0.63	2.46	4.11
T_4 - *In situ* green manuring with cowpea + vermicompost	0.59	2.18	4.17
T_5 - *In situ* green manuring with cowpea + coir pith compost	0.54	2.12	3.62
T_6 - *In situ* green manuring with cowpea + poultry manure	0.59	3.14	5.09
T_7 -Vermicompost + PGPR mix I	0.55	2.24	4.77
T_8- Coir pith compost +PGPR mix I	0.45	2.24	3.76
T_9 - Poultry manure + PGPR mix I	0.78	3.22	5.42
T_{10} (control) - 135:65:45 kg NPK ha^{-1} as inorganic fertilizers	0.90	3.21	5.97
SEm (±)	0.05	0.14	0.19
CD (0.05)	NS	0.417	0.565

DAE- Days after emergence

4.1.4 Days to 50 per cent tasseling

Result of the effect of organic nutrition on days to 50 per cent tasseling of baby corn is presented in Table 9.

The organic sources had significant influence on days to 50 per cent tasseling. The treatment T_3 (application of poultry manure) took less number of days for 50 per cent tasseling (44.66 days) and was on par with T_6 (*in situ* green manuring along with poultry manure application) which required 45.00 days for reaching 50 per cent tasseling stage. The treatment T_8 (application of coir pith compost and PGPR mix I) and T_2 (application of coir pith compost) recorded the highest number of days taken for 50 per cent tasseling (46.66) which were found to be on par with all other treatments except T_3 (44.66 days), T_6 (45.00 days) and T_9 (45.66 days).

4.1.5 Days to 50 per cent silking

Result of the effect of organic nutrition on days to 50 per cent silking of baby corn is detailed in Table 9.

Days to 50 per cent silking was found to be significantly influenced by the application of organic sources. The treatment T_6 (*in situ* green manuring and application of poultry manure) took lower number of days for reaching 50 per cent silking stage (48.66 days) compared to T_4 (*in situ* green manuring and vermicompost application-51.33 days), T_2 (application of coir pith compost-51.66 days) and T_8 (application of coir pith compost and PGPR mix I-52.00 days) but was on par with all other treatments. The treatment T_8 which recorded the highest number of days for reaching 50 per cent silking was found to be on par with all other treatments except T_6.

4.1.6 Days to maturity

The effect of application of organic sources on days to maturity of baby corn is presented in Table 9.

None of the treatments could influence the days to maturity of baby corn.

Table 9. Effect of organic nutrition on days to 50 per cent tasseling, days to 50 per cent silking and days to maturity

Treatments	Days to 50 per cent tasseling	Days to 50 per cent silking	Days to maturity
T_1- Vermicompost	46.00	51.00	54.00
T_2- Coir pith compost	46.66	51.66	54.66
T_3- Poultry manure	44.66	49.66	52.66
T_4- *In situ* green manuring with cowpea + vermicompost	46.33	51.33	54.33
T_5- *In situ* green manuring with cowpea + coir pith compost	46.33	51.00	54.00
T_6- *In situ* green manuring with cowpea + poultry manure	45.00	48.66	52.66
T_7- Vermicompost + PGPR mix I	46.00	50.66	54.33
T_8- Coir pith compost + PGPR mix I	46.66	52.00	54.33
T_9- Poultry manure + PGPR mix I	45.66	50.33	53.00
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	46.33	50.00	53.33
SEm (±)	0.33	0.43	0.51
CD (0.05)	0.981	2.342	NS

4.1.7 Days to harvest from tasseling

The effect of application of organic sources on days to harvest from tasseling of baby corn is presented in Table 10.

Days to harvest from tasseling of baby corn was found to be unaffected by the treatments.

4.1.8 Number of harvests

The effect of organic nutrition on number of harvests in baby corn is shown in Table 10.

The different organic sources could not influence the number of harvests in baby corn.

4.1.9 Dry matter production at harvest

The effect of organic sources on dry matter production of baby corn at harvest is detailed in Table 10.

Among organic nutrition treatments, T_4 (*in situ* green manuring and application of vermicompost) and T_6 (*in situ* green manuring and application of poultry manure) which were on par each other, recorded significantly higher dry matter production of 15.54 t ha^{-1} and 14.84 t ha^{-1}, respectively compared to other organic nutrition treatments. These treatments were followed by T_5 (13.25 t ha^{-1}) in which coir pith compost was applied along with *in situ* green manuring which in turn was on par with T_9 (12.76 t ha^{-1}) and T_1 (12.55 t ha^{-1}). The treatment T_1 however was on par with T_7 (12.31 t ha^{-1}) and T_8 (11.86 t ha^{-1}). The treatment T_2 (application of coir pith compost) recorded the lowest (11.25 t ha^{-1}) dry matter production at harvest and was on par with T_8 and T_3. Following the trend with respect to other growth attributes presented before, the control treatment (T_{10}) wherein nutrients were applied through inorganic fertilizers recorded significantly higher dry matter yield (16.87 t ha^{-1}) compared to organic nutrition treatments.

4.2 YIELD ATTRIBUTES AND YIELD

4.2.1 Cobs per plant

The effect of organic nutrition on number of cobs per plant of baby corn is presented in Table 11.

The number of cobs per plant was not significantly affected by different organic nutrition treatments.

4.2.2 Cob length

The influence of organic sources of nutrition on cob length of baby corn is shown in Table11.

Table 10. Effect of organic nutrition on days to harvest from tasseling, number of harvests and dry matter production at harvest

Treatments	Days to harvest from tasseling	Number of harvests	Dry matter production at harvest (t ha^{-1})
T_1- Vermicompost	7.66	3	12.55
T_2- Coir pith compost	8.00	3	11.25
T_3- Poultry manure	8.00	3	11.83
T_4- *In situ* green manuring with cowpea + vermicompost	8.00	3	15.54
T_5- *In situ* green manuring with cowpea + coir pith compost	7.66	3	13.25
T_6- *In situ* green manuring with cowpea + poultry manure	6.66	3	14.84
T_7- Vermicompost + PGPR mix I	7.33	3	12.31
T_8- Coir pith compost + PGPR mix I	8.33	3	11.86
T_9- Poultry manure + PGPR mix I	7.66	3	12.76
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	6.66	3	16.87
SEm (±)	0.66	-	0.24
CD (0.05)	NS	NS	0.705

The organic nutrition treatments T_4 (*in situ* green manuring and vermicompost application), T_5 (*in situ* green manuring and coir pith compost application), T_6 (*in situ* green manuring and poultry manure application) and T_9 (application of poultry manure and PGPR mix I) recorded significantly higher cob length of 11.28 cm, 11.25 cm, 11.02 cm and 10.92 cm, respectively which were on par each other and also on par with the chemical fertilizer application (T_{10}) producing a cob length of 11.57 cm. These treatments were followed by T_7 (application of vermicompost and PGPR mix I) which recorded a cob length of 10.52 cm which in turn was on par with T_3 (10.06cm), T_2 (9.81cm) and T_8 (9.71cm). The treatment T_1 (application of vermicompost) recorded the lowest cob length (9.19 cm) which did not differ from T_2 (9.81 cm) and T_3 (10.06 cm).

4.2.3 Cob girth

The effect of organic nutrition on cob girth of baby corn is presented in Table 11.

The cob girth did not vary significantly with the application of different organic sources of nutrition.

4.2.4 Cob weight with husk

The influence of organic sources on cob weight with husk of baby corn is indicated in Table 12.

The cob weight with husk was found to be significantly influenced by organic sources and among different treatments, the highest cob weight with husk was recorded by treatment T_4 (70.11 g cob^{-1}) in which *in situ* green manuring and vermicompost application were done and it did not statistically differ from the control producing a cob weight with husk of 74.97 g cob^{-1}. The treatment T_4 was also on par with T_5 (66.87 g cob^{-1}), T_9 (66.67 g cob^{-1}), T_7 (66.14 g cob^{-1}), T_8 (65.66 g cob^{-1}) and T_6 (65.04 g cob^{-1}). These treatments were however significantly superior to T_3 and T_1 which recorded cob weight with husk of 58.50 g $cob^{-1}$and 51.90 g cob^{-1}, respectively. The lowest cob weight of 51.64 g cob^{-1} was recorded in T_2 but was on par with T_1.

Table 11. Effect of organic nutrition on cobs per plant, cob length and cob girth

Treatments	Cobs per plant	Cob length (cm)	Cob girth (cm)
T_1- Vermicompost	3	9.19	5.39
T_2- Coir pith compost	3	9.81	5.71
T_3- Poultry manure	3	10.06	5.33
T_4- *In situ* green manuring with cowpea + Vermicompost	3	11.28	5.82
T_5- *In situ* green manuring with cowpea + coir pith compost	3	11.25	5.47
T_6- *In situ* green manuring with cowpea + poultry manure	3	11.02	5.44
T_7- Vermicompost + PGPR mix I	3	10.52	5.55
T_8- Coir pith compost + PGPR mix I	3	9.71	5.30
T_9- Poultry manure + PGPR mix I	3	10.92	5.51
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	3	11.57	5.95
SEm (±)	-	0.29	0.06
CD (0.05)	NS	0.880	NS

4.2.5 Cob yield with husk

The effect of organic nutrition on cob yield with husk of baby corn is presented in Table 12.

The organic nutrition treatment T_6 (*in situ* green manuring and poultry manure application) produced a higher cob yield with husk of 6.33 t ha^{-1} which was on par with the cob yield produced by control treatment (T_{10}- 6.65 t ha^{-1}). These treatments were significantly superior to T_9 (4.90 t ha^{-1}) which in turn was on par with T_8 and T_7 which recorded cob yield with husk of 4.83 t ha^{-1} and 4.50 t ha^{-}1,respectively. The treatment T_7 however did not differ statistically from the treatments T_1 (4.24 tha^{-1}), T_3 (4.08 t ha^{-1}), T_4 (3.94 t ha^{-1}) and T_5 (3.77 t ha^{-1}) and the lowest cob yield with husk was recorded with the treatment T_2 (3.04 t ha^{-1}).

Table 12. Effect of organic nutrition on cob weight and cob yield with husk

Treatments	Cob weight with husk (g per cob)	Cob yield with husk (t ha^{-1})
T_1- Vermicompost	51.90	4.24
T_2- Coir pith compost	51.64	3.04
T_3- Poultry manure	58.50	4.08
T_4- *In situ* green manuring with cowpea + vermicompost	70.11	3.94
T_5- *In situ* green manuring with cowpea + coir pith compost	66.87	3.77
T_6- *In situ* green manuring with cowpea + poultry manure	65.04	6.33
T_7- Vermicompost + PGPR mix I	66.14	4.50
T_8- Coir pith compost + PGPR mix I	65.66	4.83
T_9- Poultry manure + PGPR mix I	66.67	4.90
T_{10}(control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	74.97	6.65
SEm (±)	2.04	0.17
CD (0.05)	6.110	0.507

4.2.6 Marketable cob yield

The effect of organic nutrition on marketable cob yield of baby corn is detailed in Table 13.

Though significantly higher marketable cob yield (2.20 t ha^{-1}) was produced with the control treatment (T_{10}), it was followed by the organic nutrition treatment T_6 (*in situ* green manuring and poultry manure application) which recorded the marketable cob yield of 1.96 t ha^{-1}, and was significantly superior to all other organic treatments. The T_6 was followed by T_7 (1.56 t ha^{-1}) which was on par with T_9 (1.54 t ha^{-1}), T_1 (1.44 t ha^{-1}), T_8 (1.43 t ha^{-1}), and T_4 (1.40 t ha^{-1}). The treatment T_4 however did not vary statistically from T_3 (1.32 t ha^{-1}) and T_5 (1.24 t ha^{-1}). The lowest marketable cob yield (1.00 t ha^{-1}) was recorded with the treatment T_2 in which coir pith compost was applied.

4.2.7 Cob-corn ratio

The effect of organic nutrition on cob-corn ratio of baby corn is shown in Table 13.

The cob-corn ratio did not vary significantly with different organic sources of nutrition.

4.2.8 Green stover yield

The effect of organic nutrition on the green stover yield of baby corn is presented in Table 13.

Both T_6 (*in situ* green manuring and poultry manure application) and T_9 (application of poultry manure and PGPR mix I) produced significantly higher green stover yield of 25.53 t ha^{-1}compared to all other organic sources next to the control (29.20 t ha^{-1}).·The treatment T_8 recorded a green stover yield of 22.71 t ha^{-1}which was on par with T_7 (22.51 t ha^{-1}), T_3 (21.89 t ha^{-1}) and T_4 (21.43 t ha^{-1}). The treatment T_4 however did not vary statistically from T_5 (20.77 t ha^{-1}). The treatment T_1(application of vermicompost) and T_2 (application of coir pith compost) recorded low green stover yield of 19.07 t ha^{-1} and 18.11 t ha^{-1}, respectively which were on par each other.

4.3 PEST AND DISEASE INCIDENCE

No pests and disease incidence was noticed in the crop during the period of study.

4.4 PLANT ANALYSIS

4.4.1 Chlorophyll content

The effect of organic nutrition on the chlorophyll content of baby corn is presented in Table 14.

No significant effect was produced by the treatments on the chlorophyll content of baby corn at 25 DAS or 45 DAS.

Table 13. Effect of organic nutrition on marketable cob yield, cob-corn ratio and green stover yield

Treatments	Marketable cob yield (t ha^{-1})	Cob-corn ratio	Green stover yield (t ha^{-1})
T_1- Vermicompost	1.44	3.37	19.07
T_2- Coir pith compost	1.00	3.09	18.11
T_3- Poultry manure	1.32	3.09	21.89
T_4- *In situ* green manuring with cowpea + vermicompost	1.40	3.01	21.43
T_5- *In situ* green manuring with cowpea + coir pith compost	1.24	2.70	20.77
T_6- *In situ* green manuring with cowpea + poultry manure	1.96	3.10	25.53
T_7- Vermicompost + PGPR mix I	1.56	3.07	22.51
T_8- Coir pith compost + PGPR mix I	1.43	3.38	22.71
T_9- Poultry manure + PGPR mix I	1.54	3.28	25.53
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	2.20	3.98	29.20
SEm (±)	0.05	0.01	0.44
CD (0.05)	0.161	NS	1.323

Table 14. Effect of organic nutrition on chlorophyll content, mg g^{-1}

Treatments	Chlorophyll content	
	25 DAS	45 DAS
T_1- Vermicompost	0.56	1.01
T_2- Coir pith compost	0.56	1.25
T_3- Poultry manure	0.60	1.15
T_4- *In situ* green manuring with cowpea + vermicompost	0.63	1.32
T_5- *In situ* green manuring with cowpea + coir pith compost	0.64	1.23
T_6- *In situ* green manuring with cowpea + poultry manure	0.69	1.25
T_7- Vermicompost + PGPR mix I	0.70	1.06
T_8- Coir pith compost + PGPR mix I	0,69	1.18
T_9- Poultry manure + PGPR mix I	0.68	1.33
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	0.63	1.29
SEm (±)	0.01	0.02
CD (0.05)	NS	NS

DAS- Days after sowing

4.4.2 Crude protein content

The crude protein content of cob and stover of baby corn as influenced by organic nutrition is detailed in Table 15.

The treatments could not significantly influence the crude protein content of cob and stover.

4.4.3 Starch content

The effect of organic nutrition on the starch content of baby corn cob is shown in Table 16.

The starch content of baby corn cob was not significantly influenced by the application of different organic sources.

4.4.4 Total soluble sugar content

The effect of organic nutrition on the total soluble sugar content of baby corn cob is presented in Table 16.

The treatment T_9 (application of poultry manure and PGPR mix I) recorded the highest total soluble sugar content (6.75° Brix) which did not vary statistically from T_{10} (6.64 ° Brix), T_7 (6.63° Brix), T_8 (6.59° Brix) and T_6 (6.54° Brix). The treatment T_6 (*in situ* green manuring with cowpea and poultry manure application) in turn was on par with T_4 (6.35° Brix), T_5 (6.32° Brix) and T_3 (6.30° Brix). The treatment T_3 however did not vary from T_1 (6.24° Brix) and T_2 (6.21° Brix).

Table 15. Effect of organic nutrition on crude protein content of cob and stover, per cent

Treatments	Crude protein	
	Cob	Stover
T_1- Vermicompost	13.98	8.87
T_2- Coir pith compost	13.96	8.93
T_3- Poultry manure	13.40	8.54
T_4- *In situ* green manuring with cowpea + vermicompost	12.19	7.93
T_5- *In situ* green manuring with cowpea + coir pith compost	13.80	7.37
T_6- *In situ* green manuring with cowpea + poultry manure	11.61	7.91
T_7- Vermicompost + PGPR mix I	11.65	8.86
T_8- Coir pith compost + PGPR mix I	13.80	8.41
T_9- Poultry manure + PGPR mix I	11.65	8.93
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	13.78	7.79
SEm (±)	0.07	0.08
CD (0.05)	NS	NS

4.4.5 Ascorbic acid content

The effect of organic nutrition on ascorbic acid content of baby corn cob is given in Table 16.

The treatment T_6 in which poultry manure application and *in situ* green manuring were done recorded the highest ascorbic acid content (14.83 mg g^{-1}), which was significantly superior to all other treatments. The treatment T_3 (poultry manure application) recorded an ascorbic acid content of 12.03 mg g^{-1} which was superior to the control (9.29 mg g^{-1}) which in turn was on par with T_5 (9.18 mg g^{-1}) and T_9 (8.22 mg g^{-1}). However, T_9 did not vary statistically from T_7 (7.88 mg g^{-1}), T_8 (7.65 mg g^{-1}),

T_1 (7.54 mg g^{-1}) and T_2 (7.03 mg g^{-1}). The ascorbic acid content was the lowest (6.86 mg g^{-1}) in T_4.

Table 16. Effect of organic nutrition on starch, ascorbic acid and total soluble sugar content of baby corn cob

Treatments	Starch content (per cent)	Ascorbic acid (mg g^{-1})	TSS (°Brix)
T_1- Vermicompost	7.86	7.54	6.24
T_2- Coir pith compost	7.09	7.03	6.21
T_3- Poultry manure	6.96	12.03	6.30
T_4- *In situ* green manuring with cowpea + Vermicompost	7.93	6.86	6.35
T_5- *In situ* green manuring with cowpea + coir pith compost	7.34	9.18	6.32
T_6- *In situ* green manuring with cowpea + poultry manure	6.30	14.83	6.54
T_7- Vermicompost + PGPR mix I	6.91	7.88	6.63
T_8- Coir pith compost + PGPR mix I	7.06	7.65	6.59
T_9- Poultry manure + PGPR mix I	6.32	8.22	6.75
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	7.08	9.29	6.64
SEm (±)	0.09	0.41	0.02
CD (0.05)	NS	1.240	0.256

TSS- Total soluble sugar

4.4.6 Uptake of N, P and K at harvest

The effect of organic nutrition on uptake of N, P and K at harvest of baby corn is detailed in Table 17.

4.4.6.1 Uptake of N

The N uptake was the highest in T_{10} (241.17 kg ha^{-1}) which was significantly superior to all other treatments. Among the organic nutrition treatments, T_1 (application of vermicompost) had a higher N uptake (197.49 kg ha^{-1}) which was on par with T_8 (application of coir pith compost and PGPR mix I), T_9 (application of poultry manure and PGPR mix I) and T_7 (application of vermicompost and PGPR mix I) recording an uptake of 194.89 kg ha^{-1}, 190.59 kg ha^{-1} and 187.82 kg ha^{-1}, respectively. The treatment T_5 (*in situ* green manuring and coir pith compost application) was followed by T_1 with an uptake value of 183.64 kg N ha^{-1} which was on par with T_6 (*in situ* green manuring and poultry manure application), T_2 (application of coir pith compost) and T_4 (*in situ* green manuring and vermicompost application). The lowest N uptake was recorded in treatment T_3 (170.47 kg ha^{-1}) in which poultry manure was used as an organic source and it did not differ from T_2 and T_4.

4.4.6.2 Uptake of P

The uptake of P was also the highest with the control (32.16 kg ha^{-1}). Among organic nutrition treatments, T_3 (application of poultry manure) registered a higher uptake of 26.31 kg ha^{-1} which was on par with T_5 (*in situ* green manuring and coir pith compost application), T_1 (application of vermicompost), T_8 (application of coir pith compost and PGPR mix I) and T_9 (application of poultry manure and PGPR mix I) recording P uptake value of 25.02, 25.25, 24.83 and 24.84 kg ha^{-1}, respectively. These treatments were significantly superior to T_4 (*in situ* green manuring and vermicompost application) with a reduced P uptake of 19.09 kg $ha^{-1}$and was on par with T_7 (application of vermicompost and PGPR mix I) and T_6 (*in situ* green manuring and poultry manure application) registering a value of 18.75 kg ha^{-1} and 17.48 kg ha^{-1}, respectively. The lowest P uptake (16.62 kg ha^{-1}) was recorded in treatment T_2, wherein coir pith compost was applied.

4.4.6.3 Uptake of K

The organic nutrition treatment T_5 (*in situ* green manuring and coir pith compost application) recorded a higher uptake of 338.83 kg ha^{-1} which was on par with the control (348.81 kg ha^{-1}) and the former was followed by T_2 (application of coir pith compost) recording an uptake value of 302.56 kg ha^{-1}. These treatments were significantly superior to T_3 (application of poultry manure) with a P uptake of 284.50 kg ha^{-1} which in turn was on par with T_6 (*in situ* green manuring and poultry manure application), T_1 (application of vermicompost) and T_8 (application of coir pith compost and PGPR mix I) recording uptake values of 281.50 kg ha^{-1}, 281.07 kg ha^{-1}, and 280.47 kg ha^{-1}, respectively. The treatment T_8 however was on par with T_4 (*in situ* green manuring and vermicompost application) and T_7 (application of vermicompost and PGPR mix I) recording an uptake of 271.60 kg ha^{-1} and 271.19 kg ha^{-1} respectively. The lowest K uptake (249.51 kg ha^{-1}) at harvest was recorded in T_9 wherein poultry manure and PGPR mix I were applied.

Table 17. Effect of organic nutrition on N, P and K uptake, kg ha^{-1}

Treatments	N uptake	P uptake	K uptake
T_1- Vermicompost	197.49	25.25	281.07
T_2- Coir pith compost	178.42	16.62	302.56
T_3- Poultry manure	170.47	26.31	284.50
T_4- *In situ* green manuring with cowpea + vermicompost	177.44	19.09	271.60
T_5- *In situ* green manuring with cowpea + coir pith compost	183.64	25.02	338.83
T_6- In *situ* green manuring with cowpea + poultry manure	183.46	17.48	281.50
T_7- Vermicompost + PGPR mix I	187.82	18.75	271.19
T_8- Coir pith compost + PGPR mix I	194.89	24.83	280.47
T_9- Poultry manure + PGPR mix I	190.59	24.84	249.51
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	241.17	32.16	348.81
SEm (±)	5.34	0.53	7.49
CD (0.05)	13.019	1.612	10.470

4.5 SOIL ANALYSIS

4.5.1 Soil pH

Effect of organic nutrition on soil pH after the field experiment is given in Table 18.

The soil pH after the experiment was not significantly influenced by the application of organic sources. However, there was a general increase in pH irrespective of the treatments compared to the initial status in the soil.

4.5.2 Electrical conductivity

Effect of organic nutrition on electrical conductivity of soil after the experiment is presented in Table 18.

The electrical conductivity of soil after the experiment was not significantly affected by the treatments. However, there was a general decline in electrical conductivity of the soil compared to the initial status.

4.5.3 Organic carbon

Effect of organic nutrition on organic carbon content of soil after the experiment is indicated in Table 18.

The organic nutrient management practices could not influence the organic carbon content of soil after the experiment.

Table 18. Effect of organic nutrition on pH, EC and organic carbon status of soil after the experiment.

Treatments	pH	EC ($dS\ m^{-1}$)	Organic carbon (per cent)
T_1- Vermicompost	5.53	0.117	1.050
T_2- Coir pith compost	5.62	0.130	1.027
T_3- Poultry manure	5.60	0.130	1.200
T_4- *In situ* green manuring with cowpea + vermicompost	5.71	0.127	1.013
T_5- *In situ* green manuring with cowpea + coir pith compost	5.83	0.130	1.180
T_6- *In situ* green manuring with cowpea + poultry manure	5.82	0.117	1.063
T_7- Vermicompost + PGPR mix I	5.74	0.110	1.147
T_8- Coir pith compost + PGPR mix I	5.41	0.123	1.327
T_9- Poultry manure + PGPR mix I	5.60	0.120	1.013
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	5.80	0.130	1.320
SEm (±)	0.008	0.007	0.020
CD (0.05)	NS	NS	NS

EC- Electrical conductivity

4.5.4 Available nutrient status of the soil after the experiment

4.5.4.1 Available nitrogen

Effect of organic nutrition on available nitrogen status of soil after the field experiment is detailed Table 19.

There was a general increase in the available nitrogen status of soil after the experiment. The treatment T_6 (*in situ* green manuring of cowpea along with poultry manure application) recorded higher available nitrogen content in soil (397.15 kg ha^{-1}) which was on par with T_4 (380.43 kg ha^{-1}) and T_3 (376.78 kg ha^{-1}). The treatment T_3 however did not vary statistically from T_9 (359.66 kg ha^{-1}), T_8 (355.41 kg ha^{-1}) and T_5 (355.87 kg ha^{-1}) which were on par each other. These treatments were significantly superior to T_1 (application of vermicompost), which recorded an available nitrogen content of 271.79 kg ha^{-1}, which in turn was on par with T_{10} (267.61 kg ha^{-1}) and T_7 (263.42 kg ha^{-1}). The lowest available nitrogen content (258.34 kg ha^{-1}) was recorded with T_2 wherein coir pith compost was applied as a nutrient source.

4.5.4.2 Available phosphorus

The effect of organic nutrition on available phosphorus status of soil after the experiment is shown in Table 19.

The treatment T_9 (application of poultry manure and PGPR mix I) recorded the highest available phosphorus content (68.80 kg ha^{-1}) in soil and it was significantly superior to all other treatments. The T_9 was followed by T_7 (application of vermicompost and PGPR mix I) which recorded an available phosphorus content of 65.23 kg ha^{-1} which was on par with T_5 (64.40 kg ha^{-1}) and T_4 (63.57 kg ha^{-1}). However, T_4 did not vary significantly from all other treatments (T_6- 61.97 kg ha^{-1}, T_8- 61.90 kg ha^{-1}, T_2- 61.87 kg ha^{-1}, T_1- 61.83 kg ha^{-1} and T_3- 61.37 kg ha^{-1}) with respect to available phosphorus content in soil except T_{10} which recorded the lowest value (58.47 kg ha^{-1}).The available phosphorus content in the soil showed a general decline after the experiment.

4.5.4.3 Available potassium

The effect of organic nutrition on available potassium status of soil after the experiment is presented in Table 19.

The available potassium content in soil was higher (212.50 kg ha^{-1}) in T_7 (application of vermicompost and PGPR mix I) which was on par with T_4 (193.30kg ha^{-1}) in which *in situ* green manuring and vermicompost application were done. However, T_4 did not vary statistically from T_1 (181.95 kg ha^{-1}), T_8 (168.81 kg ha^{-1}), T_9 (167.74 kg ha^{-1}), T_5 (164.44 kg ha^{-1}), T_6 (162.93 kg ha^{-1}) and T_2 (162.80 kg ha^{-1}). The T_2 however was on par with T_{10} (155.9 kg ha^{-1}) and T_3 (154.33 kg ha^{-1}). There was a general decrease in the available potassium content in the soil after the field experiment.

Table 19. Effect of organic nutrition on available nitrogen, phosphorus and potassium status of soil after the experiment, kg ha^{-1}

Treatments	Available nitrogen	Available phosphorus	Available potassium
T_1- Vermicompost	271.79	61.83	181.95
T_2- Coir pith compost	258.34	61.87	162.80
T_3- Poultry manure	376.78	61.37	154.33
T_4- *In situ* green manuring with cowpea + vermicompost	380.43	63.57	193.30
T_5- *In situ* green manuring with cowpea + coir pith compost	355.87	64.40	164.44
T_6- *In situ* green manuring with cowpea + poultry manure	397.15	61.97	162.93
T_7- Vermicompost + PGPR mix I	263.42	65.23	212.50
T_8- Coir pith compost + PGPR mix I	355.41	61.90	168.81
T_9- Poultry manure + PGPR mix I	359.66	68.80	167.74
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	267.60	58.47	155.9
SEm (±)	7.17	0.79	10.19
CD (0.05)	21.440	2.362	30.500

4.6 MICROBIAL COUNT

The effect of organic nutrition on microbial count of soil after the experiment is detailed in Table 20 and 21.

The count of bacteria, fungi, actinomycetes, *Azospirillum* and phosphobacteria in soil after the experiment was significantly influenced by the organic nutrition practices in baby corn.

4.6.1 Bacteria

The effect of organic nutrition on count of bacteria in soil is given in Table 20. Bacterial count was the highest (83 x 10^7 cfu g^{-1} soil) in T_9 (application of poultry manure and PGPR mix I), followed by T_7 (application of vermicompost and PGPR mix I) and T_8 (application of coir pith compost and PGPR mix I), in which the counts recorded were 80 x 10^7cfu g^{-1} soil and 79.46 x 10^7cfu g^{-1} soil, respectively for T_7 and T_8 which were on par each other. These treatments were significantly superior to T_4 (*in situ* green manuring and vermicompost application), wherein the bacterial count was 56.67 x 10^7 cfu g^{-1} soil, followed by T_6 (*in situ* green manuring and poultry manure application) with a bacterial population of 49.66 x 10^7 cfu g^{-1} soil, T_1 (vermicompost application) with a bacterial count of 49.64 x 10^7 cfu g^{-1} soil and T_3 (poultry manure application) recording a bacterial count of 49.12 x 10^7 cfu g^{-1} soil. The treatments T_6, T_1 and T_3 were however on par each other. All the above treatments recorded significantly higher bacterial count compared to T_5 (*in situ* green manuring and coir pith compost application) and T_2 (application of coir pith compost) recording a bacterial count of 47.64 x 10^7 cfu g^{-1} soil and 46 x 10^7 cfu g^{-1} soil, respectively which did not statistically differ each other. There was a drastic reduction in the bacterial count in control (T_{10}) plots wherein nutrients were applied through inorganic fertilizers (30 x 10^7 cfu g^{-1} soil) compared to the organic treatments.

4.6.2 Fungi

The effect of organic nutrition on count of fungi in soil after the experiment is given in Table 20. The treatment T_7 (application of vermicompost and PGPR mix I) recorded the highest fungal count (29.67 x 10^5 cfu g^{-1} soil), followed by T_5 (*in situ* green manuring and coir pith compost application) and T_6 (*in situ* green manuring and poultry manure application) in which the fungal count recorded were 24.33 x 10^5 cfu g^{-1} soil and 22.32 x 10^5 cfu g^{-1} soil, respectively. These treatments were significantly superior to T_4 (*in situ* green manuring and vermicompost application) in which the count of fungi observed was 20.33 x 10^5 cfu g^{-1} soil which in turn was on par with T_8 (application of coir pith compost and PGPR mix I), T_3 (application of poultry manure) and T_9 (application of poultry manure and PGPR mix I) with a fungal population of 20.23 x 10^5 cfu g^{-1} soil, 19.96 x 10^5cfu g^{-1} soil and 19.72 x 10^5 cfu g^{-1} soil for T_8, T_3 and T_9, respectively. These were followed by T_2 (application of coir pith compost) and T_1 (application of vermicompost) with a fungal count of 17.33 x 10^5 cfu g^{-1} soil and 16.73 x 10^5 cfu g^{-1} soil, respectively which did not vary each other. The treatment T_{10} (application of nutrients through inorganic fertilizers) recorded the lowest fungal count (14.26 x 10^5 cfu g^{-1} soil) compared to organic treatments.

4.6.3 Actinomycetes

The effect of organic nutrition on the actinomycetes population in soil is presented in Table 20.

The treatments could not significantly influence the number of actinomycetes in soil after the experiment.

Table 20. Effect of organic nutrition on count of bacteria, fungi and actinomycetes in soil after the experiment.

Treatments	Bacteria (10^7cfu g^{-1} soil)	Fungi (10^5cfu g^{-1} soil)	Actinomycetes (10^4cfu g^{-1} soil)
T_1-Vermicompost	49.64	16.73	22.67
T_2- Coir pith compost	46.00	17.33	26.86
T_3- Poultry manure	49.12	19.96	23.68
T_4- *In situ* green manuring with cowpea + Vermicompost	56.67	20.33	22.69
T_5- *In situ* green manuring with cowpea + coir pith compost	47.64	24.33	23.66
T_6- *In situ* green manuring with cowpea + poultry manure	49.66	22.32	24.56
T_7- Vermicompost + PGPR mix I	80.00	29.67	24.00
T_8- Coir pith compost + PGPR mix I	79.46	20.23	26.00
T_9- Poultry manure + PGPR mix I	83.00	19.72	27.79
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	30.00	14.26	19.67
SEm (±)	4.54	0.27	0.05
CD (0.05)	1.182	0.649	NS

4.6.4 *Azospirillum*

The effect of organic nutrition on the count of *Azospirillum* in soil after the experiment is detailed in Table 21.

The *Azospirillum* count in soil was higher (11.14 x 10^5 cfu g^{-1} soil) in treatment T_9 (application of poultry manure and PGPR mix I), and was on par with T_7 (application of vermicompost and PGPR mix I) with a count of 10.56 x 10^5 cfu g^{-1} soil. The T_7 was followed by T_8 in which coir pith compost and PGPR mix I were applied, with an *Azospirillum* population of 8.46 x 10^5 cfu g^{-1} soil. These treatments were significantly superior to all the remaining treatments viz., T_4 (*in situ* green manuring and vermicompost application) with an *Azospirillum* count of 2.64 x 10^5 cfu g^{-1} soil which in turn was on par with all other treatments (T_1- 2.17 x 10^5 cfu g^{-1} soil, T_6 or T_3- 1.66 x 10^5 cfu g^{-1} soil, T_5- 1.35 x 10^5 cfu g^{-1} soil and T_2- 1.34 x 10^5 cfu g^{-1} soil) except control. The control treatment T_{10} (application of NPK through chemical fertilizers) which did not differ from T_1 (application of vermicompost), T_6 (*in situ* green manuring and poultry manure application), T_3 (application of poultry manure), T_5 (*in situ* green manuring and coir pith compost application) or T_2 (application of coir pit compost) recorded the lowest *Azospirillum* population (0.67 x 10^5 cfu g^{-1} soil) in soil.

4.6.5 Phosphobacteria

The effect of organic nutrition on count of phosphobacteria in soil after the experiment is given in Table 21.

The treatment T_7 (application of vermicompost and PGPR mix I) recorded the highest number of phosphobacteria (37.67 x 10^3 cfu g^{-1} soil) in soil followed by T_9 (application of poultry manure and PGPR mix I) and T_8 (application of coir pith compost and PGPR mix I) in which the count recorded were 32 x 10^3 cfu g^{-1} soil and 29.67 x 10^3 cfu g^{-1} soil, respectively and were on par each other. These treatments were significantly superior to all other treatments viz., T_1 (15.67 x 10^3 cfu g^{-1} soil) followed by T_5 (14.67 x 10^3 cfu g^{-1} soil), T_2 (13.66 x 10^3 cfu g^{-1} soil), T_4 (12.33 x 10^3 cfu g^{-1} soil), T_3 (12.00 x 10^3 cfu g^{-1} soil) and T_6 (11.33 x 10^3 cfu g^{-1} soil). The treatments T_1, T_5, T_2, T_4, T_3 and T_6 were significantly superior to control (T_{10}) and were also on par each other. The T_{10} recorded the lowest count of phosphobacteria (1.67 x 10^3 cfu g^{-1} soil) in soil after the experiment.

Table 21. Effect of organic nutrition on count of *Azospirillum* and phosphobacteria in soil after the experiment.

Treatments	*Azospirillum* (10^5cfu g^{-1} soil)	Phosphobacteria (10^3 cfu g^{-1} soil)
T_1- Vermicompost	2.17	15.67
T_2- Coir pith compost	1.34	13.66
T_3- Poultry manure	1.66	12.00
T_4- *In situ* green manuring with cowpea + vermicompost	2.64	12.33
T_5- *In situ* green manuring with cowpea + coir pith Compost	1.35	14.67
T_6- In *situ* green manuring with cowpea + poultry Manure	1.66	11.33
T_7- Vermicompost + PGPR mix I	10.56	37.67
T_8- Coir pith compost + PGPR mix I	8.46	29.67
T_9- Poultry manure + PGPR mix I	11.14	32.00
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	0.67	1.67
SEm (±)	0.64	1.66
CD (0.05)	1.910	4.971

4.7 ORGANOLEPTIC STUDY

4.7.1 Appearance

The data on the effect of organic nutrition on appearance of fresh baby corn cob are presented in Table 22.

The organoleptic evaluation revealed that the mean rank value (MRV) for appearance ranged between 61.90 - 137.90. Significantly higher mean rank value (MRV) of 137.90 and mean score of 8.8 for appearance of fresh baby corn cob were recorded for treatment T_7 (application of vermicompost and PGPR mix I) which was on par with T_9 (application of poultry manure and PGPR mix I-MRV 136.89). These treatments were significantly superior to T_3 (application of poultry manure alone) with MRV 102.70 which in turn was on par with T_6 (*in situ* green manuring and poultry manure application), T_5 (*in situ* green manuring and coir pith compost application) and T_4 (*in situ* green manuring and vermicompost application) with MRV 102.10, 97.20 and 93.90, respectively. The treatment T_4 however was on par with T_2 (MRV 91.70) and T_8 (MRV 88.40). The lowest MRV (61.90) for appearance was recorded in control (T_{10}) wherein nutrients were applied through fertilizer sources.

4.7.2 Colour

The data on effect of organic nutrition on colour of fresh baby corn cob are detailed in Table 22.

The organoleptic evaluation revealed that the MRV for colour ranged between 61.10- 142.40. The higher MRV (142.40) and mean score (8.8) for colour of fresh baby corn cob was recorded with T_7 (application of vermicompost and PGPR mix I) and was on par with T_9 (application of poultry manure and PGPR mix I) recording an MRV of 134.60. The treatment T_9 in turn did not vary from T_8 (application of coir pith compost and PGPR mix I) with an MRV of 130.70. These treatments (T_7, T_9 and T_8) were significantly superior to T_6 (*in situ* green manuring and poultry manure application) with an MRV of 115.30, which did not vary statistically from T_3 (MRV-107.50). The lowest MRV (61.10) and mean score (7.6) were noted in control (T_{10}) which was statistically on par with T_2 (application of coir pith compost-MRV 69.05) and T_5 (*in situ* green manuring and coir pith compost application-MRV 64.80).

4.7.3 Taste

The data on the effect of organic nutrition on taste of fresh baby corn cob is presented in Table 22.

The organoleptic evaluation revealed that the MRV for taste of fresh baby corn cob ranged between 64.20- 150.50. Higher MRV (150.50) was recorded with treatment T_9 (application of poultry manure and PGPR mix I) which was on par with T_7 (application of vermicompost and PGPR mix I) with an MRV of 142.00.

These treatments were significantly superior to T_8 (MRV-108.00) which in turn was on par with T_4 (*in situ* green manuring and vermicompost application) and T_6 (*in situ* green manuring and poultry manure application) with MRV 103.10 and 101.30, respectively. The treatment T_6 however was on par with T_1 (92.80). Both the treatments T_3 and T_5 recorded an MRV of 86.10 each which were superior to the treatment T_2 (76.90). The control (T_{10}) recorded the lowest MRV (64.20) for taste under sensory evaluation.

4.7.4 Flavour

The data on effect of organic nutrition on flavor of fresh baby corn is detailed in Table 22.

The MRV for the flavor of fresh baby corn ranged between 63.20- 148.60 and T_9 (application of poultry manure and PGPR mix I) recorded the highest value (MRV -148.60) which was on par with T_7 (application of vermicompost and PGPR mix I) registering an MRV of 139.70. The treatment T_7 however was on par with T_8 (MRV-134.00). These treatments were significantly superior to T_6 (104.10) which in turn was on par with T_4 (95.20). The treatment T_4 however did not vary statistically from T_5 (89.50), T_1 (89.30) and T_3 (88.80). The lowest MRV of 63.20 was recorded with the control (T_{10}).

4.7.5 Texture

The data on effect of organic nutrition on texture of fresh baby corn cob is depicted in Table 22.

The organoleptic evaluation revealed that the MRV for texture of fresh baby corn cob ranged between 66.40-130.60. The treatment T_7 (application of vermicompost and PGPR mix I) recorded the highest MRV (130.60) for texture which was on par with T_9 (121.70). These treatments were significantly superior to T_6 (*in situ* green manuring and poultry manure application) with MRV 110.10 which was on par with T_3 (109.20), T_8 (107.52), T_1 (105.00) and T_5 (102.19). The lowest MRV (66.40) was registered with the control (T_{10}) in which nutrients were applied as fertilizers.

4.7.6 Overall acceptability

The data on effect of organic nutrition on overall acceptability of fresh baby corn is given in Table 22.

The organic treatments did not have any significant influence on the overall acceptability of fresh baby corn cob.

Table 22. Effect of organic nutrition on sensory parameters of fresh baby corn cob

Treatment	Appearance		Colour		Taste		Flavour		Texture		Overall acceptability	
	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV
T_1	7.9	82.90	8.1	89.85	8.1	92.80	8.2	89.30	8.5	105.00	8.3	89.40
T_2	8.2	91.70	7.6	69.05	7.8	76.90	8.1	80.60	8.4	91.40	8.3	89.48
T_3	8.4	102.70	8.3	107.50	8.0	86.10	8.1	88.80	8.6	109.20	8.4	93.70
T_4	8.3	93.90	8.2	101.70	8.2	103.10	8.3	95.20	8.3	88.76	8.5	98.00
T_5	8.3	97.20	7.7	64.80	8.0	86.10	8.2	89.50	8.4	102.19	8.4	98.50
T_6	8.7	102.10	8.4	115.30	8.2	101.30	8.4	104.10	8.7	110.10	8.6	107.10
T_7	8.8	137.90	8.8	142.40	8.7	142.00	8.8	139.70	8.9	130.60	8.7	116.20
T_8	8.2	88.40	8.6	130.70	7.4	108.00	8.7	134.00	8.7	107.52	8.5	102.80
T_9	8.8	136.89	8.7	134.60	9.0	150.50	8.9	148.60	8.8	121.70	8.8	125.30
T_{10}	7.5	61.90	7.6	61.10	7.7	64.20	7.7	63.20	8.0	66.40	8.3	84.60
K value	53.95*		60.2*		50.62*		67.51*		25.79*		11.69	
CD (0.05)	9.46											

(MS- Mean score, MRV- Mean rank value)   * Significant @ 5%

4.8 SHELF LIFE OF COB

4.8.1 Overall visual quality (OVQ)

Result of the effect of organic nutrition on overall visual quality of baby corn cob on 3rd and 6th day of storage is presented in Table 23.

The treatments could significantly influence the overall visual quality of cob on 6th day of storage only. Significantly higher mean rank value (MRV) for overall visual quality (122.15) was observed in the treatment T_9 (application of poultry manure and PGPR mix I) followed by T_7 (application of vermicompost and PGPR mix I) with an MRV of 110.87 which was on par with T_6 (*in situ* green manuring and poultry manure application), T_4 (*in situ* green manuring and vermicompost application), T_8 (application of coir pith compost and PGPR mix I) and T_3 (application of poultry manure) with MRV 110.57, 108.52, 107.02 and 101.55, respectively. The treatment T_3 however was on par with T_5 (MRV 93.97) and T_1 (MRV 92.62). The control treatment (T_{10}) recorded an MRV of 84.57 which did not vary statistically from T_1 (MRV 92.62) and T_5 (MRV 93.97) while the lowest MRV for overall visual quality (76.12) was recorded with the treatment T_2 in which coir pith compost was applied as organic source.

Table 23. Effect of organic nutrition on overall visual quality of cob on 3rd and 6th day of storage

Treatments	Overall visual quality			
	3rd day		6th day	
	MS	MRV	MS	MRV
T_1- Vermicompost	8.40	97.05	6.33	92.62
T_2- Coir pith compost	8.30	90.12	5.66	76.12
T_3- Poultry manure	8.35	94.70	6.66	101.55
T_4- *In situ* green manuring with cowpea + Vermicompost	8.60	115.35	7.33	108.52
T_5- *In situ* green manuring with cowpea + coir pith compost	8.75	90.25	6.66	93.97
T_6- *In situ* green manuring with cowpea + poultry manure	8.50	106.20	7.00	110.57
T_7- Vermicompost + PGPR mix I	8.60	110.90	8.33	110.87
T_8- Coir pith compost + PGPR mix I	8.45	97.17	7.00	107.02
T_9- Poultry manure + PGPR mix I	8.70	120.05	8.66	122.15
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	8.20	83.20	6.66	84.57
K value	12.87		17.44*	
CD (0.05)	9.460			

MS- Mean score, MRV- Mean rank value)

4.8.2 Moisture loss

The data on effect of organic nutrition on moisture loss of baby corn cob during storage is presented in Table 24.

The treatments could not influence the moisture loss of baby corn cob on 3rd and 6th day of storage.

Table 24. Effect of organic nutrition on moisture loss of cob on 3rd and 6th day of storage, per cent

Treatments	Moisture loss	
	3rd day	6th day
T_1- Vermicompost	19.53	22.76
T_2- Coir pith compost	18.91	22.24
T_3- Poultry manure	18.52	22.83
T_4- *In situ* green manuring with cowpea + Vermicompost	17.70	22.76
T_5- *In situ* green manuring with cowpea + coir pith Compost	17.08	22.93
T_6- *In situ* green manuring with cowpea + poultry Manure	17.27	22.06
T_7- Vermicompost + PGPR mix I	16.00	21.76
T_8- Coir pith compost + PGPR mix I	16.20	22.17
T_9- Poultry manure + PGPR mix I	15.69	21.42
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	17.78	23.87
SEm (±)	0.206	0.130
CD (0.05)	NS	NS

4.8.3 Sensory attributes in storage

4.8.3.1 Appearance

The data on appearance of baby corn cob on 3rd and 6th day of storage as influenced by organic nutrition is given in Table 25 and 26.

On third day of storage, higher MRV for appearance (127.35) was recorded with the treatment T_7 (application of vermicompost and PGPR mix I) which was on par with T_9 (MRV- 126.17). These treatments were significantly superior to T_6 (MRV- 116.52) which in turn was on par with T_8, T_5 and T_3 with MRV 114.17, 109.52 and 107.35, respectively. These treatments were significantly superior to T_4 (MRV 94.87), which in turn was on par with T_2 (MRV 85.62). The lowest MRV (76.75) for appearance on the 3rd day of storage was recorded with control (T_{10}) which did not vary from T_1 and T_2.

The treatments could not significantly influence the appearance of baby corn cob on 6th day of storage.

4.8.3.2 Colour

The data on colour of baby corn cob on 3rd and 6th day of storage did not show any significant variation with respect to organic nutrition, and is detailed in Table 25 and 26.

4.8.3.3 Taste

The data on taste of baby corn cob on 3rd and 6th day of storage as influenced by organic nutrition is presented in Table 25 and 26.

The taste of baby corn cob was influenced significantly by organic nutrition on 3rd and 6th day of storage. On 3rd day, the treatment T_9 (application of poultry manure and PGPR mix I) recorded higher MRV for taste (120.65) which was on par with T_7, T_4 and T_8 with MRV 116.92, 114.10 and 113.20, respectively. These treatments were significantly superior to T_6 (MRV -101.61) which in turn was on par with T_3 (MRV-96.37). T_3 however did not statistically differ from T_2 (MRV 90.72) and T_1 (MRV 87.0). The control treatment (T_{10}) in which the nutrients were applied through inorganic fertilizers recorded the lowest MRV (83.27) which was on par with T_5 (86.1), T_1 (87.00) and T_2 (90.72).

On 6th day of storage, the treatment T_9 registered higher MRV (125.65) for taste which was on par with T_7 (application of vermicompost and PGPR mix I), T_8 (application of coir pith compost and PGPR mix I) and T_4 (*in situ* green manuring and vermicompost application) with MRV 121.92, 120.20 and 120.10, respectively. These treatments were significantly superior to T_6 (106.61) which in turn was on par with T_3 (101.37) in which poultry manure was used. However, T_3 was found to be on par with T_2 (application of coir pith compost) and T_1 (application of vermicompost). The lowest MRV for taste (88.27) was recorded in T_{10} (control) which did not differ from T_2 (MRV 95.72), T_1 (MRV 92.00) and T_5 (MRV 91.10) which were on par each other.

4.8.3.4 Flavour

The data on the effect of organic nutrition on the flavor of baby corn cob on 3rd and 6th day of storage is presented in Table 25 and 26.

The highest MRV for flavor on 3rd day after storage (136.50) was obtained for the treatment T_9 (application of poultry manure and PGPR mix I) followed by T_8 (123.40) which was on par with T_7 (122.70). These treatments were significantly superior to T_4 with MRV 108.90 which did not statistically differ from T_6 (106.67). The above treatments produced significantly higher MRV compared to T_1 (90.65) which was on par with T_5 (89.95), T_2 (83.47) and T_3 (82.70), respectively. The lowest MRV for flavor on 3rd day of storage (80.05) was recorded for the control (T_{10}) which was also on par with the treatments T_2 and T_3.

On 6th day of storage, the highest MRV for flavor (136.05) was recorded inT_9 which was on par with T_7 (128.70) which in turn did not vary statistically from T_8 (125.40). The treatment T_8 was however significantly superior to T_6 (113.67) which in turn was on par with T_4 (112.90). All these treatments were significantly superior to T_5 (93.85) which was on par with T_1 (92.62), T_2 (88.47) and T_3 (85.70). The treatment T_{10} (control) recorded the lowest MRV (81.05) on 6th day of storage which statistically did not differ from T_2 and T_3.

4.8.3.5 Texture

The data on texture of baby corn on 3rd and 6th day of storage is shown in Table 25 and 26.

The treatments could significantly influence the texture of baby corn cob on 6th day of storage only. The highest MRV for texture (128.12) was recorded for the treatment T_9, followed by T_8 (118.22) which was on par with T_7 (116.80) and T_4 (110.32). The T_4 treatment however was on par with T_6 (106.47) and T_3 (106.00). The T_3 did not vary statistically from T_1 (99.67) and T_2 (98.20). The lowest MRV for baby cob texture on 6th day of storage was recorded with the T_{10} (88.45) which was on par with T_5 (95.72) which in turn did not vary from T_2 (98.20).

4.8.3.6 Overall acceptability

The data on overall acceptability of baby corn cob on 3rd and 6th day of storage as influenced by organic nutrition is given in Table 25 and 26.

On 3rd day of storage, higher MRV for overall acceptability (132.40) was observed in T_9 (application of poultry manure and PGPR mix I) which was on par with T_7 (128.25) and T_8 (125.56). These treatments were significantly superior to T_4 (110.12) which was on par with T_3 (105.67) and T_6 (104.13). T_6 however did not vary statistically from T_1 (98.68), T_2 (97.30) and T_5 (95.23). The lowest MRV (78.40) for overall acceptability was recorded in control (T_{10}).

Similar results were obtained on the 6th day of storage also. Higher MRV for overall acceptability (138.40) was recorded in T_9 (application of poultry manure and PGPR mix I) which was on par with T_7 (132.25) and T_8 (130.16). These treatments were significantly superior to T_4 (115.12) which in turn was on par with T_3 (110.67), T_6 (110.13) and T_5 (106.23). The T_5 was however on par with T_1 (99.68) and T_2 (98.30). The lowest value for overall acceptability of baby corn cob on 6th day of storage (MRV 83.40) was recorded in control (T_{10}) in which nutrients were applied as inorganic fertilizers.

Table 25. Effect of organic nutrition on sensory parameters of cob on 3rd day of storage

Treatment	Appearance		Colour		Taste		Flavour		Texture		Overall acceptability	
	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV
T_1	7.9	84.45	8.3	96.15	7.6	87.00	7.8	90.65	7.7	94.67	7.7	98.68
T_2	8.0	85.62	7.6	74.87	7.65	90.72	7.8	83.47	7.55	95.20	7.6	97.30
T_3	8.2	107.35	8.2	94.70	7.75	96.37	7.9	82.70	7.6	101.00	7.9	105.67
T_4	8.1	94.87	8.6	117.50	8.0	114.10	8.0	108.90	8.0	107.32	8.0	110.12
T_5	8.3	109.52	8.3	99.55	7.6	86.10	7.7	89.95	7.7	90.72	7.6	95.23
T_6	8.3	116.52	8.5	112.65	7.9	101.61	7.9	106.67	7.95	100.47	7.7	104.13
T_7	8.4	127.35	8.5	116.05	8.05	116.92	8.05	122.70	8.2	110.22	8.3	128.25
T_8	8.5	114.17	8.4	107.80	8.3	113.20	8.0	123.40	8.2	106.80	8.3	125.56
T_9	8.5	126.17	8.6	115.21	8.1	120.65	8.1	136.50	8.4	113.12	8.4	132.40
T_{10}	7.7	76.75	8.0	74.80	7.5	83.27	7.65	80.05	7.3	85.45	7.3	78.40
K value	28.72*		16.49		21.09*		32.30*		4.93		23.95*	
CD (0.05)	9.46											

(MS- Mean score, MRV- Mean rank value) * Significant @ 5 %

Table 26. Effect of organic nutrition on sensory parameters of cob on 6th day of storage

Treatment	Appearance		Colour		Taste		Flavour		Texture		Overall acceptability	
	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV	MS	MRV
T_1	7.9	80.30	8.2	96.25	7.6	92.00	7.8	92.62	7.6	99.67	7.8	99.68
T_2	8.0	86.30	7.6	81.26	7.5	95.72	7.7	88.47	7.5	98.20	7.7	98.30
T_3	8.0	88.20	8.1	98.70	7.7	101.37	7.8	85.70	7.7	106.00	8.1	110.67
T_4	8.3	108.10	8.6	120.50	8.1	120.10	8.1	112.90	7.6	110.32	8.2	115.12
T_5	8.2	104.00	8.4	103.55	7.7	91.10	7.7	93.85	8.0	95.72	7.9	106.23
T_6	8.6	117.90	8.5	115.65	7.9	106.61	7.9	113.67	7.8	106.47	8.1	110.13
T_7	8.5	118.04	8.6	119.05	8.0	121.92	8.1	128.70	7.9	116.80	8.4	132.25
T_8	8.4	116.00	8.4	110.80	8.4	120.20	8.2	125.40	8.3	118.22	8.4	130.16
T_9	8.6	129.90	8.5	118.21	8.2	125.65	8.4	136.05	8.4	128.12	8.5	138.40
T_{10}	7.6	60.40	7.9	79.80	7.6	88.27	7.7	81.05	7.4	88.45	7.6	83.40
K value	15.33		11.12		17.00*		25.46*		25.98*		26.29*	
CD (0.05)	9.46											

(MS- Mean score, MRV- Mean rank value) * Significant @ 5 %

4.9 ECONOMIC ANALYSIS

4.9.1 Total cost of cultivation

The result of organic nutrition on total cost of cultivation of baby corn is presented in Table 27. The cost of cultivation was the lowest in T_{10} (₹ 84555 ha^{-1}) wherein chemical fertilizers were applied as source of nutrients and higher in organic nutrition treatments. Among organic nutrition treatments, T_3 (application of poultry manure) had the lowest cost of cultivation (₹ 145404 ha^{-1}) and was followed by T_9 (₹ 156279 ha^{-1}), T_6 (₹ 165404 ha^{-1}), T_2 (₹ 227624 ha^{-1}), T_1 (₹229855 ha^{-1}), T_5 (₹237624 ha^{-1}), T_8 (₹ 238499), T_4 (₹ 239855 ha^{-1}) and T_7 (₹ 240730 ha^{-1}).

4.9.2 Net income

The results of organic nutrition on net income is indicated in Table 27. The treatment T_6 (*in situ* green manuring with poultry manure application) recorded the highest net income of ₹ 340996 ha^{-1}. It was followed byT_9 (₹ 235721 ha^{-1}), T_3 (₹ 180996 ha^{-1}), T_8 (₹ 147901 ha^{-1}), T_7 (₹ 119270 ha^{-1}), T_1(₹ 109345 ha^{-1}),T_{10} (₹ 81695 ha^{-1}), T_4 (₹ 75345 ha^{-1}) and T_5 (₹ 63976 ha^{-1}). The lowest net income of ₹ 15576 ha^{-1} was recorded in the treatment T_2 (application of coir pith compost).

4.9.3 Benefit: cost ratio (BCR)

The results of organic nutrition on benefit: cost ratio (BCR) is given in Table 27. The treatment T_6 (*in situ* green manuring along with poultry manure application) recorded the highest BCR of 3.06 which was followed by T_9 (2.50), T_3 (2.24), T_{10} (1.97), T_8 (1.62), T_7 (1.49), T_1 (1.47), T_4 (1.32) and T_5 (1.27). The lowest benefit cost ratio (1.06) was recorded in T_2 in which coir pith compost was applied.

Table 27. Effect of organic nutrition on economics of cultivation

Treatments	Total cost of cultivation (₹ ha^{-1})	Net income (₹ ha^{-1})	BCR
T_1- Vermicompost	229855	109345	1.47
T_2- Coir pith compost	227624	15576	1.06
T_3- Poultry manure	145404	180996	2.24
T_4- *In situ* green manuring with cowpea + vermicompost	239855	75345	1.32
T_5- *In situ* green manuring with cowpea + coir pith compost	237624	63976	1.27
T_6- *In situ* green manuring with cowpea + poultry manure	165404	340996	3.06
T_7- Vermicompost + PGPR mix I	240730	119270	1.49
T_8- Coir pith compost + PGPR mix I	238499	147901	1.62
T_9- Poultry manure + PGPR mix I	156279	235721	2.50
T_{10} (control) -135:65:45 kg NPK ha^{-1} as inorganic fertilizers	84555	81695	1.97

The results of the study revealed the influence of organic nutrition practices on growth attributes, yield, nutrient uptake, nutrient quality, sensory characters, shelf life and economics of cultivation of baby corn

DISCUSSION

5. DISCUSSION

The study entitled "Organic nutrition in baby corn (*Zea mays* L.)" was carried out during 2018-20 at College of Agriculture, Vellayani, Thiruvananthapuram to investigate the effect of organic nutrition on growth, yield, and quality of baby corn. The results of the study are discussed in this chapter.

5.1 GROWTH AND GROWTH ATTRIBUTES

Among different organic nutrition treatments, poultry manure and biofertilizer (PGPR mix I) combination was equally effective as the chemical fertilizer application in favouring the crop growth of baby corn with respect to different parameters. This treatment was as effective as the inorganic fertilizer treatment in improving the plant height at 15 DAE (Fig. 3), producing more number of leaves per plant at 30 and 45 DAE (Fig. 4) and higher LAI at 30 DAE (Fig. 5).

The mineralization pattern of poultry manure has indicated that nearly 60 per cent of nitrogen in this manure is present as uric acid which quickly changes to ammoniacal form that can be easily utilized by crop (Smith, 1950). Furthermore, the PGPR mix I contains component cultures, *viz*., *Azospirillum lipoferum, Azotobacter chroococcum, Bacillus megaterium* and *Bacillus sporothermodurans*as which is a consortium for supplementing all the major nutrients as reported by Gopi *et al.* (2020). Vacheron *et al.* (2013) pointed out that the PGPR can produce phytohormones and promote enzymatic activities which in turn may improve the root growth, uptake of minerals and water, and growth of the whole plant. As reported by Vikram (2007), PGPR inoculated maize plants were found to grow faster than the uninoculated plants. The PGPR application promoting the colonization of microbes in the rhizosphere which facilitates better mineral nutrition leading to increased vegetative growth has been previously reported by Kavya (2017). This is in agreement with the recent findings of Namitha (2019) in baby corn. Higher soil microbial population of *Azospirillum* and phosphobacteria after the field experiment due to PGPR application (Table 21) further corroborates this finding.

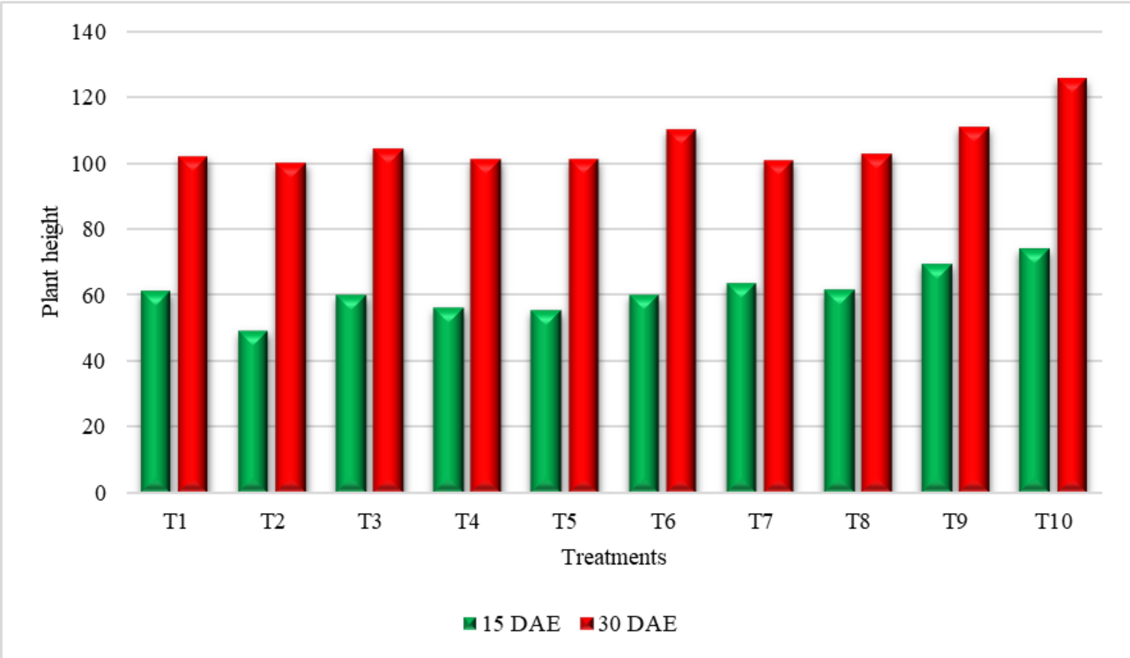

Fig 3. Effect of organic nutrition on plant height, cm

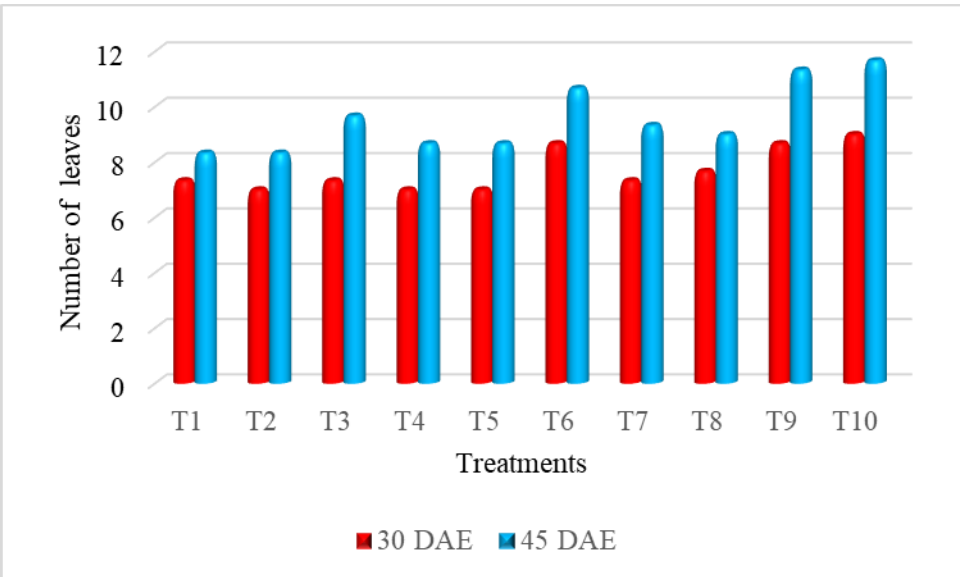

Fig 4. Effect of organic nutrition on number of leaves per plant

The combined effect of the quick release of nutrient nitrogen from poultry manure and the crop growth augmenting effect of PGPR would have been the reason for its on par performance with chemical sources of nutrients with respect to the growth and growth attributes.

As a universal trend, application of major nutrients through inorganic fertilizers produced taller plants at 15 and 30 DAE (Fig. 3), more number of leaves (Fig. 4) and LAI at 30 and 45 DAE (Fig. 5) and higher dry matter production at harvest (Fig. 7) compared to the organic sources of nutrients. Urea, Rajphos and Muriate of potash were used as chemical sources of nitrogen, phosphorus and potassium respectively in control treatment in this study, which are quickly released compared to the organic sources. The nutrients released in a faster pace from the inorganic fertilizers would have been utilized more effectively for the early vegetative growth of the crop as evident from the growth parameters. Application of mineral fertilizers containing nitrogen, phosphorus and potassium improving the growth attributes and dry matter production of baby corn was previously reported by Dadarwal *et al*. (2009) and Singh *et al*. (2010).

All the organic nutrition combinations involving poultry manure as an organic source (poultry manure alone, in combination with PGPR I or *in situ* green manuring) took lesser number of days for tasseling (Fig. 6). The days to 50 per cent silking was also shortened by the poultry manure application in combination with *in situ* green manuring (Fig. 6). As explained earlier, the poultry manure quickly releases nitrogen to the soil as more than 60 per cent of its total N is present as uric acid which is easily converted to ammonia. According to Amanullah *et al*. (2010) the C:N ratio of poultry manure is narrow (9:1) and this would have further favoured its quick mineralization and release of nitrogen. The nitrogen released by the poultry manure in a relatively faster pace would have maintained its sufficient levels in soil to trigger the flowering and reproductive growth of the crop owing to the potential of this nutrient to regulate flowering as suggested by Weber and Burow (2017).

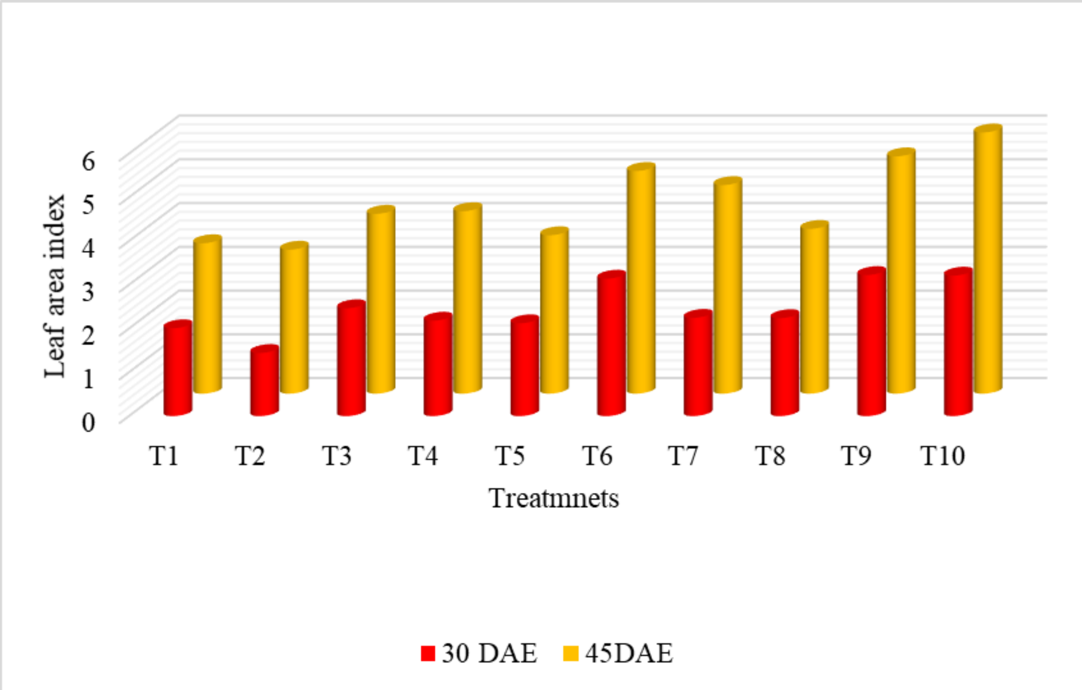

Fig 5. Effect of organic nutrition on leaf area index

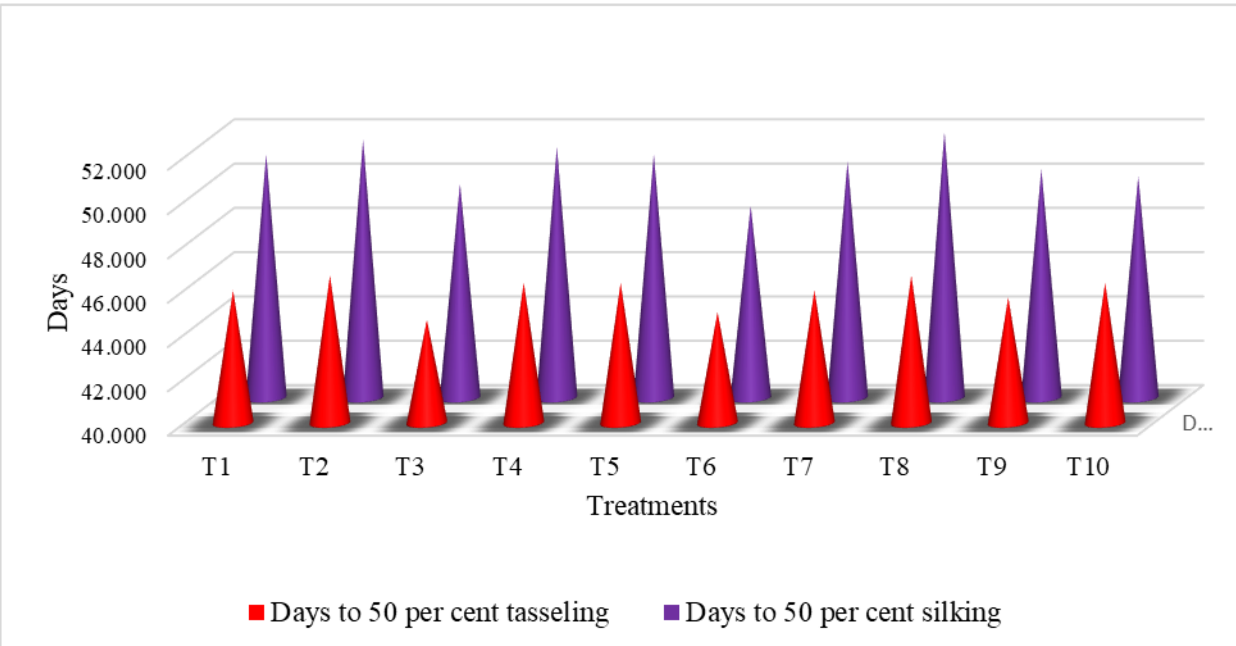

Fig 6. Effect of organic nutrition on days to 50 per cent tasseling and silking

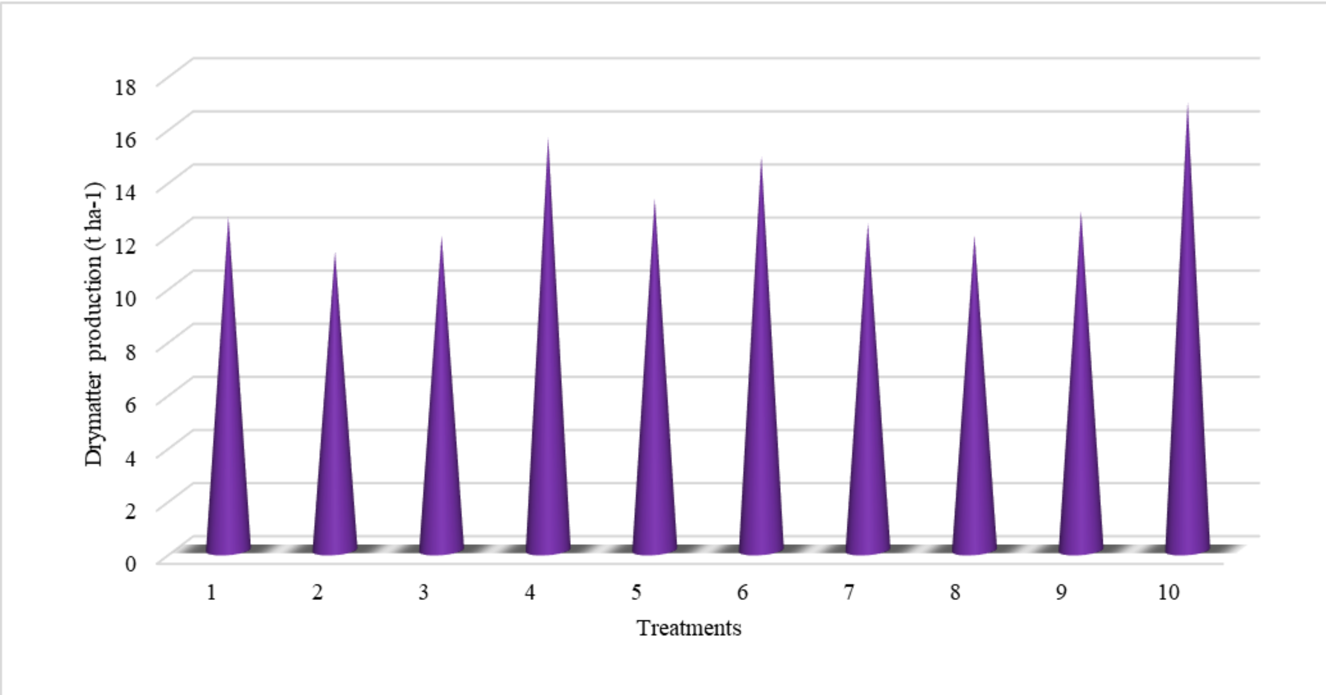

Fig 7. Effect of organic nutrition on dry matter production at harvest, t ha^{-1}

A different trend was noticed with respect to the growth attributes such as days to 50 per cent tasseling and silking in baby corn under organic nutrition with coir pith compost. Application of coir pith compost with or without biofertilizer PGPR mix I was found to widen the days for 50 per cent tasseling. A near similar trend was noticed with respect to days to 50 per cent silking wherein the combined application of coir pith compost and PGPR I resulted in more days for silking. Coir pith compost is an organic manure produced by composting process of coir pith with an objective to reduce the C:N ratio and to improve its manurial value as organic source. The significant change in composting of coir pith is that its C:N ratio is reduced from 112:1 to 24:1(KAU, 2016). However, an organic substrate having a C:N ratio between 1 and 15 mineralizes rapidly and release nitrogen quickly for the immediate use of crop and lower the C:N ratio, more rapidly the nitrogen will be released into the soil (Watson *et al*., 2002). When the C:N ratio is more than 35, it results in microbial immobilization and ratio between 20 and 30 leads to an equilibrium state between mineralization and immobilization. Under this condition the microorganisms try to find enough carbon and some amount of nitrogen from soil to maintain the C:N ratio in their cell (Howell, 2005). However no basal dose of chemical N was applied in organic treatments including treatments with coir pith compost in this study and hence the release of N from the coir pith compost treatments would have been delayed during the early crop growth stages. Furthermore, there exists a relationship between nutrient N and flowering. According to Weber and Burow (2017), nitrogen specifically nitrate -N act as a signal regulator of flowering responses in plants and modify the onset of flowering and low nitrogen conditions promote early flowering while high nitrogen as well as nitrogen starvation can delay the initiation of reproductive phase. In this light, the equilibrium state of mineralization and immobilization would have caused a nitrogen starvation consequent to coir pith compost application during the early growth stage of the crop which would have widened the days for tasseling and silking in baby corn. The poor growth performance of the crop under coir pith compost application especially during the early growth stages further justifies this reasoning.

5.2 YIELD ATTRIBUTES AND YIELD

The organic nutrient management practices involving combined application of organic manures along with other organic sources of nutrition such as *in situ* green manuring or use of biofertilizer (PGPR mix I) were equally effective as inorganic fertilizer application in improving the yield attributes and yield specifically in case of cob length (Fig. 8), cob weight with husk (Fig. 9) and cob yield with husk (Fig. 10) in this study. Combinations of *in situ* green manuring with application of vermicompost or coir pith compost or poultry manure were equally beneficial as the inorganic fertilizer application in producing longer cobs. Likewise, combined application of *in situ* green manuring along with vermicompost application had the same positive effect of inorganic fertilizer application on cob weight with husk of baby corn while the *in situ* green manuring along with poultry manure application produced comparable yield with chemical fertilizer application in terms of cob yield with husk, and next higher yield compared to chemical fertilizer application with respect to marketable cob yield (Fig.10).

The *in situ* green manuring practice with cowpea added 3.44 t ha^{-1} of green matter on dry weight basis with a relatively higher N and K content of 2.3 and 1.90 per cent respectively (Table 4) than other organic sources. The green manure applied to soil undergoes a series of chemical changes wherein the carbon compounds are converted to carbon dioxide and water, the nitrogenous compounds like protein are finally converted to nitrate and the mineral constituents like phosphorus, potassium, calcium, magnesium etc. present in the organic form or to some extent in the inorganic form are converted to more soluble forms and they become readily available to the succeeding crop (Palaniappan and Annadurai, 1999). The *in situ green* manuring with cowpea having a higher nitrogen and potassium content in combination with other organic sources would have increased plant available forms of nutrients and this in turn would have promoted the yield attributes and yield of succeeding crop of baby corn. Favorable effect of green manuring on yield attributes and yield has been previously reported by Turgut *et al*. (2005) in sweet corn and Kar and Ram (2014) in baby corn.

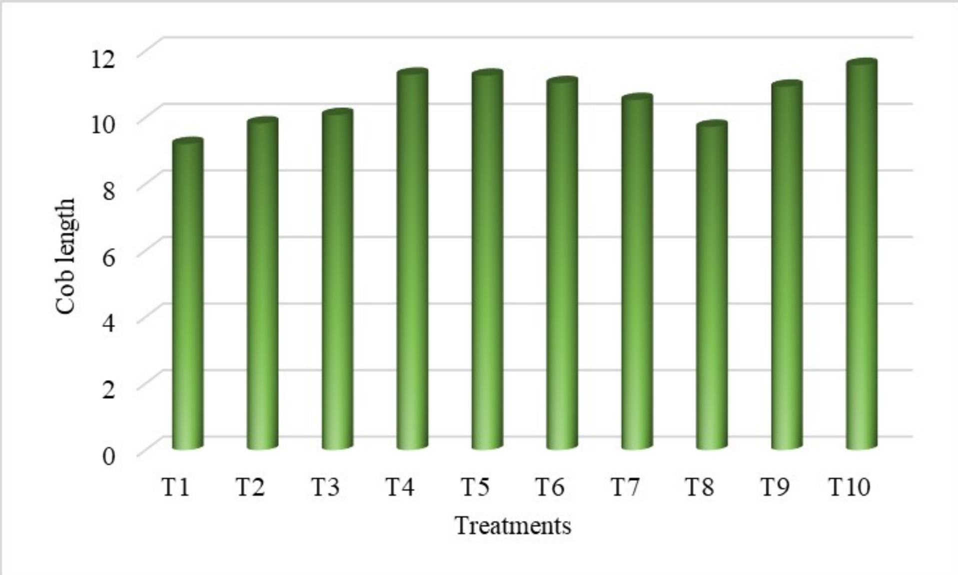

Fig 8. Effect of organic nutrition on cob length, cm

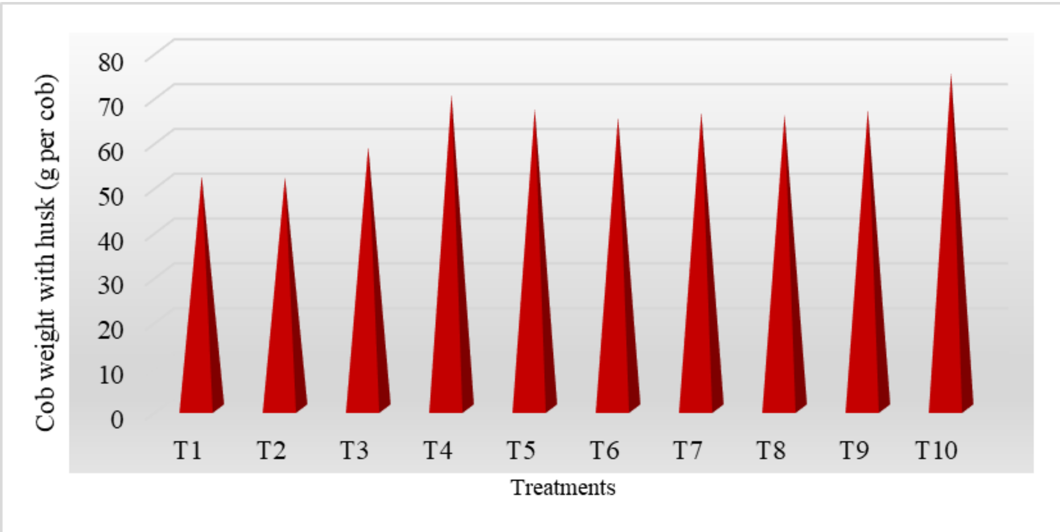

Fig 9. Effect of organic nutrition on cob weight with husk, g per cob

The *in situ* green manuring along with poultry manure application or combined application of poultry manure and PGPR mix I was the second best treatment next to inorganic fertilizer application with respect to green stover yield (Fig. 11). As explained by Smith (1950), the nitrogen present in poultry manure is mostly in the uric acid form which quickly gets mineralized into ammoniacal form that can be easily utilized by the crop. The low C:N ratio of poultry manure (Amanullah *et al*., 2010) further explains its rapid mineralization property. The PGPR mix I contains component cultures viz., *Azospirillum lipoferum, Azotobacter chroococcum, Bacillus megaterium* and *Bacillus sporothermodurans* as a consortium for supplementing all the major nutrients as reported by Gopi *et al*. (2020). Furthermore, the biofertilizer PGPR is reported to produce biologically active substances like vitamins, nicotinic acid, indole acetic acid and gibberellin (Ranjan *et al*., 2013) which have a growth promoting effect on crops. This is in agreement with the findings of Jinjala *et al*. (2016) in baby corn. The quick release of nitrogen from the poultry manure coupled with better availability of nutrients through green manure decomposition or increased nutrient availability consequent to the PGPR application would have resulted in higher green stover yield in baby corn.

However, as observed in case of growth attributes, application of major nutrients through chemical fertilizer sources (control) could improve the yield attributes and yield of baby corn and it produced the highest marketable cob yield and green stover yield compared to organic sources of nutrition. Favourable influence of chemical nutrition on yield attributes and yield was previously reported by Sahoo and Mahapatra (2004) in sweet corn and Dadarwal *et al*. (2009) in baby corn.

5.3 NUTRIENT CONTENT AND UPTAKE

Highest soluble sugar content in baby corn cob was recorded by the application of poultry manure and PGPR mix I (Fig. 12). The poultry manure had a higher potassium content than other organic sources and the potassium nutrition is found to favour the sugar accumulation as reported by Xing *et al*. (2020). The PGPR application is also reported to have a favourable effect on sugar content of the plant. As pointed out by EL-Hamid *et al.* (2006), the improved sugar content in the cob would have been due to the synergistic effect of *Azotobacter* and *Azospirillum* present in the PGPR consortium. These results are in agreement with the findings of Golda *et al.* (2013) in baby corn.

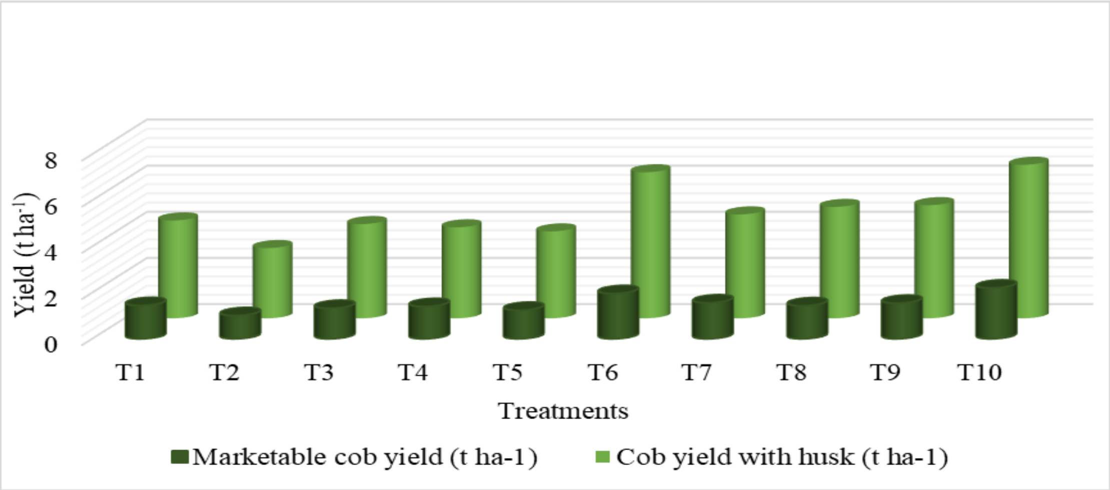

Fig 10. Effect of organic nutrition on cob yield with husk and marketable cob yield, t ha^{-1}

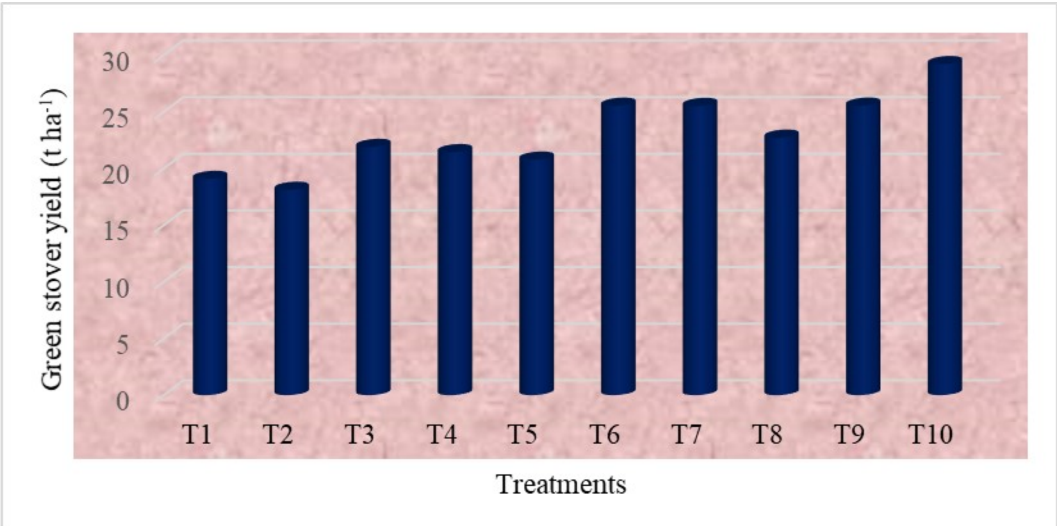

Fig 11. Effect of organic nutrition on green stover yield of baby corn, t ha^{-1}

Application of poultry manure along with *in situ* green manuring produced the highest ascorbic acid content in baby corn cob (Fig. 12). According to Bybordi and Malkouti (2007), the content of ascorbic acid in plant is a function of the content of ascorbic acid oxidase enzyme and zinc and manganese concentrations have key roles in enabling the ascorbic acid oxidase enzyme pathways. The concentration of ascorbic acid is therefore a function of the content of ascorbic acid oxidase enzyme and zinc and manganese concentrations within the plant. Amanullah *et al*. (2007) reported that the Zn content ranged from 90-460 ppm in various types of poultry manure while the Mn content ranged from 190-590 ppm.The higher content of Zn and Mn in poultry manure would have resulted in improvement in the uptake and utilization of zinc and manganese, increasing the activity of the ascorbic acid oxidase enzyme resulting in more concentration of ascorbic acid. Similar results were reported by Srinivasan *et al*. (2014) in baby corn. The legume cowpea used for *in situ* green manuring had a C:N ratio of 13.9:1 (Kirchmann, 1988) and is quickly decomposed converting the nitrogenous compounds like protein to nitrate and the mineral constituents into more soluble form (Palaniappan and Annadurai, 1999). The improved availability of trace elements consequent to the green manuring coupled with the beneficial influence of poultry manure application would have reflected in accumulation of ascorbic acid in the cob.

Among the organic nutrition treatments, application of vermicompost alone or vermicompost, poultry manure or coir pith compost in combination with PGPR mix resulted in a higher N uptake (Fig. 13). Gunes *et al.* (2015) reported that apart from fixing nitrogen, PGPR can affect plant growth directly by the synthesis of phytohormones (auxins, cytokinins, gibberellins) and vitamins, inhibition of plant ethylene synthesis, enhanced stress resistance and improved nutrient uptake. Plants take up most mineral nutrients through the rhizosphere where microorganisms interact with plant products in root exudates and also render the insoluble organic fractions into plant available form and thus changing the mineral status of rhizosphere. The PGPR mediated rhizosphere modification could be therefore considered as a possible reason for the higher N uptake under combined application of organic sources and PGPR.

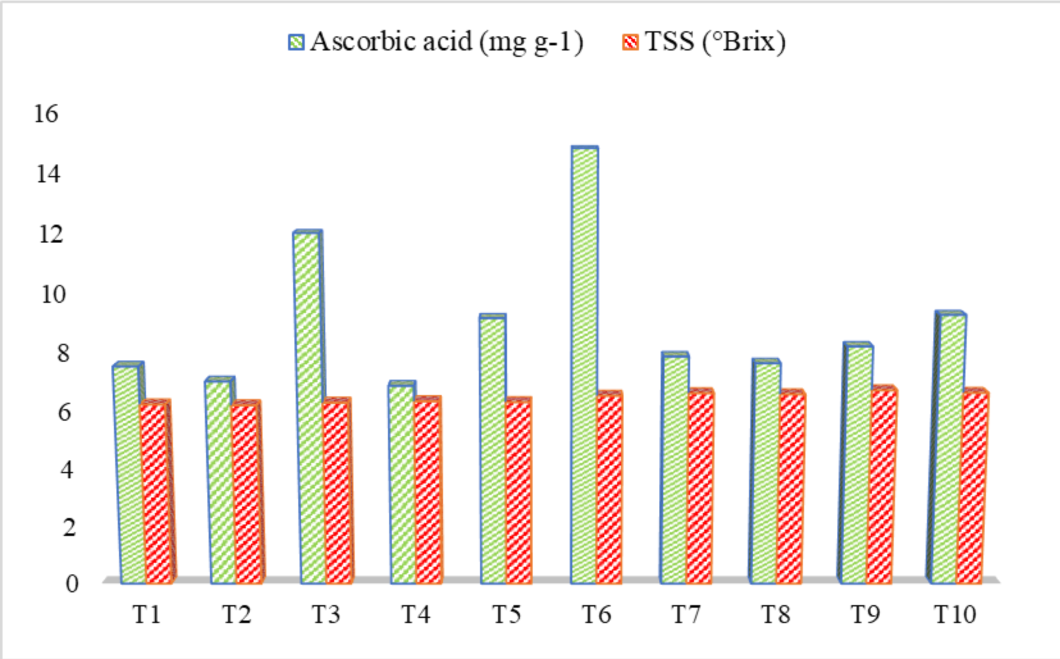

Fig 12. Effect of organic nutrition on ascorbic acid content (mg g^{-1}) and total soluble sugar content (^{0} Brix) of baby corn

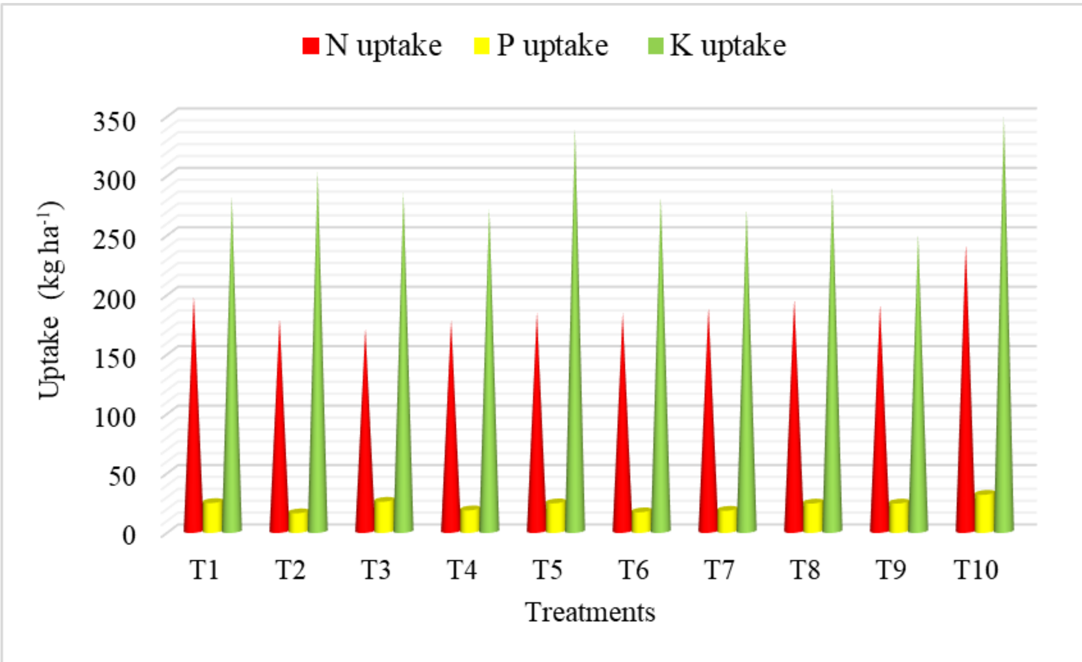

Fig 13. Effect of organic nutrition on N, P and K uptake at harvest, kg ha^{-1}

The PGPR application mobilising more N into the maize cob was previously reported by Kuan *et al*. (2016). The chemical fertilizer treatment however recorded the highest N uptake which is a universal response of plants to the supply of easily available form of inorganic fertilizer nitrogen.

Among organic nutrition treatments, the P uptake was higher under application of poultry manure or vermicompost alone or on adopting *in situ* green manuring and application of coir pith compost (Fig. 13.). Application of coir pith compost or poultry manure along with PGPR mix I also was equally effective in increasing the P uptake. The vermicompost and poultry manure had a relatively higher P content (Table 4) compared to coir pith compost and hence their sole application would have added more phosphorus to the soil resulting in higher P uptake. Though the coir pith compost had a low P content, adoption of *in situ* green manuring would have added organically bound compounds to the soil due to decomposition which could have improved the P uptake. As discussed earlier, PGPR improves the availability of nutrients in soil and an increase in phosphatase activity is reported due to the presence of *Bacillus megaterium* in PGPR which increases P availability and uptake through mineralization of soil P (Gunes *et al*., 2015). The PGPR application increasing the P uptake of maize was previously reported by Moridi *et al*. (2019). As observed in case of nitrogen uptake, the NPK application through chemical fertilizers produced the highest P uptake also.

The organic nutrition treatment *in situ* green manuring and coir pith compost application recorded a higher K uptake (Fig. 13) and it did not differ from K uptake with the chemical fertilizer treatment. The green manure cowpea and coir pith compost had a reasonably higher K content and the combined application of these two sources would have released more potassium to the soil resulting in higher uptake. Further more, the maize roots have high affinity to potassium absorption due to the co transport of H^+ and K^+ ions into the roots (Kochian *et al.,* 1989) since the soil was strongly acidic, and this would have further improved the K uptake.

5.4 SOIL PROPERTIES

There was a general increase in soil pH and decline in EC after the experiment though the treatments could not influence these parameters. The increase in pH may be due to the presence of basic cations produced from the mineralization of organic matter that are rich in Ca, Mg, and K. Being strongly acidic, the soil might have been rich in hydroxides of iron and aluminium. There occurs ion exchange reaction with the terminal OH^- ion of Fe and Al with that of the organic anions from the decaying organic sources. This might have enhanced the hydroxyl content in the rhizosphere which caused the reduction in the acidity of soil (Jacob, 2018).

There was a general increase in the available nitrogen status of soil after the experiment. The *in situ* green manuring of cowpea along with poultry manure application recorded the highest available nitrogen content in soil (Fig. 14). As discussed before, poultry manure has a moderately higher N content and this coupled with the faster release of N through the conversion of uric acid in the manure would have improved the available N status of soil after the experiment. When green manuring has preceded the poultry manure application, it would have further added more N to the soil through the decomposition of proteinous substances in the legume, slowly enriching the available N status of the soil.

Application of poultry manure and biofertilizer PGPR mix I recorded the highest available phosphorus content in soil after the experiment (Fig. 14). The favourable effect of PGPR on rhizosphere modification is well known and this together with increased phosphatase activity (Gunes *et al*., 2015) would have enhanced the available P content of soil after the experiment through the dissolution of organic phosphorus fractions in soil.

The highest available potassium content in soil was recorded with the application of vermicompost and PGPR mix I or *in situ* green manuring along with application of vermicompost (Fig. 14). The vermicompost is rich in phosphorus and potassium and its application along with PGPR would have released more plant available potassium to the soil since PGPR is a consortium of microorganisms including the K solubilizing bacteria.

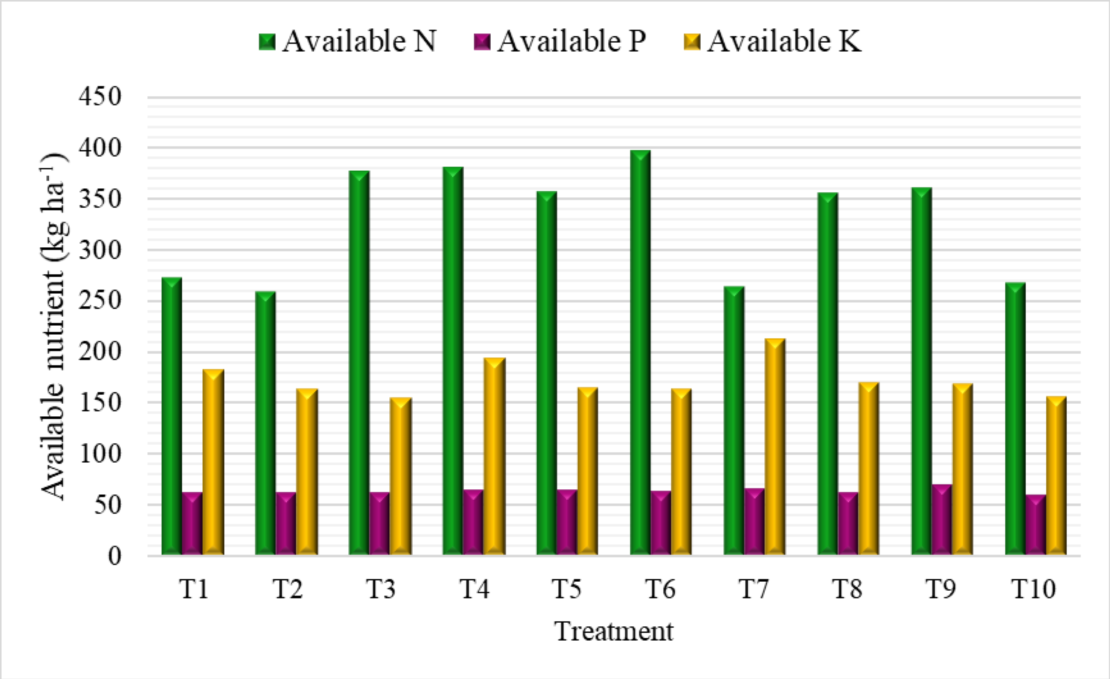

Fig 14. Effect of organic nutrition on available nutrient status of soil after the experiment, kg ha^{-1}

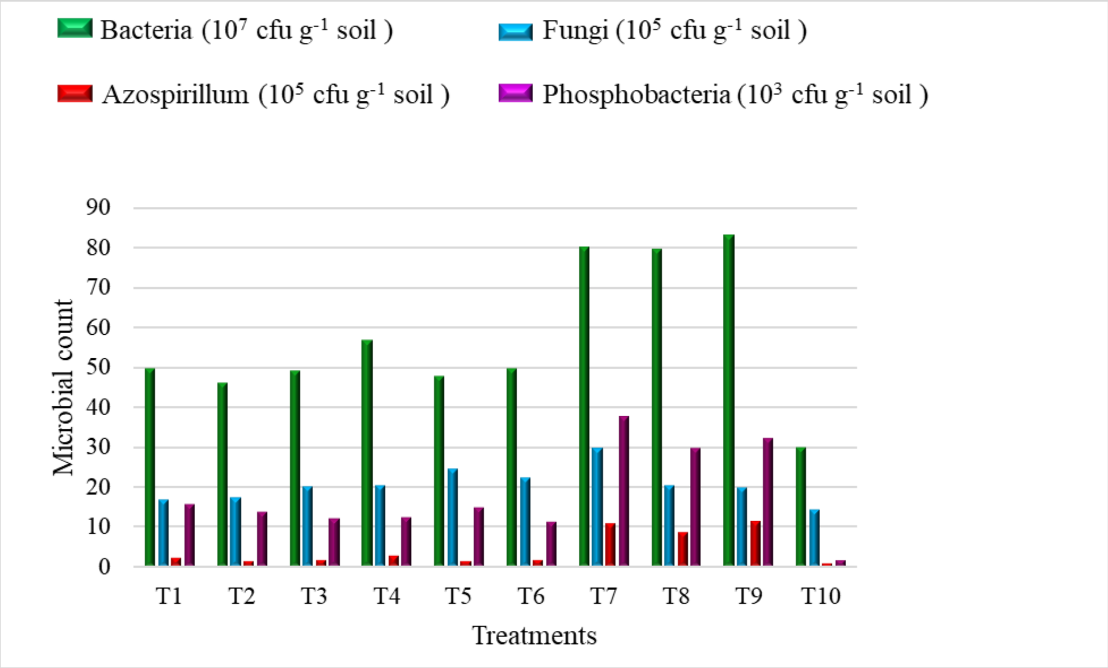

Fig 15. Effect of organic nutrition on soil microbial count after the experiment

5.5 MICROBIAL COUNT

Influence of organic nutrition on soil microbial count is depicted in Fig. 15. Bacterial count was the highest with the application of poultry manure and PGPR mix I while application of vermicompost and PGPR mix I recorded the highest fungal and phosphobacterial count. The highest *Azospirillum* population was recorded with the application of poultry manure or vermicompost along with PGPR mix I.

As reported by Pujiastuti *et al*. (2018), application of chicken manure or poultry manure has several benefits including the soil organic matter enrichment. The soil organic matter serves as a source food for the microorganisms in the soil which could be responsible for the higher microbial population with the application of poultry manure. The PGPR mix I is a consortium of component cultures viz., *Azospirillum lipoferum, Azotobacter chroococcum, Bacillus megaterium* and *Bacillus sporothermodurans* for supplementing all the major nutrients to the crop as reported by Gopi *et al*. (2020). The PGPR application modifies the mineral status of the crop rhizosphere through the secretion of amino acids, organic acids and other compounds which are also having a stimulatory effect on soil microbial activity.

As suggested by Uz and Tavali (2014) vermicompost is an excellent source of organic matter and supports higher microbial population and its diversity, specifically the bacterial population. Application of organic sources of nutrients improving the microbial counts and soil microbial biomass carbon has been previously reported by Nakhro and Dkhar (2010).

There was a drastic reduction in the microbial population in case of control treatment wherein nutrients were applied through inorganic fertilizers. This may be due to the suppressing effect of fertilizer sources on microbial community as suggested by Staley *et al*. (2018) who reported the decreased microbial diversity in agricultural soils with urea amendment.

5.6 ORGANOLEPTIC STUDY

According to Stonel and Sidel (2002), organoleptic evaluation is the scientific method to evoke, analyse and interpret the responses as perceived through smell, touch, sight or taste.

Analysis of the sensory parameters of fresh baby corn cob was done under the organoleptic study and the organic nutrition treatments were found to be superior to the chemical fertilizer application (Fig. 16). Application of vermicompost or poultry manure along with PGPR mix I had higher mean rank values for appearance, colour, taste, flavor and texture of fresh baby corn cob. The results of the analysis of sensory parameters in general revealed that, the organic sources (poultry manure and vermicompost) and biofertilizer (PGPR) played a significant role in the taste and likeness by the respondents. The preference by the consumers was based on the taste, flavor, sweetness and juiciness of the fresh steamed baby corn. Higher content of total soluble sugar in cob produced with these treatments might have contributed to its sweetness and taste. As reported by Worthington (2001), crops raised by organic practices contain more vitamin C, iron, magnesium, phosphorus and less nitrates than conventional crops and the reduced nitrate level leads to higher quality and better consumer acceptance. Kavya (2017) reported higher sensory values of baby corn grown with manurial combinations involving biofertilizer.

Application of nutrients through chemical fertilizers (control) recorded the lowest mean rank value for appearance, colour, taste, flavor and texture in case of fresh baby corn cob indicating poor consumer acceptance. In this treatment a higher quantity of nitrogen (135 kg) was applied through inorganic source which might have negatively influenced the sensory quality of the fresh produce. The negative influence of nitrogen nutrition on appearance and sweetness was previously pointed out by Raese *et al*. (2007) in apple.

5.7 SHELF LIFE

Organic nutrition practices excelled the chemical fertilizer application in case of shelf life quality of the baby corn cob.

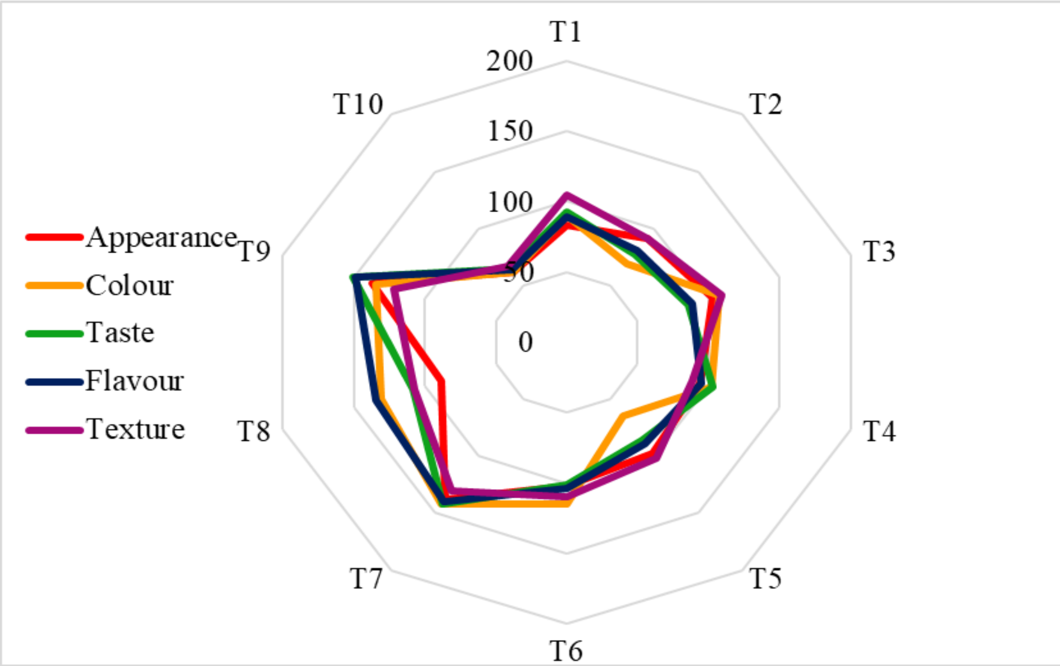

Fig 16. Effect of organic nutrition on sensory parameters of fresh baby corn

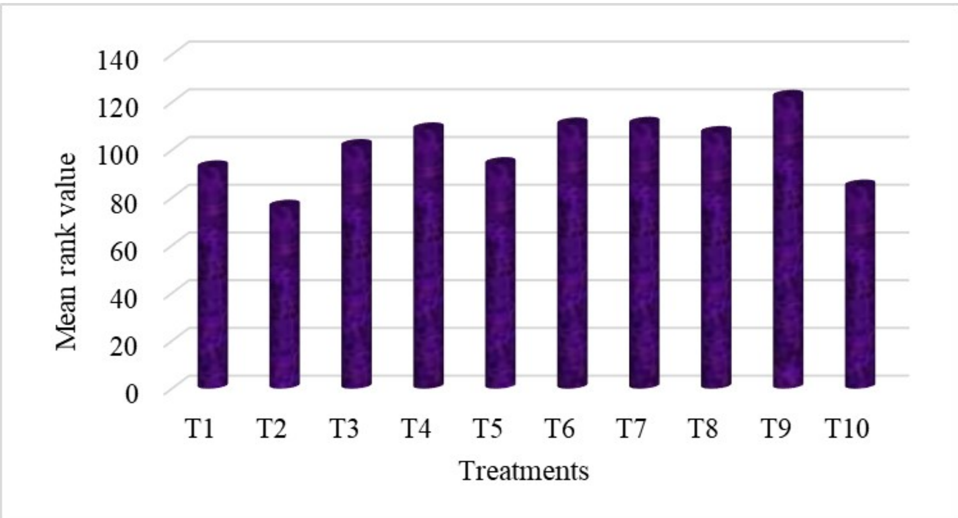

Fig 17. Effect of organic nutrition on overall visual quality of baby corn cob on 6th day of storage

On 6th day of storage, baby corn cob produced with the application of poultry manure and PGPR mix I had the highest overall visual quality as evaluated by the respondents (Fig. 17). Evaluation of sensory attributes in storage indicated that on third day of storage, application of vermicompost or poultry manure with PGPR mix I recorded the highest mean rank value for appearance (Fig. 18) while application of poultry manure and PGPR mix I recorded the highest mean rank value for taste on 3rd and 6th day of storage. The same treatment (application of poultry manure and PGPR mix I) had the highest consumer preference on 3rd and 6th day of storage in terms of flavour. On 6th day of storage, application of poultry manure and PGPR mix I was evaluated as best treatment with respect to texture (Fig. 19). On 3rd day and 6th day of storage, the highest overall acceptability was recorded in cobs produced with application of poultry manure or vermicompost or coir pith compost with PGPR mix I. Thus in short, the baby corn produced under organic nutrition practices involving poultry manure or vermicompost or coir pith compost in combination with PGPR had higher consumer acceptance with respect to different quality traits.

Application of poultry manure as an organic source has been found to improve the soil properties through the supply of micro nutrients and other growth promoting substances. Bitzer and Sims (1988) reported that a long term increase in the level of nutrients such as B, Ca, Mg and Zn can be expected on application of poultry manure. Importance of micro nutrients like B on keeping quality and shelf life of the fruits and tubers have been indicated by Tisdale *et al*. (1995) and this could have been attributed as the reason for enhanced storage quality under poultry manure application.

Vermicompost is a promising high value biofertilizer which not only increases the plant growth and productivity through nutrient supply but also is cost effective at farm level production besides being pollution free. It contains all the essential nutrients for the crop growth besides certain growth promoting substances and vitamins secreted by the earth worms. In addition to that, the N released by organic sources such as vermicompost has got a beneficial effect on the shelf life of fruits, due to the delayed activity of organic N compounds in the source as suggested by Asano (1981).

The combined application of organic sources and PGPR would have improved the rhizosphere activity of the beneficial microorganisms releasing even the insoluble forms of organic nutrients into plant available form contributing to the quality attributes and shelf life of the crop.

The coir pith compost application was found to have least consumer acceptance with respect to overall visual quality on 6th day of storage. When coir pith compost is used as an organic manure, there is a possibility that it might contain chloride (Prabhu and Thomas, 2002) which can adversely affect the crop growth and quality of produce. Chlorine reducing the firmness of fruits in tomato was reported by Acedo *et al*. (2009). Another aspect is that the coir pith compost contains high K and the K:Mg ratio is not suitable for Mg uptake which can cause Mg deficiency (Prabhu and Thomas, 2002). According to Gerendas and Fuhrs (2013), in fruits and vegetables, ratio of Mg to other nutrients like Ca and K is a reliable indicator of the quality response including the organoleptic parameters.

Baby corn produced with inorganic fertilizer management had poor consumer acceptance with respect to all other sensory parameters on 3rd or 6th day of storage. As discussed in case of organoleptic evaluation, the higher amount of nutrient N applied through the chemical fertilizer might have negatively influenced the quality parameters during the storage life of produce. The negative influence of nitrogen nutrition on storage life has been reported by Baser (1986) in potato and Aschcroft and Jones (1993) in tomato.

5.8 ECONOMIC ANALYSIS

Application of vermicompost and PGPR mix I resulted in higher cost of cultivation, while the control treatment in which N, P and K were added through chemical fertilizers had the lowest cost of cultivation. The highest net income was produced by the organic nutrition treatment of *in situ* green manuring along with poultry manure application (Fig. 20).

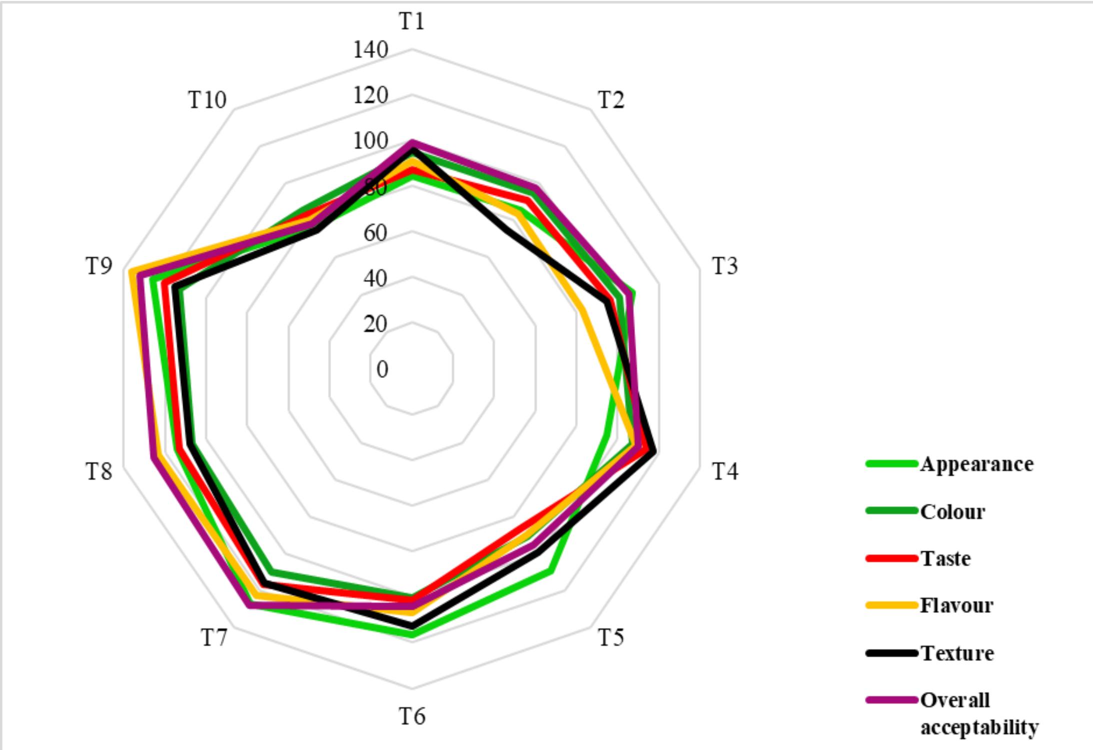

Fig 18. Effect of organic nutrition on sensory parameters of cob on 3rd day of storage

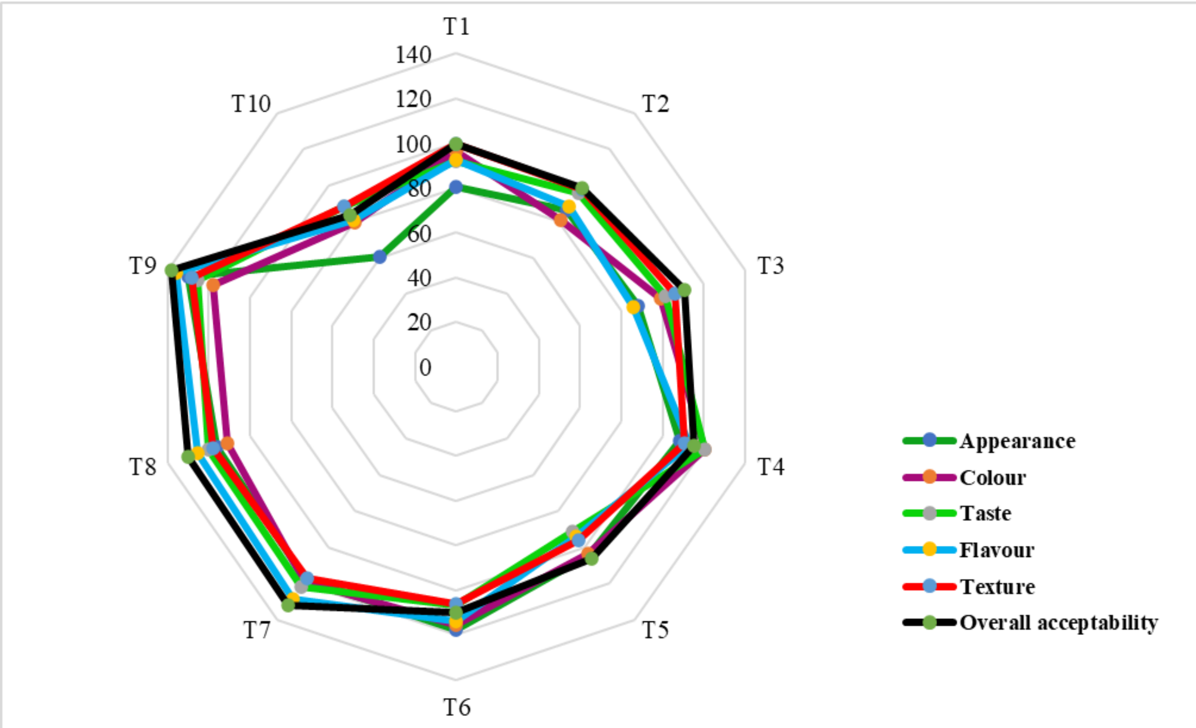

Fig 19. Effect of organic nutrition on sensory parameters of cob on 6th day of storage

This treatment also recorded the highest BCR of 3.06 (Fig. 21). Though the total cost of cultivation was the lowest for control, the net returns were comparatively lower as normal market price was considered for the economic analysis. However, in case of organic nutrition treatments, the cost analysis was done based on premium price of the produce, and higher net returns and BCR were expressed. The treatments with vermicompost and coir pith compost incurred higher input cost and hence had higher cost of cultivation and lower BCR. The combinations involving PGPR also incurred an additional cost for purchase of cow dung for its field application. Green manuring is a cheap method of organic nutrition and when this was combined with application of poultry manure which is relatively cheaper with more N content, higher net returns and BCR were obtained.

Baby corn, mostly consumed as a raw vegetable is preferred as an organic product and the health conscious urban consumers will not compromise the quality and would prefer a high quality produce even at premium price. Organic nutrition of baby corn is highly relevant in the present times when food is treated as a medicine for staying healthy.

The discussion of the results of this investigation indicated that the organic nutrient management practices involving combined application of organic manures (poultry manure, vermicompost or coir pith compost) along with other organic sources of nutrition such as *in situ* green manuring or use of biofertilizer (PGPR mix I) were equally effective as inorganic fertilizer application in improving the yield attributes and yield. Poultry manure application along with PGPR mix I or *in situ* green manuring was effective for producing higher nutrient content in baby corn. Application of poultry manure or vermicompost with PGPR was the best organic nutrition practice with respect to sensory parameters, consumer preference and shelf life. The highest net income and BCR were obtained from the organic nutrition practice of *in situ* green manuring and application of poultry manure as an organic source.

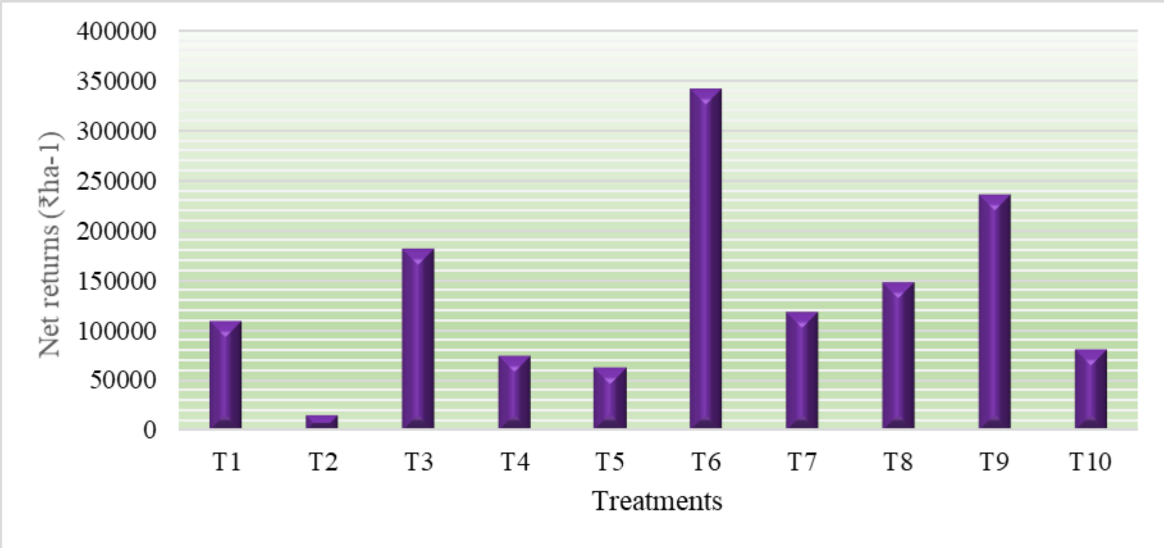

Fig 20. Effect of organic nutrition on economics of baby corn cultivation-net returns, ₹ ha^{-1}

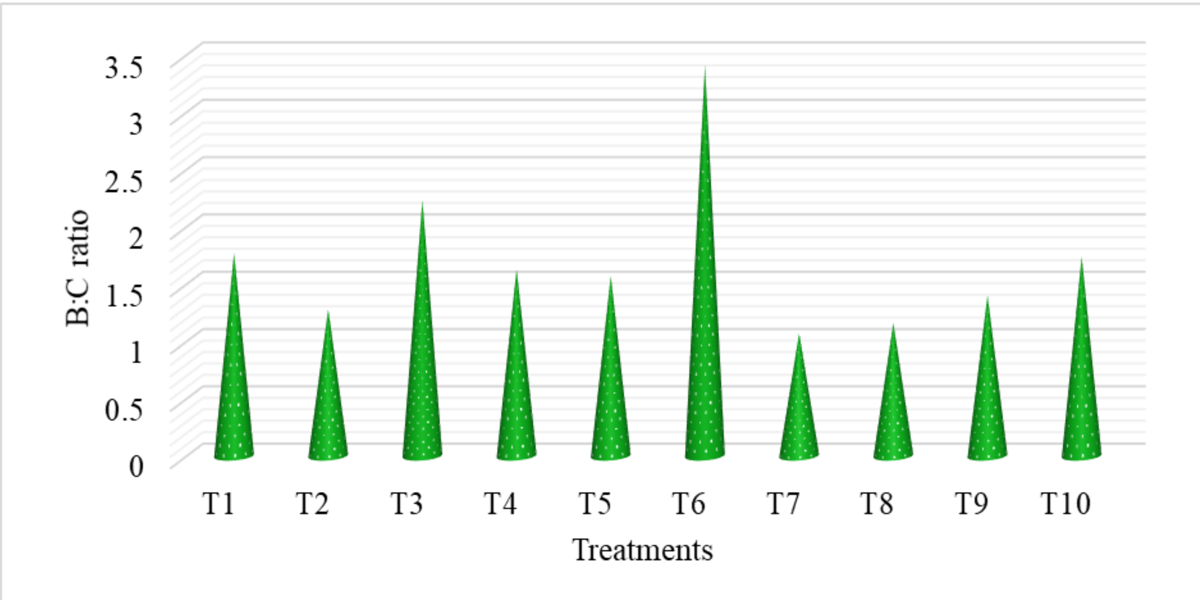

Fig 21. Effect of organic nutrition on economics of baby corn cultivation- benefit: cost ratio

SUMMARY

6. SUMMARY

The study entitled "Organic nutrition in baby corn (*Zea mays* L.)" was carried out during 2018-20 at College of Agriculture, Vellayani to investigate the effect of organic nutrition on growth, yield and quality of baby corn and to work out the economics of cultivation.

The experiment was laid out in Randomized Block Design with 10 treatments replicated thrice. The treatments comprised of nine organic nutrition treatments and a control. The treatments were T_1- vermicompost, T_2- coir pith compost, T_3- poultry manure, T_4- *In situ* green manuring with cowpea + vermicompost application, T_5- *In situ* green manuring with cowpea+ coir pith compost application, T_6- *In situ* green manuring with cowpea + poultry manure application, T_7- PGPR mix I + vermicompost, T_8- PGPR mix I + coir pith compost, T_9- PGPR mix I + poultry manure and T_{10}- 135:65:45 kg NPK ha^{-1} as inorganic fertilizers (control). Organic sources were applied as basal on nitrogen equivalent basis as per the treatments. In case of control, the N and K were given in two split doses, ½ as basal+ ½ at 25 DAS and full quantity of P was given as basal. For *in situ* green manuring, cowpea was raised and incorporated at 50 per cent flowering stage and sowing of baby corn was done two weeks after incorporation. The PGPR mix I was applied as seed treatment @ 30 g kg^{-1} followed by soil application @ 110g m^2 area. The salient findings of this study are summarized below.

The results indicated that organic nutrition had significant effect on growth, growth attributes, yield attributes, yield and quality of baby corn. The organic nutrition treatment T_9 (application of poultry manure and PGPR mix I) recorded significantly higher plant height of 69.27 cm at 15 DAE which was on par with the plant height recorded (73.80 cm) with the control (T_{10}) wherein nutrients were applied through chemical sources. At 30 DAE also, significantly higher plant height was recorded by T_9 treatment (110.86 cm) which was the second best treatment after the control (T_{10}-125.41cm), which was significantly superior to all other treatments. At 30 DAE, the treatment T_9 and T_6 recorded significantly higher number of leaves per plant (8.66) which was on par with the control (T_{10}) producing 9.00 leaves per plant. At 45 DAE also similar trend was noticed wherein significantly higher number of leaves per plant was recorded with T_9 (11.33) followed by T_6 (10.66) and were on par each other and statistically similar to T_{10} treatment in which nutrients were applied through chemical fertilizers (11.66). The organic nutrition treatment T_9 produced the highest LAI at 30 DAE (3.22) and 45 DAE (5.42) which were on par with the control (T_{10} - LAI 3.21 and 5.97) and T_6 (LAI 3.14 and 5.09).

The treatments T_3 andT_6 recorded less number of days for 50 per cent tasseling (44.66 and 45.00, respectively) and T_6 recorded lesser days for 50 per cent silking (48.66) compared to other treatments. More days were required for reaching 50 per cent tasseling under T_8 and T_2 (46.66 days), while T_8 took more days (52.00) for 50 per cent silking also. Total dry matter production of baby corn was significantly influenced by the organic nutrition treatments. Among organic nutrition treatments, T_4 (*in situ* green manuring and application of vermicompost) and T_6 (*in situ* green manuring and application of poultry manure) which were on par each other, recorded significantly higher dry matter production of 15.54 t ha^{-1} and 14.84 t ha^{-1}, respectively. However, the total dry matter production was higher in control wherein the nutrients were applied through inorganic fertilizers (16.87 t ha^{-1}), compared to organic nutrition treatments.

Yield attributes like cob length, cob weight with husk, cob yield with husk, marketable cob yield and green stover yield were significantly influenced by the organic nutrition treatments. The treatments T_4, T_5, T_6 and T_9 recorded significantly higher cob length of 11.28 cm, 11.25 cm, 11.02 cm and 10.92 cm, respectively which were on par each other and also on par with T_{10} (chemical fertilizer application) producing a cob length of 11.57 cm. Among different organic nutrition treatments, the highest cob weight with husk was recorded in T_4 (70.11 g cob^{-1}) and it did not statistically differ from control (T_{10}) producing a value of 74.97 g cob^{-1}. The treatment T_6 (*in situ* green manuring and poultry manure application) produced a cob yield with husk of 6.33 t ha^{-1} which was on par with control (6.65 t ha^{-1}). Though significantly higher marketable cob yield (2.20 t ha^{-1}) was recorded in control (T_{10}), it was followed by the organic nutrition treatment T_6 (*in situ* green manuring and poultry manure application) with a marketable cob yield of 1.96 t ha^{-1}. Both T_6 (*in situ* green manuring and poultry manure application) and T_9 (application of poultry manure and PGPR mix I) produced significantly higher green stover yield of 25.53 t ha^{-1} next to control (green stover yield -29.20 t ha^{-1}).

Significantly higher ascorbic acid content (14.83 mg g^{-1}) was recorded in the treatment T_6 (*in situ* green manuring with poultry manure application) and the highest total soluble sugar content (6.75° Brix) was recorded in T_9 (application of poultry manure and PGPR mix I) which was on par with T_{10} (6.64 ° Brix), T_7 (6.63° Brix), T_8 (6.59° Brix) and T_6 (6.54° Brix).

The control (T_{10}) recorded the highest uptake of N (241.17 kg ha^{-1}) and P (32.16 kg ha^{-1}) at harvest which was significantly superior to all other treatments. Among the organic nutrition treatments, T_1 (application of vermicompost) had higher N uptake (197.49 kg ha^{-1}), which was on par with T_8 (application of coir pith compost and PGPR mix I), T_9 (application of poultry manure and PGPR mix I) and T_7 (application of vermicompost and PGPR mix I) recording an uptake value of 194.89 kg ha^{-1}, 190.59 kg ha^{-1} and 187.82 kg ha^{-1}, respectively. Among organic nutrition treatments, T_3 (poultry manure) registered a higher P uptake of 26.31 kg ha^{-1} which was on par with T_5, T_1, T_8 and T_9 (25.02, 25.25, 24.83 and 24.84 kg ha^{-1} respectively). The organic nutrition treatment T_5 (*in situ* green manuring and coir pith compost application) recorded a higher K uptake of 338.83 kg ha^{-1} which was on par with the K uptake by control (348.81 kg ha^{-1}).

The organic nutrition significantly influenced the available nutrient status of the soil after the experiment. The treatment T_6 recorded the highest available nitrogen content in soil after the experiment (397.15 kg ha^{-1}) which was on par with T_4 (380.43 kgha^{-1}) and T_3 (376.78 kg ha^{-1}). The treatment T_9 (poultry manure and PGPR mix I) recorded the highest available phosphorus content (68.80 kg ha^{-1}) and it was significantly superior to all other treatments. The highest available potassium content in soil (212.50 kg ha^{-1}) was recorded in T_7 (vermicompost and PGPR mix I) which was on par with T_4 (193.30kg ha^{-1}) where *in situ* green manuring and vermicompost application were done.

The microbial count in soil was significantly influenced by the organic nutrition practices. Bacterial count (83×10^7 cfu g^{-1} soil) and *Azospirillum* count (11.14×10^5 cfu g^{-1} soil) were the highest in T_9 (application of poultry manure and PGPR mix I), and T_7 (application of vermicompost and PGPR mix I) recorded the highest count of fungi (29.67×10^5 cfu g^{-1} soil) and phosphobacteria (37.67×10^3 cfu g^{-1} soil) in soil after the experiment.

Organoleptic study revealed that the organic nutrition practices significantly influenced the sensory characters of fresh baby corn. The treatment T_7 (vermicompost with PGPR mix I) recorded the highest mean rank value (MRV) for appearance, colour and texture (137.90, 142.40, 130.60, respectively) and it was on par with T_9 (MRV 136.89, 134.60, 121.70, respectively). The MRV for taste and flavour were the highest for T_9 (150.50 and 148.60, respectively) which was on par with T_7 (142.00 and 139.70, respectively).

The organic nutrition practices had significantly influenced the overall visual quality and sensory parameters of baby corn in storage also. The overall visual quality at 6th day of storage was significantly influenced by the treatments and T_9 recorded the highest MRV (122.15). On third day of storage, the highest MRV for appearance (127.35) was recorded in T_7 (application of vermicompost and PGPR mix I) which was on par with T_9 (126.17). The highest MRV for taste, flavour and overall acceptability on 3rdday (120.65, 136.50 and 132.40, respectively) and 6th day of storage (123.65, 136.05 and 138.40 respectively) were recorded in T_9. Organoleptic scores were low in T_{10} (control) wherein chemical fertilizers were applied as sources of nutrients.

The lowest cost of cultivation (₹ 84555 ha^{-1}) was recorded in the control (T_{10}) and the total cost of cultivation was higher in organic nutrition treatments. Among organic treatments, total cost of cultivation was the lowest (₹ 145404 ha^{-1}) in T_3 (application of poultry manure). The treatment T_6 (*in situ* green manuring and poultry manure application) recorded the highest net income of ₹ 340996 ha^{-1} and the highest BCR of 3.06.

The results of the study indicated that the organic nutrient management practices comprising combined application of organic manures (poultry manure, vermicompost or coir pith compost) along with other organic sources of nutrition such as *in situ* green manuring or use of biofertilizer (PGPR mix I) were as effective as inorganic fertilizer application in improving the yield attributes and yield of baby corn. Poultry manure application along with PGPR mix I or *in situ* green manuring was effective for producing higher nutrient content in baby corn. Application of poultry manure or vermicompost with PGPR was found to improve the sensory parameters, consumer preference and shelf life of baby corn. The highest net income and BCR were obtained when *in situ* green manuring was practiced, along with poultry manure application.

Results pointed out the feasibility of organic nutrient management in a short duration crop like baby corn with apparent benefits on growth attributes and yield attributes, yield, quality, consumer acceptability and economic returns. The *in situ* green manuring practice along with the application of poultry manure as organic source was found to be the most suited organic nutrition practice for higher cob yield with husk, marketable cob yield, net income and benefit: cost ratio together with reasonably higher consumer acceptance.

FUTURE LINE OF WORK

- Exploring the possibility of liquid organic manures in baby corn cultivation.
- Investigating the organic ways of weed management and plant protection in baby corn.

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ORGANIC NUTRITION IN BABY CORN (*Zea mays* L.)

By

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ABSTRACT

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ABSTRACT

The investigation entitled "Organic nutrition in baby corn (*Zea mays* L.)" was conducted at College of Agriculture, Vellayani, Thiruvananthapuram during 2018-20 to study the influence of organic nutrition on growth, yield, quality and economics of cultivation of baby corn (*Zea mays* L.).

The field experiment was conducted during *Kharif* 2019 (May to September) at the Instructional Farm, College of Agriculture, Vellayani. The experiment was laid out in Randomized Block Design with 10 treatments replicated thrice. The treatments were T_1- vermicompost, T_2- coir pith compost, T_3- poultry manure, T_4- *in situ* green manuring with cowpea + vermicompost application, T_5- *in situ* green manuring with cowpea+ coir pith compost application, T_6- *in situ* green manuring with cowpea+ poultry manure application, T_7- PGPR mix I + vermicompost, T_8- PGPR mix I + coir pith compost, T_9- PGPR mix I + poultry manure and T_{10}- 135:65:45 kg NPK ha^{-1} as inorganic fertilizers (control). Organic sources were applied as basal on nitrogen equivalent basis as per the treatments. For *in situ* green manuring, cowpea was raised and incorporated at 50 per cent flowering stage and sowing of baby corn was done two weeks after incorporation. The PGPR mix I was applied as seed treatment @ 30 g kg^{-1} followed by soil application @ 110g m^2 area at sowing and at 15 DAS.

The results of the study revealed that the growth characters such as plant height, leaves per plant and LAI were higher in T_9 which was on par with T_{10}. The duration for 50 per cent tasseling was less in T_3 and T_6 while for 50 per cent silking, the duration was less in T_6. The treatment T_4 recorded higher dry matter production and the same treatment produced higher cob length and cob weight with husk and was on par with T_{10}. The cob yield with husk (6.33 t ha^{-1}) and marketable cob yield were found to be higher in T_6 (1.96 t ha^{-1}). Comparison between organic and inorganic treatments revealed the superiority of the inorganic treatment (T_{10}) in producing higher marketable cob yield and green stover yield.

The treatment T_9 recorded the highest total soluble sugar content while T_6 recorded the highest ascorbic acid content. Among organic nutrition treatments, T_1

recorded higher N uptake, T_3 recorded higher P uptake and T_5 recorded higher K uptake at harvest. Compared to organic treatments, the inorganic nutrition (T_{10}) resulted in more N and P uptake though T_5 recorded K uptake comparable with T_{10}. The N, P and K content in soil after the experiment were the highest in treatments T_6, T_9 and T_7, respectively. Bacterial count and *Azospirillum* count of soil were the highest in treatment T_9, while the fungal count and phosphobacterial count were the highest in treatment T_7. The treatments T_7 and T_9 produced higher organoleptic score for fresh baby corn and baby corn in storage upto 6 days. The organoleptic score was the lowest in T_{10}. The economic analysis revealed the superiority of treatment T_6 in terms of net income (₹ 340996 ha^{-1}) and benefit: cost ratio (3.06).

The results of the study revealed that *in situ* green manuring along with application of poultry manure (T_6) was the most suited organic nutrition practice for baby corn, for higher cob yield with husk, marketable cob yield, net income and benefit: cost ratio and had reasonably higher consumer acceptance.

സംഗ്രഹം

പിഞ്ചുചോളത്തിലെ ജൈവപോഷണം എന്ന വിഷയത്തിൽ ഒരു പഠനം 2018-20 കാലയളവിൽ വെള്ളായണി കാർഷികകോളേജിൽ നടന്നു. പിഞ്ചുചോളത്തിന്റെ വളർച്ച, ഉത്പാദക്ഷമത, സംഭരണകാലാവധി ഗുണമേന്മ, ആദായം എന്നിവയിൽ ജൈവപോഷക പരിപാലന രീതികളുടെ സ്വാധീനം മനസിലാക്കുക എന്ന ലക്ഷ്യത്തോടെയാണ് പ്രസ്തുത പഠനം നടത്തിയത്.

വെള്ളായണി കാർഷികകോളേജിലെ ഇൻസ്ട്രക്ഷണൽ ഫാമിൽ 2019 മെയ് - സെപ്റ്റംബർ കാലയളവിലാണ് ഫീൽഡ് പരീക്ഷണം നടത്തിയത്. സങ്കരയിനത്തിൽപെട്ട G 5414 എന്ന പിഞ്ചുചോള ഇനമാണ് പ്രസ്തുത പരീക്ഷണത്തിന് ഉപയോഗിച്ചത്. റാൻഡമൈസ്ഡ് ബ്ലോക്ക് ഡിസൈൻ എന്ന സ്റ്റാറ്റിസ്റ്റിക്കൽ പഠനരീതിയാണ് അവലംബിച്ചത്. ഈ രീതിയിൽ 10 പഠനമുറകൾ 3 തവണ ആവർത്തിച്ചാണ് പരീക്ഷണം നടത്തിയത്. ടി 1 - മണ്ണിര കമ്പോസ്റ്റ്, ടി 2- ചകിരിച്ചോർ കമ്പോസ്റ്റ് , ടി 3- കോഴിവളം , ടി 4- പയർ ഉപയോഗിച്ചു പച്ചിലവള പ്രയോഗവും മണ്ണിര കമ്പോസ്റ്റും , ടി 5- പയർ ഉപയോഗിച്ചു പച്ചിലവള പ്രയോഗവും ചകിരിച്ചോർ കമ്പോസ്റ്റും, ടി 6- പയർ ഉപയോഗിച്ചു പച്ചിലവള പ്രയോഗവും കോഴിവളവും, ടി 7- മണ്ണിര കമ്പോസ്റ്റും പി ജി പി ആർ മിശ്രിതം 1 ജീവാണുവള പ്രയോഗവും ടി 8- ചകിരിച്ചോർ കമ്പോസ്റ്റും പി ജി പി ആർ മിശ്രിതം 1 ജീവാണുവള പ്രയോഗവും, ടി 9- കോഴിവളവും പി ജി പി ആർ മിശ്രിതം 1 ജീവാണുവള പ്രയോഗവും ടി 10- 135:65:45 കിലോഗ്രാം എൻ പി കെ ഒരു ഹെക്ടറിന് (രാസവളങ്ങൾ) എന്നീ പഠനമുറകൾ ഉപയോഗിച്ചാണ് പരീക്ഷണം നടത്തിയത്. ജൈവസ്രോതസുകൾ നൈട്രജന് തുല്യമായ അളവിൽ അടിവളമായി പ്രയോഗിച്ചു. പച്ചിലവള പ്രയോഗത്തിനായി വളർത്തിയ പയർ 50 ശതമാനം പൂവിട്ടപ്പോൾ മണ്ണിൽ സംയോജിപ്പിക്കുകയും രണ്ടാഴ്ചക്കു ശേഷം പിഞ്ചുചോളം വിതയ്ക്കുകയും ചെയ്തു.

കോഴിവളവും ജീവാണുവളവും (പി ജി പി ആർ മിശ്രിതം 1) ജൈവവളമായി നൽകിയപ്പോൾ (ടി9) വളർച്ചാപ്രതീകങ്ങളായ ചെടിയുടെ ഉയരം, ഇലകളുടെ എണ്ണം, എന്നിവ കൂടുതലാണെന്നും ഇത് രാസവളപ്രയോഗത്തിന് (ടി10) ഒപ്പമാണെന്നും പഠനഫലങ്ങൾ വ്യക്തമാകുന്നു. പിഞ്ചുചോളത്തിന്റെ വിളവ് (6.33 ടൺ ഹെക്ടർ$^{-1}$), വിപണന

യോഗ്യമായ വിളവ് (1.96 ടൺ ഹെക്ടർ$^{-1}$) എന്നിവ പയർ ഉപയോഗിച്ചു പച്ചിലവള പ്രയോഗം നടത്തുകയും കോഴിവളം നൽകുകയും ചെയ്തപ്പോൾ (ടി 6) കൂടുതലാണ് എന്ന് കണ്ടെത്തി. ജൈവ അജൈവ രീതികൾ താരതമ്യം ചെയ്തപ്പോൾ ഉയർന്ന വിപണന യോഗ്യമായ പിഞ്ചുചോള വിളവും തീറ്റപ്പുൽ വിളവും നൽകുന്നതിൽ രാസവളപ്രയോഗ രീതികൾ (ടി 10) മുന്നിട്ടു നിന്നതായി കണ്ടു.

ജൈവവളത്തോടൊപ്പം മിത്രസൂക്ഷ്മാണുക്കളുടെ ഉപയോഗം മണ്ണിന്റെ പോഷകഗുണവും (എൻ, പി, കെ അളവ്) സൂക്ഷ്മാണുക്കളുടെ എണ്ണവും വർധിപ്പിക്കുന്നതായി കണ്ടെത്താൻ കഴിഞ്ഞു. മിത്രസൂക്തമാണുക്കളോടൊപ്പം കോഴിവളമോ മണ്ണിര കമ്പോസ്റ്റോ നൽകുമ്പോൾ ഉയർന്ന സംഭരണകാലാവധിയും ഗുണമേന്മയും ഉള്ള പിഞ്ചുചോളം ലഭിക്കുന്നതായി മനസിലാക്കാൻ കഴിഞ്ഞു. സാമ്പത്തിക വിശകലനത്തിൽ ഉയർന്ന അറ്റാദായം (ഹെക്ടറിന് 340996 രൂപ), വരവ്:ചെലവ് അനുപാതം (3.06) എന്നിവ ടി 6 പഠനമുറയിൽ മെച്ചമായി കാണപ്പെട്ടു.

പയർ ഉപയോഗിച്ചു പച്ചിലവള പ്രയോഗം ചെയ്യുകയും ഒപ്പം കോഴിവളം അടിവളമായി നൽകുകയും ചെയ്യുന്നതാണ് പിഞ്ചുചോളത്തിന് ഏറ്റവും അനുയോജ്യമായ ജൈവ വള പ്രയോഗ രീതിയെന്ന് രീതിയെന്ന് പഠനഫലങ്ങൾ തെളിയിച്ചു.

APPENDIX

APPENDIX I

Weather parameters during the period of field experiment (May 2019- September 2019)

Std week	Mean temperature		Mean RH		Rainfall	Sunshine hrs
	Max	Min	Max	Min		
20 (14May - 20May)	34.5	26.2	81.3	66.7	0.0	9.4
21 (21May- 27May)	33.5	26.5	87.4	73.1	83.5	6.9
22 (28May - 03Jun)	33.6	26.7	90.4	68.6	25.5	7.7
23 (04 Jun- 10Jun)	32.2	25.3	89.3	81.6	0.0	4.8
24 (11Jun- 17Jun)	31.1	24.8	93.3	81.1	114.40	4.6
25 (18Jun- 24Jun)	31.9	24.9	90.0	78.7	28.60	4.0
26 (25Jun- 01July)	32.0	26.0	87.1	75.2	0.00	7.6
27 (02 July- 08July)	32.2	25.9	90.3	77.1	32.10	6.7
28 (09 July- 15July)	30.7	25.3	90.2	79.00	42.10	4.5
29 (16July-22July)	30.0	23.7	94.1	81.5	10.80	3.5
30 (23 July- 29July)	30.3	24.3	92.2	82.4	7.7	2.8
31 (30 July-05Aug)	31.4	25.6	89.2	77.5	17.50	6.5
32 (06Aug- 12Aug)	30.0	23.6	94.5	81.7	198.1	1.7
33 (13Aug- 19Aug)	30.4	24.0	91.5	76.5	18.20	4.2
34 (20 Aug- 26Aug)	31.1	24.2	92.1	77.4	34.9	4.9
35 (27 Aug- 02Sep)	30.6	23.9	93.1	77.8	91.9	5.7
36 (03 Sep- 09 Sep)	30.8	24.3	90.5	80.1	84.00	5.5
37 (10 Sep- 16 Sep)	31.3	24.3	88.8	76.4	12.9	4.3
38 (17 Sep - 23 Sep)	30.9	24.9	91.1	77.8	19.4	5.9
39 (24 Sep- 30 Sep)	31.0	24.1	93.2	75.5	123.8	4.6

APPENDIX II

Sensory Evaluation
SCORE CARD

Particulars	Score	Appearance	Colour	Flavour	Taste	Texture	Overall acceptability	Overall visual quality
Like Extremely	9							
Like Very Much	8							
Like Moderately	7							
Like Slightly	6							
Neither Like nor Dislike	5							
Dislike Slightly	4							
Dislike Moderately	3							
Dislike Very Much	2							
Dislike extremely	1							

APPENDIX III
Media for microbial culture

1. Nutrient Agar (1 Litre)

Particulars	Quantity
Peptone	5 g
Beef extract	3 g
Agar	20 g
Distilled water	1000 ml

2. Martin's Rose Bengal agar (1 Litre)

Particulars	Quantity
Glucose	10 g
Peptone	5 g
KH_2PO_4	1g
$Mg\ SO_4.\ 7H_2O$	0.5 g
Streptomycin	30 mg
Agar	15 g
Rose Bengal	35 mg
Distilled water	1000 ml

3. Kenknight's Agar (1 Litre)

Particulars	Quantity
Dextrose	1 g
KH_2PO_4	0.1 g
$NaNO_3$	0.1 g
KCl	0.1 g
$Mg\ SO_4.\ 7H_2O$	0.1 g
Agar	15 g
Distilled water	1000 ml

4. N free semisolid malate medium (1 Litre)

Particulars	Quantity
Malic acid	5 g
KH_2PO_4	0.5 g
Mg SO_4. $7H_2O$	0.2 g
NaCl	0.1 g
$CaCl_2$	0.02 g
Trace element solution	2 ml
BTB (0.5% alcoholic solution)	2 ml
$FeSO_4$	0.5 g
Vitamin solution	4 ml
KOH	4 g
Agar	20 g
Distilled water	1000 ml

5. Pikovskaya's medium (1 litre)

Particulars	Quantity
Glucose	10 g
$Ca_3(PO_4)_2$	5 g
$(NH_4)_2SO_4$	0.5 g
KCl	0.2 g
Mg SO_4. $7H_2O$	0.1 g
$MnSO_4$	Trace
Yeast extract	0.5 g
Agar	15 g
Distilled water	1000 ml
$FeSO_4$	Trace

APPENDIX IV

AVERAGE INPUT COST AND MARKET PRICE OF PRODUCE

Items	Cost
Inputs	
Labour wages	
Men	700/ day
Women	500/ day
Seed	
Baby corn	650 kg^{-1}
Green manure cowpea	150 kg^{-1}
Farmyard manure (FYM)	800 t^{-1}
Vermicompost	20 kg^{-1}
Coir pith compost	12 kg^{-1}
Poultry manure	8 kg^{-1}
Urea	8 kg^{-1}
Rajphos	15 kg^{-1}
Muriate of Potash (MOP)	23 kg^{-1}
Lime	18 kg^{-1}
Market price of produce	
Inorganic baby corn	25 kg^{-1}
Organic baby corn	80 kg^{-1}