PRODUCTION TECHNOLOGY FOR ORGANIC SWEET POTATO

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DECLARATION

I hereby declare that this thesis entitled **"Production technology for organic sweet potato"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other university or society.

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DEDICATED TO

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LIST OF ABBREVIATIONS

%	Per cent
BCR	Benefit Cost Ratio
CD	Critical difference
cm	Centimetre
cm^2	Square centimetre
CPC	Coir Pith Compost
CTCRI	Central Tuber crops Research Institute
DAP	Days After Planting
et al.	And others
Fig.	Figure
FYM	Farmyard manure
g	gram
ha	hectare
ha^{-1}	Per hectare
K	Potassium
Kg ha^{-1}	Kilogram per hectare
Kg	Kilogram
LAI	Leaf Area Index
m	Metre
N	Nitrogen
^{o}C	Degree Celsius
P	Phosphorous
PM	Poultry manure
PSB	Phosphorous Solubilizing Bacteria
t ha^{-1}	Tonnes per hectare
UI	Utilization index
VAM	Vesicular Arbuscular Mycorrhizae
var.	Variety

Introduction

1. INTRODUCTION

The sweet potato (*Ipomoea batatas* L. (Lam) a member of Convolvulaceae family is one of the most important tropical food crops with versatile utility. This crop is now grown throughout the tropics for its edible tubers, and is an important food source in many countries. Among the food crops sweet potato (*Ipomoea batatas* L.) ranked as the 5^{th} most important crop producing substantially high edible energy per hectare per day compared to rice, wheat, maize and cassava. The tubers are used as a subsidiary food after boiling, baking and frying and also form as an industrial raw material for the production of starch, alcohol, pectin etc. Besides energy provider, it is a good source of minerals and vitamins. More than this, the tubers are having a number of nutrient categories responsible for the health benefits like antioxidants, anti-inflammatory nutrients, and blood sugar-regulating nutrients. Orange flesh sweet potatoes are rich in ß-carotene -precursor for vitamin A (Sreekanth, 2008) and help to alleviate vitamin A deficiency which causes night blindness (Anderson *et al.*, 2007). The variety Sree Kanaka used in this experiment is orange fleshed with short duration of 85-90 days.

Recently, organic agriculture has gained international recognitions as a valid alternative to conventional food production. There is growing concern about soil health and productivity and contamination of food and the environment, due to the increased consumption of chemical fertilizers and insecticides. Organic production technologies are adopted with a main objective of producing safe food and maintaining a pollution free environment. The consumers today are willing to pay a premium for safe products and so the organic agriculture is fastly growing across the world. The interest in organic agriculture is increasing rapidly and its market is growing not only in developed countries but in many other developing countries also. But organic farming does not hold good for all crops in all situations. Tuber crops in general are very much suited for organic production system.

Organic manure is known to be effective in maintenance of adequate supply of organic matter in soils with attendant improvement in soil physical and chemical conditions and enhanced crop performance. India has a potential of manurial resources like farm yard manure, poultry manure and coir pith compost. Large quantities of different organic materials are easily available and are effective source of nutrient for tuber crop like sweet potato. Farm yard manure (FYM) is the most commonly used organic manure. Inadequate availability of FYM has led us to think of alternate sources of organic manure. Large quantities of organic materials are available which poses disposal problems and environmental hazards, can be used as effective source of nutrient for tuber crops like sweet potato. Coir pith is abundantly available in Kerala as byproduct of coir industry. This can be used as organic manure after narrowing down its C: N ratio with *Pleurotus* sp. The comparative effectiveness of these different organic nutrient sources and their levels on the growth and yield of Sweet potato has not been explored till date.

Incorporation of bioinoculants along with organic manures have emerged as a promising component of organic production system as it can enhance crop yields per unit of applied nutrients by providing a better physical, chemical and biological environment conducive to higher productivity of crops. Pandey and Kumar (2002) suggested the use of biofertilisers as a cost effective supplement in crop production. The information available is much scanty on the beneficial role of biofertilisers on growth and yield of sweet potato especially along with different organic sources.

More than this the research evidences indicate that the application of inorganic fertilizers increases root yield (Nedunchezhiyan and Srinivasulu Reddy, 2002) but hampers the quality of sweet potato (Nedunchezhiyan *et al.*, 2003). Continuous use of fertilizer nitrogen may in some situation have detrimental effects on tuber quality. So the use of organic source of nutrient is a viable alternative as it provides life to soil, strengthens the natural resource base and sustains crop production.

Keeping these facts in view, present study "Production Technology for Organic Sweet potato" was carried out with the objectives to develop an organic production package involving sources of organic manure, its levels and bioinoculant and to work out the economics of cultivation.

Review of literature

2. REVIEW OF LITERATURE

2.1 EFFECT OF ORGANIC MANURES

Organic materials are valuable byproducts of farming and allied industries, derived from plant and animal sources. The living phase of the soil is greatly stimulated by the addition of organic materials in the soil. The augmented microbial population helps in organic matter decomposition, N fixation, P solubilizaton and increases the availability of plant nutrients (Allison, 1973). Addition of organic manures increased the status of organic carbon and available N, P and K status of soil (Srivastava, 1985 and More, 1994). Organic manure serves slow release source of N, P and S for plant nutrition and microbial growth. It possess considerable water holding capacity acts as buffer against changes in pH of the soil and cements clay and silt particles together contributing to crumb structure of the soils. It also binds micronutrient metal ion in soil that otherwise might be leached out (Rammohan *et al.*, 2002).

Cassava responds to both bulky and concentrated organic manure (Thampan, 1979). Traditionally cassava is fertilized only with organic manures such as FYM and wood ash and even today this is followed by subsistence farmers. This may be of particular importance in sandy soils to improve water and nutrient holding capacity (Mohankumar *et al.,* 2000).

2.1.1. Effect of farmyard manure

Farmyard manure, the most commonly used organic manure is a good source of both macro and micro nutrients. It has both residual effects in plant nutrition.

2.1.1.1. Growth characters

Application of FYM @ 12.5 t ha^{-1} to cassava gave better response in terms of growth characters (Asokan and Sreedharan, 1977).

Increasing rates of FYM increased plant height but had inconsistent effect on the number of main stem per hill in potato (Wildjajanto and Widodo, 1982).

Sahota (1983) found that FYM application increased plant height and number of leaves per plant in potato.

Application of FYM @ 12.5 t ha^{-1} to cassava gave better response in terms of growth characters (KAU, 1996). In a study conducted by Veenavidyadharan (2000) in arrow root revealed that plant height, number of leaves per plant, sucker number per hill and dry matter production were increased by the highest level of FYM tried (20 t ha^{-1}). Farm yard manure produced significantly higher number of leaves, plant height in cassava reported by Pamila (2003).

FYM was found to be the best organic manure for the highest dry matter production irrespective of growth stages of coleus (Archana, 2001).

Suja *et al.* (2009) reported that application of FYM @12.5 t ha^{-1} along with wood ash @3 t ha^{-1} favoured plant height and leaf production in tannia.

The organic manure (FYM) had no significant effect in modifying the vine production in sweet potato (CTCRI, 2010).

2.1.1.2. Yield components and yield

Application of FYM @ 20 t ha^{-1} produced significantly superior tuber yield in *Dioscorea alata* (CTCRI, 1973). But Mohankumar and Nair (1979) suggested that yield increase obtained by the application of FYM @ 20 t ha^{-1} over lower doses (10-15 t ha^{-1}) was not sufficient to compensate the increased cost of FYM and hence 10 t ha^{-1} of FYM is recommended for *Dioscorea alata* to obtain economic returns.

Saraswat and Chettiar (1976) recorded a yield of 32 t ha^{-1} when 66.6% of N requirement was met by FYM application. Studies conducted at CTCRI and KAU revealed that basal application of FYM @ 12.5 t ha^{-1}enhanced the yield of cassava (Mohankumar *et al.*, 1976; Ashokan and Sreedharan, 1977; Pillai *et al.*, 1987 and Ravindran and Balanambiasm, 1987). Cassava yield was increased over control by 11.8% when FYM was applied (Gaur *et al.*, 1984). KAU (2002) also recommends 12.5 t $ha^{-1}$of FYM for cassava.

Experiments conducted in Karnataka to find out the effect of sweet potato to FYM showed 30.6% increase over control (Gaur *et al.*, 1984). Studies conducted at CTCRI revealed that basal application of 5 t ha^{-1} FYM to sweet potato was beneficial in enhancing the yield (Pillai *et al.*, 1987 and Ravindran and Balanambisan, 1987). The presence of FYM enhanced tuber yield both under lowland and upland situations indicating that FYM is essential for higher tuber production in sweet potato (Ravindran and Balanambisan, 1987).

Application of FYM alone resulted in higher yields in elephant foot yam (Patel and Mehta, 1987).

Maheswarappa *et al.* (1997) found that application of FYM resulted in significantly higher harvest index and length of rhizomes in arrow root. Veenavidyadharan (2000) also reported the profound influence of FYM on the number of rhizomes per plant and yield of arrowroot.

Farmyard manure as the source of organic manure for coleus had positive influence on yield components like number and weight of tubers and weight of marketable tubers per plant, as observed by Archana (2001).

Low nutrient content and slow mineralisation of FYM affects plant uptake during critical stages (Nedunchezhiyan and Srinivasulu Reddy, 2002). The manuring in the conventional practice resulted in the production of more number of tubers per plant (3.18/2.25) as compared to organic practice with FYM (2.65/1.59) in sweet potato (CTCRI, 2010). The conventional practice of manuring resulted in the higher tuber yield (438/389 g) as compared to the organic practice (305/259 g).

Nedunchezhiyan *et al.* (2010) concluded that among organic production types, root yield of sweet potato in FYM based organic production was lower. Organic manuring practice was helpful in increasing the dry matter and total carbohydrate contents of sweet potato tuber than conventional practice (CTCRI , 2010).

2.1.1.3. Quality characters

Kurien *et al.* (1976) found that application of cow dung alone to cassava resulted in an increase in bitterness and cyanogens content of tubers. But a mixture of cow dung and ash tended to reduce cyanogens. Application of FYM @ 12.5 t ha^{-1} enhanced the quality of tubers as reported by Mohankumar *et al.* (1976) and Pillai *et al.* (1987).

CTCRI (2010) suggested that the application of organic manures viz., vermicompost and coir pith compost instead of FYM produced tubers with low cyanogenic glucoside contents and comparatively higher starch contents in cassava. There was no marked difference in the cyanogenic glucoside content of tubers due to application of FYM and green manuring *in situ* with cowpea. CTCRI (2010) reported that application of organic manures viz., green manuring *in situ* with cowpea (23.87 t ha^{-1}), vermicompost (30.32 t ha^{-1}) and coir pith compost (27.16 t ha^{-1}) produced yield on par with FYM (31.02 t ha^{-1}) indicating the possibility of substituting FYM with these organic manures. CTCRI (2010) reported that application of organic manures alone (T7), half the recommended dose of chemical fertilizers along with organic manures (T6) produced significantly lower yields (22.34 and 21.40 t ha^{-1} respectively). However, absolute control resulted in the lowest yield of 13.98 t ha^{-1}.

Ravindran and Balanambisan (1987) observed that quality of tubers in sweet potato was not much affected by different doses of FYM.

Nedunchezhiyan *et al.* (2010) found that dry matter, β-carotene and starch content in roots were higher in 100% N through any one of the sources than 50% N through any one of the sources + biofertilizers application in sweet potato. Root dry matter content was higher in FYM based organic production. They also reported that starch content in roots was higher in FYM based organic production than other systems.

2.1.2. Effect of coir pith compost

Coir pith is abundantly available in Kerala as byproduct of coir industry. It is light fluffy refuse obtained during the separation of coir fiber from coconut husk. This can be used as an organic manure after narrowing down its C: N ratio with *Pleurotus* sp. The literature available on the effect of coir pith on tuber crops is meagre and hence other upland crops are also reviewed here.

Coir pith compost (CPC) has beneficial effects as manure in increasing the yield of crops like turmeric (Selvakumari *et al.*, 1991). But Maheswarappa *et al.*, (1997) observed that application of CPC produced lower values of growth characters, yield and yield components, quality parameters and nutrient uptake by arrow root. Similar effect of CPC was also observed by Archana (2001) in coleus. However, Suja (2001) found that tuber quality of white yam in terms of starch and crude protein contents were improved by CPC application.

Suharban *et al.* (1997) reported that in a pot culture experiment with bhindi, maximum yield was recorded by the treatment CPC alone followed by the treatment with half the recommended dose of N as FYM and half as fertilizer. But Arunkumar (2000) reported that amaranthus performed inferior with respect to growth characters like number of leaves and number of branches when CPC was used as organic manure but DMP was superior.

Yield of sesamum could be increased by 63% with the application of CPC over farmer's practice (Venkatakrishnan and Ravichandran, 1996).

2.1.3. Effect of poultry manure

Poultry manure is a bulky organic manure which is commonly used by farmers especially in lowlands. Singh *et al.* (1973) attributed the higher efficiency of PM to its narrow C: N ratio and comparatively higher content of mineralizable N. In this manure, 60% of N is present as uric acid, 30% as more stable organic N forms and balance as mineral N (Srivastava, 1988). When entire quantity of PM is applied as basal, more than 60% of its N present as acid rapidly changes to ammoniacal form.

A study on optimum level of poultry manure requirement for cauliflower by Singh *et al.* (1970) revealed progressive increase in growth and yield of cauliflower when the dose was increased from 0 to 169.6 q ha^{-1}.

Singh *et al.* (1973) reported that PM application exhibited better response, than FYM, in yield and growth attributes of potato.

Ayoola *et al.* (2006) suggested that cassava yields were statistically the same under NPK alone and NPK + poultry manure but significantly higher than poultry manure alone.

Amanullah *et al.* (2006) reported that among the manures, composted poultry manure either alone or with FYM had the highest tuber yield. Six organic manurial treatments viz., FYM (25 t ha^{-1}), Poultry manure (10 t ha^{-1}), composted poultry manure (10 t ha^{-1}), FYM (12.5 t ha^{-1}) + poultry manure (5 t ha^{-1}), FYM (12.5 t ha^{-1}) + composted poultry manure (5 t ha^{-1}) along with control (no organic manure) were used.

2.1.4. Comparison of different organic manures

Higher efficiency of FYM in producing higher yield of cassava compared to castor oilcake and urea was revealed by Gomes *et al.* (1983). But Ayyaswami *et al.* (1996) observed significant increase in tuber yield due to incorporation of coir waste @ 10 t ha^{-1} compared to FYM @12.5 t ha^{-1} and coir waste @ 5 t ha^{-1}. The positive effect of coir waste on yield might be due to its water holding capacity and better nutrient uptake by the crop.

Field experiments undertaken at CTCRI (CTCRI, 1998b) to study the possibility of substituting FYM in cassava production with recently available organic manures like pressmud and CPC indicated that there was no conspicuous yield variation among the various organic manures suggesting the suitability of pressmud or CPC as alternative to FYM for cassava depending upon availability.

Three organic manurial treatments *viz.*, FYM (25 t ha^{-1}), poultry manure (10 t ha^{-1}) and composted poultry manure (10 t ha^{-1}) were used for the experiment. Among the organic manures, composted poultry manure registered higher dry matter at all the stages of crop growth in cassava (Amanullah *et al.*, 2006). Ayoola (2006) suggested that cassava yields were statistically the same under NPK alone and NPK + poultry manure but significantly higher than both poultry manure alone.

According to Maheswarappa *et al.* (1997), application FYM and vermicompost recorded significantly higher yield of arrowroot compared to CPC application. In general, CPC was found inferior to other organic manures in its effects on growth, yield and quality of arrowroot. Similar results were also reported by Archana (2001) in coleus. The highest tuber yield was produced by FYM and the lowest by CPC. Net income and BCR were maximum when FYM was used as the organic manure. CPC recorded the lowest net income.

Growth response of white yam to various organic manures (Suja, 2001) indicated that application of CPC favoured crop growth condition by producing longer plants and retaining more number of leaves. Higher dry matter accumulation in leaves, vines, tubers and thereby in the whole plant were obtained due to CPC application. Maximum LAI was also obtained in the plot that received CPC. FYM and CPC had similar effects in promoting bulking rate, weight, length and girth of tubers of white yam. There was no conspicuous variation in tuber yield among FYM and CPC which implies the suitability of CPC as alternative to FYM.

Yield response of cassava to various organic manures indicated that application of PM treated plants produced more number of tuber and weight of tuber was reported by Pamila (2003). The highest tuber yield was produced by PM but it on par with FYM.

Nedunchezhian *et al.* (2003) reported that better quality characters were associated with 100% N supplied through any of the organic manure such as FYM, PM and pig manure. This showed that increasing the level of organic manures as a source of N increased quality characters of sweet potato tubers. The tuber quality was found to be reduced due to 100% N supplied through fertilizer N.

Agbede and Adekiya (2006) reported that yields given by 5, 10 and 15 t/ha poultry manure were not significantly different under both manually cleared and conventionally tilled treatments. Conventional tillage plus 5 t/ha poultry manure (CT+5 PM) produced the highest overall yield. Therefore the use of 5 t/ha poultry manure with conventional tillage is recommended for sweet potato production on an Alfisol of southwest Nigeria.

FYM + ash resulted in significantly greater biomass accumulation in cormels and mother corm leading to greater total plant biomass (Suja *et al.*, 2009). It also favoured the yield attributes and resulted in significantly higher number of cormels, cormel yield and mother corm yield (Suja *et al.*, 2009).

Incorporation of 20 t ha^{-1} of FYM into soil one day prior to transplanting gave the highest fruit yield of tomato (19 t ha^{-1}) followed by 20 t ha^{-1} of coir pith (16 t $ha^{-1)}$ and the lowest in the control plot (11.5 t ha^{-1}) which were treated with neither FYM nor coir pith (Ahmed, 1993).

Anitha (1997) reported that in chilli, various attributes like plant height, number of branches and DMP were better with PM application as compared to FYM and vermicompost application. Joseph (1998) observed that growth characters and yield attributing characters of snake gourd were higher in FYM treated plants as compared to PM or vermicompost treated plants. But PM treated plants recorded the highest crude protein content and the lowest fiber content.

Among the different organic manures like vermicompost, neem cake, CPC, FYM and PM tried in amaranthus, FYM and vermicompost performed better in terms of plant height, number of leaves, number of branches and leaf area index (Arunkumar, 2000). Higher yield were obtained from 100, 125 and 150 per cent leaves of FYM, vermicompost, PM and neem cake. CPC treatment recorded maximum fiber content but protein and moisture contents were superior.

2.1.5 Effect of bioinoculant on growth, yield and seed quality parameters

Sattar and Gaur (1987) reported that P-solubilizers improved the plant growth and development by the production of plant growth hormones like indole acetic acid (IAA), gibberellic acid (GA) and cytokinins.

Jeeva (1987) reported that total soluble solids (TSS), total sugar and sugar to acid ratios were greatly and positively influenced by the inoculation of *Azospirillum* to banana crop over uninoculated control.

Black gram seeds treated with biofertilizers (*Rhizobium*+ phosphobacteria 2% each) recorded the highest plant height (20.4cm), number of seed per pod (5.56), seed yield (3.24 q/ha), 100 seed weight (3.91g), germination percentage (87.5), seedling length (33.7cm), and vigour index (2944) over control (Ahamed, 1999).

Shashidhara (2000) noticed that *Azospirillum* + phosphobacteria recorded higher 1000-seed weight (5.93 g) which was significantly superior over 50 per cent RDF (5.40 g) in chilli.

The highest and significantly higher number of pods/plant and average fruit weight over control was noticed in bhindi, which was inoculated with *Azospirillum* and supplied with 75% of the recommended N (Bahadur and Manohar, 2001).

In recent years biofertilizers *viz. Azospirillum, Acetobacter* and phosphorous solubilizing bacteria, have given good responses in many crops. As a cost effective supplement to chemical fertilizers and renewable energy source, biofertilizers can help to economize on the high investment needed for fertilizers use as far as N and P are considered (Pandey and Kumar, 2002).

Vasanthakumar (2003) reported that combined inoculation of *Azospirillum* (AZUS10) and PSB isolate (PSB7) produced synergistic effect, resulting in increased root length, shoot length, stem girth, number of leaves and number of branches in solanaceous crop plants.

Chandrashekar (2003) observed that the plant growth parameters *viz.,* shoot and root length and number of leaves per plant in green gram plants at 45 DAS were significantly increased due to inoculation of P-solubilizing fungal strains along with rock phosphate application as compared to rock phosphate alone (control). Meena *et al.* (2003) reported that inoculation with PSB significantly increased the grain yield, straw yield and harvest index in chick pea. Tanwar *et al.* (2003) observed that PSB significantly improved yield, N, P content and uptake in both seed and straw in black gram. Application of 50% recommended dose of P as superphosphate along with PSB and VAM recorded the highest yield during the first year in soybean and during both the years in wheat.

Devi krishna (2005) reported that in cowpea, growth characters including height of plant, number and weight of effective nodules, bhusa yield and total dry matter production recorded the highest values with vermicompost and phosphorous solubilizing microbes application.

Satesh Kumar and Sharma (2006) studied the effect of different methods of biofertilzer application in tomato seed production. They used four biofertilzers, namely *Azotobacter*, *Azospirillum*, *Pseudomonas* and vesicular arbuscular mycorrhiza (VAM). Application of these biofertilizers was done with three methods i.e., nursery soil treatment, seedling treatment and field soil treatment, individually and in combinations. The study revealed that *Azotobacter* when applied to nursery, seedling and field soil resulted in maximum values of number of fruits per plant (19.23), fruit yield per plant (1109 g) and per hectare (356.9 q), 1000 seed weight (3.63 g), seed yield per plant (4.58 g) and per hectare (152.70 kg) and cost benefit ratio (1:1.45).

Nair *et al.* (2001) found that inoculation of the biofertilizer (*Azospirillum*) had a depressing effect on the growth of sweet potato. But Saikia and Borah (2007) reported that application of *Azospirillum* had significantly influenced the growth and yield of sweet potato. Application of 2/3rd recommended dose of nitrogen + 2 kg ha^{-1} of the biofertilizer as vine dipping + 10 kg ha^{-1} of the biofertilizer as soil application produced significantly higher leaf area index of

4.71 and 4.67 respectively during two consecutive years. Number of tubers and yield of marketable tubers were significantly improved by this treatment.

The conjoint use of organic manures along with biofertilizer (Azospirilltum) and inorganic fertilizers exerted a significant influence on growth, dry matter production and tuber yield of cassava as reported by Ramanandam (2008).

Materials and methods

3. MATERIALS AND METHODS

A field investigation was carried out College of Agriculture, Vellayani to develop an organic production package involving different sources and levels of organic manures and bioinoculant from August 2010 to November 2010. The details of the materials used and the methods adopted are presented in this chapter.

3.1 MATERIALS

3.1.1 Experimental site

The investigation was conducted at the Instructional Farm attached to the College of Agriculture, Vellayani situated at 8.5 ^{0} North latitude and 76.9^0 East longitude and at an altitude of 29 m above mean sea level.

3.1.2 Soil

The soil of the experimental site was sandy clay loam belonging to the order oxisol of Vellayani series. The important physico-chemical properties of the soil and the methods adopted for analysis are presented in Table 1.

3.1.3 Cropping history of the field

The experimental area was kept fallow for more than 8 months before raising the crop.

3.1.4 Season

The experiment was conducted during August 2010 to November 2010. The crop was planted on 20th August and harvested on 23rd November.

Table 1. Physico-chemical properties of the soil at the experimental site

Sl. No	Parameter Content	Content	Methods adopted
A.	Chemical composition		
1.	P^H	5.69	P^H meter with glass electrode (Jackson,1973)
2.	Available N (kg ha^{-1})	320.49	Alkaline potassium permanganate method (Subbiah andAsija,1956)
3.	Available P (kg ha^{-1})	13.50	Bray colorimeter method (Jackson ,1973)
4.	Available K (kg ha^{-1})	112.00	Neutral normal ammonium acetate method(Jackson,1973)
B.	Mechanical composition		
1.	Coarse sand	49.15 %	International pipette method (Piper, 1966)
2.	Fine sand	14. 4 %	
3.	Silt	6.25 %	
4.	Clay	27.5 %	
	Texture	Sandy clay loam	

3.1.5 Weather conditions

The weekly averages of the weather parameters *viz.* maximum and minimum temperature, relative humidity and rainfall received during the cropping period collected from the meteorological observatory at College of Agriculture, Vellayani are given in Appendix 1 and illustrated in Fig.1.

3.1.6 Planting material

Sweet potato variety Sree Kanaka released from Central Tuber Crops Research Institute (CTCRI), Sreekariyam, Thiruvananthapuram was the crop used for the experiment. Sree Kanaka is orange fleshed variety and it is a short duration hybrid rich in carotene (8.8-9 mg/g fresh weight). The plants possess thick vines with dark purple coloured leaves. The tubers are cylindrical in shape and it yields 10 - 15 t ha^{-1}.

3.1.7 Manures and Fertilizers

Organic manures used in the experiment were Farmyard manure (FYM) containing 0.5 % N, 0.3 % P, 0.5 % K, poultry manure(PM) containing 1 % N, 1.5 % P, 0.8% K and coir pith compost(CPC) containing 1 % N, 0.06 % P, 1.2 % K.

3.2 METHODS

3.2.1 Details of treatments

The treatments consisted of three sources of organic manure and two levels of nutrients with and without bioinoculant.

i. Organic manure (M)

(To supply NPK @ 75:50:75 Kg/ha)

M_1 - Farmyard manure

M_2 - Poultry manure

M_3 - Coir pith compost

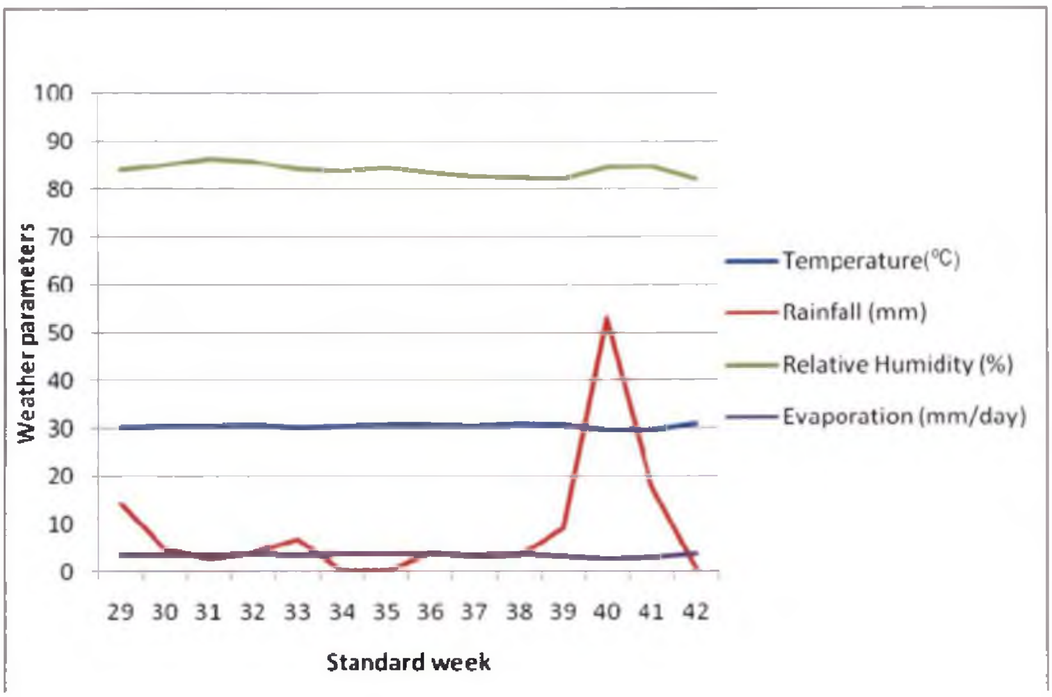

Fig. 1. Weather parameters during the crop growth period

ii. Levels of nutrients (L)

L_1 - 100% of the recommendation

L_2 - 75% of the recommendation

iii. Bioinoculant (B)- Consortium developed at microbiology department, College of Agriculture, Vellayani.

B_1 - with bioinoculant

B_2 - without bioinoculant

Treatment combination

T_1 - $M_1L_1B_1$	**T_5 - $M_2L_1B_1$**	**T_9 - $M_3L_1B_1$**
T_2 - $M_1L_1B_2$	**T_6 - $M_2L_1B_2$**	**T_{10} – $M_3L_1B_2$**
T_3 - $M_1L_2B_1$	**T_7 - $M_2L_2B_1$**	**T_{11} – $M_3L_2B_1$**
T_4 - $M_1L_2B_2$	**T_8 - $M_2L_2B_2$**	**T_{12} – $M_3L_2B_2$**

3.2.2 Experimental design and layout

The experiment was laid out as a 3 x 2 x 2 asymmetrical factorial design. The lay out of the experiment is presented in Fig. 2

The details of the layout are given below:

Design	: Factorial RBD
Treatments	: 12
Replication	: 3
Total number of plots	: 36
Number of blocks per replication	: 3
Number of plots per block	: 4
Plot Size	: 3.6 m X 3.6 m
Variety	: Sree Kanaka
Spacing	: 60 cm x 20 cm

Plate 1 General view of experimental area

Fig.2. Lay out Plan of the Experiment

→ N

R 1			R 2			R 3		
$M_2L_1B_1$	$M_1L_1B_2$	$M_1L_2B_2$	$M_3L_1B_2$	$M_2L_1B_1$	$M_1L_2B_2$	$M_1L_1B_2$	$M_3L_1B_1$	$M_2L_1B_2$
$M_1L_2B_1$	$M_3L_1B_2$	$M_3L_2B_1$	$M_1L_1B_2$	$M_2L_2B_1$	$M_3L_2B_2$	$M_1L_2B_1$	$M_1L_1B_1$	$M_3L_2B_1$
$M_2L_2B_2$	$M_2L_2B_1$	$M_1L_1B_1$	$M_2L_2B_2$	$M_2L_1B_2$	$M_1L_1B_1$	$M_3L_1B_2$	$M_2L_1B_1$	$M_1L_2B_2$
$M_3L_2B_2$	$M_3L_1B_1$	$M_2L_1B_2$	$M_3L_1B_1$	$M_1L_2B_1$	$M_3L_2B_1$	$M_2L_2B_2$	$M_2L_2B_1$	$M_3L_2B_2$

3.2.3 Details of cultivation

3.2.3.1 Land preparation

The experimental area was cleared, dug well, stubbles were removed and clods were broken. The field was laid out as per the design and individual plots were dug well and levelled. In the plots of 3.6 m x 3.6 m size, ridges were taken at 60 cm x 20 cm spacing for planting vines. Manures such as FYM, PM, CPC wear applied to the plots in appropriate quantities as per the treatment schedule and well incorporated with soil.

3.2.3.2 Application of manures

The quantities of organic manures like FYM, PM and CPC were calculated on nitrogen equivalent basis in order to supply POP recommendation of NPK @ 75:50:75 Kg/ha and 10 t/ha of FYM were applied to plots as basal dose.

Table 2. Quantity of organic manures and consortium applied per plot

Treatment	Quantity of organic manure (kg per plot)	Quantity of consortium (g per plot)
$T_1 - M_1L_1B_1$	FYM – 10.8	108
$T_2 - M_1L_1B_2$	FYM – 10.8	---
$T_3 - M_1L_2B_1$	FYM – 8.1	81
$T_4 - M_1L_2B_2$	FYM – 8.1	---
$T_5 - M_2L_1B_1$	PM - 5.4	54
$T_6 - M_2L_1B_2$	PM - 5.4	---
$T_7 - M_2L_2B_1$	PM - 4.05	40.5
$T_8 - M_2L_2B_2$	PM - 4.05	---
$T_9 - M_3L_1B_1$	CPC – 5.4	54
$T_{10} - M_3L_1B_2$	CPC – 5.4	---
$T_{11} - M_3L_2B_1$	CPC – 4.05	40.5
$T_{12} - M_3L_2B_2$	CPC – 4.05	---

3.2.3.3 Biofertilizer application

The microbial consortium received from the department of Microbiology, College of Agriculture, Vellayani was used for the experiment. It is the combination of different biofertilisers like *Azospirillum, Azetobacter* and Phosphorus solubilizing bacteria. The consortium was applied to the plots as per treatment after mixing with respective organic manures at the rate of 1 %.

3.2.3.4 Planting

Vines cutting of 20 - 25 cm length were planted on the top of ridges taken at a spacing of 60 x20 cm. Planted the vine cuttings with the middle portion buried deep in the soil and the two cut ends exposed to the surface.

A plot was maintained by applying required quantity of nutrients as farmyard manure for the ancillary study for understanding the tuber initiation and tuber development.

3.2.3.5 After cultivation

Dried and un sprouted vines were removed and gap filling with vines was done one week after planting. Weeding and earthing up was done 30 and 45 DAP. Plant protection measures such as application of *Eupatorium odoratum* leaves as mulch at the time of planting and 30 DAP and application of 2 % neem oil garlic emulsion were adopted to control sweet potato weevil.

3.2.3.6 Harvest

The crop was ready for harvest 85 days after planting. Harvesting was done by digging out the tubers carefully and the tubers were separated from the shoot portion. The border rows and observational plants were harvested separately from each plot.

Land Preparation **Planting**

Intercultural Operation

Plate 2 Land Preparation, Planting and Intercultural Operation

3.3 OBSERVATIONS

Single line of plants all round in each plot was left out as border row. Four plants were randomly selected from the net plot and tagged as observational plants.

3.3.1 Growth characters

Growth characters were recorded from the four observational plants at 30 days intervals from planting upto harvest and the average worked out.

3.3.1.1 Length of the vine

Length of the vine was measured from the base of the plant to the tip of the growing point and expressed in cm.

3.3.1.2 Number of branches per plant

Number of branches per plant were counted and the average value recorded.

3.3.1.3 Number of leaves per plant

Number of functional leaves at the time of observation were counted and the average value recorded.

3.3.1.4 Leaf area index (LAI)

Leaf area index was calculated by adopting disc method. Leaves from the two uprooted plants were separated and punched. The discs as well as the leaves were dried in hot air oven at 70^0C and their respective dry weights were recorded. From the data, leaf area per plant was computed and LAI was worked out using the following formula (Watson, 1952).

$$\text{LAI} = \frac{\text{Leaf area}}{\text{Land area}}$$

3.3.2 Yield

3.3.2.1 Number of tubers per plant

Total number of tubers from the observational plants were counted and their average worked out.

3.3.2.2 Tuber weight per plant

Weight of tubers from the observational plants were recorded and average was worked out.

3.3.2.3 Length and girth of tuber

Length of the tuber from observation plants were measured from the base to the tip of the tuber and expressed in cm. Tuber girth was measured by encircling a twine around the middle portion of the tuber and the twine length was measured using a scale and expressed in centimeters.

3.3.2.4 Tuber yield

Yield of tubers obtained from net plot was recorded and expressed in t ha^{-1}.

3.3.3 Physiological parameters

3.3.3.1 Dry matter production

Dry matter production was recorded at harvest stage of the crop. The sample plants uprooted prior to general harvest were used for computing dry matter production. These plants were separated out into stem, leaves, tuber rind and flesh. Fresh weights of each part were recorded and sub-samples were taken for estimating the dry weight. The sub-samples were dried in an oven at $70^{o}C \pm 5\ ^{o}C$ to constant dry weight. Then the dry weight of each part as well as the dry matter production at harvest were computed in kg ha^{-1}

3.3.3.2 Utilization index

It is the ratio of the tuber yield to top yield on fresh weight basis. This was worked out from the tuber weight and top weight of the observational plants and average recorded.

3.3.4 Chemical analysis

Sample plants collected from each plot at harvest were chopped, sun dried and oven dried to a constant weight. Samples were ground to pass through a 0.5 mm mesh in a Willey Mill and the required quantity of samples were digested and used for nutrient content analysis.

3.3.4.1 Uptake of Nitrogen

The nitrogen content in plant samples was estimated by the modified microkjeldhal method (Jackson, 1973) and the uptake of nitrogen was calculated by multiplying the nitrogen content of plant sample with the total dry weight of plants. The uptake values were expressed in kg ha^{-1}.

3.3.4.2 Uptake of Phosphorus

The phosphorus content in plant samples was colorimetrically determined by wet digestion of the sample, developing colour by ascorbic acid method and read in a Spectrophotometer (Bray and Kurtz 1964). The uptake of phosphorus was calculated by multiplying the phosphorus content of plant sample with the total dry weight of plants. The uptake values were expressed in kg ha^{-1}.

3.3.4.3 Uptake of Potassium

The potassium content in plant sample was determined by flame photometer method and the uptake of potassium was calculated by multiplying the potassium content of plant sample with the total dry weight of plants. The uptake values were expressed in kg ha^{-1}.

3.3.5 Quality assessment

3.3.5.1 Starch

Starch content of the flesh of tuber was estimated by using potassium ferricyanide method (Ward and Pigman, 1970). The values were expressed as % on fresh weight basis.

3.3.5.2 Total sugar

Sugar content of the flesh of tuber was estimated by using potassium ferricyanide method (Aminoff *et al.,* 1970). The values were expressed as % on fresh weight basis.

3.3.5.3 Organoleptic test (Score)

Organoleptic test was conducted to rate the appearance, colour and taste of the cooked tuber. A panel of 5 members tested the organoleptic qualities and expressed their opinion in a score card.

3.3.6 Soil Analysis

Soil samples were taken from the experimental area before and after the experiment. The composite samples from the experimental area before the experiment was analysed for mechanical composition and chemical properties. After the experiment, composite samples were collected from each plot, air dried, powdered and passed through a 2 mm sieve and analysed for available N, P and K using the standard procedures. The air dried samples were analysed for available nitrogen by the alkaline potassium permanganate method (Subbiah and Asija, 1956), available phosphorus by Bray's colorimeter method and available potassium by ammonium acetate method (Jackson, 1973).

3.3.7 Incidence of Pests and Diseases

The incidence of the important pests and the diseases through out the crop period was monitored. The severity of incidence of sweet potato weevil was scored using an index scale.

Incidence of pests and diseases.

0	No incidence
Below 50%	Mild incidence
Above 50%	Severe incidence

3.3.8 Economics of cultivation

Economic analysis considering the high market price of organic produce was attempted. The income from sweet potato was calculated to find out the benefit cost ratio as per the formulae given below.

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

3.3.9 Ancillary study on tuber initiation

From the plot maintained for tuberization study, three plants were uprooted on alternate days upto tuber initiation and thereafter at weekly intervals upto harvest for taking observations on number of roots, number of tuberous roots, length and girth of tuberous roots and weight of tuberous roots.

Results

4. RESULTS

A field investigation was conducted at the Instructional farm, College of Agriculture, Vellayani from August 2010 to November 2010 to develop production technology for organic sweet potato and to work out the economics of cultivation. The study was laid out in asymmetrical factorial with 12 treatments and three replications. The experimental data was statistically analysed and the results are presented in this chapter.

4.1 GROWTH CHARACTERS

4.1.1 Length of vine

The data on the effect of organic manures, its different levels and bioinoculant on vine length at different stages of growth are presented in Table 3.

The length of vine of sweet potato went on increasing with increase in the age of the plants upto harvest.

Different organic manures did not exert any significant difference on vine length. However PM treated plants produced the longest vines at 40 DAP. But at all other stages of growth, vine length was maximum for FYM.

Levels of organic manures showed no significant influence on length of vine. But at all stages of growth L_1 (100 % recommendation of nutrient as organic manure) produced the highest length of vine than L_2 (75% recommendation).

There was no significant difference in vine length with bio inoculant (B_1) and without bioinoculant (B_2) at different growth stages. However B_1 recorded maximum vine length at 40 and 60 DAP while B_2 recorded highest value at 80 DAP.

The interactions among the various factors were not significant at any stage of growth.

4.1.2 Number of branches

The data on the effect of organic manures, its different levels and bioinoculant on total branches at different stages of growth are presented in Table 4.

Different organic manures did not have any significant difference on number of branches. However, PM produced the highest number of branches at harvest.

Levels of organic manures and bioinoculant also showed no significant influence on number of branches.

The interactions among the various factors were also not significant at any stage of growth.

4.1.3 Total number of leaves

The data on the effect of organic manures, its different levels and bioinoculant on total number of leaves at different stages of growth are presented in Table 5a and 5b.

The number of leaves increased with increasing age of the plants and the highest value recorded at harvest stage for all the treatments.

The organic manures did not show any significant difference in total number of leaves at all growth stages. However PM treated plots (M_2) recorded the highest number of leaves at harvest stage.

The levels of organic manures did not show any significant difference in total number of leaves at all growth stages.

Bioinoculant also showed no significant difference in total number of leaves at all growth stages.

The interaction between organic manures and its different levels were significant only at 60 DAP. The interaction M_3L_2 was significantly superior to all other interaction treatments of organic manures and its levels, recording the highest value of 88.88 this was followed by M_2L_2 (PM with 100 %

Table 4. Effect of organic manures, its different levels and bioinoculant on number of branches

Treatments	40 DAP	60 DAP	Harvest
Organic manures (M)			
M_1 (FYM)	4.23	5.75	7.58
M_2 (PM)	4.21	5.46	7.71
M_3 (CPC)	4.04	5.67	6.50
F	0.49	0.27	2.92
SE±	0.15	0.29	0.39
CD(0.05)	NS	NS	NS
Levels (L)			
L_1 (100 %)	4.07	5.57	7.24
L_2 (75 %)	4.25	5.68	7.29
F	1.13	0.11	0.02
SE±	0.12	0.23	0.32
CD(0.05)	NS	NS	NS
Bioinoculant (B)			
B_1 (with bioinoculant)	4.15	5.61	7.29
B_2 (with out bioinoculant)	4.17	5.64	7.24
F	0.01	0.01	0.02
SE±	0.12	0.23	0.32
CD(0.05)	NS	NS	NS

NS – Non significant

Table 5a. Effect of organic manures its different levels and bioinoculant on total number of leaves

Treatments	40 DAP	60 DAP	Harvest
Organic manures (M)			
M_1 (FYM)	51.63	68.44	77.90
M_2 (PM)	51.27	66.23	83.38
M_3 (CPC)	48.04	72.13	70.92
F	1.30	3.18	1.07
SE±	1.73	1.67	6.03
CD(0.05)	NS	NS	NS
Levels (L)			
L_1 (100 %)	49.43	67.58	75.60
L_2 (75 %)	51.19	70.28	79.19
F	0.78	1.95	0.27
SE±	1.42	1.36	4.93
CD(0.05)	NS	NS	NS
Bioinoculant (B)			
B_1 (with bioinoculant)	51.46	68.65	77.26
B_2 (with out bioinoculant)	49.17	69.21	77.53
F	1.31	0.08	0.00
SE±	1.42	1.36	4.93
CD(0.05)	NS	NS	NS

NS – Non significant

Table 5b. Interaction effect of organic manures its different levels and bioinoculant on total number of leaves

Treatments	40 DAP	60 DAP	Harvest
$M_1 L_1$	52.00	68.38	76.71
$M_1 L_2$	51.25	68.50	79.08
$M_2 L_1$	51.88	79.00	87.50
$M_2 L_2$	50.67	53.46	79.25
$M_3 L_1$	44.42	55.38	62.58
$M_3 L_2$	51.67	88.88	79.25
F	1.88	78.50 **	1.07
SE±	2.45	2.36	8.53
CD(0.05)	NS	6.9300	NS
$M_1 B_1$	53.33	66.58	74.21
$M_1 B_2$	49.92	70.29	81.58
$M_2 B_1$	51.75	61.83	78.50
$M_2 B_2$	50.79	70.63	88.25
$M_3 B_1$	49.29	77.54	79.08
$M_3 B_2$	46.79	66.71	62.75
F	0.13	9.29 **	1.43
SE±	2.45	2.36	8.53
CD(0.05)	NS	6.9300	NS
$L_1 B_1$	50. 56	65.58	78.42
$L_1 B_2$	48.31	69.58	72.78
$L_2 B_1$	52.36	71.72	76.11
$L_2 B_2$	50.03	68.83	82.28
F	0.00	3.19	0.72
SE±	2.00	1.93	6.97
CD(0.05)	NS	NS	NS

** – Significant at 1 % level
NS – Non significant

Table 6. Effect of organic manures its different levels and bioinoculant on LAI

Treatments	40 DAP	60 DAP	Harvest
Organic manures (M)			
M_1 (FYM)	1.91	3.30	3.87
M_2 (PM)	1.67	3.26	4.47
M_3 (CPC)	1.79	3.22	3.75
F	0.56	0.11	0.99
SE±	0.16	0.12	17.77
CD(0.05)	NS	NS	NS
Levels (L)			
L_1 (100 %)	2.08	3.41	3.87
L_2 (75 %)	1.50	3.10	4.19
F	9.17 **	4.94 *	0.98
SE±	0.13	0.10	14.51
CD(0.05)	0.3935	0.2841	NS
Bioinoculant (B)			
B_1 (with bioinoculant)	1.56	3.25	4.31
B_2 (without bioinoculant)	2.02	3.26	3.75
F	6.10 *	0.01	1.00
SE±	0.13	0.10	14.51
CD(0.05)	0.3935	NS	NS

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

Table 5b. Interaction effect of organic manures its different levels and bioinoculant on total number of leaves

Treatments	40 DAP	60 DAP	Harvest
$M_1 L_1$	52.00	68.38	76.71
$M_1 L_2$	51.25	68.50	79.08
$M_2 L_1$	51.88	79.00	87.50
$M_2 L_2$	50.67	53.46	79.25
$M_3 L_1$	44.42	55.38	62.58
$M_3 L_2$	51.67	88.88	79.25
F	1.88	78.50 **	1.07
SE±	2.45	2.36	8.53
CD(0.05)	NS	6.9300	NS
$M_1 B_1$	53.33	66.58	74.21
$M_1 B_2$	49.92	70.29	81.58
$M_2 B_1$	51.75	61.83	78.50
$M_2 B_2$	50.79	70.63	88.25
$M_3 B_1$	49.29	77.54	79.08
$M_3 B_2$	46.79	66.71	62.75
F	0.13	9.29 **	1.43
SE±	2.45	2.36	8.53
CD(0.05)	NS	6.9300	NS
$L_1 B_1$	50. 56	65.58	78.42
$L_1 B_2$	48.31	69.58	72.78
$L_2 B_1$	52.36	71.72	76.11
$L_2 B_2$	50.03	68.83	82.28
F	0.00	3.19	0.72
SE±	2.00	1.93	6.97
CD(0.05)	NS	NS	NS

** – Significant at 1 % level
NS – Non significant

recommendation) which was also significantly superior to all other levels. The leaf production was the lowest for M_2L_2 which recorded the value of 53.38 and it was on par with M_3L_1.

The interactions between the organic manures and bioinoculant showed significant influence at 60 DAP. The highest value was recorded by M_3B_1 (CPC with bio inoculant) and it was on par with M_2B_2 (PM without bioinoculant) and superior than other treatments.

The interaction between different levels of organic manures and bioinoculant were not significant.

4.1.4 Leaf Area Index

The data on LAI as influenced by treatments and their interactions at different stages of growth are given in Table 6.

Organic manures did not produce any significant variation in LAI at any stage of growth. But the highest value of LAI was produced by FYM at early stage and PM at harvest.

At early stages of growth, levels of organic manures showed significant influence on LAI. At 40 and 60 DAP, L_1 produced significantly higher LAI than L_2. At harvest, difference in LAI was not significant.

Bioinoculant produced significant variation in LAI of sweet potato at 30 DAP and B_2 (without inoculation) recorded the highest value of 2.02 as against 1.56 for B_1 (with inoculation). After this stage there was no significant difference in LAI due to bio inoculant.

The interaction effect between organic manures, its levels and bioinoculant were not significant.

4.2 YIELD

The data on the effect of treatments on yield components are given in Table 7a and 7b.

Table 6. Effect of organic manures its different levels and bioinoculant on LAI

Treatments	40 DAP	60 DAP	Harvest
Organic manures (M)			
M_1 (FYM)	1.91	3.30	3.87
M_2 (PM)	1.67	3.26	4.47
M_3 (CPC)	1.79	3.22	3.75
F	0.56	0.11	0.99
SE±	0.16	0.12	17.77
CD(0.05)	NS	NS	NS
Levels (L)			
L_1 (100 %)	2.08	3.41	3.87
L_2 (75 %)	1.50	3.10	4.19
F	9.17 **	4.94 *	0.98
SE±	0.13	0.10	14.51
CD(0.05)	0.3935	0.2841	NS
Bioinoculant (B)			
B_1 (with bioinoculant)	1.56	3.25	4.31
B_2 (without bioinoculant)	2.02	3.26	3.75
F	6.10 *	0.01	1.00
SE±	0.13	0.10	14.51
CD(0.05)	0.3935	NS	NS

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

4.2.1 Number of tubers per plant

The data on the effect of organic manures, its different levels and bioinoculant on number of tuber per plant at different stages of growth are presented in Table 7a and 7b.

Number of tubers per plant was significantly varied due to the use of different organic manures. The treatment M_1 (FYM) produced the highest value of 3.00 which was significantly superior to M_2 (2.58) and M_3 (2.37). M_2 (PM) and M_3 (CPC) were on par.

Different levels of organic manures also caused significant variation in number of tubers per plant. The level L_1 (100% recommendation) produced more number of tubers per plant than L_2.

Treatment with bioinoculant was not significant in the number of tubers per plant recording the highest value of 2.77 for without bioinoculant treatment and 2.52 for with bioinoculant treatment.

The interaction effect was significant only between organic manures and bioinoculant. The highest value was recorded by M_1B_2 which was significantly higher than all other treatments and this was on par with M_2B_2, M_3B_1. The lowest value of 1.83 was recorded by M_3B_2 (CPC without inoculation).

Other interaction effects were not significant.

4.2.2 Tuber weight per plant

There was significant variation in weight of tubers per plant due to different sources of organic manure (Table 7a and 7b). The highest tuber weight per plant was recorded by M_1 (201.04 g per plant) followed by M_2 (171 g per plant) and these two treatments were significantly superior to M_3 (131 g per plant).

Weight of tuber was not influenced by levels of organic manure, but L_1 treated plants had more tuber weight than L_2.

Table 7a. Effect of organic manures its different levels and bioinoculant on yield components

Treatments	Number of tubers per plant	Tuber weight per plant. (g/plant)	Length of tuber (cm)	Girth of tuber (cm)
Organic manures (M)				
M_1 (FYM)	3	201.04	13.53	9.79
M_2 (PM)	2.58	171	13.72	10.02
M_3 (CPC)	2.37	131	12.65	9.29
F	4.94*	10.14**	1.41	2.09
SE±	0.14	10.91	0.48	0.26
CD(0.05)	0.419	31.943	NS	NS
Levels (L)				
L_1 (100 %)	2.86	178.03	14.13	10.23
L_2 (75 %)	2.45	157.92	12.46	9.17
F	6.36*	2.55	9.08 **	12.95 **
SE±	0.11	8.90	0.39	0.21
CD(0.05)	0.342	NS	1.150	0.6158
Bioinoculant (B)				
B_1 (with bioinoculant)	2.52	143.62	14.39	10.27
B_2 (without bioinoculant)	2.77	192.34	12.20	9.14
F	2.29	15.02**	15.59 **	14.47 **
SE±	0.11	8.90	0.39	0.21
CD(0.05)	NS	26.082	1.150	0.6158

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

Bioinoculant also caused significant variation in weight of tubers per plant. The treatment B_2 (without inoculation) produced more weight of tubers and it is significantly superior to B_1 (with inoculation).

The interaction effect of different organic manures and its levels were not significant while interaction between organic manures and bioinoculant were significant. The interaction M_1B_2 produced significantly higher tuber weight than other treatments except M_2B_2 which was on par with M_1B_2. The lowest tuber weight of 96.67 g per plant was recorded by M_3B_2 closely followed by M_2B_1 and M_1B_1 which were on par.

The interaction effect of levels of organic manures and bioinoculant were not significant on tuber weight. Tuber weight was more in L_1B_2.

4.2.3 Length of tuber

Table 7a indicated that length of tubers was not influenced by source of organic manure.

Levels of organic manures caused significant variation in length of tuber and 100% recommended dose of organic manures (L_1) showed significantly longer tubers than 75% recommended dose of organic manures (L_2).

Bioinoculant treated plants produced significantly longer tubers than the bio-inoculant untreated plants.

No interaction effects were observed on length of tuber.

4.2.4 Girth of tuber

The results (Table 7a) showed that sources of organic manure did not have any significant difference on tuber girth.

Levels of organic manures caused significantly variation in girth of tuber and plants treated with L_1 produced significantly higher tuber girth than L_2.

Bioinoculant had significant effect on girth of tuber. The treatment B_1 produced significantly bigger tuber than B_2.

Table 7b. Interaction effect of organic manures its different levels and bioinoculant on yield components

Treatments	Number of tubers per plant	Tuber weight per plant. (g/plant)	Length of tuber (cm)	Girth of tuber (cm)
$M_1 L_1$	3.16	198.75	14.98	10.13
$M_1 L_2$	2.83	203.34	12.07	9.45
$M_2 L_1$	2.91	195.75	14.11	10.77
$M_2 L_2$	2.25	146.25	13.32	9.27
$M_3 L_1$	2.5	139.58	13.30	9.81
$M_3 L_2$	2.25	124.16	11.99	8.78
F	0.59	1.57	0.23	0.63
SE±	0.21	15.41	0.68	0.36
CD(0.05)	NS	NS	NS	NS
$M_1 B_1$	2.5	149.58	13.95	10.46
$M_1 B_2$	3.5	252.5	13.11	9.13
$M_2 B_1$	2.16	114.6	15.57	10.53
$M_2 B_2$	3	227.84	11.86	9.51
$M_3 B_1$	2.91	167.08	13.66	9.81
$M_3 B_2$	1.83	96.67	11.63	8.77
F	16.37**	22.51**	2.25	0.12
SE±	0.21	15.41	0.68	0.36
CD(0.05)	0.593	41.173	NS	NS
$L_1 B_1$	2.61	141.12	15.36	11.01
$L_1 B_2$	3.12	214.95	12.90	9.46
$L_2 B_1$	2.45	146.12	13.42	9.52
$L_2 B_2$	2.67	169.73	11.50	8.81
F	2.02	3.98	0.23	1.94
SE±	0.16	12.58	0.55	0.21
CD(0.05)	NS	NS	NS	NS

** – Significant at 1 % level
NS – Non significant

Interaction effects of treatments on tuber girth were absent.

4.2.5 Top yield

Different organic manures did not had any significant difference on top yield per plant (Table 8a and 8b). However, FYM produced the highest top yield than PM and CPC.

Levels of organic manures and bioinoculant also showed no significant influence on top yield per plant.

The interactions among the various factors were also not significant.

4.2.6 Tuber yield

The data on the effect of organic manures, its different levels and bioinoculant on tuber yield are presented in Table 8a and 8b.

Source of organic manure did not have significant difference on tuber yield. The levels of organic manures showed significant variation on tuber yield. The treatment 100 % recommended dose of nutrient as organic manure registered more yield than 75% dose and L_1 was significantly superior to L_2.

There was no significant difference in tuber yield due to application of bioinoculant.

The interaction effect of different organic manures and its levels were not significant. The highest value was recorded by PM applied at full recommended level closely followed by FYM at full recommendation.

The interaction effect of organic manures and bioinoculant (MxB) were also not significant on tuber yield. The combination M_2B_2 recorded the highest tuber yield.

The interaction effect of levels of organic manures and bioinoculant (LxB) were significant on tuber yield. Tuber yield was more in L_1B_2 (12.54 t ha^{-1}) and it was significantly superior than other treatments. But the treatments L_1B_1, L_2B_1 and L_2B_2 were on par.

Table 8a Effect of organic manures its different levels and bioinoculant on top yield and tuber yield of sweet potato.

Treatments	Top yield t ha^{-1}	Tuber yield t ha^{-1}
Organic manures (M)		
M_1 (FYM)	25.70	10.67
M_2 (PM)	24.50	10.51
M_3 (CPC)	19.24	9.78
F	3.32	0.78
SE±	1.89	0.54
CD(0.05)	NS	NS
Levels (L)		
L_1 (100 %)	24.04	11.2
L_2 (75 %)	22.26	9.43
F	0.67	7.93*
SE±	1.54	0.44
CD(0.05)	NS	1.29
Bioinoculant (B)		
B_1 (with bioinoculant)	23.29	10.06
B_2 (without bioinoculant)	23.01	10.57
F	0.02	0.66
SE±	1.54	0.44
CD(0.05)	NS	NS

** – Significant at 1 % level
NS – Non significant

Table 8b Interaction effect of organic manures its different levels and bioinoculant on top yield and tuber yield of sweet potato.

Treatments	Top yield t ha^{-1}	Tuber yield t ha^{-1}
$M_1 L_1$	25.93	11.71
$M_1 L_2$	25.48	9.61
$M_2 L_1$	27.91	12.09
$M_2 L_2$	21.09	8.94
$M_3 L_1$	18.29	9.78
$M_3 L_2$	20.19	9.75
F	1.43	2.14
SE±	2.67	0.76
CD(0.05)	NS	NS
$M_1 B_1$	24.54	10.54
$M_1 B_2$	26.87	10.81
$M_2 B_1$	25.66	9.34
$M_2 B_2$	23.34	11.69
$M_3 B_1$	19.67	10.33
$M_3 B_2$	18.81	9.21
F	0.40	2.6
SE±	2.67	0.76
CD(0.05)	NS	NS
$L_1 B_1$	24.22	9.85
$L_1 B_2$	23.86	12.54
$L_2 B_1$	22.36	10.27
$L_2 B_2$	22.15	8.60
F	0.00	12.07**
SE±	2.18	0.62
CD(0.05)	NS	1.832

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

4.3 PHYSIOLOGICAL PARAMETERS

The data on dry matter production and utilization index are shown in Table 9a and 9b.

4.3.1 Dry matter production

Data on dry matter production presented in Table 9a revealed no significant difference among different organic manures, their levels and bioinoculant.

Among the interaction effects the interaction between the levels of organic manures and bio-inoculants were only significant and the highest value was recorded by L_1B_1 which was significantly superior to all other treatments.

4.3.2 Utilization index

Utilization index was not influenced by source of organic manure (Table 9a).

The different levels of manures varied significantly in their effects on the utilization index. The highest UI was registered by L_1 (100 % recommendation) followed by L_2 (75 % recommendation).

There was significant difference in utilization index between the bioinoculant treatments. The treatment B_2 (without bioinoculant) recorded higher UI of 0.82and for B_1 (with bio inoculant) the value was only 0.62.

The effect of MxB interaction (Table 9b) showed significant influence in utilization index. M_1B_2 recorded higher UI but it was on par with M_2B_2 and significantly superior to M_3B_1, M_3B_2, M_1B_1 and M_2B_1.

No other interaction effects were significant on utilization index.

4.4 UPTAKE OF NUTRIENT

Nutrient uptake in terms of N, P and K uptake (kg ha^{-1}) as affected by treatments are presented in Table 10a and their interaction effects in Table 10b.

Table 9a. Effect of organic manures, its different levels and bioinoculant on physiological parameters

Treatments	Dry matter production kg /ha	Utilization index
Organic manures (M)		
M_1 (FYM)	1851.23	0.80
M_2 (PM)	1861.37	0.74
M_3 (CPC)	1851.68	0.63
F	0.03	1.54
SE±	31.02	0.07
CD(0.05)	NS	NS
Levels (L)		
L_1 (100 %)	1879.74	0.82
L_2 (75 %)	1829.78	0.62
F	1.94	6.53 *
SE±	25.33	0.06
CD(0.05)	NS	0.1655
Bioinoculant (B)		
B_1 (with bioinoculant)	1888.24	0.54
B_2 (without bioinoculant)	1821.28	0.90
F	3.50	20.78 **
SE±	25.33	0.06
CD(0.05)	NS	0.1655

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

Table 9b. Interaction effect of organic manures, its different levels and bioinoculant on physiological parameters

Treatments	Dry matter production kg /ha	Utilization index
$M_1 L_1$	1884.37	0.94
$M_1 L_2$	1818.10	0.66
$M_2 L_1$	1877.93	0.77
$M_2 L_2$	1844.80	0.70
$M_3 L_1$	1876.93	0.76
$M_3 L_2$	1826.43	0.50
F	0.07	0.68
SE±	43.87	0.10
CD(0.05)	NS	NS
$M_1 B_1$	1895.53	0.53
$M_1 B_2$	1806.93	1.07
$M_2 B_1$	1922.03	0.46
$M_2 B_2$	1800.70	1.01
$M_3 B_1$	1847.17	0.63
$M_3 B_2$	1856.20	0.63
F	1.20	5.30 *
SE±	43.87	0.10
CD(0.05)	NS	0.2867
$L_1 B_1$	1951.84	0.64
$L_1 B_2$	1807.64	1.01
$L_2 B_1$	1824.64	0.44
$L_2 B_2$	1834.91	0.80
F	4.65 *	0.01
SE±	35.82	0.08
CD(0.05)	105.0595	NS

* – Significant at 5 % level
NS – Non significant

4.4.1 N uptake

Uptake of N was significantly influenced by organic manures. M_3 (CPC) recorded the highest value of 39.72 kg ha^{-1} which was on par with M_2 (PM) and significantly superior to M_1 (FYM).

Levels of organic manures showed significant variation in uptake of nitrogen. The treatment L_1 recorded higher uptake than L_2.

There was no significant influence in uptake of nitrogen due to bioinoculant.

The interaction effect of source of organic manure and its level showed significant variation. The interaction M_3L_1 registered higher value and it was significantly superior than other treatments. This was followed by M_2L_1 which was significantly superior to all other treatments combination. The lowest value was recorded by M_1L_2 and this was significantly inferior to all other treatments.

The interaction effect of different levels of organic manures and bioinoculant were not significant (Table 10b) whereas interaction between organic manures and bioinoculant showed significant influence in N uptake. The highest value was recorded by M_3B_1 closely followed by M_2B_1 but it is on par and significantly superior than all other treatment combinations.

4.4.2 P uptake

It is evident from Table 10a that different sources of manures, levels of manures and bioinoculant treatments caused significant variation in P uptake.

Among the different sources, M_3 (CPC) recorded the highest uptake of 8.63 kg ha^{-1} followed by M_1 (FYM) and these were on par. The lowest value of uptake was recorded PM which was significantly inferior to CPC and on par with FYM.

Uptake of P increased with increase in levels of manures. The treatment L_1 recorded significantly higher uptake of P than the L_2.

Bioinoculant showed significant difference in P uptake. With bioinoculant (B_1) showed significantly higher P uptake than without bioinoculant (B_2).

Table 10a. Effect of organic manures its different levels and bio-inoculants, on uptake of nutrients (kg ha^{-1})

Treatments	N	P	K
Organic manures (M)			
M_1 (FYM)	30.06	7.99	27.12
M_2 (PM)	37.69	7.40	23.87
M_3 (CPC)	39.72	8.63	23.35
F	33.08 **	4.17 *	3.04
SE±	0.89	0.30	1.17
CD(0.05)	2.5960	0.8840	NS
Levels (L)			
L_1 (100 %)	38.23	8.76	26.71
L_2 (75 %)	33.41	7.26	22.85
F	22.28 **	18.51 **	8.14 **
SE±	0.72	0.25	0.96
CD(0.05)	2.1196	0.7218	2.8095
Bioinoculant (B)			
B_1 (with bioinoculant)	39.53	8.60	26.01
B_2 (without bioinoculant)	32.11	7.42	23.55
F	0.60	11.64 **	3.30
SE±	0.72	0.25	0.96
CD(0.05)	NS	0.7218	NS

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

Table 10b. Interaction effect of organic manures its different levels and bio-inoculants, on uptake of nutrients (kg ha^{-1})

Treatments	N	P	K
$M_1 L_1$	32.50	9.14	30.39
$M_1 L_2$	27.62	6.85	23.86
$M_2 L_1$	39.40	7.85	25.96
$M_2 L_2$	35.98	6.96	21.78
$M_3 L_1$	42.80	9.29	23.79
$M_3 L_2$	36.63	7.97	22.91
F	52.70 **	1.41	1.47
SE±	1.25	0.43	1.66
CD(0.05)	2.1196	NS	NS
$M_1 B_1$	31.87	8.57	29.03
$M_1 B_2$	28.25	7.41	25.22
$M_2 B_1$	41.96	8.56	25.24
$M_2 B_2$	33.42	6.24	22.50
$M_3 B_1$	44.76	8.67	23.77
$M_3 B_2$	34.67	8.59	22.93
F	3.64 *	3.47 *	0.41
SE±	1.25	0.43	1.66
CD(0.05)	3.6713	1.2502	NS
$L_1 B_1$	42.40	9.79	28.45
$L_1 B_2$	34.06	7.72	24.98
$L_2 B_1$	36.66	7.41	23.57
$L_2 B_2$	30.16	7.11	22.13
F	0.82	6.40 *	0.56
SE±	1.02	0.35	1.35
CD(0.05)	NS	1.0208	NS

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

The interaction effect of different organic manures and its levels were not significant whereas interaction between organic manures and bio-inoculants showed significant influence. M_3B_1 registered more P uptake than other treatments but it was on par with M_3B_2, M_1B_1, and M_2B_1 and were significantly superior to M_1B_2 and M_2B_2.

The interaction effect of levels of organic manures and bioinoculant were also significant on P uptake. Uptake of P was the highest in L_1B_1 and this was significantly superior to all other treatments.

4.4.3. K uptake

No significant variation in K uptake was observed due to either source of manure or the bioinoculant (Table 10a).

But levels of manures produced significant variation in K uptake. The treatment L_1 was superior to L_2.

The interaction effects of various treatments on K uptake were not significant.

4.5 QUALITY PARAMETERS

Table 11a and 11b show the data on the quality characters of tuber namely starch and, sugar content and organoleptic test as affected by the treatments and their interactions.

4.5.1. Starch content

The source of organic manure, its levels and bioinoculant caused significant variation in starch content of tuber.

Plants treated with FYM (M_1) recorded higher starch content of tuber and it was on par with CPC treated plants and significantly superior than PM.

Among the levels of manures, L_1 recorded significantly higher starch content than L_2.

Table 11a. Effect of organic manures its different levels and bio-inoculants, on quality assessment of sweet potato (%)

Treatments	Starch	Sugar
Organic manures (M)		
M_1 (FYM)	18.05	3.02
M_2 (PM)	14.70	3.11
M_3 (CPC)	17.64	2.97
F	3.50 *	0.44
SE±	0.98	0.11
CD(0.05)	2.8679	NS
Levels (L)		
L_1 (100 %)	19.00	3.23
L_2 (75 %)	14.59	2.83
F	15.29 **	10.65 **
SE±	0.80	0.09
CD(0.05)	2.3417	0.2524
Bioinoculant (B)		
B_1 (with bioinoculant)	18.38	3.11
B_2 (without bioinoculant)	15.21	2.95
F	7.89 *	1.77
SE±	0.80	0.09
CD(0.05)	2.3417	NS

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

Table 11b. Interaction effect of organic manures its different levels and bio-inoculants, on quality assessment of sweet potato (%)

Treatments	starch	Sugar
$M_1 L_1$	20.22	3.18
$M_1 L_2$	15.87	2.85
$M_2 L_1$	16.74	3.31
$M_2 L_2$	12.66	2.90
$M_3 L_1$	20.05	3.19
$M_3 L_2$	15.23	2.75
F	0.04	0.08
SE±	1.38	0.15
CD(0.05)	NS	NS
$M_1 B_1$	18.95	3.40
$M_1 B_2$	17.15	2.63
$M_2 B_1$	17.10	3.14
$M_2 B_2$	12.29	3.07
$M_3 B_1$	19.10	2.79
$M_3 B_2$	16.19	3.15
F	0.61	7.40 **
SE±	1.38	0.15
CD(0.05)	NS	0.4371
$L_1 B_1$	21.66	3.40
$L_1 B_2$	16.35	3.06
$L_2 B_1$	15.11	2.82
$L_2 B_2$	14.07	2.84
F	3.57	2.15
SE±	1.13	0.12
CD(0.05)	NS	NS

** – Significant at 1 % level
NS – Non significant

With bioinoculant (B_1) registered higher starch content than without bioinoculant (B_2).

Starch content was not influenced by any type of interaction between the tested factors (Table 11b).

4.5.2. Sugar content

Neither manures nor bioinoculant produced any significant variation in sugar content of the tuber (Table 11a), but levels of organic manure caused significant variation. L_1 recorded the highest sugar content of 3.23% than L_2.

The interaction effect was significant only between organic manures and bioinoculant (Table 11b). The highest value was recorded by M_1B_1 but it was on par with M_3B_2, M_2B_1, M_2B_2 and significantly different from M_3B_1, M_1B_2.

4.5.3 Organoleptic test

Data on organoleptic test revealed no significant difference among different organic manures, their levels and bio inoculants.

4.6 SOIL NUTRIENT STATUS AFTER THE EXPERIMENT

Available N, P and K contents of the soil after the experiment as influenced by the treatments and their interaction are given in Table 12a and 12b.

4.6.1 Available Nitrogen

Available N status of the soil after the experiment varied significantly with the sources of organic manure. Poultry manure registered superior status of available N in the soil while the effects of CPC and FYM were on par (Table 12a).

Levels of organic manures showed significant influence on available N status of the soil. The treatment L_1 recorded more available N than L_2.

No significant variation in available N status of the soil was observed due to bioinoculant.

Table 12a. Effect of organic manures its different levels and bioinoculant on nutrient status after the experiment (kg ha^{-1})

Treatments	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
Organic manures (M)			
M_1 (FYM)	359.30	71.60	221.47
M_2 (PM)	389.90	65.01	240.27
M_3 (CPC)	384.68	68.59	225.12
F	4.36 *	0.79	1.62
SE±	7.84	3.72	7.84
CD(0.05)	22.9922	NS	NS
Levels (L)			
L_1 (100 %)	389.36	72.81	263.62
L_2 (75 %)	366.56	63.98	194.28
F	6.34 *	4.22	58.63 **
SE±	6.40	3.04	6.40
CD(0.05)	18.7731	NS	18.7830
Bioinoculant (B)			
B_1 (with bioinoculant)	370.54	71.85	251.90
B_2 (without bioinoculant)	385.38	64.95	206.00
F	2.69	2.58	25.69 **
SE±	6.40	3.04	6.40
CD(0.05)	NS	NS	18.7830

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

The interaction effect was significant only between organic manures and bioinoculant. The highest value was recorded by M_1B_2 but it was on par with all other treatments except M_1B_1.

4.6.2 Available phosphorous

The individual effect of sources of organic manures its different levels and bioinoculant were not significant on available P status of soil.

The interactions among the various factors were also not significant.

4.6.3 Available potassium

It is observed from Table 12a that sources of organic manure did not produce any significant variation in the available potassium in the soil after the experiment.

There was significant difference among different levels of organic manures. Among the levels L_2 recorded higher value than L_1.

The interaction effect was significant only between organic manures and bio inoculants. The highest value was recorded by M_1B_1 but it was on par with M_2B_1 and M_3B_1 and significantly different from M_2B_2, M_3B_2 and M_1B_2. M_1B_2 recorded the lowest values and it was significantly inferior to all other treatments.

4.7 INCIDENCE OF SWEET POTATO WEEVIL

Total number of weevil affected tubers from each net plot was recorded. No other serious pest or diseases was noticed. It showed that there was no significant difference among various treatments and their treatment combinations.

4.8 ECONOMICS

$M_2L_1B_2$ (PM full recommendation without bioinoculant) recorded the highest BCR of 2.03 which was followed by $M_1L_1B_2$ (1.81). The lowest BCR of 0.92 was recorded by $M_3L_2B_2$. The treatment $M_3L_1B_1$ registered a highest value of Rs. 78,706 in cost of cultivation while $M_1L_1B_2$ recorded a lowest value of Rs. 67,026.

Table 12b. Interaction effect of organic manures its different levels and bioinoculant on nutrient status after the experiment (kg ha^{-1})

Treatments	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
$M_1 L_1$	371.54	75.21	263.00
$M_1 L_2$	347.05	67.99	179.93
$M_2 L_1$	401.40	69.30	277.23
$M_2 L_2$	378.41	60.72	203.30
$M_3 L_1$	395.13	73.93	250.63
$M_3 L_2$	374.23	63.24	199.60
F	0.01	0.05	1.11
SE±	11.09	5.27	11.09
CD(0.05)	NS	NS	NS
$M_1 B_1$	321.37	75.30	262.07
$M_1 B_2$	397.22	67.90	180.87
$M_2 B_1$	395.13	62.48	254.77
$M_2 B_2$	384.68	67.54	225.77
$M_3 B_1$	395.13	77.77	238.87
$M_3 B_2$	374.23	59.40	211.37
F	11.47 **	2.48	3.80 *
SE±	11.09	5.27	11.09
CD(0.05)	32.5159	NS	32.5332
$L_1 B_1$	385.68	78.10	295.71
$L_1 B_2$	393.04	67.53	231.53
$L_2 B_1$	355.41	65.60	208.09
$L_2 B_2$	377.71	62.36	180.47
F	0.68	0.73	4.07
SE±	9.05	4.30	9.06
CD(0.05)	NS	NS	NS

** – Significant at 1 % level
* – Significant at 5 % level
NS – Non significant

Table 13. Effect of organic manures, its levels and bioinoculant on economics of sweet potato cultivation

Treatments	Cost of Cultivation	Gross Returns	Net Returns	BCR
$M_1L_1B_1$	71,207	1,12,666	41,457	1.58
$M_1L_1B_2$	67,391	1,21,767	54,376	1.81
$M_1L_2B_1$	70,114	97,900	27,786	1.40
$M_1L_2B_2$	67,026	94,467	27,441	1.41
$M_2L_1B_1$	70,374	1,04,000	33,626	1.48
$M_2L_1B_2$	68,016	1,37,867	69,851	2.03
$M_2L_2B_1$	69,488	82,733	13,245	1.19
$M_2L_2B_2$	67,495	96,100	28,605	1.42
$M_3L_1B_1$	78,706	79,100	394	1.01
$M_3L_1B_2$	76,348	1,16,667	40,319	1.53
$M_3L_2B_1$	75,736	1,27,500	51,764	1.68
$M_3L_2B_2$	73,743	67,633	- 6110	0.92

FYM - Rs.350/ton
Poultry Manure -Rs.1000/ton
Price of tuber – Rs.10/kg

Coir pith Compost-Rs.5/Kg
Vines-25ps/vine

Gross returns and net returns were higher in $M_2L_1B_2$ while it was lower in $M_3L_2B_2$ (Table 13).

4.9 ANCILLARY STUDY ON TUBER INITIATION

The study revealed that on 5th day of planting the plants started producing roots. And on 31st day the tuberous roots were appeared. The number of tuberous roots went on increasing upto 52 days. The increase in length, girth and weight of tubers were observed upto harvest stage (Table 14).

Tuber development at 45 days after planting

Tuber development at 90 days after planting (Harvest)

Plate 3. Tuber development at 45 days after planting and Harvest

Table 14 Ancillary study on tuber initiation in sweet potato

Days after planting	Number of roots/ plant	Number of tuberous roots/plant	Length of tuberous roots (cm)	Girth of tuberous roots (cm)	Weight of tuberous roots (g per plant)
3	Nil	---	---	---	---
5	3.5	---	---	---	---
7	4	---	---	---	---
9	6.5	---	---	---	---
11	10	---	---	---	---
13	11	---	---	---	---
15	12	---	---	---	---
17	13	---	---	---	---
19	13.5	---	---	---	---
21	14	---	---	---	---
23	14	---	---	---	---
25	15.5	---	---	---	---
27	16	---	---	---	---
29	17	---	---	---	---
31	16	1	2.5	2	5
38	15	2	7.5	7.5	27
45	14	2	8	11.5	48.5
52	13	3	9	11.5	102.5
59	14	3	10	12	120
66	12	3	10.5	13	194
73	10	3	12.5	13.5	221.5
80	8	3	13	14	270
87 (harvest date)	8	3	13.5	14	312.5

Discussion

5. DISCUSSION

The results of the study conducted to develop the production technology for organic sweet potato are discussed in this chapter.

5.1 Growth characters

Organic manures tested in the experiment namely farmyard manure, poultry manure, and coir pith compost did not cause any significant variation in any of growth characters of sweet potato. However FYM produced a slight improvement in vine length at later growth stages of the plant (Table 2). A positive influence of FYM in increasing the plant height of cassava was reported by Pamila (2003).

Levels of organic manures and bioinoculant did not cause any significant influence in length of vine. However a slight improvement was observed with 100% recommendation of nutrient as organic manure with bioinoculant as compared to 75% organic manure and without bioinoculant though the effect were non significant (Table 2). It is a proven fact that for producing optimum plant height or vine length the plant require adequate quantity of nutrients which could be supplied only through the full recommended dose of nutrients. Bio inoculant did not show any significant variation on length of vine. Increased vine length of sweet potato due to increased levels of nutrient was reported by Purewal and Dargen (1969). The influence of P and K in improving the plant height was documented by several works (Ngongy 1976), Nair (1986) in cassava and Hussain and Rashid (1982) in colocasia.

Different source of organic manure, its levels and bioinoculant could not exert any significant variation in number of branches of sweet potato.

Number of leaves and LAI did not show any variation for different sources of organic manure used. The LAI of sweet potato in this experiment ranged from 3.22 to 3.30 at 60 DAP. Ravi *et al.* (1999) reported that LAI of 3-4 maximised the solar radiation interception and dry matter production of sweet potato. A small

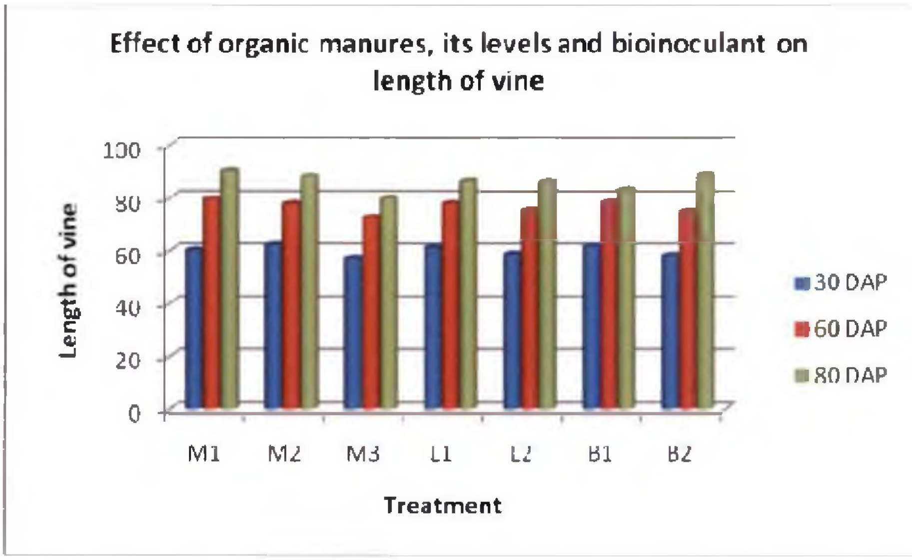

Fig2 Effect of organic manures, its levels and bioinoculant on length of vine

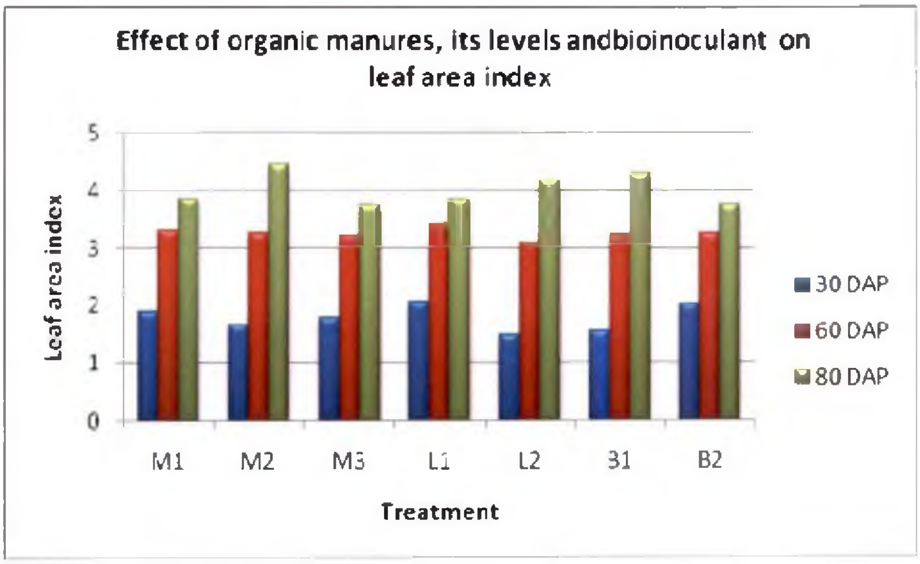

Fig 3 Effect of organic manures, its levels and bioinoculant on leaf area index

improvement in LAI was observed for FYM applied plants at 40 and 60 DAP, though the effects were not significant. Significant improvement in LAI was reported by Pamila (2003) in cassava upto 4 MAP. The higher efficiency of FYM in promoting the growth characters as compared to other organic manures was reported by Veena (2000) in arrow root and Archana (2001) in coleus. At harvest stage PM registered a higher LAI of 4.47 which probably may be a value above optimum. This indicated that PM is contributing to enhanced production of leaves even at the tuber development stage. In this stage lowest LAI was reported for coir pith compost and similar result reported by Arunkumar (2000) in amaranthus.

Levels of organic manures produced significant variation in number of leaves and LAI. Higher number of leaves and LAI was reported by 100% of nutrient through organic source. This indicated that adequate supply of nutrient promote vegetative growth especially leaf production in the plant. The data from the Table 5 indicated that higher level of manures contributed to higher LAI upto the grand growth phase of the plant upto 60 DAP. Similar results of higher levels of nutrient (N) favouring the vegetative growth of the plant was reported by Mandal et al (1978), Pillai and George (1978) and Nair (1986) in cassava. At later growth stages (80DAP) lower levels of organic sources of nutrient produced higher LAI which probably may be at the expense of tuber growth. A significant reduction in the LAI was observed due to inoculation with microbial consortium at early growth stage which was nullified at the later growth stage. This probably may be due to the utilization of the manure source by the microorganism itself for their multiplication resulting in reduced availability of nutrients at the early stage for growth the crop.

5.2 Yield components

Number of tubers per plant was significantly varied due to the use of different organic manures. FYM produced the highest number of tuber which was significantly superior than PM and CPC. Veena (2000) reported the positive influence of FYM on the number of rhizomes per plant and yield of arrowroot.

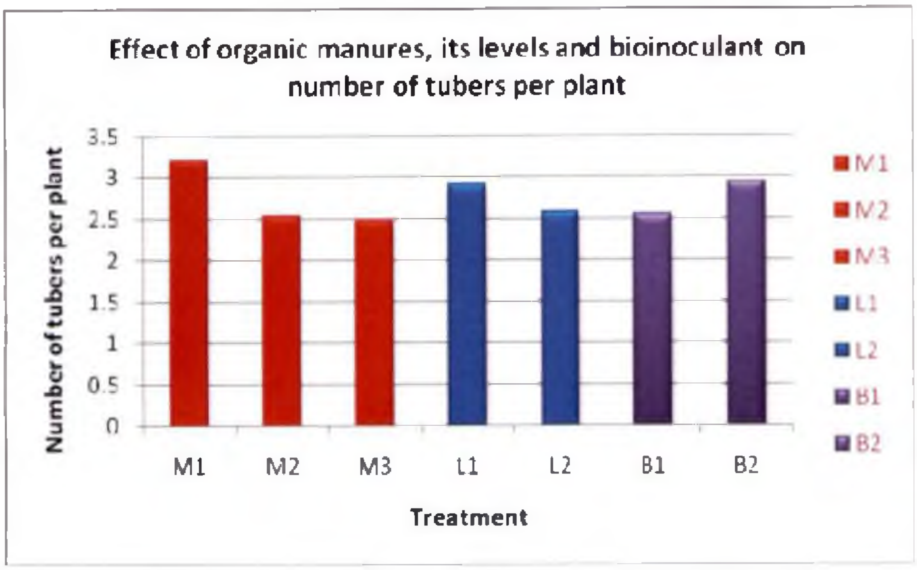

Fig4 Effect of organic manures, its levels and bioinoculant on number of tubers per plant.

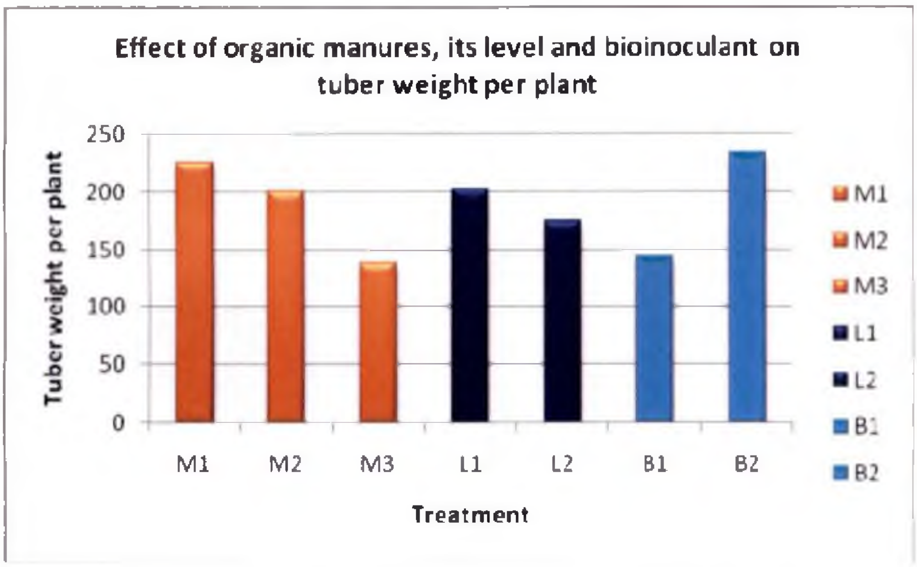

Fig 5 Effect of organic manures, its levels and bioinoculant on tuber weight per plant.

The data (Table 7a) showed that as compared to PM and CPC the use of FYM as a source of organic manure produced 25% increase in the tuber number in sweet potato. Archana (2001) also observed that farmyard manure as a source of organic manure for coleus had a positive influence on yield and yield components. This indicated that FYM had influenced the production of sink prior to storage. The reduction in the tuber number by the use of other sources likes PM and CPC may be due to the effect of these sources on the growth characters of the plant during tuber development stage. Levels of organic manure also caused significant variation in number of tuber per plant. Full recommended dose of nutrient as (100%) organic manure favoured higher number of tuber per plant than 75% recommendation. This indicated that adequate quantity of nutrients supplied from the higher level of organic sources promote greater vine length, LAI which were maintained throughout the tuber initiation phase resulting in the production of more numbers of tubers. An increase in the number of cormels per plant was reported with increase in N in colocasia by Hussain and Rashid (1982). Bioinoculant showed significant variation in number of tubers per plant. Plants treated with microbial inoculation produced lower number of tubers as compared to plants without bioinoculant treatment. The significant reduction in LAI (Table 5) might have contributed for producing less number of tubers with bioinoculant as the tuber initiation in sweet potato takes place within 40 days after planting.

Weight of tubers per plant was significantly influenced by different sources of organic manure. Farm yard manure produced more tuber weight than PM and CPC. Significant influence in tuber weight per plant by FYM is attributed to the production of higher number of tubers and combined effect of higher LAI and higher vine length at the early growth phase. The significantly higher leaf area exhibited by the crop at the tuber bulking phase might have favoured better photosynthesis and enhanced translocation of photosynthates of tuber which in turn might have led to greater tuber weight per plant. Higher efficiency of FYM for producing higher yield was reported by Gomez et al (1983). Ravindran and

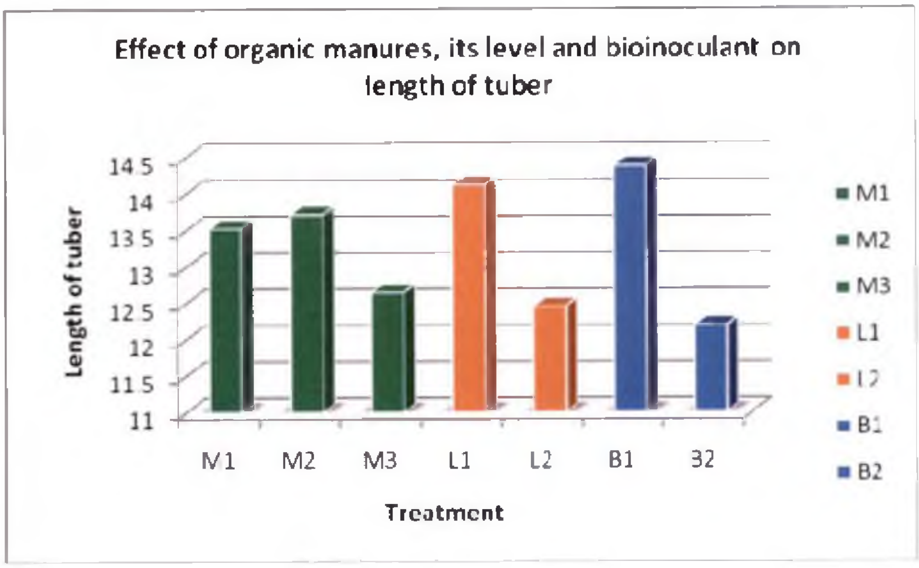

Fig 6 Effect of organic manures, its levels and bioinoculant on length of tuber.

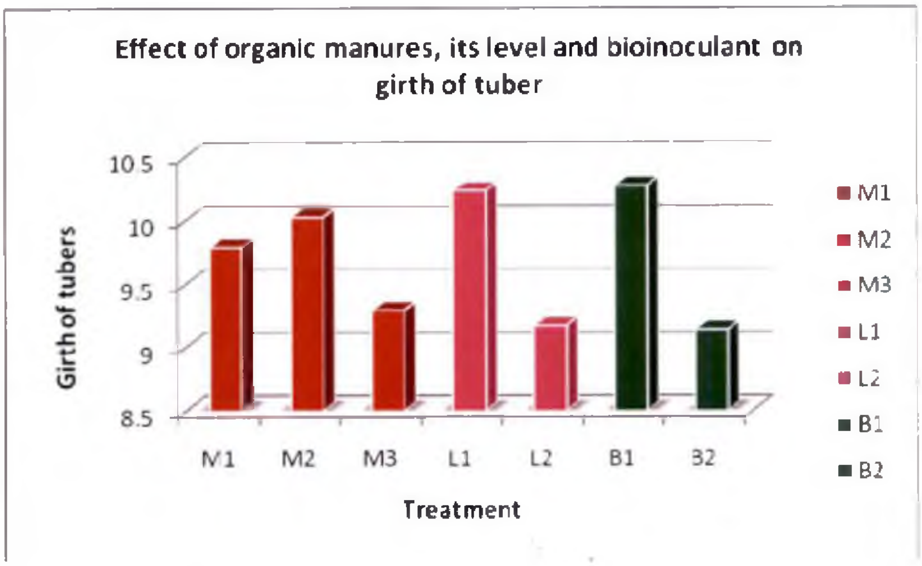

Fig7 Effect of organic manures, its levels and bioinoculant on girth of tuber.

Bala nambisan (1987) reported that basal application of 5t of FYM to sweet potato was beneficial in enhancing the yield and quality of tuber. Levels of organic manure could not exert any significant influence in tuber weight. Bioinoculant showed significant variation in number of tubers per plant. Inoculation with microbial consortium produced lesser tuber weight than without microbial consortium.

Length and girth of tubers were not significantly influenced by sources of organic manure (Table 6a). The similar result of non significant influence of organic manures on length and girth of tuber was reported by Pamila (2003) in cassava and Suja (2001) in yams. Levels of organic manures and bioinoculant caused significant variation in length and girth of tubers (Table 6a). Full dose (100%) of organic manure produced significant influence than 75% dose which indicates that adequate quantity of nutrients is essential for expressing the potential character of tuber. Inoculation with microbial consortium produced longer tubers with higher girth. This showed the positive influence of microbial consortium for enhancing the size of the tuber, though they have contributed a negative influence in the tuber number and tuber weight per plant. This again suggests that the consortium is effective only at the later stage causing increase in the size of the tuber.

Tuber yield of sweet potato were not significantly varied due to different sources of organic manure. This indicated that all the organic sources are equally effective in expressing the tuber yield per ha. This is the conformity with the result of Suja (2001) in African yam and Pamila (2003) in cassava. Full dose of organic manure reported higher tuber yield than 75% dose. By the application of full dose of organic manure, the crop received 75 kg N (that is the recommended dose) whereas with 75% dose the crop received only 50kg N. Thus with 25% reduction in nutrient, caused about 20 % reduction in tuber yield. Significant increase in number of tubers along with higher tuber weight per plant might have resulted in producing higher yield with full dose of manure. This again indicated the necessity of full recommended dose of nutrient for expressing the potential

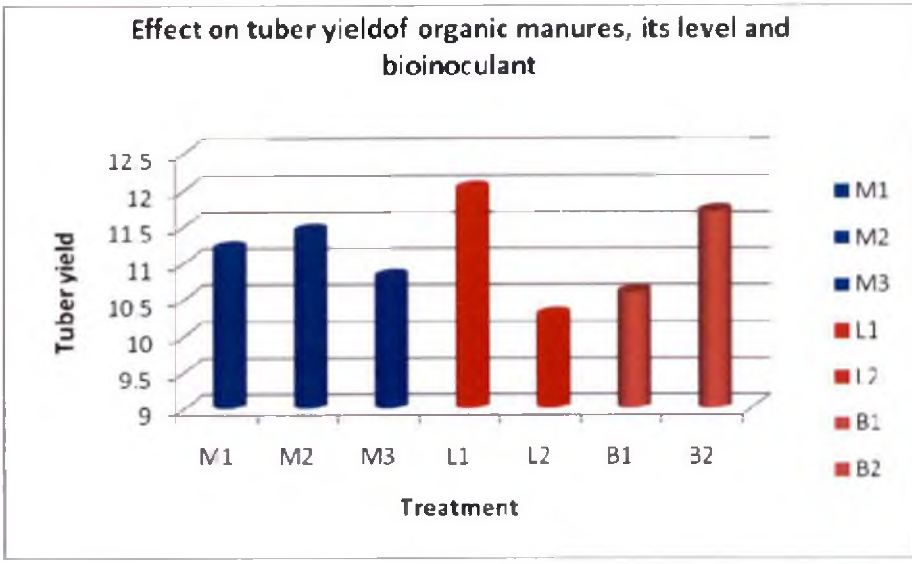

Fig 8 Effect on tuber yield of organic manures, its levels and bioinoculant.

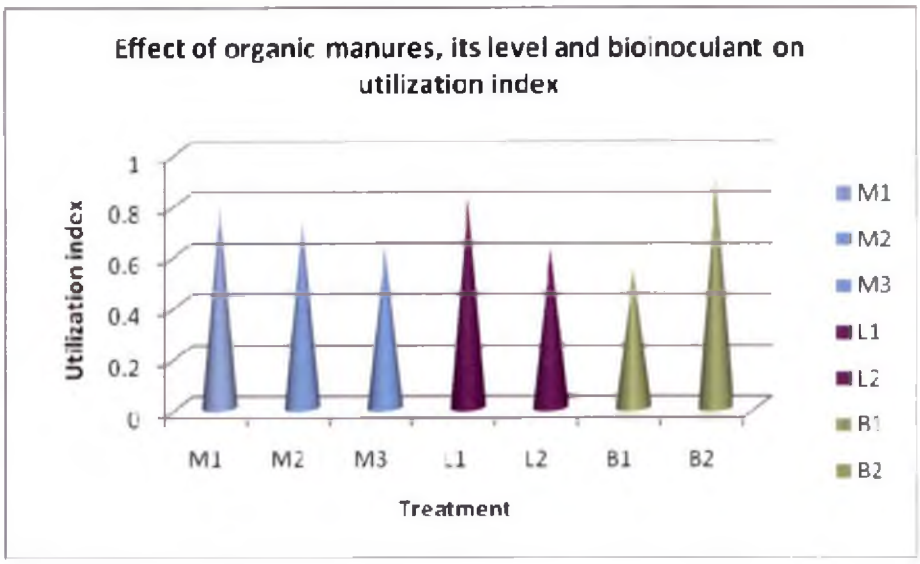

Fig 9 Effect of organic manures, its levels and bioinoculant on utilization index.

yield. Bioinoculant caused significant variation in tuber yield per ha. Inoculation with microbial consortium produced lesser tuber yield than without microbial consortium. This is in conformity with the result of tuber weight per plant. The lesser tuber number and tuber weight per plant might have resulted in producing reduced tuber yield.

5.3 Physiological parameters

Application of organic manures or its levels or bioinoculant could not contribute any significant variation in dry matter production of sweet potato may be due to the non significant effect of source of organic manure and bioinoculant on growth characters and yield components. Pamila (2003) also reported no variation in dry matter production due to source of organic manure when FYM, PM and CPC were used. The interaction between levels of organic manure and bioinoculant were significant. Dry biomass yield of tannia were reported to be favoured by FYM @12.5 t ha^{-1}(Suja *et al* 2009). An 8% improvement in dry matter production was observed with the use of microbial consortium at highest level of manure (100% recommendation). Whereas at lower level (75% recommendation) the contribution with microbial consortium was negligible. Hence it is evident that for the proper functioning of beneficial microbes, adequate quantity of organic manure source is essential. This again signifies that microbial consortium was effective irrespective of the kind of organic source.

Utilization index did not vary between organic manures (Table 7a). The non significant influence of tuber weight per plant and top yield of the plant might have contributed to the effect (Table 6a). This indicates that the different organic sources were equally effective in translocation of nutrient to different parts of the plant. Higher levels of organic manures significantly favoured the UI. An increase in UI with increase in the levels of organic manure from 75-100% was noticed. Increase in UI with increase in N level was reported by Pamila (2003) in cassava. A significant reduction in UI was observed due to microbial consortium (Table7a). Interaction effect of organic manure and bioinoculant also showed significant variation in UI. Inoculation with microbial consortium with PM registering the lowest value followed by FYM with microbial consortium. Since the nutrients are in available form in PM and FYM at the early stage of incorporation, the use of microbes might have resulted in utilization of available nutrients for their growth and multiplication causing a reduction in the nutrient availability to the crop plant. This is quite evident from the reduced number of tubers per plant and tuber weight per plant as observed from the Table 6a.

5.4 Uptake

Among the organic manures, CPC recorded the highest N uptake which was on par with PM and significantly superior to FYM. This trend could be associated with an increase in soil available nitrogen for these treatments (Table 10a) and is in conformity with the result of Suja (2001) in African yam. Higher N uptake was noticed for higher level (100% organic source) of nutrient. Increased uptake of nitrogen due to higher rates of application of organic source is approved fact. Availability of nutrients is higher and plant absorption will be higher. Bioinoculant could not exert any significant influence in N uptake.

Coir pith compost registered the highest P uptake value of 8.63 kg/ha. Enhanced P uptake at higher level of organic manure is attributed to high dry matter production, UI, tuber number, tuber weight. Inoculation of microbial consortium enhance the P uptake and it maintained the increased DMP.

All the three organic manures produced almost similar K uptake. Non significant influence of dry matter production observed from Table 7a may be the reason. K uptake was attributed by high level of nutrients and this can be ascribed to greater dry matter and tuber number and weight. Inoculation of microbial consortium could not exert any significant variation.

5.5 Quality

Organic manures produced significant variation in starch content of sweet potato. The highest value of starch content was produced by FYM. This probably

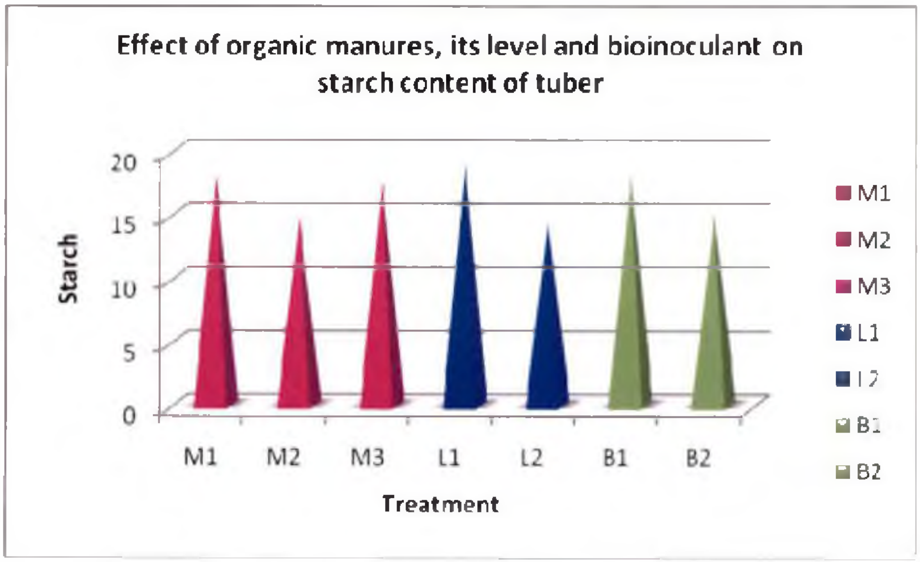

Fig 10 Effect of organic manures, its levels and bioinoculant on starch content of tuber

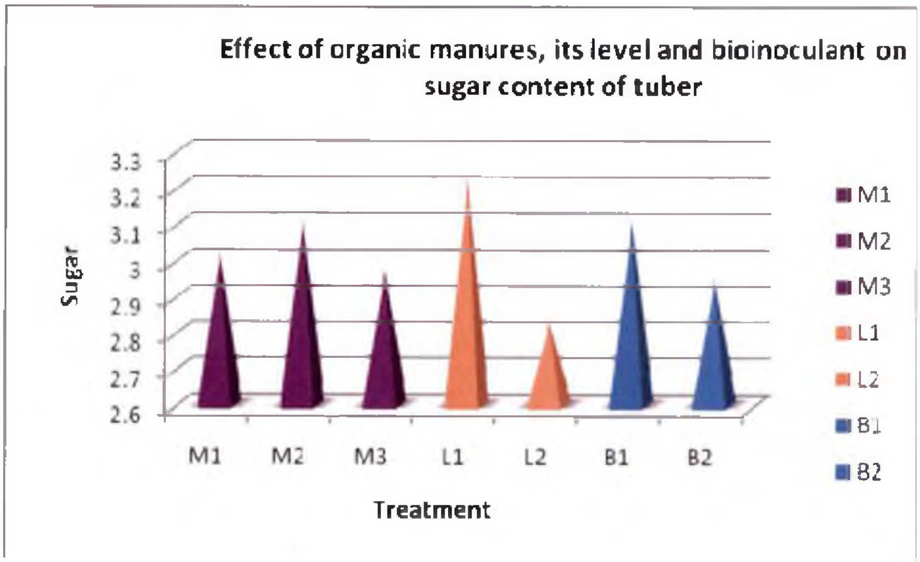

Fig 11 Effect of organic manures, its levels and bioinoculant on sugar content of tuber.

may be due to the greater production and translocation of photosynthates as observed from the higher tuber yield (Table 7a) which leads to the synthesis of storage starch. Higher levels significantly increase the starch content. It is generally observed that CHO utilization is treated to N supply. As this supply of nutrient is adequate the CHO synthesized will be stored in the sink as storage starch. In this experiment bioinoculant promoted the starch content of the tuber.

Total sugar content of sweet potato was not influenced by different sources of organic manure, its levels and bioinoculant.

Organoleptic test also showed no significant variation indicating that all the treatments expressed same appearance, colour and taste.

5.6 Soil nutrient status after the experiment

Available N, P and K status of the soil after the experiment was maintained at the initial level of 320kg ha^{-1}, 13.5 kg ha^{-1} and 112 kg ha^{-1}. Significant variation in available N status of soil was observed due to organic manure and its levels. Among organic manures, PM registered significantly higher status of N in the soil while the effect of FYM and CPC were on par. But in the case of available P and K status of soil were not significant due to application of organic manure. Available P was more in CPC applied plots but K content was more in PM treated plots.

Available N, P and K status of soil increased with increase in level of organic manure. Effect of levels of organic manure was significant in N and K but effect of P was not significant.

Bioinoculant registered higher status of available K in the soil after the experiment and there was no significant variation in available N and P. Interaction effect of organic manure and bioinoculant were significant only for available N and K status of soil. Farm yard manure with bioinoculant registered the lowest value of 321 kg available N per ha which was significantly inferior to all other treatments and were on par. FYM with bioinoculant produced the highest value of

262.07 kg ha^{-1} of available K and the lowest value of 180.87 kg ha^{-1} was recorded by FYM without bioinoculant.

Poultry manure full recommendation without bioinoculant ($M_2L_1B_2$) recorded the highest BCR of 2.03 which was followed by 1.81 for $M_1L_1B_2$ (full recommendation of FYM without bioinoculant). The lowest BCR of 0.92 was recorded by $M_3L_2B_2$ (coir pith compost with out bioinoculant at 75%). The treatment $M_3L_1B_1$ (coir pith compost with bioinoculant at 100%) registered a highest value of Rs. 78,706 in cost of cultivation. This may be due to higher cost of coir pith compost. The treatment $M_1L_1B_2$ recorded a lowest value of Rs. 67,026. Gross returns and net returns were higher in $M_2L_1B_2$ while it was lower in $M_3L_2B_2$ (Table 13).

Ancillary study on tuber initiation revealed that on 5th day of planting the plants started producing roots. And on 31st day the tuberous roots were appeared. The number of tuberous roots went on increasing upto 52 days. The increase in length, girth and weight of tubers were observed upto harvest stage (Table 14).

Summary

6. SUMMARY

An investigation entitled "Production technology for organic sweet potato" was undertaken at College of Agriculture, Vellayani to develop an organic production package involving source of organic manure, its levels and bioinoculant and work out the economics of cultivation. The field study was conducted in the instructional farm attached to college from August 2010 to November 2010. The treatment consists of factorial combinations of three sources of organic manures (farmyard manure, poultry manure and coir pith compost) , two levels of nutrients as organic manure (100% POP recommendation of fertilizer as organic manure and 75% recommendation) and two levels of bioinoculant (with bioinoculant and without bioinoculant). The trial was laid out in asymmetrical factorial design with three replications. The salient findings of the study are summarized below.

The individual and interaction effect of organic manures, its different levels and bioinoculant were not significant on length of vine of sweet potato.

The total number of leaves of sweet potato was not significant due to individual effect of treatments. Significant effects of organic manures with levels (MxL) and organic manures with bioinoculant (MxB) were observed.

The treatments organic manure, its levels and bioinoculant did not exert any significant variation on total number of branches of sweet potato.

Leaf area index did not vary between organic manures. But the levels of organic manures were significant in LAI at 30 DAP and 60 DAP. The treatment full recommended dose of organic manure (L_1) registered highest LAI. Effect of bioinoculant on LAI was significant at early stage but later stages no variation was observed.

Total dry matter production was not influenced by individual effect of treatments. The interaction between levels of organic manure and bioinoculant (LxB) were only significant. Among this, 100% dose of nutrient as organic source with bioinoculant registered the higher dry matter production.

There was no significant variation among organic manures (M) on utilization index. But the levels of organic manures were significant. The treatment L_1 produced higher utilization index. The treatment bioinoculant has significant influence on utilization index. The treatment without bioinoculant recorded the higher value. The interaction between organic manure with bioinoculant (MxB) was significant. Farmyard manure without bioinoculant produced the highest utilization index.

Number and weight of tuber per plant of sweet potato were significantly varied due to sources of organic manure. Farmyard manure registered higher value on number and weight of tubers. Levels of organic manures showed significant variation in number of tubers. The treatment 100 % dose of organic manure registered higher number of tuber but in the case of tuber weight, levels were not significant. The treatment bioinoculant application was significant on weight of tuber. The treatment without bioinoculant showed higher number and weight of tuber.

The organic manures did not show significant influence on length and girth of tubers. Levels of organic manures showed significant variation on length and girth of sweet potato. Full recommended dose of organic manure registered higher length and girth of tuber than 75%. The treatment bioinoculant application was significant. With bioinoculant registered higher length and girth of tuber than without bioinoculant.

Different source of organic manure, its levels and bioinoculant could not exert any significant variation in top yield of sweet potato.

Sources organic manure and bioinoculant did not produce any significant difference in tuber yield. But the levels of organic manure were significant. The treatment 100 % recommended dose of organic manure registered more tuber yield than 75 % recommendation. The LxB interaction was significant on tuber yield of sweet potato.

Uptake of N and P were influenced by organic manures. But K uptake did not vary between organic manures. Coir pith compost registered higher uptake of N and P compared to other manures. The highest uptake of nutrients was registered by 100% recommendation of nutrients as organic manure. Uptake of nutrients did not vary with bioinoculant except P uptake and the treatment with bioinoculant (B_1) showed significant increase in P uptake than without bioinoculant (B_2).

Starch content was significantly influenced by organic manures, levels and bioinoculant. Farmyard manure registered higher value than CPC and PM. Among the levels L_1 registered higher starch content than L_2. Plants treated with bioinoculant (B_1) recorded higher starch content than without bioinoculant (B_2).

Sugar content of sweet potato was not influenced by source of organic manure and bioinoculant. But levels of organic manure showed significant variation on sugar content. Higher levels of organic manure (100% dose of organic manure) produced maximum sugar content than 75% dose of organic manure. No significant difference among different organic manures, their levels and bioinoculant on organoleptic test.

Available N content of soil significantly varied due to sources of organic manure and its different levels. But bioinoculant showed no significant variation. Among the source of organic manure FYM produced higher value than other sources. The treatment 100% dose of organic manure recorded higher value than 75% dose. Available P content of soil was not significantly influenced by sources of organic manure, its level and bioinoculant. Available K content of soil was not influenced by sources of organic manure. But its different levels and bioinoculant showed no significant variation. The treatment 100% dose of organic manure recorded higher value than 75% dose. The treatment with bioinoculant showed significant variation on available K content of soil.

The incidence of sweet potato weevil was not influenced by sources of organic manure, its levels and bioinoculant.

$M_2L_1B_2$ (PM full recommendation without bioinoculant) recorded the highest BCR of 2.03 which was followed by $M_1L_1B_2$ (1.81). The lowest BCR of 0.92 was recorded by $M_3L_2B_2$. Gross returns and net returns were higher in $M_2L_1B_2$ while it was lower in $M_3L_2B_2$.

Ancillary study on tuber initiation revealed that on 5th day of planting the plants started producing roots. And on 31st day the tuberous roots were appeared. The number of tuberous roots went on increasing upto 52 days.

The present investigation revealed that all the nutrient sources tested in this experiment namely farmyard manure, poultry manure and coir pith compost are equally effective on the growth and yield of sweet potato. The full recommended dose of nutrient through organic manure is required for expressing the yield potential of this crop. The effect of bioinoculant at the present rate had no significant influence in any of the growth and yield of sweet potato.

Considering the economics, the organic production system was found economically feasible. Poultry manure without bioinoculant at 100% dose of nutrient as organic source was the best treatment followed by FYM without bioinoculant at 100% dose giving BCR values of 2.03 and 1.81 respectively.

Future line of research

Organic production practices were found economically feasible for the crop sweet potato and hence similar studies may be conducted for other tuber crops also. In the present investigation only one variety of sweet potato was studied. There are a number of other popular high yielding varieties of sweet potato which also needs further testing for their suitability under organic farming.

The result of the experiment revealed that bioinoculant had no significant influence in modifying the growth and yield of sweet potato. Here, the incorporation of bioinoculant with organic manure was done only at 1% level (1g bioinoculant in 100g organic manure) which may be insufficient and hence need further investigation with higher levels. Different methods of bioinoculant application may also be tried for enhancing the effectiveness.

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PRODUCTION TECHNOLOGY FOR ORGANIC SWEET POTATO

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ABSTRACT

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ABSTRACT

The present investigation entitled "Production technology for organic sweet potato" was undertaken at College of Agriculture, Vellayani to develop an organic production package involving sources of organic manure, its levels and bioinoculant and work out the economics of cultivation. The field study was conducted in the Instructional farm attached to college from August 2010 to November 2010. The treatments consisted of factorial combinations of three sources of organic manure (farmyard manure, poultry manure and coir pith compost) , two levels of nutrients as organic manure (100% POP recommendation of nutrient as organic manure and 75% recommendation) and two levels of bioinoculant (with bioinoculant and without bioinoculant). The trial was laid out in asymmetrical factorial design with three replications.

The sources of organic manure did not show any significant influence on growth characters like length of vine, number of branches, number of leaves and leaf area index. The levels of organic manure caused significant variation on the number of leaves and LAI. Inoculation with microbial consortium caused significant influence on LAI only at early growth stage of the plant.

Number and weight of tuber per plant of sweet potato were significantly varied due to sources of organic manure. Farmyard manure registered the highest value on number and weight of tubers. Levels of organic manures showed significant variation in number of tubers. Full recommended dose of organic manure registered the highest number of tubers but in the case of tuber weight, levels were not significant. The highest number and weight of tubers were noticed in treatments where no bioinoculant was applied.

The organic manures did not show significant influence on length and girth of tubers. Levels of organic manures showed significant variation on length and girth of sweet potato. Full recommended dose of organic manure registered higher length and girth of tuber than 75 % recommended dose. Application of bioinoculant caused higher length and girth of tuber than without bioinoculant.

Different source of organic manure, its levels and bioinoculant could not exert any significant variation in top yield of sweet potato. Sources organic manure and bioinoculant did not produce any significant difference in tuber yield. But the levels of organic manure were significant. The treatment 100 % recommended dose of organic manure registered more tuber yield than 75 % recommendation.

Total dry matter production and utilization index were significantly influenced by the interaction effect of organic manures and bioinoculant. Full recommended dose of nutrient as organic source with bioinoculant registered the highest total dry matter production. Application of FYM without bioinoculant recorded the highest utilization index.

Uptake of N and P were significantly influenced by organic manures. But K uptake did not vary among different organic manures. CPC registered a higher uptake of N and P when compared to other manures. The highest uptake of nutrients was registered by 100% recommendation of nutrients as organic manure. Application of bioinoculant showed significant effect on P uptake but it had no effect on N and P uptake.

Starch content was significantly influenced by organic manures, its levels and bioinoculant. FYM with 100 % recommended dose registered higher value than CPC and PM. Plants treated with bioinoculant (B_1) recorded higher starch content than without bioinoculant (B_2).

Levels of organic manure showed significant variation on sugar content. Higher levels of organic manure (100% recommended dose of organic manure) produced maximum sugar content than 75% recommended dose of organic manure. However no significant difference was observed among different organic manures, their levels and bioinoculant on organoleptic test.

Available N content of soil significantly varied due to sources of organic manure and its different levels. FYM with 100% recommended dose increased available N content of soil when compared to 75% recommended dose. Sources of organic manure had no effect on available P content and K content of soil. Full recommended dose of organic manures with application of bioinoculant recorded higher values for available K content of soil than 75% recommended dose.

The incidence of sweet potato weevil was not influenced by sources of organic manure, its levels and bioinoculant.

Poultry manure full recommendation without bioinoculant ($M_2L_1B_2$) recorded the highest BCR of 2.03 which was followed by farmyard manure full recommendation without bioinoculant (1.81). The lowest BCR of 0.92 was recorded by coir pith compost without bioinoculant at 75% recommended dose ($M_3L_2B_2$).

The present investigation revealed that all the nutrient sources tested in this experiment namely farmyard manure, poultry manure and coir pith compost were equally effective on the growth and yield of sweet potato. The full recommended dose of nutrient through organic manure was required for expressing the yield potential of this crop. The effect of bioinoculant at the present rate had no significant influence on growth and yield of sweet potato. Considering the economics, the organic production system was found economically feasible. Poultry manure at 100% recommended dose was the best treatment followed by FYM at 100% dose giving a BCR value of 2.03 and 1.81 respectively.

Appendix - 1

Weather parameters during the crop growth period

Standard week	Temperature(^{0}C) (maximum)	Rainfall (mm)	Relative Humidity (%)	Evaporation (mm/day)
29	30.17	14.07	84.14	3.40
30	30.34	4.73	85.07	3.42
31	30.34	2.60	86.29	3.46
32	30.46	3.80	85.86	3.51
33	30.20	6.69	84.36	3.29
34	30.37	0	83.79	3.51
35	30.46	0	84.50	3.51
36	30.60	3.83	83.49	3.49
37	30.43	3.03	82.86	3.40
38	30.80	3.37	82.43	3.51
39	30.66	8.97	82.36	3.11
40	29.63	53.03	84.43	2.60
41	29.69	17.74	84.79	2.80
42	30.80	0.46	82.29	3.60

Appendices

Appendix - 1

Weather parameters during the crop growth period

Standard week	Temperature(^{0}C) (maximum)	Rainfall (mm)	Relative Humidity (%)	Evaporation (mm/day)
29	30.17	14.07	84.14	3.40
30	30.34	4.73	85.07	3.42
31	30.34	2.60	86.29	3.46
32	30.46	3.80	85.86	3.51
33	30.20	6.69	84.36	3.29
34	30.37	0	83.79	3.51
35	30.46	0	84.50	3.51
36	30.60	3.83	83.49	3.49
37	30.43	3.03	82.86	3.40
38	30.80	3.37	82.43	3.51
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PRODUCTION TECHNOLOGY FOR ORGANIC SWEET POTATO

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ABSTRACT

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ABSTRACT

The present investigation entitled "Production technology for organic sweet potato" was undertaken at College of Agriculture, Vellayani to develop an organic production package involving sources of organic manure, its levels and bioinoculant and work out the economics of cultivation. The field study was conducted in the Instructional farm attached to college from August 2010 to November 2010. The treatments consisted of factorial combinations of three sources of organic manure (farmyard manure, poultry manure and coir pith compost) , two levels of nutrients as organic manure (100% POP recommendation of nutrient as organic manure and 75% recommendation) and two levels of bioinoculant (with bioinoculant and without bioinoculant). The trial was laid out in asymmetrical factorial design with three replications.

The sources of organic manure did not show any significant influence on growth characters like length of vine, number of branches, number of leaves and leaf area index. The levels of organic manure caused significant variation on the number of leaves and LAI. Inoculation with microbial consortium caused significant influence on LAI only at early growth stage of the plant.

Number and weight of tuber per plant of sweet potato were significantly varied due to sources of organic manure. Farmyard manure registered the highest value on number and weight of tubers. Levels of organic manures showed significant variation in number of tubers. Full recommended dose of organic manure registered the highest number of tubers but in the case of tuber weight, levels were not significant. The highest number and weight of tubers were noticed in treatments where no bioinoculant was applied.

The organic manures did not show significant influence on length and girth of tubers. Levels of organic manures showed significant variation on length and girth of sweet potato. Full recommended dose of organic manure registered higher length and girth of tuber than 75 % recommended dose. Application of bioinoculant caused higher length and girth of tuber than without bioinoculant.

Different source of organic manure, its levels and bioinoculant could not exert any significant variation in top yield of sweet potato. Sources organic manure and bioinoculant did not produce any significant difference in tuber yield. But the levels of organic manure were significant. The treatment 100 % recommended dose of organic manure registered more tuber yield than 75 % recommendation.

Total dry matter production and utilization index were significantly influenced by the interaction effect of organic manures and bioinoculant. Full recommended dose of nutrient as organic source with bioinoculant registered the highest total dry matter production. Application of FYM without bioinoculant recorded the highest utilization index.

Uptake of N and P were significantly influenced by organic manures. But K uptake did not vary among different organic manures. CPC registered a higher uptake of N and P when compared to other manures. The highest uptake of nutrients was registered by 100% recommendation of nutrients as organic manure. Application of bioinoculant showed significant effect on P uptake but it had no effect on N and P uptake.

Starch content was significantly influenced by organic manures, its levels and bioinoculant. FYM with 100 % recommended dose registered higher value than CPC and PM. Plants treated with bioinoculant (B_1) recorded higher starch content than without bioinoculant (B_2).

Levels of organic manure showed significant variation on sugar content. Higher levels of organic manure (100% recommended dose of organic manure) produced maximum sugar content than 75% recommended dose of organic manure. However no significant difference was observed among different organic manures, their levels and bioinoculant on organoleptic test.

Available N content of soil significantly varied due to sources of organic manure and its different levels. FYM with 100% recommended dose increased available N content of soil when compared to 75% recommended dose. Sources of organic manure had no effect on available P content and K content of soil. Full recommended dose of organic manures with application of bioinoculant recorded higher values for available K content of soil than 75% recommended dose.

The incidence of sweet potato weevil was not influenced by sources of organic manure, its levels and bioinoculant.

Poultry manure full recommendation without bioinoculant ($M_2L_1B_2$) recorded the highest BCR of 2.03 which was followed by farmyard manure full recommendation without bioinoculant (1.81). The lowest BCR of 0.92 was recorded by coir pith compost without bioinoculant at 75% recommended dose ($M_3L_2B_2$).

The present investigation revealed that all the nutrient sources tested in this experiment namely farmyard manure, poultry manure and coir pith compost were equally effective on the growth and yield of sweet potato. The full recommended dose of nutrient through organic manure was required for expressing the yield potential of this crop. The effect of bioinoculant at the present rate had no significant influence on growth and yield of sweet potato. Considering the economics, the organic production system was found economically feasible. Poultry manure at 100% recommended dose was the best treatment followed by FYM at 100% dose giving a BCR value of 2.03 and 1.81 respectively.