EVALUATION OF ORGANIC AND INORGANIC SOURCES OF NUTRIENTS ON YIELD AND QUALITY OF SNAKE GOURD

(Trichosanthes anguina L.)

By

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Thesis

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THIRUVANANTHAPURAM

1998

DEDICATED TO

My Beloved Parents

and Sisters

DECLARATION

I hereby declare that this thesis entitled "***Evaluation of organic and inorganic sources of nutrients on yield and quality of snake gourd (Trichosanthes anguina L.)*** " 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, associateship, fellowship or other similar title, of any other university or society.

Vellayani,

22-01-1998

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CERTIFICATE

Certified that this thesis entitled "***Evaluation of organic and inorganic sources of nutrients on yield and quality of snake gourd (Trichosanthes anguina L.)***" is a record of research work done independently by Ms. Phebe Joseph under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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PHEBE JOSEPH

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INTRODUCTION

1. INTRODUCTION

Attainment of food sufficiency to provide a healthy life to the human population is perhaps the greatest challenge before mankind in the 21st century. Vegetables play a vital role in the health and nutrition of people throughout the world. The food experts and nutritionists have realised and appreciated the food value of vegetables because of the low calorific value high contents of protein, vitamins and minerals. Recently our country was striving hard to achieve nutritional security because of the scare supply of vegetables.

India is the second largest producer of vegetables in the world next to China with a production of 46 MT from an area of 4.5 M ha. However there is a wide gap between the per capita availability of vegetables (135g day^{-1}) and minimum requirement of vegetables. (285g day^{-1}). The low per capita consumption of vegetable is mainly due to low production levels. By the year 2000 A. D. India's population is expected to be one billion requiring more than 110 MT of vegetables. Hence in India, with a large vegetarian population, production of vegetables need to be greatly augmented by the adoption of various technologies.

Snake gourd (*Trichosanthes anguina* L.) has captured a prominent position among the vegetables in Kerala due to its year round cultivation, export potential and nutritive value. It contains 94.1 per cent water, 4.4 per

cent carbohydrate, 0.5 per cent protein, 0.3 per cent fat, 0.7 per cent mineral matter, 0.035 per cent sulphur and 1601 IU of vit. A (Aykroyd *et al.*, 1958).

As far as Kerala is concerned, the extent of cultivated land is limited and hence we should exploit the potential of vegetable production fully through proper agronomic practices. Nutrient management by the continuous use of chemical fertilizers distroy the physical properties of the soil. Proper soil management without impairing soil health is a pre-requisite for achieving higher productivity from agricultural land (Anina, 1995). Organic farming is the pathway that leads to achieve sustainability in agricultural production. Organic farming play a key role in improving the physico-chemical and biological properties of soil. The use of organic manure will reduce the chances of crop failure to a large extent and improves the quality of agricultural produce. Hence, organically grown agricultural produces are preferred for their flavour, taste, nutritive value and extended shelflife.

India has a vast potential of manurial resources. Farmyard manure and poultry manure are the commonly used organic manures in agriculture. Because of the high cost and difficulty in transport of manures, especially farmyard manure and poultry manure, their usage is now very much restricted in our state. Since vermicompost is a potential organic manure that can be prepared in small farm holdings with family labour, its use can reduce the cost of cultivation substantially. This is not only economical but also will improve the physico-chemical and biological properties of the soil. Moreover vermicompost have a definite advantage over other organic manures in respect of quality and shelf life of the produce (Khamkar, 1993).

The projected requirement of vegetable is at least two times than the present production. There is thus ample scope to widen the frontiers of scientific research for increasing productivity and quality of vegetable crops to assure the country of a better economic status and a healthy population. A planned development in the field of vegetable production will not only improve the nutritional quality of food for masses but can also meet the challenges of adequate supply to the growing population in India.

With this background the present study was taken up with the objectives of **assessing the potential of using farmyard manure, poultry manure, vermicompost and chemical fertilizers on yield and quality of snake gourd and the extent to which organic sources can substitute chemical fertilizers for vegetable cultivation.**

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Vegetables play a very important role in the human diet. They are essential for a balanced diet and maintenance of good health. But in India vegetable husbandary is not yet properly developed and we must increase the vegetable production to meet the growing demand. Application of manures and fertilizers are essential for increasing the production of vegetables. The experiments conducted in India and abroad showed that remarkable improvement in yield and quality of vegetables could be brought about by judicious and regular manuring.

The present study is aimed at estimating the potential of using farmyard manure, poultry manure, vermicompost and fertilizers on yield and quality of snake gourd (*Trichosanthes anguina* L.). The efficacy of organic and inorganic sources of nutrients on vegetable crops have been studied by several workers but the work regarding their influence on the yield and quality of snake gourd is meager. So the available literature on this aspect pertaining to crops other than snake gourd are also reviewed here.

2.1 Yield and yield attributing characters

2.1.1 Sex ratio

2.1.1.1 Effect of inorganic fertilizers

In small gherkin, Hall (1949) observed that increased nitrogen supply reduced the male female flower ratio from 6:1 to 4.58:1. Enhanced production

of female flowers with increased nitrogen supply was observed in cucurbits by a number of workers (Brantley and Warren 1958; 1960a and 1960b and Pustgarvi, 1961). On the other hand Pandey and Singh (1973) found that nitrogen at 50 or 100 kg ha^{-1} increased pistillate and staminate flowers, number of fruits as well as yield with out affecting the ratio of female to male flower in bottle gourd.

The effect of nitrogen fertilizers on sex expression and yield of summer squash was studied under field conditions during spring and fall season by Mallop and Basher (1985). They found that the most effective rate of nitrogen was 160 kg ha^{-1} which lowered the position of first pistillate flower and increased the number of pistillate flowers per plant. Nair and Peter (1990) reported that application of higher levels of inorganic fertilizers showed wider sex ratio.

2.1.1.2 Effect of organic sources

In water melon, vigorous growth and increased number of flowers were observed when treated with vermicompost (Ismail *et al.* 1991).

2.1.1.3 Effect of combination of organic sources and inorganic fertilizers

Application of chemical fertilizers in the absence of farmyard manure retarded the formation of vegetative organs and subsequently the reproductive organs and resulted in lower flower production. (Cerna, 1980 and Valsikova and Ivanic, 1982).

influenced by nitrogen fertilization. Thomas (1984) reported an increase in mean length of the bitter gourd fruits by the application of organic and inorganic combination.

2.1.4.2 Weight of fruit

Srinivas and Doijode (1984) reported progressive increase in fruit weight in muskmelon with increase in nitrogen levels upto 100 kg ha^{-1}. In water melon maximum weight of fruits was obtained from lines treated with 70 kg N ha^{-1}, 35 kg P_2O_5 ha^{-1} and 50 kg K_2O ha^{-1} (Deshwal and Patil, 1984).

2.1.4.3 Number of fruits

Khan and Suryanarayana (1977) summarising the results of the manurial experiments on chillies, reported that pod number was highest with 120 kg N ha^{-1}. Similar results were also reported by Chougule and Mahajan (1979) and Joseph (1982).

Singh *et al.* (1983) obtained maximum number of fruits and maximum diameter of fruits in roundmelon at 75 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1}. Shukla *et al.* (1987) reported that the number of fruits $plant^{-1}$ was significantly influenced by varying levels of nitrogen. Similar results were also noted in chillies by Singh and Srivastava (1988); John (1989); Natarajan (1990); Ajaykumar and Thakral (1993) and Lata and Singh (1993).

Riverra (1986) from Philippines reported that amargoso or bitter gourd plants grown in soil medium containing 75 per cent earth worm cast produced higher bi-weekly growth increment, larger and more fruits. A trial conducted

2.1.2 Fruit set

Maynard (1962) observed an increasing trend in setting percentage of the fruits by the application of nitrogen. According to Mohamed (1968), there was an increased fruit setting by the application of nitrogen at 75 kg ha^{-1} over a rate of 25kg ha^{-1}. Significant increase in setting percentage by the application of gradual doses of nitrogen was reported by Joesph (1982). Response of pumpkin to potash fertilization showed that, fruit set was decreased in sandy soil at a low rate of 56 kg N ha^{-1} and 112 kg K ha^{-1} (Swaider *et al.*, 1994).

2.1.3 Days for first fruit picking

Brantley and Warren (1960a) reported that heavy application of nitrogen promoted early fruit maturity. Studies conducted by Singh *et al.* (1982) observed that, maximum number of days taken for fruit maturity in tinda was at lowest levels of nitrogenous fertilizers. Application of 100 kg nitrogen, 60 kg phosphorus and 60 kg potassium significantly increased the early fruit maturity in muskmelon (Singh *et al.* 1995).

2.1.4 Fruit characters

2.1.4.1 Length of fruit

Application of gradual doses of nitrogen upto 75 kg ha^{-1} increased the length and girth of the pods in chilli (Joseph, 1982). Dod *et al.* (1983) also observed an increase in length of the chilli fruits with increased N levels. However according to Mohamed (1968), the length of chilli pods were not

influenced by nitrogen fertilization. Thomas (1984) reported an increase in mean length of the bitter gourd fruits by the application of organic and inorganic combination.

2.1.4.2 Weight of fruit

Srinivas and Doijode (1984) reported progressive increase in fruit weight in muskmelon with increase in nitrogen levels upto 100 kg ha^{-1}. In water melon maximum weight of fruits was obtained from lines treated with 70 kg N ha^{-1}, 35 kg P_2O_5 ha^{-1} and 50 kg K_2O ha^{-1} (Deshwal and Patil, 1984).

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Riverra (1986) from Philippines reported that amargoso or bitter gourd plants grown in soil medium containing 75 per cent earth worm cast produced higher bi-weekly growth increment, larger and more fruits. A trial conducted

by Mesina (1986) in Philippines revealed that application of 10 t cattle dung ha^{-1} along with 120 kg N ha^{-1} as chemical fertilizer increased the number of fruits per plot.

2.1.5 Fruit yield

2.1.5.1 Effect of inorganic fertilizers

Studies conducted by Padda *et al.* (1968) obtained most profitable yield of muskmelon by the application of 56 kg N ha^{-1}.

Significant increase in fruit weight and yield by nitrogen application in muskmelon was reported by Jassal *et al.*, 1970.

For pumpkin and snake gourd the optimum doses of NPK fertilizers were 80 : 30 : 60 and 40 : 30 : 30 kg ha^{-1} respectively as reported by Sreenivasan and Chockalingam (1973).

Sundarajan and Muthukrishnan (1975) obtained higher yield in CO-2 pumpkin by the application of 40 : 40 : 80 kg NPK ha^{-1}.

Nitrogen nutrition is important in watermelon production and highest yield was reported with 100 kg N ha^{-1} (Bhosale *et al.*, 1978).

A single application of N was reported to have more beneficial effect than topdressing, on fruit yield of cucumber (Ishkaev and Ibragimov, 1980).

Rajendran (1981) suggested that the response to nitrogen was quadratic in the case of pumpkin and the economic levels were worked out to be 71 kg N

ha^{-1} and 50 kg P_2O_5 ha^{-1}.

Highest number of fruits $plant^{-1}$, fruit weight per vine and fruit quality in muskmelon was reported from plots receiving nitrogen at the rate of 50 kg ha^{-1} and P_2O_5 at the rate of 37.5 kg ha^{-1} (Randhawa *et al.*, 1981).

A 3 x 3 x 3 factorial experiment with N (0,60, 120 kg ha^{-1}), P_2O_5 (0,45,95 kg ha^{-1}) and K_2O (0,45, 90 kg ha^{-1}) was laidout to find the optimum and economic levels of the above nutrients for maximising fruit yield in oriental pickling melon. Response to nitrogen was observed to be quadratic and the optimum level was calculated as 96.6 kg ha^{-1} and the economic level as 45.38 kg ha^{-1}. The P_2O_5 application produced no significant effect on melon for different characters studied. Response to K_2O was linear (Hussan *et al.*, 1984).

Lingaiah *et al.* (1988) reported that, nitrogen at 80 kg ha^{-1}, P_2O_5 at 30 kg ha^{-1} and K_2O at zero level recorded highest yield in bitter gourd in coastal regions of Karnataka.

Satish and Arora (1988) noticed that in sponge gourd 50 and 20 kg ha^{-1} of N and P respectively gave the maximum number of fruits and more weight of fruits $plant^{-1}$ in the early and total yields.

Haris (1989) reported that in snake gourd, response to nitrogen was linear upto 90 kg ha^{-1} and an optimum level could not be arrived at and in the case of P_2O_5 and K_2O there was no significant effect on yield beyond the lowest level tried. i.e. 25 kg each of P_2O_5 and K_2O ha^{-1}.

Mary and Balakrishnan (1990) observed that increase in nitrogen application increased the yield of chilli. Similar results were reported by Thiagarajan(1990); Jayaraman and Balasubramanian (1991); Ahmed and Tanki (1991); Pandey *et al.* (1992); Prabhakar and Naik (1993); Subbiah (1993) and Gulati *et al.* (1995).

Csermi *et al.* (1990) obtained best results in seed crop of cucumber with 180 kg ha^{-1} of K.

Studies conducted by Vijayakumar *et al.* (1992) revealed that application of 12 : 24 : 12g of NPK pit^{-1} and a spacing of 2 x 2.5 m were optimum for getting higher seed yield in snake gourd.

Results of studies have shown that among the macronutrients, nitrogen is the key nutrient to increase the seed yield as it exhibits a higher positive response in bhindi (Fagaria *et al.*, 1993).

Trials on irrigation and fertilizer levels for cucumber conducted by Yingjajaval and Markmoon (1993) revealed that for optimum yield, N level of 10 kg rai^{-1} and K level of 5 kg rai^{-1} (I rai = 1600 m^2) were adequate.

Rajput *et al.* (1993) reported that the application of 75 and 100 kg K_2O ha^{-1} gave significantly higher yield over 50 kg K_2O ha^{-1} in water melon. But the yield difference between 75 and 100 kg K_2O ha^{-1} was statistically nonsignificant.

2.1.5.2 Effect of organic sources

Rawankar *et al.* (1984) revealed that application of farmyard manure produced significantly higher seed cotton yield by 41.4 per cent over the control. Incorporation of composted coir-pith along with farmyard manure (5 t ha^{-1}) into the soil one day prior to transplanting gave the highest fruit yield (19t ha^{-1}) followed by 20t ha^{-1} coirpith (16t ha^{-1}) and the lowest in control plot (11t ha^{-1}) which were treated with neither farmyard manure nor coirpith (Ahmed, 1993).

A study on the optimum level of poultry manure requirement for cauliflower by Singh *et al.* (1970) revealed a progressive increase in growth and yield of cauliflower when the doses were increased from 0 to 169.6q ha^{-1}. In lettuce, poultry manure applied at 0, 20 and 40m^3 ha^{-1} either as entire basal or in splits, increased the yield from 0.66 to 0.88 and 0.90 kg $plant^{-1}$ (Anez and Tavira, 1984). Studies conducted by James *et al.* (1993) with broiler litter at different levels i.e. 4.8t ha^{-1}, 9.5t ha^{-1} and 19t ha^{-1} to snap beans revealed that broiler litter at the rate of 4.8t ha^{-1} was as effective as the commercial fertilizer. The broiler litter applied at higher dose didn't lower the yield.

Sheshadri *et al.* (1993) conducted an experiment to study the comparative effect of vermicompost, farmyard manure and fertilizers on the yield of chilli. The results showed that the yield of dry chillies obtained from vermicompost applied plot was higher than control and farmyard manure applied plot and lower than the fertilizer treated plot. But the yield of fresh

chilli was maximum in the vermicompost treated plots compared to other treatments. The capsicum yield in vermicompost treated plot was 16t $acre^{-1}$ compared to chemical fertilizer applied plots (18t $acre^{-1}$). But tomato grown after chilli gave yields similar to that of fertilizer treated plots (Desai, 1993). Gunjal (1993) found an increase in fruit yield to the tune of 40 per cent and 36 per cent due to the application of chemical fertilizers and vermicompost respectively over zero level. Barve (1993) reported the superiority of vermiculture farming in grape cultivation when compared to chemical farming. Phule (1993) studied the effect of vermiculture in sugarcane and reported that treatment with vermicompost yielded 125t ha^{-1}. While the control experiment with chemical fertilizer and farmyard manure yielded 100 and 75t ha^{-1}. Dharmalingam *et al.* (1995) studied the effect of vermicompost pelleted soybean seeds and reported 16 per cent increase in yield over non-pelletted seeds.

2.1.5.3 Effect of combination of organic sources and inorganic fertilizers

In an experiment with inorganic fertilizers and organic manures like farmyard manure and groundnut cake, Chinnaswammy (1967) reported that the mixture of organic manures and inorganic fertilizers gave better results than organic manure given alone.

Ivanov and Surlekov (1975) showed that cucumber crop receiving a basal dose of 30 t farmyard manure ha^{-1} alongwith N at 100 and 70 kg ha^{-1} raised the yield by 28.1 and 25.6 per cent respectively compared with untreated control.

In a two year study with cabbage cv. Slava Gribovskaga 231, Lucknik (1975) noted maximum yield by the application of 40t farmyard manure with NPK at the rate of 90 : 90 : 60 kg ha^{-1}, compared to NPK alone.

For a successful crop of bitter gourd, Katyal (1977) suggested 50t ha^{-1} farmyard manure and 100 kg ha^{-1} of ammonium sulphate.

Application of chemical fertilizers in the absence of farmyard manure retarded the formation of vegetative organs and subsequently the reproductive organs. Farmyard manure favourably affected the vegetative mass, dry weight, plant height, rate of dry matter increment per unit leaf area and hence the photosynthetic yield (Cerna, 1980 and Valsikova and Ivanic, 1982).

Subbiah *et al.* (1983) reported that the yield of brinjal fruit was significantly influenced by the level of farmyard manure (0, 12.5, 25 and 37.5t ha^{-1}) but not by the levels of fertilizers (0, 50, 100 and 150 per cent of the recommended dose) or by the interaction between farmyard manure and inorganic fertilizers. Application of 12.5t ha^{-1} of farmyard manure recorded the highest yield of 54.28t ha^{-1}. Among the inorganic fertilizer levels 50 per cent of the recommended dose recorded the highest yield of 50.89t ha^{-1}. A combination of 12.5t ha^{-1} farmyard manure and 50 per cent recommended dose of fertilizer was found to be beneficial for improving yield.

Nair and Peter (1990) reported highest yield in chilli with 15t farmyard manure and 5 : 40 : 25 kg NPK ha^{-1} in the three season trial, when compared to farmyard manure alone or inorganic fertilizers alone.

Subbiah and Sunderarajan (1993) found that combined application of 12.5t ha^{-1} of farmyard manure alongwith recommended dose of macronutrients and 25 kg Zn SO_4 ha^{-1} in bhindi was better than farmyard manure alone or combination of 25t ha^{-1} farmyard manure with the recommended dose of fertilizers with or without micronutrients.

Minhas and Sood (1994) reported that farmyard manure application significantly increased the crop yields. Superimposition of farmyard manure over the inorganic fertilizers had a spectacular effect on crop yields.

Phosphorus application to an onion crop grown on an alfisol increased bulb yield and P uptake. However incorporation of 10t farmyard manure ha^{-1} along with P, further improved bulb yield and P uptake (Sharma and Raina, 1994).

Onion was grown in pots filled with Sandy loam soil amended with N, P, Zn and farmyard manure. The highest bulb yield (50.6g pot^{-1}) was obtained from plants fertilized with farmyard manure 10t ha^{-1}, 40 kg N and 60 kg P ha^{-1} (Singh *et al.*, 1995).

Singh *et al.*(1973) conducted experiment on poultry manure in potato and observed a progressive increase in the growth and tuber yield of potato when the level of N in the form of poultry manure was increased from 80 to190 kg ha^{-1} in the soil. A combination of 80 kg N through poultry manure and 80kg N through inorganic fertilizers gave significantly better growth and yield, which was the most economical dose over all the treatments and control

followed by farmyard manure in combination with fertilizers.

Mina (1986) reported that application of poultry manure alone and in combination with 14:14:14 NPK fertilizer mixture irrespective of rates significantly increased the yield of musk melon.

A trial conducted by Rala and Garcia (1992) in upland rice revealed that application of 50 per cent nitrogen as chicken manure and 50 per cent nitrogen as inorganic sources produced higher yield of rice.

An increase in fruit yield to the tune of 40 per cent and 36 per cent due to the application of chemical fertilizers and vermicompost respectively over the control of nutrient application was reported by Gunjal (1993).

Ismail *et al.* (1993) conducted a comparative evaluation of vermicompost, farmyard manure and fertilizers on yields of bhindi and water melon and observed an increase in yield in all the cases with vermicompost.

Vermicompost along with POP recommendations of inorganic fertilizers increased yield by 21.1 per cent and 19 per cent in bitter gourd and cowpea respectively. (Jiji *et al.*, 1996).

Ushakumari *et al.* (1996) conducted an experiment to study the seasonal response of bhindi to vermicompost. The results showed that when cattle manure was substituted by vermicompost in package of practice recommendations of Kerala Agricultural University for bhindi, the yield of green vegetable obtained was 1.05 per cent more.

Highest yield of chilli i.e. 8.5t ha^{-1} was obtained for the treatment with vermicompost 25t ha^{-1} and NPK fertilizers at 75 : 40 : 25 kg ha^{-1} (Rajalakshmi, 1996). The same combination in tomato gave 10.8t ha^{-1} of fruits (Pushpa, 1996).

In the case of radish, spinach and green peas, yields were better with 50 per cent of the recommended dose of NPK through chemical fertilizers and the rest through vermicompost (Jambhekar, 1996).

2.2 Growth characters

2.2.1 Effect of inorganic fertilizers

Mc collum and Miller (1971) observed maximum dry matter production at 48 kg P_2O_5 ha^{-1} and 91 kg K_2O ha^{-1} in pickling cucumber.

Dry matter content of leaves, branches and fruits were significantly influenced by higher and medium doses of nitrogen application (Chougule and Mahajan, 1979) in chilli.

Rajendran (1981) reported that total dry matter content of pumpkin was not significantly influenced by potassium application and that total dry matter production at 60 days after sowing and at harvest was increased with increasing levels of N.

Thomas (1984) reported increased leaf area index and dry matter production with N upto 60 kg ha^{-1} and P_2O_5 upto 30 kg ha^{-1} in bitter gourd. Hedge (1987) observed the same in watermelon upto 120 kg N ha^{-1}.

2.2.2 Effect of organic sources

Application of farmyard manure recorded higher vegetative mass, dry weight, plant height and rate of dry matter increment per unit leaf area (Cerna, 1980 and Valsikova and Ivanic, 1982) in capsicum.

2.2.3 Effect of combination of organic sources and inorganic fertilizers

Jose *et al.* (1988) found that in brinjal among organic and inorganic forms of N, half (50 kg) as poultry manure and remaining half (50 kg) as urea increased the dry matter production.

2.3 Soil characters

2.3.1 Soil reaction (pH)

2.3.1.1 Effect of inorganic fertilizers

Application of acid forming fertilizers decreases the pH of the soil and deteriorate the soil productivity (Tisdale and Nelson, 1993 and Patiram and Singh, 1993).

2.3.1.2 Effect of organic sources

Olsen *et al.* (1970) reported that addition of manures increased the soil pH. However in a permanent manurial experiment conducted at Pattambi, pH was observed to be unaffected by the application of organic manure (Kurumthottical, 1982).

Farmyard manure application resulted in lowest acidity due to the decrease in exchangable and soluble AI in the soil (Nambiar, 1994 and Patiram, 1996).

The calciform glands in worms fix $CaCo_3$ and prevent any fall in pH of the soil (Kale and Krishnamoorty, 1980 and Wallwork, 1983).

Lee (1985) observed that, the application of vermicompost raised the pH of the soil. Wormcasts have a pH near to neutral range than the surrounding soil and the possible factors that act on soil pH may be excretion of NH_4^+ ions and excretions from calciferous glands of the earth worms.

Earth worms significantly influence the pH of the humus and the effect of earth worm on the soil pH was probably due to an increase in the concentration of ammoniacal nitrogen (Binkley and Richter 1987 and Haimi and Huhta, 1990).

Bhawalkar and Bhawalkar (1993) opined that earth worms participate in soil forming processes by influencing the soil pH.

Hulugalle and Ezumah (1991) reported that pH of the earth worm cast was higher than that of non-ingested soil. Similar result was also reported by Basker *et al.* (1994).

2.3.2 Organic carbon

2.3.2.1 Effect of inorganic fertilizers

Alexander (1977) reported that inorganic fertilizer application increased the organic carbon content of the soil due to the assimilation of CO_2 from the atmosphere by the microorganisms present in the soil.

2.3.2.2 Effect of organic sources

Havanagi and Mann (1970) reported that farmyard manure application increased the organic carbon content of the soil.

Gattani *et al.* (1976) conducted a permanent manurial experiment at Rajasthan on wheat - bajra cropping sequences and reported that continuous use of farmyard manure had increased the organic carbon content of the soil to a good extent. Similar result was also reported by Khaleel *et al.* (1981).

Carbon content of soil increased from 0.91 to 158 per cent by the continuous application of organic manures and among the organic manures, farmyard manure had a significant influence (Udayasoorian *et al.*, 1988).

Gupta *et al.* (1988) opined that irrespective of the levels of farmyard manure used, carbon content was increased upto 52 days after application and there after it decreased.

By introducing earth worm and applying organic manures in the red arid soil, Shuxin *et al.* (1991) reported that, the organic carbon in the soil increased from 0.5 to 0.6 per cent.

Gaur and Singh (1995) stated that earth worm mediated conservation system is a mechanism in which vermicasting can replinish the organic carbon content of soils.

2.3.3 Cation exchange capacity

2.3.3.1 Effect of inorganic fertilizers

Application of higher levels of inorganic fertilizers resulted in increasing cation excahange capacity. The exchangeable cations are replaced by NH_4^+ and Mg^+ ions and the cation exchange sites become saturated with NH_4^+ and K^+ ions (Tisdale and Nelson, 1993).

2.3.3.2 Effect of organic sources

Miller and Donahue (1992) reported that application of organic matter increased the cation excahange capacity of the soil.

2.3.3.3 Effect of combination of organic sources and inorganic fertilizers

Increase in cation excahange capacity by the application of farmyard manure alone or in combination with fertilizers or lime and a reduction in cation excahange capacity by the application of fertilizers alone was noticed in the permanent mannurial experiment conducted by Sharma, *et al.* (1988) at Chotanagpur.

2.3.4 Water holding capacity

2.3.4.1 Effect of inorganic fertilizers

Sarkar *et al.* (1989) suggested that continuous application of inorganic fertilizers increased bulk density and decreased water holding capacity. Similar result was also reported by Nambiar (1994).

2.3.4.2 Effect of organic sources

Das *et al.* (1966) observed that water holding capacity of soil was improved due to the continuous use of farmyard manure to a greate extent and this was due to the improvement of soil structure in the presence of farmyard manure. In a long-term manurial experiment conducted by Havanagi and Mann (1970) under dry farming conditions in Delhi, reported that continuous application of farmyard manure and use of green manures decreased the bulk density of soil and increased the water stable aggregates. The beneficial effect of farmyard manure in increasing the water stable aggregates was also reported by Kanwar and Prihar (1982) and Prasad and Singh (1980). Rabindra *et al.* (1985) opined that farmyard manure has favourable effect on soil stable aggregation compared to fertilizers. Sarkar *et al.* (1989) suggested that continuous application of farmyard manure increased water holding capacity due to the improvement in porosity and soil aggregation. From a long term field experiment in England, Rose (1990) reported that continuous application of farmyard manure increased the total porosity.

Vijayalakshmi (1993) reported that soil physical properties such as porosity, soil aggregation and conductivity of wormcast applied soil was higher when compared to no worm cast amended soil. Body exudates of earth worm improved the water holding capacity of soil and promoted the establishment of microorganisms (Kale, 1994).

2.3.4.3 Effect of combination of organic sources and inorganic fertilizers

Continuous application of farmyard manure in combination with chemical fertilizer was proved to be beneficial in increasing the water holding capacity of the soil (Manickam and Venkitaraman, 1972 and Prasad and Singh, 1980). Similar result was reported by Bhriguvanshi (1988). Patnaik *et al.* (1989) conducted long-term fertilizer experiment with wet land rice and found that available water content was increased by the application of NPK fertilizer together with compost or farmyard manure. In a long term fertilizer trial in sandy loam soil under soybean - wheat cropping sequence, Bhatnagar *et al.* (1992) noticed that the water holding capacity of the soil was increased by 26.5 and 2.3 per cent of the initial value under N with farmyard manure and NPK with farmyard manure respectively.

2.3.5 Soil available NPK

2.3.5.1 Effect of inorganic fertilizers

In a long term fertilizer trial on paddy - wheat cropping sequence, addition of higher doses of nitrogen showed more depletion of available P both in the absence and presence of farmyard manure (Kaushik *et al.*, 1984). Srivastava (1985) observed that increased use of nitrogen as fertilizer decreased total N, available P and K status of soil.

2.3.5.2 Effect of organic sources

Havanagi and Mann (1970) reported that farmyard manure application increased available P_2O_5 content of the soil but not the total nitrogen in a long term fertilizer experiment under dry farming conditions in Delhi. Incubation

studies conducted by Debnath and Hajra (1972) observed that available K content increased upto sixteenth day, decreased on thirtieth day followed by an increase and then stabilized when farmyard manure and daincha were added.

In wheat- maize rotation, available N and P_2O_5 content of the soil increased with continuous use of farmyard manure(Prasad and Singh, 1980). Available K increased slightly with the addition of farmyard manure for a long time (Sharma *et al.*, 1984). An increase in available N content of soil upto 20 days after farmyard manure application and a decrease thereafter was noticed in a long-term field experiment with wheat (Gupta *et al.*, 1988). Sharma and Sharma (1988) compared the effect of farmyard manure and green manure and inferred that there was a build up of available K which was maximum with the use of farmyard manure than greenmanure. Available phosphorus content of soil was significantly increased with the incorporation of farmyard manure. Dhanorkar *et al.* (1994) reported that continuous use of farmyard manure raised the available K by 1.3 to 5.4 folds over control.

2.3.5.3 Effect of combination of organic sources and inorganic fertilizers

Kurumthottical (1982) revealed that application of nitrogen and phosphorus in combination with organics had resulted in higher content of available nitrogen and phosphorus as compared to inorganic fertilizers alone. Combination of organic manure with inorganic fertilizers had a moderating effect on soil reaction particularly under acidic soil and improvement in sustained availability of N, P, K, S and the micronutrients particularly zinc (Nambiar and Abrol, 1989).

2.4 Nutrient uptake studies

2.4.1 Effect of inorganic fertilizers

Mc Collum and Miller (1971) reported that the total uptake of N, P_2O_5 and K_2O by pickling cucumber was 100, 13.34 and 161.2 kg ha^{-1} respectively and estimated nitrogen, phosphorus and potassium removed by harvested fruits were 44.5, 6.7 and 61.1 kg ha^{-1} respectively.

In muskmelon, the percentage of NPK in the plant tissue was highest at its highest level of application (Jassal *et al.*, 1972).

Tesi *et al.* (1981) reported that with adequate N, P and K application, the uptake of N, P and K by summer squash was 170.5, 71.2 and 394.4 kg ha^{-1} respectively.

Total uptake of nitrogen by chilli was significantly increased by increased levels of N, P and K. Similar trends were also noted in the uptake of P and K (Joseph, 1982).

Subba Rao (1989) reported that in cucumber, the different nitrogen levels significantly increased the percentage of nitrogen in all the stages. Nitrogen uptake was significantly increased by the applicaiton of higher levels of nitrogen. Uptake of nitrogen, phosphorus and potassium also showed marked increase under higher levels of potassium. However, Russo (1991) opined that the levels of nutrients in leaves and fruits did not respond to further application. At full dose of the recommended N and P, chilli crop had recorded the highest N, P and K uptake (Subbiah, 1994).

2.4.2 Effect of organic sources

Concentration of potassium in seedling tissues of vegetable crops like snapbean, cucumber, radish, spinach and tomato increased progressively as the levels of mushroom spent compost increased (Sherry Hsiao - Lei Wang *et al.*, 1984).

An experiment conducted by Shuxin *et al.* (1991) reported that 30 to 50 per cent increase in nitrogen uptake in vermicompost applied sugarcane.

Application of farmyard manure was beneficial in enhancing the uptake of phosphorus by potato and maize (Minhas and Sood, 1994).

2.4.3 Effect of combination of organic sources and inorganic fertilizers

Ramaswami and Raj (1972) in a pot culture experiment with rice CO-32 strain as a test crop observed that, phosphorus and potassium uptake by straw were enhanced by phosphorus and green manure application. Highest P per cent of 0.319 was observed in fruits obtained from plots treated with 80 kg poultry manure along with 80 kg fertilizer than all other combinations (Singh *et al.*, 1973). In soybean, uptake of nitrogen at flowering and harvesting stages were significantly enhanced due to the increased level of P and farmyard manure (Nimje and Seth, 1988).

Sharma *et al.* (1988) noticed higher uptake of N by rice with the application of organic manure along with increasing doses of inorganic nitrogen.

Zhao Shi-wei and Huong Fu Zhan (1988) demonstrated that chemical fertilizer application, along with vermicompost increased the nutrient uptake and net production of wheat and sugarcane.

Organic manures applied in conjunction with optimal NPK dose resulted in highest potassium uptake by crops (Sarkar *et al.* 1989 and Singh and Tomar, 1991).

The uptake of nitrogen and phosphorus was greater in the treatment combination of half inorganic and half organic, particularly from poultry manure. The highest K uptake was observed in plants applied with equal quantities of organic and inorganic nitrogen. (Abusaleha, 1992).

2.5 Quality

Quality is the sum total of attributes which can partly be measured objectively (eg. size, shape, constituents) and partly be valued subjectively (eg. flavour).

2.5.1 Moisture

Singh *et al.* (1970) conducted studies on poultry manure in relation to vegetable production. He observed slight increase of moisture content in the curd of cauliflower with increasing levels of poultry manure. Highest moisture content in the curd was found when the plants were manured with 169.6 q ha^{-1} of poultry manure.

2.5.2 Total soluble solids

An experiment conducted at Gujarat Agricultural College revealed that highest total soluble solids in radish was reported at 90 kg N ha^{-1} and 30 kg P ha^{-1} (Joshi and Paul, 1988). Rao and Srinivas (1990) analysed the effect of different levels of K (0, 60 kg ha^{-1}) on petiole and leaf nutrients and their relationship to fruit yield and quality in muskmelon cv. Haramadhu. They found that K markedly increased the fruit yield and total soluble solid content. Similar result was also reported by Rao (1994) in cauliflower. Inorganic fertilizer application showed a significant effect on total soluble solid. The total soluble solid content of the fruit was increased with increased nitrogen doses (Singh *et al.*, 1995).

2.5.3 Ascorbic acid (Vit C)

2.5.3.1 Effect of inorganic fertilizers

Vegetables are rich in Vit. C. Vit. C is concerned fundamentally with the formation of intercellular cement substances and increase the power of resistance in animals. Fritz and Habben (1972) reported that potassium fertilization increased Vit.C content in vegetables. Studies conducted by Krynska *et al.* (1976) with N at 80, 160 and 240 kg ha^{-1} and K at 120, 240 and 360 kg ha^{-1} in cucumber revealed that vit.C content of fruits increased with increasing N doses along with increase in yield of fruits but nitrogen rates had adverse effect on the fruit quality.

Khan and Suryanarayana (1977) found that ascorbic acid content in fruit was increased by nitrogen application to a maximum of 54.5 mg 100^{-1}g.

Joseph (1982) observed that incremental doses of nitrogen and phosphorus significantly increased the ascorbic acid content of fruits. But K has no significant effect on ascorbic acid. Dod *et al.* (1983) reported profound effect of nitrogen fertilization on ascorbic acid content.

Further studies by Amrithalingam (1988) indicated that application of 87.5 kg N ha^{-1} recorded maximum ascorbic acid content in chilli. Increased doses of potassium fertilizers resulted in an increased ascorbic acid content in chilli fruits (Uddin and Begum, 1990).

In a study on the influence of irrigation, N and P, the ascorbic acid content of green chillies and red ripe chillies increased significantly with nitrogen at 87.5 kg ha^{-1} and potassium at 52.5 kg ha^{-1}. Ascorbic acid content in green and red ripe chilli was 100.6 and 114.82 mg 100^{-1}g respectively. This increased Vit.C, may be due to the enrichment of enzymatic activities for amino acid synthesis, under increased level of N. (Mary and Balakrishnan, 1990). Similar results were reported by Demirovska *et al.* (1992) and Lata and Singh (1993). According to Kaminwar and Rajagopal (1993) application of NPK at the rate of 100:75:100 kg ha^{-1} recorded the highest ascorbic acid content in chilli.

Vit.C is irregularly influenced by the amount of nitrogen. Contradictory results were also reported. Belichki (1988) observed that ascorbic acid content of chilli fruit decreased as the application of NPK increased.

2.5.3.2 Effect of organic sources

Application of poultry manure showed a slight increase in ascorbic acid content of cauliflower. The highest Vit.C content was obtained in the curds with 169.6 q ha^{-1} of poultry manure (Singh *et al.*, 1970). Kansal *et al.* (1981) opined that application of 20 t farmyard manure ha^{-1} increased the ascorbic acid content in spinach leaves. Studies conducted by Meier-ploeger and Lehri (1989) revealed that plants grown with compost produced fruits with higher Vit.C content.

2.5.3.3 Effect of combination of organic sources and inorganic fertilizers

Application of both organic and inorganic fertilizers resulted in high Vit.C content in cabbage (Luchnik, 1975).

2.5.4 Acidity

Fruit quality of tomato cv. Roma grown on red sandy loam soils of Tirupati during 1977-78 under different nutrient application revealed that titrable acidity was greater when two top dressing of potash, each at 30 kg ha^{-1} was applied (Narayana and Rama, 1978). Rao (1994) conducted a field experiment in red loam soils to find out the effect of K at 0, 50, 100, 150 and 200 kg K_2O ha^{-1} as KCl or K_2SO_4 on growth, yield and quality of tomato cv. Arka Saurabh, carrot cv. Early Nantes and cauliflower cv Aghani were examined and found that titrable acidity was increased as K increased. Gradual increase in acidity in banana fruits with increasing levels of nitrogen was observed by Mustaffa (1983) and Sindhu (1996).

2.5.5 Crude protein

2.5.5.1 Effect of inorganic fertilizers

Proteins are the body builders in animals. The influence of nitrogen fertilzation is strongest on the amount and quality of crude protein content in fruits.

Higher levels of nitrogen increased the protein content of the fruits due to the favourable effect of nitrogen on amino acid synthesis (Singh *et al.*, 1973 and Sujatha and Krishnappa, 1995).

2.5.5.2 Effect of organic sources

Singh *et al.* (1970) reported gradual increase in the protein content of the fruit with higher levels of poultry manure. Increase in the grain protein content of rice due to the application of Karanja and Mahua seed cake was reported by Sahrawat and Mukherjee (1977) and Sahrawat (1981).

Earth worm castings increased protein yield by 24 per cent in lettuce and 32 per cent in radish (Tomati *et al.*, 1990).

2.5.5.3 Effect of combination of organic sources and inorganic fertilizers

A combined application of farmyard manure and fertilizer nitrogen was found to significantly increase the protein content of grains in redgram (Muthuvel *et al.*, 1985), ragi (Chellamuthu, 1987) and wheat (Patel *et al.*, 1993) than when either applied alone.

2.5.6 Crude fibre

Crude fibre is a mixture of substances, which make up the frame work of plants and is composed of cellulose, hemicellulose and lignin of the cell walls, which is indigestable fraction. It swells up absorbing water and accelerate bowel movements in human beings.

Increase in crude fibre content of cassava tubers by the application of N and K was reported by Muthuswamy and Rao (1981).

Mani and Ramanathan (1981) reported that crude fibre content of bhindi fruit was significantly decreased by nitrogen fertilization. However, Remesan *et al.* (1996) observed significant increase in crude fibre content of arrowroot by the application of nitrogen. The highest level of nitrogen i.e. 150 kg ha^{-1} recorded maximum crude fibre content (1.13%).

2.5.7 Total sugar and Reducing sugar

Application of both organic and inorganic fertilizers resulted in high sugar content in cabbage (Luchnik, 1975). Almazov and Kholuyako (1990) found increased sugar content in tomato due to the application of NPK alone. Sujatha and Krishnappa (1995) conducted studies in potato to note the quality attributes of potato tubers influenced by different fertilizer levels. Highest reducing sugars were observed in treatment with 120 : 100 : 120 kg NPK ha^{-1} and 50 t ha^{-1} of farmyard manure.

2.5.8 Shelf life

2.5.8.1 Effect of inorganic fertilizers.

In oriental pickling melon (*Cucumis melo*), the organic form of manures showed a definite advantage over inorganic fertilizers in respect of storability, while the degree of rotting increased in treatments which received inorganic form of NPK (Kerala Agricultural University, 1987).

2.5.8.2 Effect of organic sources

Meier- ploeger and Lehri (1989) studied the quality of food plants grown with compost from biogenic waste. Composts were applied at various levels to tomatoes. NPK fertilizers, composted farmyard manure and commercial organic fertilizers were used for comparison. They found that storage quality and content of nutrients were improved by compost treatments. Considerable scientific data are being generated to show that the produce obtained with the use of vermicompost is nutritionally superior, tastes good, has good texture and hence better keeping quality (Lampkin, 1990). According to the report by Khamkar (1993) vermicompost can be well adopted for vegetable farming and vegetables with good keeping quality was obtained from vermi culture plots compared to chemical fertilizer applied plots.

2.5.8.3 Effect of combination of organic sources and inorganic fertilizers

Field experiments were conducted at College of Horticulture, Vellanikkara during March to July 1987 to study the effect of organic and inorganic fertilizers and their combinations on yield and storage life of chilli var. KAU. cluster. The number and weight of unmarketable fruits after 10

days of storage from harvest of green chillies increased with increasing rates of NPK along with farmyard manure (Nair and Peter, 1990).

Shanmugavelu (1989) pointed out that the application of a mixture of farmyard manure and inorganic fertilizer mixture was found to be best for firmness, storage life and keeping quality of tomato for a long time.

2.6 Economics of cultivation

Thomas (1984) opined that the bitter gourd crop responded well to NPK at the rate of 60 : 30 : 60 kg ha^{-1} along with 18 t ha^{-1} of farmyard manure producing maximum yield and net return. The economic optimum dose of nitrogen, phosphorus and potassium for chilli crop was 110 : 67 : 57 kg ha^{-1} respectively (John, 1989).

Arokiaraj and Kannappan (1995) studied the effect of organic waste on yield and economics of sorghum (CO-25) and reported higher straw yield and grain yield resulting in higher net returns and B:C ratio, by the application of farmyard manure 5 t ha^{-1}.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The present investigation was conducted to study the effect of vermicompost, poultry manure, farmyard manure and fertilizers on yield and quality of snake gourd. The details of the materials used and methods adopted are presented in this chapter.

3.1 Materials

3. 1. 1 Experimental site

The experiment was carried out in the Instructional Farm attached to the College of Agriculture, Vellayani situated at 8.5^0 N latitude, 76.9^0 E longitude at an altitude of 29 m above mean sea level.

3. 1. 2 Soil

Soil of the experimental site was lateritic red loam belonging to the Vellayani series. A representative soil sample was collected before the start of the experiment. This sample was air dried in shade, gravel and roots removed, gently powdered with a wooden plank and passed through a 2 mm sieve. The processed sample was subjected to laboratory analysis for their physico-chemical properties. The important physico-chemical properties of the soil and the methods adopted for the analysis are presented hereunder.

Soil characteristics of the experimental site

a. **Physical composition**

Sl. No.	Fraction	Content in soil (per cent)	Method
1.	Coarse sand	36.35	
2.	Fine sand	15.00	Bouyoucos Hydrometer method
3.	Silt	17.50	(Bouyoucos, 1962)
4.	Clay	30.00	

b. **Physico-chemical properties**

Sl. No.	Parameter	Value	Method
1	Soil reaction (pH)	4.90	Direct reading using pH meter (Elico-model L1. 120) in 1 : 2.5 soil water suspension (Jackson, 1973)
2	Cation exchange capacity (mol kg^{-1})	5.36	Ammonium saturation using neutral normal ammonium acetate (Jackson, 1973)
3	Organic carbon (Per cent)	0.43	Walkley and Black's rapid titration method (Jackson, 1973.)
4	Available N (kg ha^{-1})	228.00	Alkaline permanganate method (Subbiah and Asija, 1956)

5	Available P_2O_5 (kg ha^{-1})	40.38	Bray extraction and Klett summerson photoelectric colorimeter making use of chlorostannous reducing molybdo phosphoric blue colour in HCl system (Jackson, 1973)
6	Available K_2O (kg ha^{-1})	91.0	Neutral Normal ammonium acetate method (Jackson, 1973)
7	Water holding capacity (per cent)	29.89	Gupta and Dakshinamoorthy (1980)
8	Soil temperature (^0C) (mean of two weeks)	Minimum - 27.0 Maximum - 30.05	Direct-reading (at a depth of 15 cm) using Indian Meteorological Department (IMD) glass thermometer.

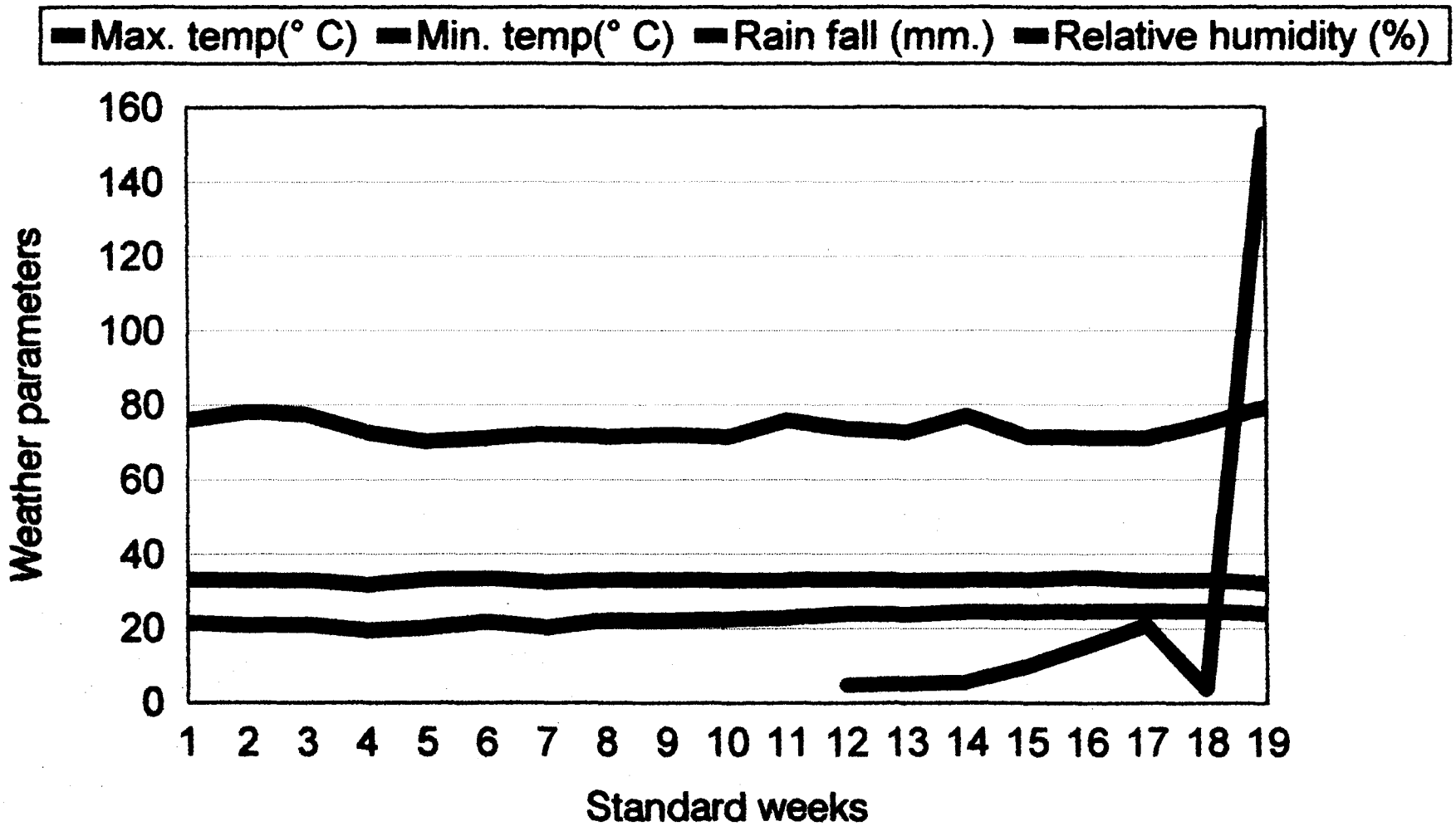
3. 1. 3 Cropping history of the field

The experimental area was previously cropped with a bulk crop of maize.

3. 1. 4 Season

The experiment was carried out during January to May 1997. The crop was raised as a summer crop.

Fig.1 Weather conditions (weekly means) during cropping period (January to May 1997)



3. 1. 5 Climate

A humid tropical climate prevailed at the experimental site. The data on various weather parameters viz. weekly rainfall, maximum temperature, minimum temperature and relative humidity during the cropping period are presented in Appendix. I and is graphically represented in Fig.1.

Climatic conditions were favourable for the satisfactory growth of the crop.

3. 1. 6 Variety

Snake gourd variety TA-19, released from the Kerala Agricultural University, Vellanikkara was used for this study. This is a high yielding variety with a duration of about 120 days. It produces medium sized fruits with dark green colour having white striations. The seed was obtained from the Instructional Farm, College of Agriculture, Vellayani.

3. 1. 7 Manures and fertilizers

Farmyard manure (0.50% N, 0.20% P, 0.50% K), poultry manure (1.5% N, 1.016% P, 0.43% K) and vermicompost (1.5% N, 0.48% P, 1.80% K) were used as organic sources and urea (46% N), mussouri rock phosphate (20% P_2O_5) and muriate of potash (60% K_2O) as the inorganic sources for N, P and K respectively.

3. 1. 8 Drip unit

A drip irrigation unit was installed in the field for irrigating the crop with a discharge rate of 4 litres hr^{-1}.

3.2 Methods

3. 2. 1 Design and layout

The experiment was laidout as a 3 x 3 + 3 factorial experiment in randomised block design with three replications.

The details of the layout were as follows:

Net plot size	- 4 x 4 = 16 m^2
Number of plants per net plot	- 8
Spacing	- 2 x 2 m
Number of blocks	- 3
Replications	- 3
Number of the plots per block	- 12
Total number of plots	- 36

The procedure followed for allocation of various treatments to different plots was in accordance with Yates (1964). The layout plan is shown in Fig.2.

3. 2. 2 Treatments

T_1	$M_1 F_1$	FYM + 1/2 NPK
T_2	$M_1 F_2$	FYM + 3/4 NPK
T_3	$M_1 F_3$	FYM + Full NPK (POP recommendation of KAU)
T_4	$M_2 F_1$	PM + 1/2 NPK
T_5	$M_2 F_2$	PM + 3/4 NPK
T_6	$M_2 F_3$	PM + Full NPK

T_7	$M_3 F_1$	VC + 1/2 NPK
T_8	$M_3 F_2$	VC + 3/4 NPK
T_9	$M_3 F_3$	VC + Full NPK
T_{10}		FYM + FYM to substitute full NPK
T_{11}		PM + PM to substitute full NPK
T_{12}		VC + VC to substitute full NPK

M_1 Farmyard manure (FYM) 25 t ha^{-1} **

M_2 Poultry manure (PM) 8.25 t ha^{-1} **

M_3 Vermicompost (VC) 8.25 t ha^{-1} **

F_1 1/2 NPK - 35 : 12.5 : 12.5 kg NPK ha^{-1}

F_2 3/4 NPK - 52.5 : 18.75 : 18.75 kg NPK ha^{-1}

F_3 Full NPK - 70 : 25 : 25 kg NPK ha^{-1}

T_{10} FYM + FYM to substitute full NPK

T_{11} PM + PM to substitute full NPK

T_{12} VC + VC to substitute full NPK

Additional treatments

FYM to substitute NPK - 14 t ha^{-1}

PM to substitute NPK - 4.7 t ha^{-1}

VC to substitute NPK - 4.7 t ha^{-1}

Fig. 2 Layout plan of the experimental field.

Replication I	T_{10}	T_5	T_{12}	T_3	T_7	T_4	T_8	T_{11}	T_9	T_2	T_6	T_1
Replication II	T_6	T_2	T_{11}	T_9	T_1	T_{12}	T_{10}	T_7	T_3	T_5	T_8	T_4
Replication III	T_8	T_4	T_7	T_3	T_6	T_1	T_9	T_5	T_{12}	T_2	T_{11}	T_{10}

T_1 - M_1F_1
T_2 - M_1F_2
T_3 - M_1F_3
T_4 - M_2F_1
T_5 - M_2F_2
T_6 - M_2F_3
T_7 - M_3F_1
T_8 - M_3F_2
T_9 - M_3F_3
T_{10}, T_{11}, T_{12}] Additional treatments

** Quantity of farmyard manure (FYM), poultry manure (PM) and vermicompost (VC) were computed on the basis of the percentage content of nitrogen (single nutrient basis) before the application of the manures.

3. 2. 3 Field culture

3. 2. 3. 1 Land preparation

The experimental field was dug twice, stubbles removed, clods broken and the field was laidout into blocks and plots. Pits of 60 cm diameter with a depth of 30 to 45 cm were taken in each plot at a spacing of 2 x 2 m.

3. 2. 3. 2 Manure and fertilizer application

Manures and fertilizers were applied as per the schedule of treatments. The entire dose of organic manures, phosphorus, potassium and half of nitrogen were applied as basal dressing. One fourth of nitrogen was applied 25 days after planting and remaining one fourth at 30 days after the first top dressing.

3. 2. 3. 3 Seeds and sowing

Plumpy seeds selected for planting were soaked in water overnight before sowing. Four seeds were planted per pit.

3. 2. 3. 4 After cultivation

At 15 days after sowing, the plant population was adjusted to two in each pit. Sticks of length 1.5 m were fixed in each pit and the plants were

allowed to trail on it. At 20 days after sowing, pandals at a height of 1.8 m were erected and the vines were trailed on the pandals regularly. Regular weeding operations were carried out to keep the plots free of weeds for the entire cropping period. Crops were irrigated every day with a drip unit, except on rainy days during the cropping period for one hour with a discharge rate of 4 litres pit^{-1} .

3. 2. 3.5 ***Plant protection***

Just after fruit set, fruit traps were set to protect the crop against fruit flies (*Dacus cucurbitae*). To prevent downy mildew and jassids infestation a mixture of mancozeb 0.2% and metacid 0.5% was sprayed prophylatically once in three weeks.

3. 2. 3. 6. ***Harvesting***

The crop was harvested at weekly intervals. A total of eleven harvests were taken over the entire cropping period. The fruits were harvested at vegetable maturity stage as judged by visual observations.

3. 2. 4. ***Observations***

The sample plants were maintained in each treatment and the following observations were recorded.

3. 2. 4. 1. ***Sex ratio***

The sex ratio was calculated based on observations at flowering and expressed as number of male flowers to female flower.

3. 2. 4. 2 ***Fruit set***

This was worked out by dividing the total number of fruits harvested per plot by the total number of female flowers produced per plot and percentage fruit set was worked out.

3. 2. 4. 3 ***Days for first fruit picking***

Duration from planting to first harvest of each treatment was recorded and expressed in days.

3. 2. 4. 4 ***Average fruit length***

All fruits harvested from the plots except those from last three harvests were selected for measuring the length of the fruit. The length of the fruit was measured from the stalk end to the tip of the fruit and expressed in cm.

3. 2. 4. 5 ***Average fruit weight.***

Weight of a single fruit was obtained by dividing the total weight of fruits per plot by the number of fruits and expressed in grams.

3. 2. 4. 6 ***Number of fruits per plant***

Number of fruits per plant was obtained by dividing total number of fruits per plot by number of plants.

3. 2. 4. 7 ***Yield***

Fruits were harvested at vegetable maturing stage and yield ha^{-1} was worked out.

3. 2. 4. 8 ***Harvest index***

Harvest index was worked out from the data on dry matter production by the fruits and vines as follows.

$$HI = \frac{\text{Economic yield}}{\text{Biological yield}} = \frac{\text{fruit yield}}{\text{fruit yield + vine yield}}$$

3. 2. 4. 9 ***Crop duration***

The period from planting to the final harvest was recorded and expressed in days.

3.2.5 Growth characters

3. 2.5. 1 ***Weight of roots per plant***

After the final harvest, sample plants from the net plot area were uprooted carefully, the roots were washed free of soil particles, dried in an oven at 80^0C and weight of the roots per plant was recorded and expressed in grams per plant.

3. 2. 5. 2 ***Dry matter production***

The fruits at each harvest and the vines at final harvest were separately chopped and oven dried to constant weight at 80^0C. The dry weight of plants recorded and expressed in grams per plant.

3. 2. 6. ***Analytical procedures***

3. 2. 6. 1 ***Soil analysis***

Soil samples were collected from each plot after the harvest of the crop. Composite samples collected from each plot were air dried, gently powdered, passed through a 2 mm sieve and analysed for soil reaction (pH), organic carbon (OC), cation exchange capacity (CEC), available N, available P and available K as per the standard analytical methods described earlier. Water holding capacity and soil temperature were also analysed as per the methods described earlier.

3. 2. 6. 2 ***Plant analysis***

The whole plant was analysed for nitrogen, phosphorus and potassium after final harvest. One fruit from each harvest was selected at random from each plot. The plant samples were collected after harvest from each plot. The plant and fruit samples were separately chopped and dried in an air oven at 80^0C until two successive weighings recorded equal weights.

Fruit samples at different harvests from the same plot were bulked. The samples were then ground to pass through a 0.5 mm mesh in a Wileymill. The required quantity of samples were then weighed out accurately in an electronic balance and analysed. The methods adopted for the chemical analysis are given below.

Sl. No.	Estimated character	Methods followed
1	N	Modified Microkjeldahl method (Jackson, 1973).
2	P	Nitric-perchloric-sulphuricacid(10:4:1) digestion and Klett summerson photoelectric colorimeter making use of vanadomoloybdate yellow colour in sulphuric acid medium. (Jackson, 1973).
3	K	Flame photometry. (Jackson, 1973).

3. 2. 7 Uptake studies

3. 2. 7. 1 Uptake of nitrogen, phosphorus and potassium

This was calculated by multiplying the dry weights of plants or fruits with the nitrogen, phosphorus and potassium content of the plant or fruits. The uptake values were expressed in kg ha^{-1}. Uptake of nitrogen, phosphorus and potassium by whole plant was determined by adding uptake values for plants and fruits.

3. 2. 8 Quality studies

The fruits collected from plants of different treatments at peak harvests viz. 5th, 6th and 7th harvests were used for quality analysis. Known weight of sample taken from top, middle and bottom of sample fruits were macerated in a blender and made upto a known volume. Aliquots taken from this were used for the analysis of acidity, total sugars, reducing sugars and ascorbic acid.

3. 2. 8. 1 ***Moisture***

A weighed quantity of the fruit sample was dried in an air oven at 105^0C and the loss of weight noted and expressed in per cent (A.O.A.C method, 1975).

3. 2. 8. 2 ***Ascorbic acid***

Ascorbic acid content was estimated as per the method suggested by Ranganna (1977) and expressed as mg per 100g of fruit sample.

3. 2. 8. 4 ***Acidity***

Titrable acidity was determined following the procedure proposed by Ranganna (1977). An aliquot from the sample was titrated against 0.1 N NaOH and the results expressed as per cent.

3. 2. 8. 5 ***Crude protein***

The per cent of crude protein was calculated by multiplying the percentage of nitrogen in the fruits by the factor 6.25 (Simpson *et al.*, 1965).

3. 2. 8. 6 ***Crude fibre***

Crude fibre content was determined by the A. O. A. C. method (1975).

3. 2. 8. 7 ***Total and reducing sugars.***

Total and reducing sugars were determined as per the method described by Ranganna (1977) and expressed as percentage on fresh weight basis.

3. 2. 8. 8 ***Keeping quality under ambient condition.***

The number of days required from harvest to the development of yellow colour on the fruit was recorded to determine the shelf life or storage life of fruits at room temperature.

3. 2. 9 ***Incidence of major pests and diseases***

To prevent pests and diseases a mixture of mancozeb 0.2% and metacid 0.5% was sprayed prophylatically once in three weeks.

3. 2. 10 ***Economics of production***

The economics of cultivation was worked out considering all aspects of cost of cultivation and the income derived from the treatments. It was calculated as per the norms and rates fixed by the Instructional Farm, College of Agriculture, Vellayani.

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

3. 2. 11 ***Statistical analysis***

The experimental data were analysed statistically by applying the technique of analysis of variance suggested by Panse and Sukhatme, 1995 and correlations as suggested by Snedecor and Cochran, 1967.

RESULTS

4. RESULTS

An experiment was conducted at the Instructional Farm, College of Agriculture, Vellayani during the period from January to May 1997 to assess the efficiency of using organic and inorganic sources of nutrients on the yield and quality of snake gourd under drip irrigation. The trial was laid out in factorial RBD with twelve treatments and three replications. The experimental data were subjected to statistical analysis (Appendix III) and the results of the study are presented below;

4. 1 Yield attributing characters

4. 1. 1 Sex ratio

Table 1 indicates the yield and yield attributing characters of the plants viz. sex ratio, fruit set, days for first fruit picking, length of the fruit, weight of the fruit, number of fruits, yield of fruit and harvest index of the plant.

Perusal of the data revealed that the levels of inorganic fertilizers alone exerted an appreciable influence on the sex ratio of the crop. The organic sources, its interaction with inorganic sources and substitution of organic manures for chemical fertilizers did not produce any marked difference on sex ratio of the plant. An increase in fertilizer level upto 3/4 of the recommended dose of NPK (F_2) increased the sex ratio of the plant and was on par with full dose of NPK (F_3).

4. 1. 2 ***Fruit set (Per cent)***

There was no significant variation in setting percentage of fruits due to different organic sources, levels of inorganic fertilizers, their interactions and additional treatments.

4. 1. 3 ***Days for first fruit picking***

Application of different organic sources showed significant variation on the number of days taken for first fruit picking. In the case of vermicompost applied plots, 61.66 days were taken for the first fruit picking, while a noticeable earliness was recorded in plots where farmyard manure and poultry manure were applied.

Levels of NPK, interaction effect of organic sources and inorganic fertilizers and additional treatments did not show any significant variations on the number of days taken for first fruit picking.

Significant difference in days required for first fruit picking was observed between the mean of factorial treatment combinations and mean of additional treatments. The factorial treatment combinations had taken minimum number of days (57.66 days) for the first fruit picking compared to the mean of additional treatments (61.55 days).

4. 1. 4 ***Average length of the fruits (cm)***

Average fruit length of snake gourd was favourably influenced by different organic sources. Application of farmyard manure (M_1)

Table 1. **Effect of organic sources and levels of inorganic fertilizers on yield and yield attributing characters of snake gourd.***

Treatments	Sex ratio	Fruit set (%)	Days for first fruit picking (days)	Length of the fruit (cm)	Weight of fruit (g)	Number of fruits plant^{-1}	Yield (kg ha^{-1})	Harvest Index
M_1 FM	17.66	21.88	56.66	83.33	871.11	9.55	42125.00	0.43
M_2 PM	16.88	21.77	54.66	83.00	844.33	9.88	41456.00	0.43
M_3 VC	17.22	21.33	61.66	72.22	798.22	9.66	38281.00	0.41
SE±	-	-	**1.281**	**2.702**	-	-	-	-
CD (0.05)	-	-	**3.758**	**7.926**	-	-	-	-
F_1	15.88	21.00	57.33	78.22	800.22	8.66	34606.00	0.39
F_2	17.11	21.44	58.22	79.88	849.33	10.22	43562.00	0.44
F_3	18.77	22.55	57.44	80.44	864.11	10.22	43693.00	0.44
SE±	**0.620**	-	-	-	-	-	-	-
CD (0.05)	**1.820**	-	-	-	-	-	-	-
M_1F_1	15.33	20.66	58.00	80.00	759.00	7.66	28050.00	0.36
M_1F_2	18.00	21.33	56.00	83.00	890.66	9.33	42706.00	0.40
M_1F_3	19.66	23.66	56.00	87.00	963.66	11.66	55625.00	0.53
M_2F_1	16.33	21.33	56.00	81.33	856.00	9.00	38831.00	0.34
M_2F_2	16.33	21.33	54.00	88.33	892.33	11.00	48287.00	0.51
M_2F_3	18.00	22.66	54.00	79.33	784.66	9.66	37256.00	0.44
M_3F_1	16.00	21.00	58.00	73.33	785.66	9.33	36943.00	0.47
M_3F_2	17.00	21.66	64.66	68.33	765.00	10.33	39693.00	0.41
M_3F_3	18.66	21.33	62.33	75.00	844.00	9.33	38206.00	0.36
SE±	-	-	-	-	-	-	-	**0.04**
CD (0.05)	-	-	-	-	-	-	-	**0.12**
Treatment mean	17.25	21.60	57.66	79.51	837.88	9.70	40625.00	0.42
Additional treatment mean	16.77	22.66	61.55	77.77	916.44	10.77	49470.66	0.40
T_{10}	18.00	24.00	64.66	83.33	929.33	12.66	57250.00	0.34
T_{11}	16.00	22.66	57.33	88.33	976.66	11.00	53500.00	0.51
T_{12}	16.33	21.33	62.66	66.66	843.33	8.66	37662.00	0.36
SE±	-	-	-	**4.680**	-	**0.984**	**5361.25**	**0.04**
CD (0.05)	-	-	-	**13.729**	-	**2.887**	**15725.00**	**0.12**

* Where ever F values are significant CD values are presented in the Table

recorded a maximum fruit length of 83.33 cm and was on par with the application of poultry manure (M_2) and were significantly superior to vermicompost (72.22 cm).

Different levels of inorganic fertilizers, its interaction with organic sources and the effect between the treatment combinations and additional treatments did not show significant influence on the length of the fruits. While the additional treatments showed significant variations in fruit length. Among them, poultry manure applied plots yielded fruits of 88.33 cm length which was on par with farmyard manure (83.33 cm) and superior to vermicompost (66.66 cm).

*4. 1. 5 **Average weight of the fruits (g)***

Average weight of the fruit was not significantly influenced by different organic sources, levels of NPK, their interactions and additional treatments. But a maximum fruit weight of 976.66 g was produced by the application of poultry manure alone (T_{11}).

Significant increase in weight of the fruit was observed by the three additional treatments (916.44 g) over the nine treatment combinations (837.88 g).

*4. 1. 6 **Number of fruits plant^{-1}***

The number of fruits harvested per plant was not significantly influenced either by organic sources, levels of inorganic fertilizers or their

interactions. However, significant difference on the number of fruits per plant was observed in the case of additional treatments. Among the additional treatments, farmyard manure (T_{10}) yielded the maximum number of fruits (12.66) and was on par with poultry manure (11).

4. 1. 7 Fruit Yield (kg ha^{-1})

It is evident from the Table 1 that there was no marked variation on fruit yield due to the application of organic manures, levels of fertilizers and their interactions. However, the mean of additional treatments were found to record a significantly higher yield (49470 kg ha^{-1}) compared to the mean of factorial treatment combinations (40625 kg ha^{-1}).

The additional treatments also showed significant difference in yield among themselves. In these treatments, farmyard manure application was found to be the best (57250 kg ha^{-1}) which was on par with poultry manure (53500 kg ha^{-1}) and superior to vermicompost application (37662 kg ha^{-1}).

4. 1. 8 Harvest index

The different organic sources and levels of inorganic fertilizers had produced no significant difference in harvest index. Also there was no significant variation in harvest index between factorial treatment combination and the additional treatments. However, the additional treatments recorded significant variation in harvest index among themselves. Among additional treatments, highest value (0.51) was noticed

Table 2. **Effect of organic sources and levels of inorganic fertilizers on weight of roots and drymatter production of snake gourd***

Treatments	Weight of roots plant^{-1} (g)	Dry matter production (g plant^{-1})
M_1	17.32	390.55
M_2	18.00	421.55
M_3	19.04	444.77
SE±	-	-
CD (0.05)	-	-
F_1	18.48	427.00
F_2	17.41	406.00
F_3	18.48	423.88
SE±	-	-
CD (0.05)	-	-
M_1F_1	19.33	413.33
M_1F_2	17.46	413.66
M_1F_3	15.19	344.66
M_2F_1	24.74	580.66
M_2F_2	13.70	321.00
M_2F_3	15.56	363.00
M_3F_1	11.39	287.00
M_3F_2	21.06	483.33
M_3F_3	24.68	564.0
SE±	**3.560**	**79.656**
CD (0.05)	**10.444**	**233.637**
Treatment mean	18.12	418.96
Additional treatment mean	19.80	431.44
T_{10}	26.53	569.66
T_{11}	17.44	368.00
T_{12}	15.46	356.66
SE±	-	-
CD (0.05)	-	-

* Wherever F values are significant CD values are presented in the Table

by the application of poultry manure which was significantly superior to vermicompost and farmyard manure.

4. 1. 9 ***Crop duration***

The crop duration of snake gourd was not influenced by any of the treatments or their interactions. A period of 117 days from the date of sowing was noticed for senescence of the crop.

4.2. Growth characters

The results on the weight of roots and dry matter production are furnished in Table 2.

4. 2. 1 ***Weight of roots plant^{-1} (g)***

There was no significant variations in the weight of roots per plant by the application of organic sources , levels of fertilizers and additional treatments. However, the highest root weight of 24.74 g was recorded by the application of 8.25t poultry manure with 1/2 NPK.

4. 2. 2. ***Dry matter production (g plant^{-1}).***

Dry matter production of plant was not significantly influenced by the organic sources, levels of inorganic fertilizers and additional treatments.

4.3 Soil analysis

Soil chemical properties like soil reaction (pH), organic carbon (OC), cation exchange capacity (CEC), available nutrient contents in the

soil and physical property like water holding capacity (WHC) of the soil were analysed and the data are presented in Table 3.

4.3.1 Soil reaction (pH)

Before the start of the experiment the soil pH recorded was 4.9 and there was increase in soil pH from 5.07 to 5.67 after the experiment.

Among organic manures, farmyard manure application resulted in an increase of pH to 5.38 which was significantly superior to poultry manure and vermicompost application. Similarly, significant variation in soil pH was also observed by the application of inorganic fertilizers. Lowest level of NPK (F_1) recorded the highest value for pH (5.41) which was superior to 3/4 NPK and full dose of NPK.

Interaction between organic sources and inorganic fertilizers were found to be significant. Among the treatment combinations T_7, T_1 and T_2 recorded more or less similar values of soil pH and was significantly superior to all other treatment combinations.

Marked difference in pH of the soil was observed between the mean of factorial treatment combinations and the mean of additional treatments. The lowest soil pH of 5.3 was observed for the treatment combination. Among additional treatments, application of vermicompost (T12) raised the pH of the soil to 5.67 which was on par with farmyard manure (5.48) and significantly superior to poultry manure (5.27).

Table 3 **Effect of organic sources and levels of inorganic fertilizers on soil characteristics after the harvest of snake gourd***

Treatments	pH	Organic carbon (%)	Cation exchange capacity (mol kg^{-1})	Water holding capacity (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
M_1	5.38	0.73	8.21	31.79	356.66	45.64	170.40
M_2	5.28	0.56	7.03	31.91	360.00	47.70	178.49
M_3	5.23	0.53	8.46	31.21	356.66	45.79	198.40
SE±	**0.022**	**0.020**	**0.269**	**0.149**	-	-	-
CD (0.05)	**0.065**	**0.059**	**0.790**	**0.438**	-	-	-
F_1	5.41	0.60	7.32	32.99	336.66	42.59	164.80
F_2	5.23	0.55	8.15	31.56	353.33	46.18	196.80
F_3	5.25	0.67	8.23	30.36	383.33	50.38	185.69
SE±	**0.022**	**0.020**	**0.269**	**0.149**	-	**1.365**	**8.015**
CD (0.05)	**0.065**	**0.059**	**0.790**	**0.438**	-	**4.004**	**23.509**
M_1F_1	5.45	0.72	7.17	33.59	350.00	43.05	164.40
M_1F_2	5.40	0.52	9.31	31.37	320.00	43.51	169.20
M_1F_3	5.30	0.96	8.17	30.41	400.00	50.38	177.60
M_2F_1	5.29	0.55	6.72	33.27	380.00	42.36	146.40
M_2F_2	5.22	0.57	6.67	32.18	350.00	50.38	220.80
M_2F_3	5.35	0.57	7.71	30.29	350.00	50.38	168.29
M_3F_1	5.51	0.55	8.09	32.12	280.00	42.36	183.60
M_3F_2	5.07	0.56	8.48	31.13	390.00	44.65	200.40
M_3F_3	5.11	0.49	8.81	30.39	400.00	50.38	211.20
SE±	**0.038**	**0.035**	-	**0.258**	**28.758**	-	-
CD (0.05)	**0.112**	**0.103**	-	**0.759**	**84.349**	-	-
Treatment mean	5.30	0.61	7.90	31.64	357.77	46.38	182.43
Additional treatment mean	5.47	0.55	7.13	33.73	303.33	47.69	153.20
T_{10}	5.48	0.44	6.17	33.88	280.00	45.80	144.00
T_{11}	5.27	0.65	8.55	33.58	320.00	50.38	157.20
T_{12}	5.67	0.56	6.67	33.73	310.00	46.90	158.40
SE±	**0.038**	**0.035**	**0.466**	-	-	-	-
CD (0.05)	**0.112**	**0.103**	**1.368**	-	-	-	-

* Where ever F values are significant CD values are presented in the Table

4.3.2 Organic carbon (per cent)

The initial organic carbon content of the soil was 0.43 per cent and there was increase in the organic carbon content of soil after the experiment. The organic carbon per cent was highest in farmyard manure applied plot (0.73 per cent) which was significantly superior to poultry manure (0.56 per cent) and vermicompost (0.53 per cent).

There was significant increase in the organic carbon content of the soil with inorganic fertilizer application. Organic carbon content of 0.67 per cent was observed in plots treated with full NPK which was superior to 1/2 NPK (0.60 per cent) and 3/4 NPK (0.55 per cent).

Interaction effect of organic sources and levels of inorganic fertilizers were also found to be significant. Application of 25t farmyard manure along with full NPK showed highest organic carbon content of 0.96 per cent in the soil.

The mean of factorial treatment combinations (0.61 per cent) showed remarkable variation in the organic carbon content of the soil than the mean of additional treatments (0.55 per cent). Among additional treatments poultry manure application resulted in highest value of organic carbon content in the soil (0.65 per cent) which was significantly superior to farmyard manure (0.44 per cent).

4.2.3 *Cation exchange capacity (mol kg^{-1})*

Different organic sources significantly influenced the cation exchange capacity of the soil. Due to the application of vermicompost (M3) the cation exchange capacity of the soil inreased to 8.46 mol kg^{-1} which was on par with farmyard manure (8.21 mol kg^{-1}) and superior to poultry manure (7.03 mol kg^{-1}).

Among inorganic fertilizers highest value of cation exchange capacity was observed with full NPK (8.23 mol kg^{-1}) which was on par with 3/4 NPK (8.15 mol kg^{-1}) and significantly superior to 1/2 NPK (7.32 mol kg^{-1}).

Interaction of organic sources and levels of inorganic fertilizers did not show any appreciable influence on cation exchange capacity of the soil.

Significant difference in cation exchange capacity of the soil was observed between the mean of treatment combinations and the mean of additional treatments, with lower value being observed by the mean of additional treatments (7.13 mol kg^{-1}). Among the additional treatments, substitution of poultry manure for chemical fertilizers showed cation exchange capacity of 8.55 mol kg^{-1} which was significantly superior to T_{10} (6.67 mol kg^{-1}) and T_{12} (6.17 mol kg^{-1}).

4.3.4 *Water holding capacity (per cent)*

The water holding capacity of the soil was significantly influenced by organic sources. Addition of poultry manure recorded the highest water

holding capacity of 31.91 per cent, which was on par with the application of farmyard manure (31.79 per cent) and was superior to vermicompost (31.21 per cent).

Significant difference in water holding capacity of the soil was noticed by the application of inorganic fertilizers. Water holding capacity was highest (32.99 per cent) at lowest level of fertilizer which was significantly superior to 3/4 NPK and full NPK.

Among interaction effects, application of 25t farmyard manure with 1/2 NPK resulted in highest water holding capacity of 33.59 per cent which was on par with 8.25t poultry manure along with 1/2 NPK and significantly superior to all other treatments.

The mean of additional treatments showed significantly higher water holding capacity of 33.73 per cent in the soil compared to the mean of nine treatment combinations (31.64 per cent). While the additional treatments did not show any significant variation in water holding capacity of the soil.

4.3.5 Soil temperature

Different organic manures, levels of inorganic fertilizers, their interactions and additional treatments had no influence on soil temperature. The minimum temperature recorded was 27 ^{0}C and maximum being 31.5 ^{0}C. All the treatments showed the same trend.

4.3.6 Available nitrogen (kg ha^{-1})

Scrutiny of the data revealed that the available nitrogen content of the soil after the harvest of the crop was not significantly influenced by the application of organic sources, levels of inorganic fertilizers and additional treatments. Since the main effects had no significant influence on the available nitrogen content of the soil after the harvest of the crop, it is not worthy to mention the significant influence of interaction effect.

However significant difference in the available nitrogen content of the soil was observed between the mean of treatment combinations and the mean of additional treatments. Comparatively lower values of available nitrogen content of the soil (303.33 kg ha^{-1}) was recorded by the mean of additional treatments.

4.3.7 Available phosphorus (kg ha^{-1})

Initial phosphorus content of the soil was 40.38 kg ha^{-1} and there was significant variation in the available phosphorus content of the soil after the harvest of the crop. The available phosphorus content of the soil was not influenced by the application of organic sources or its interaction with inoganic fertilizer levels and additional treatments.

However, effect of inorganic fertilizer levels showed significant variations in available phosphorus content of the soil. Highest phosphorus content of 50.38 kg ha^{-1} was noticed with full dose of NPK which was superior to 3/4 NPK and 1/2 NPK.

4.3.8 Available potassium (kg ha^{-1})

The effect of organic manures were found to be not significant in increasing the available potassium content of the soil, but inorganic fertilizers showed significant variations. Among inorganic fertilizer levels available potassium content was greater in 3/4 and full NPK level and was superior to 1/2 NPK.

Interaction effect of organic sources and inorganic fertilizers not significantly influenced the availability of potassium. However, application of 8.25 t poultry manure with 3/4 NPK showed the highest value of potassium content in soil (220.8 kg ha^{-1}).

The mean of nine treatment combinations recorded significantly higher potassium content (182.43 kg ha^{-1}) as compared to the mean of additional treatments (153 kg ha^{-1}). However additional treatments had no significant effect on potassium content of soil among themselves.

4.4 Plant analysis

The results on the nitrogen, phosphorus and potassium content of the plant and fruits are presented in Table 4.

4.4.1 Nitrogen content of plant parts (per cent)

The results revealed that the sources of organic manures had no influence on the nitrogen content of the plant. But, application of inorganic fertilizers had significant influence on the nitrogen content of plant parts. The higher dose of inorganic fertilizers (F_3) resulted in the

Table 4. **Effect of organic sources and levels of inorganic fertilizers on NPK content of plant and fruits after harvest of snake gourd***

	Plant parts			Fruit		
Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Nitrogen (%)	Phosphorus (%)	Potassium (%)
M_1	2.06	0.24	1.72	2.22	0.42	2.24
M_2	2.25	0.28	1.88	2.38	0.44	2.39
M_3	2.26	0.25	2.29	2.35	0.42	2.36
SE±	-	-	**0.097**	**0.035**	-	**0.035**
CD (0.05)	-	-	**0.266**	**0.100**	-	**0.103**
F_1	2.04	0.27	1.76	2.19	0.43	2.26
F_2	2.21	0.28	2.04	2.34	0.44	2.39
F_3	2.32	0.23	1.96	2.42	0.40	2.33
SE±	**0.066**	-	-	**0.035**	-	-
CD (0.05)	**0.194**	-	-	**0.100**	-	-
M_1F_1	1.98	0.25	1.47	2.16	0.42	2.16
M_1F_2	2.09	0.22	1.69	2.19	0.37	2.24
M_1F_3	2.13	0.26	1.72	2.31	0.46	2.33
M_2F_1	2.20	0.33	1.74	2.28	0.50	2.30
M_2F_2	2.03	0.33	2.31	2.28	0.51	2.63
M_2F_3	2.52	0.20	1.88	2.58	0.32	2.24
M_3F_1	1.94	0.22	2.07	2.15	0.38	2.34
M_3F_2	2.51	0.28	2.14	2.55	0.43	2.31
M_3F_3	2.32	0.25	2.29	2.37	0.43	2.44
SE±	**0.115**	**0.024**	-	**0.061**	**0.027**	**0.060**
CD (0.05)	**0.337**	**0.070**	-	**0.181**	**0.080**	**0.178**
Treatment mean	2.19	0.26	1.92	2.32	0.42	2.33
Additional treatment mean	2.07	0.32	1.86	2.30	0.50	2.22
T_{10}	1.99	0.33	1.80	2.18	0.53	2.22
T_{11}	2.23	0.23	1.55	2.42	0.41	2.13
T_{12}	1.99	0.40	2.24	2.30	0.57	2.32
SE±	-	**0.024**	**0.157**	-	**0.027**	-
CD (0.05)	-	**0.070**	**0.460**		**0.080**	-

* Where ever F values are significant CD values are presented in the Table

highest nitrogen content of 2.32 per cent which was on par with 3/4 NPK and significantly superior to 1/2 NPK.

Interaction effects were significant with regard to the nitrogen content of the plant. Differential responses were observed in the nitrogen content of the plant with different treatment combinations. But no significant variation in nitrogen content of the plant was observed between the mean of nine treatment combinations and mean of three additional treatments. Also no significant difference in nitrogen content of the plant was observed among additional treatments.

4.4.2 Phosphorus content of the plant parts (per cent)

Different organic sources and levels of inorganic fertilizers did not show any significant effect on phosphorus content of plant parts. However, the mean of treatment combinations and the mean of additional treatments differed significantly on this character. The mean of additional treatments was higher (0.32 per cent) than mean of treatment combinations (0.26 per cent).

Among additional treatments, highest phosphorus content of plant parts(0.40 per cent) was noticed with vermicompost applied plots which was on par with farmyard manure.

4.4.3 Potassium content of plant parts (per cent)

Significant effect on potassium content of plant was observed by different sources of organic manures. Highest value of potassium content

(2.29 per cent) was recorded with vermicompost (M_3) and was superior to poultry manure (M_2) and farmyard manure (M_1).

Levels of inorganic fertilizers and the interaction of organic sources and fertilizer levels did not show any significant variation in potassium content of the plant parts. On the other hand, additional treatments had positive influence on the potassium content of the plant parts. Highest value of 2.24 per cent was recorded with vermicompost, which was on par with farmyard manure and superior to poultry manure.

4.4.4 Nitrogen content of fruits (per cent)

The nitrogen content of fruits were found to be significantly influenced by different organic manures. The effect of poultry manure was superior (2.38 per cent) and was on par with vermicompost and superior to farmyard manure.

As the levels of inorganic fertilizers increased, nitrogen content of snake gourd fruit showed an increasing trend. Highest value of 2.42 per cent was noticed with full NPK (F_3) which was on par with 3/4 NPK (F2) and the lowest value of 2.19 per cent was recorded with the application of 1/2 NPK (F1).

Interaction effect of organic sources and inorganic fertilizer levels were found to be significant. Highest value of 2.58 per cent was observed with the application of 8.25 t poultry manure along with full NPK which was on par with 8.25 t of vermicompost with 3/4 NPK.

No significant variation in the nitrogen content of the fruit was observed between the mean of treatment combinations and the mean of additional treatments as well as among the additional treatments.

4.4.5 Phosphorus content of fruits (per cent)

Different organic sources and levels of inorganic fertilizer had no significant influence on phosphorus content of the fruits and hence their interactions had no impact on phosphorus content of fruits.

Significant difference in phosphorus content of fruit was observed between the mean of treatment combinations and the mean of additional treatments. Mean of additional treatments was higher (0.50 per cent) than mean of treatment combinations (0.42 per cent).

Among additional treatments, vermicompost was significantly superior (0.57 per cent) and was statistically on par with farmyard manure (T_{10}). The substitution by vermicompost for chemical fertilizers resulted in highest phosphorus content in fruits.

4.4.6 Potassium content of fruits (per cent)

Potassium content of fruits was highest in plots where poultry manure was applied (2.39 per cent) and its effect was statistically on par with that of vermicompost and superior to farmyard manure.

Levels of inorganic fertilizers and additional treatments did not show any significant variation. Interaction between organic sources and

Table 5 **Effect of organic sources and levels of inorganic fertilizers on uptake of nutrients by snake gourd.***

Treatments	Uptake of nutrients		
	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})
M_1	40.04	4.84	31.44
M_2	47.21	6.17	40.63
M_3	51.70	6.00	49.12
SE±	-	-	-
CD (0.05)	-	-	-
F_1	44.03	6.08	37.22
F_2	45.73	5.74	41.56
F_3	49.18	5.18	42.41
SE±	-	-	-
CD (0.05)	-	-	-
M_1F_1	40.76	5.28	30.12
M_1F_2	42.89	4.78	34.61
M_1F_3	36.48	4.47	29.58
M_2F_1	63.68	9.66	51.59
M_2F_2	32.67	5.31	37.33
M_2F_3	45.28	3.55	32.98
M_3F_1	27.66	3.32	29.95
M_3F_2	61.64	7.15	52.76
M_3F_3	65.80	7.53	64.66
SE±	**9.670**	**1.252**	-
CD (0.05)	**28.380**	**3.672**	-
Treatment mean	46.32	5.67	40.40
Additional treatment mean	44.34	7.02	40.32
T_{10}	56.91	10.12	51.03
T_{11}	39.49	4.15	30.04
T_{12}	36.61	6.80	39.89
SE±	-	**1.252**	-
CD (0.05)	-	**3.672**	-

* Where ever F values are significant CD values are presented in the Table

inorganic fertilizers was found to be significant. Among interaction effect 8.25t poultry manure with 3/4 NPK resulted in the maximum value of 2.63 per cent potassium content in fruits and was significantly superior to all other treatment combinations.

4. 5. Uptake studies

The results on the uptake studies of the plants are furnished in Table 5.

4. 5. 1. Utake of nitrogen (kg ha^{-1})

There was no significant difference in nitrogen uptake of plants by different organic sources, levels of inorganic fertilizers, their interactions and additional treatments.

4. 5.2. Uptake of phosphorus (kg ha^{-1})

Effect of organic manures and levels of inorganic fertilizers on phosphorus uptake were not significant. Though the interaction effect had no impact due to the above trend, the application of 8.25 t poultry manure with 1/2 NPK showed maximum values of phosphorus uptake (9.66 kg ha^{-1}) which was on par with T_9 and T_8.

Significant difference on the phosphorus uptake of the plant was observed among additional treatments. Among additional treatments,

farmyard manure application recorded high content of 10.12 kg ha^{-1} of phosphorus which was on par with vermicompost (6.80 kg ha^{-1}).

4. 5.3 Uptake of potassium (kg ha^{-1})

There was no significant difference in potassium uptake of plants by different organic sources, levels of inorganic fertilizers, their interactions and additional treatments.

4. 6 Quality studies

Table 6 indicates the quality parameters of the fruits.

4. 6. 1 Moisture content of the fruit (per cent)

It is evident from the data that organic sources, levels of inorganic fertilizers, their interactions and additional treatments had no significant effect on the moisture content of the fruit. But the mean of additional treatments (96.96 per cent) and the mean of treatment combinations (96.16 per cent) varied significantly.

4. 6. 2 Total soluble solids (per cent)

There was no significant effect on total soluble solids of the fruits due to the application of organic sources. But the effect of different levels of inorganic fertilizers were significant. Total soluble solids was highest (2.75 per cent) with lowest NPK level (F_1) and was significantly superior to 3/4 NPK and full NPK and thus a decreasing trend of total soluble solid with increased levels of NPK could be observed.

Table 6. **Effect of organic sources and levels of inorganic fertilizers on quality attributes of the fruits**

Treatments	Moisture (%)	Total soluble solids (%)	Ascorbic acid (mg/100 g)	Acidity (%)	Crude protein (%)	Crude fibre (%)	Total sugars (%)	Reducing sugars (%)	Keeping quality (days)
M_1	96.04	2.41	4.85	0.0560	13.88	18.36	3.42	1.84	14.33
M_2	96.26	2.50	3.90	0.0550	14.94	15.31	3.61	1.76	17.66
M_3	96.17	2.50	4.54	0.0520	14.72	17.42	3.32	1.72	18.66
SE±	-	-	**0.141**	**0.0002**	**0.225**	-	**0.011**	-	**0.677**
CD (0.05)	-	-	**0.414**	**0.0027**	**0.662**	-	**0.135**	-	**1.987**
F_1	96.02	2.75	5.48	0.0440	13.73	16.55	3.43	1.56	25.22
F_2	96.31	2.50	4.74	0.0460	14.64	19.14	3.44	1.77	17.44
F_3	96.14	2.16	3.09	0.0770	15.17	15.41	3.47	1.99	8.00
SE±	-	**0.072**	**0.141**	**0.0002**	**0.225**	**0.982**	-	**0.071**	**0.677**
CD (0.05)	-	**0.211**	**0.414**	**0.0027**	**0.662**	**2.880**	-	**0.120**	**1.987**
M_1F_1	95.64	2.75	5.82	0.0400	13.49	19.03	3.06	1.58	21.33
M_1F_2	96.58	2.25	4.64	0.0480	13.71	20.46	3.43	1.79	14.33
M_1F_3	95.92	2.25	4.10	0.0800	14.43	15.61	3.76	2.15	5.33
M_2F_1	96.00	2.75	4.91	0.0400	14.27	13.92	3.48	1.56	27.33
M_2F_2	96.45	2.75	4.42	0.0450	14.28	18.64	3.75	1.73	17.66
M_2F_3	96.33	2.00	2.45	0.0800	16.27	13.39	3.59	2.00	8.00
M_3F_1	96.43	2.75	5.72	0.0400	13.43	16.70	3.75	1.56	27.00
M_3F_2	95.91	2.50	5.18	0.0440	15.93	18.32	3.16	1.78	18.33
M_3F_3	96.18	2.25	2.73	0.0720	14.81	17.23	3.07	1.82	10.66
SE±	-	-	**0.244**	-	**0.391**	-	**0.020**	-	-
CD (0.05)	-	-	**0.744**	-	**1.147**	-	**0.063**	-	-
Treatment mean	96.16	2.47	4.44	0.0500	14.51	17.03	3.45	1.70	14.80
Additional treatment mean	96.96	2.83	4.63	0.04	14.41	18.10	3.67	1.45	31.55
T_{10}	97.35	2.75	4.09	0.0400	13.65	19.22	3.60	1.55	28.66
T_{11}	96.42	2.75	3.00	0.0400	15.16	15.97	2.84	1.45	32.33
T_{12}	97.11	3.00	6.82	0.0400	14.42	19.10	4.56	1.35	33.66
SE±	-	-	**0.244**	-	**0.391**	-	**0.620**	-	**1.173**
CD (0.05)	-	-	**0.744**	-	**1.147**	-	**0.063**	-	**3.440**

* Where ever F values are significant CD values are presented in the Table

The interaction effect of organic sources and levels of inorganic fertilizers and additional treatments could not produce significant variation in total soluble solids. However, mean of treatment combinations (2.47 per cent) and the mean of additional treatments (2.83 per cent) were significantly different.

4. 6. 3 Ascorbic acid content (mg 100^{-1}g.)

Ascorbic acid content of the fruit was significantly influenced by different organic sources. Application of farmyard manure resulted in a higher level of ascorbic acid content (4.85 mg 100^{-1}g) in fruits and was on par with vermicompost and superior to poultry manure (M_2).

As the levels of inorganic fertilizers decreased, ascorbic acid content of the fruits showed an increasing trend. A significantly higher value of ascorbic acid content (5.48 mg 100^{-1}g) was noticed with the lowest level of inorganic fertilizers (1/2 NPK) and was significantly superior to 3/4 NPK and full NPK.

Among the interaction effects, application of 25 t farmyard manure with 1/2 NPK produced fruits with highest content of ascorbic acid (5.82 mg 100^{-1}g). However, lowest value of 2.45 mg 100^{-1}g was observed in treatment 8.25 t poultry manure with full NPK (T_6)

Substitution of vermicompost for inorganic fertilizers increased the ascorbic acid content of the fruits (6.82 mg 100^{-1}g) which was significantly higher than by the substitution with farmyard manure and poultry manure.

4. 6. 4 Acidity (per cent)

Acidity of the fruit was significantly influenced by different organic sources. The acid content of fruits in farmyard manure applied plot was high (0.056 per cent) which was statistically on par with poultry manure (0.055 per cent) and significantly superior to vermicompost (0.052 per cent).

High level of inorganic fertilizer (F_3) produced high acidity in fruits (0.077 per cent) which was significantly superior to other two lower doses viz. 1/2 NPK and 3/4 NPK. Lowest value of 0.44 per cent was observed in 1/2 NPK applied plots.

Interaction effect of organic sources and levels of inorganic fertilizers and additional treatments did not show significant differences. But mean of treatment combinations (0.05 per cent) was significantly superior to mean of additional treatments (0.04 per cent).

4. 6. 5. Crude protein (per cent)

Different organic sources, levels of inorganic fertilizers, their interactions and additional treatments had significant influence on crude protein content of fruits. Among the organic sources, application of poultry manure produced fruits with high crude protein content (14.94 per cent) which was on par with vermicompost (14.72 per cent) and significantly superior to farmyard manure (13.88 per cent).

Inorganic fertilizer levels showed significant influence on crude protein content of the fruits. Increasing the fertilizer level could increase the protein content. Fruits having highest content of crude protein (15.17 per cent) were obtained in full NPK applied plots which was on par with 3/4 NPK and superior to 1/2 NPK.

Significant difference in crude protein content due to interaction effect was noticed. The highest crude protein content (16.27 per cent) was recorded with the application of 8.25 t poultry manure alongwith full NPK and this was on par with 8.25 t vermicompost along with 3/4 NPK.

The mean of nine treatment combinations and the mean of three additional treatments did not show any significant difference in crude protein content of the fruits. However significant difference was observed among additional treatments. Among these treatments the highest crude protein content of 15.16 per cent was noticed in fruits obtained from poultry manure applied plots and was on par with vermicompost applied plots.

4.6.6 Crude fibre (per cent)

Crude fibre content of the fruit was not influenced by organic sources, its interaction with inorganic fertilizers and additional treatments.

There was significant influence on crude fibre content of the fruits by the applicaiton of inorganic fertilizers. The inorganic fertilizer level of 3/4 NPK produced fruits having highest fibre content (19.14 per cent).

4.6.7 ***Reducing sugar (per cent)***

The influence of organic sources on reducing sugar content of fruit was not significant. However, significant effect was observed by the application of different inorganic fertilizer levels. Fruits with high reducing sugar (1.99 per cent) were yielded from plots applied with full NPK.

Interaction effects of organic and inorganic fertilizers and additional treatments were found to be nonsignificant. But, the mean of treatment combinations (1.70 per cent) was significantly superior to the mean of additional treatments (1.45 per cent).

4.6.8 ***Total sugar (per cent)***

Total sugar content was significantly influenced by the application of different organic manures. Poultry manure application could produce fruits with high total sugar content (3.61 per cent) and was significantly superior to the fruits obtained from plots applied with farmyard manure and vermicompost.

The levels of inorganic fertilizers had no significant effect on the total sugar content of the fruits. But its interaction with organic sources was significant. Plots applied with 25t farmyard manure along with full NPK yielded fruits with high levels of total sugar content (3.76 per cent) which was on par with 8.25t poultry manure along with 3/4 NPK and 8.25t vermicompost and with 1/2 NPK.

Mean of the three additional treatments (3.67 per cent) was significantly superior to mean of treatment combinations (3.45 per cent). Among the additional treatments substitution of vermicompost for chemical fertilizers (T_{12}) produced fruits with highest total sugar content(4.56 per cent).

4.6.9 Shelf life

Different organic sources, levels of inorganic fertilizers and additional treatments had significant effect on shelf life of the fruits.

Among organic sources, application of farmyard manure (M_1) showed lowest shelf life of 14.33 days. Maximum shelf life (18.66 days) was observed in fruits obtained from vermicompost applied plots which was on par with poultry manure applied plots (17.66 days).

Application of highest level of NPK reduced the keeping quality of the fruits to 8 days. On the otherhand, low level of NPK (F_1) increased the shelf life of fruits upto 25.22 days.

Interaction of organic and inorganic fertilizer levels had no significant effect on shelf life of the fruits.

Significant difference on shelf life of the fruit was observed between the mean of additional treatments and the mean of treatment combinations. The lowest shelf life of 16.8 days was observed under the treatment combinations compared to additonal treatments (31.5 days).

Shelf life of the fruit was significantly influenced by additonal treatments. Among additional treatments, longer shelf life of 33.66 days could be noticed in fruits obtained from vermicompost applied plots and was on par with polutry manure applied plots (32.33 days)

4.7 Correlation studies

Correlations between yield and yield components; nutrient contents of fruits and quality of fruits, soil characters and quality of fruits were worked out and are presented in Table 7.

The results showed that yield and yield components such as fruit set, length of fruits, weight of the fruit and number of fruits per plants were significantly and positively correlated.

Positive significant correlation was also found between nitrogen content in fruits and ascorbic acid content in fruits. A negative correlation was observed in the case of shelf life of the fruits and acidity and reducing sugar content of the fruits.

4.8 Incidence of major pests and disease

No serious incidence of pests and diseases were noticed.

4.9 Economics of production

The data on economics of production is presented in Appendix II.

The results indicated that nine treatment combinations and three additional treatments were able to fetch more profit. The maximum

benefit : cost ratio of 5.5 with a net profit of Rs. 162205.07 ha^{-1} was obtained by the application of 8.25 t vermicompost along with 3/4 NPK. However substitution of chemical fertilizers by farmyard manure resulted maximum net profit of Rs. 231611.95 ha^{-1} with a benefit : cost ratio of 4.93. This was followed by the treatement wherein fertilizer was applied as per Package of Practice Recommendations (25 t farmyard manure along with full NPK).

Table. 7 **Correlation coefficients**

Sl. No	Characters studied	Correlation coefficient
1	Yield ha^{-1} x fruit set (%)	0.662**
2	Yield ha^{-1} x length of the fruit (cm)	0.687**
3	Yield ha^{-1} x weight of the fruit (g)	0.833**
4	Yield ha^{-1} x number of fruits per $plant^{-1}$	0.921**
5	N content in fruits (%) x Vit. C in fruits (mg $100g^{-1}$)	0.399**
6	Moisture content in fruits (%) x water holding capacity of soil (%)	0.334*
7	Shelf life (days) x TSS (%)	0.718**
8	Shelf life (days) x Vit. C in fruits (mg $100g^{-1}$)	0.474**
9	Shelf life (days) x Acidity in fruits (%)	-0.850**
10	Shelf life (days) x Reducing sugar in fruits (%)	-0.852**

** Significant at 1 per cent

* Significant at 5 per cent

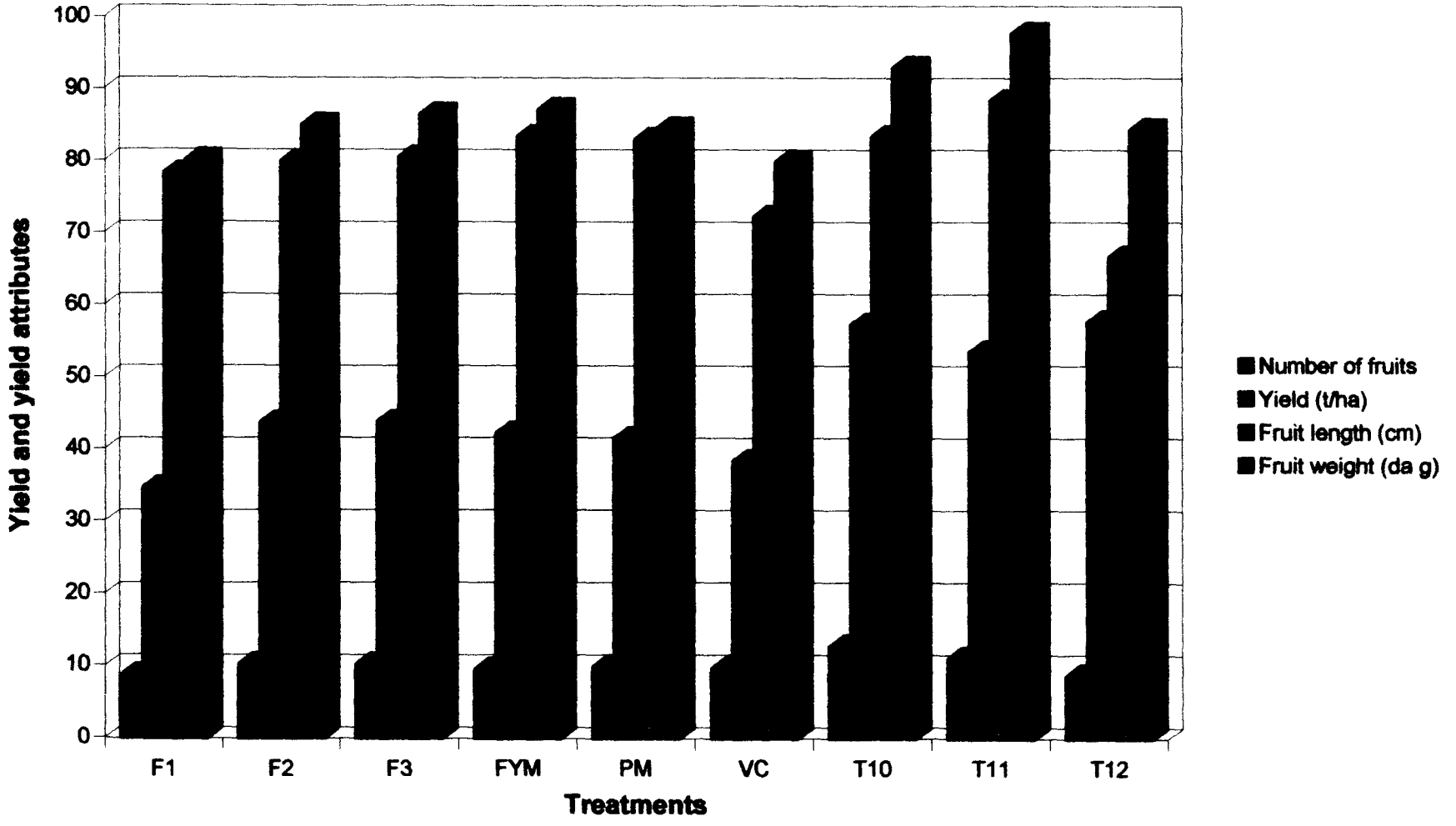
DISCUSSION

5. DISCUSSION

The recent performance of Indian agriculture makes it clear that, the challenges in vegetable production in the next decade has to be met with novelty. Agricultural production factors consist mainly of high yielding varieties, irrigation facilities and chemical fertilizers. Constant use of chemical fertilizers impair soil health. Today much attention is being given to reverse this situation by popularising the concept of organic farming and integrated nutrient management. Organic residue incorporation to the soil improves the overall physical, chemical and biological properties of soil and regular return of organic residues to the soil, contributes to the soil nutrient pool in a gradual manner, besides offering other indirect benefits (Srivastva, 1988 and Palaniappan and Natarajan, 1993). In this context, the emphasis is to reduce the use of chemical fertilizers by substituting it with organic manures without affecting the crop productivity.

An experiment was conducted at the Instructional Farm attached to the College of Agriculture, Vellayani with the objective of finding out the potential of using farmyard manure, poultry manure, vermicompost and fertilizers on yield and quality of snake gourd. The analysed results presented in the preceding chapter are discussed below.

Fig 3. Effect of organic sources and inorganic fertilizers on yield and yield attributes



5.1 Yield attributing characters

5.1.1 Sex ratio

The result presented in Table1 revealed that the sex ratio of the plant was increased by increasing levels of inorganic fertilizers. Different sources of organic manures, their interaction with inorganic fertilizers and substitution of organic manures for chemical fertilizers did not have any marked influence on this character. Narrow sex ratio was noted in plants applied with lowest level of NPK, because application of higher levels of inorganic fertilizers retarded the formation of vegetative organs and subsequently reproductive organs (Cerna, 1980). This is in agreement with the findings of Nair and Peter (1990) in Chilli.

5.1.2 Fruit set

Results given in Table1 revealed that there was no significant difference in fruit set by the application of organic manures, inorganic fertilizers, their interactions and additional treatments. However, the highest fruit set per cent was observed in plants treated with farmyard manure along with its additonal dose. This might be due to the failure in the formation of reproductive organs by the application of higher levels of inorganic fertilizers (Cerna, 1980). The same was reported by Nair and Peter (1990).

5.1.3 Days for first fruit picking

Days for first fruit picking was significantly influenced by the application of poultry manure. Observations of Table1 revealed that in poultry

manure applied plots, 54.66 days were required for the first fruit picking compared to farmyard manure (56.66 days) and vermicompost (61.66 days). This might be due to the better initial vegetative growth observed in plots applied with poultry manure. Presence of readily available form of nitrogen (Smith, 1950) and higher P content in poultry manure or increased availability of native soil P through the increased biological activity resulted in better initial vegetative growth. (Singh *et al.*, 1973). Increased photosynthetic activity due to the early vegetative growth would have enhanced early flower initiation and fruit maturity in the poultry manure treated plots.

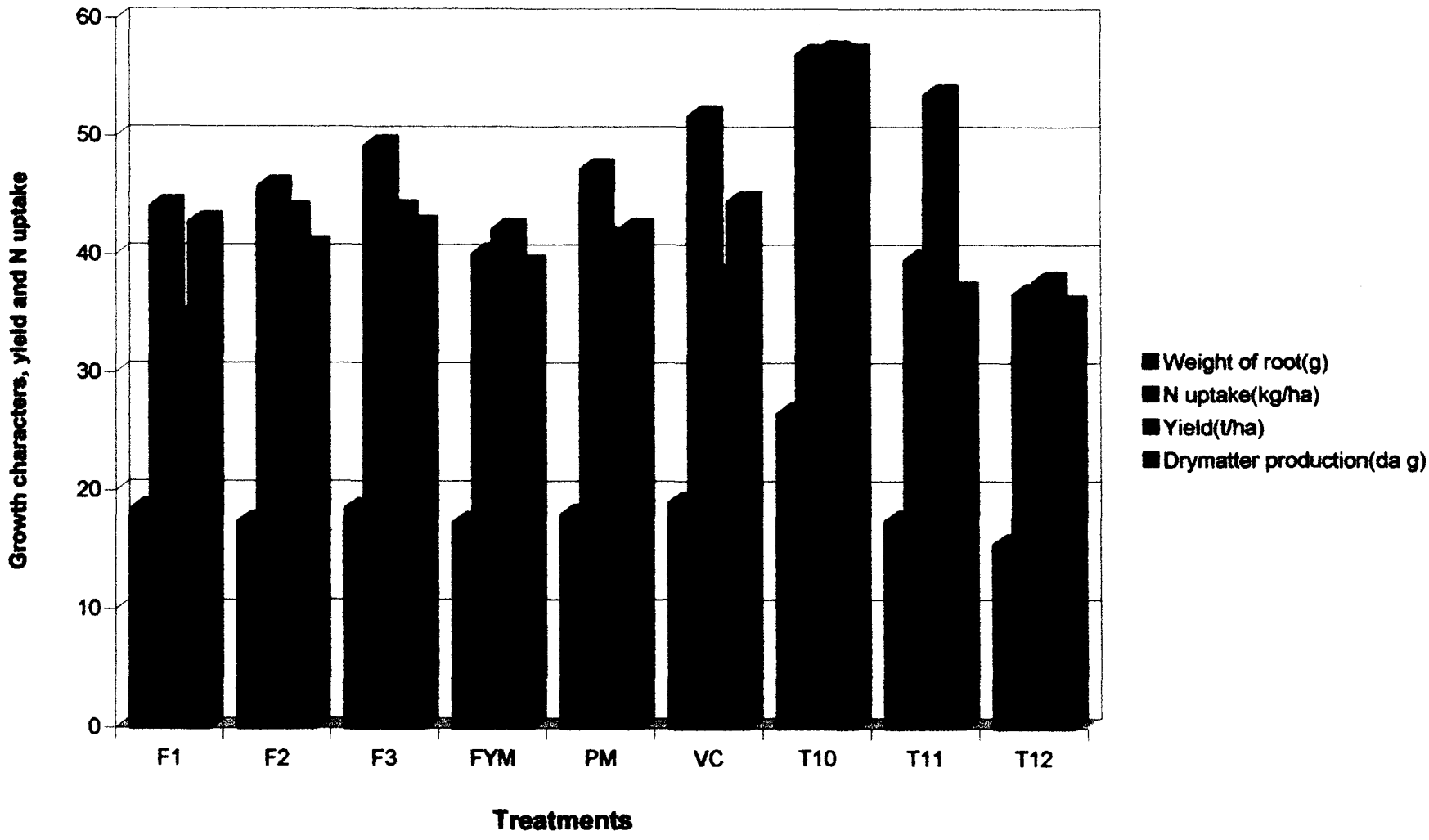
5.1.4 Fruit characters

Among different fruit characters viz. length of the fruit, weight of the fruit and number of fruits were not significantly influenced by the levels of fertilizers. (Table1). However, all these characters showed an increasing trend with increased levels of fertilizers. This increase in fruit length and fruit weight might be due to the increased photosynthetic efficiency with increased levels of fertilizers. Similar results were noted by Joseph (1982), Singh and Srivastava (1988), John (1989) and Prabhakar and Naik (1993).

5.1.5 Fruit yield

It is evident from the Table1 that substitution of organic manures for chemical fertilizers alone had an appreciable influence on the yield of the crop. The organic sources, levels of inorganic fertilizers and their interactions did not produce any marked difference on the yield of the crop. This might be due

Fig.4 Effect of organic sources and levels of inorganic fertilizers on growth characters,yield and uptake of nutrients



to the absence of substantial variation in root weight and dry matter production by the application of organic sources and chemical fertilizer levels (Table 2). Even though, the yield was non significant there was a positive correlation between yield and the fruit characters, such as number of fruits, weight of the fruit and length of the fruit (Table 1). Among additional treatments, farmyard manure application had a profound influence on the yield of the crop and almost similar result was observed with poultry manure application (Fig. 3). This might be due to the readily available form of nitrogen (Smith, 1950) and higher P content in poultry manure or increased availability of native P through increased biological activity (Singh *et al.*, 1973). It can be seen from the Fig.4 that there was an increase in root weight, dry matter production and uptake of nutrients in farmyard manure applied plots. This might have resulted in higher yield from farmyard manure applied plots. This is in confirmity with the findings of Rawankar *et al.* (1984).

5.1.6 Harvest Index

Harvest index of the crop did not vary significantly with organic sources and levels of chemical fertilizers (Table1). However, substitution of poultry manure for chemical fertilizers recorded highest value of harvest index. This might be due to the higher yield and lowest dry matter production showed by poultry manure applied plots.

5. 2 Growth characters

Growth characters such as weight of roots plant^{-1} and dry matter production were not influenced by the application of organic sources, inorganic

fertilizers and additional treatments (Table 2). However, among additional treatments, substitution of farmyard manure instead of chemical fertilizers resulted in highest root weight and dry matter production. This might be due to an increased uptake of nutrients from the farmyard manure applied plots. Similar results were reported by Cerna (1980) and Valsikova and Ivanic (1982).

5.3 Soil characters

5.3.1 Soil reaction (pH)

The preliminary analysis of the soil before the experiment have indicated a pH of 4.9 and it was appreciably increased to the level of 5.07 to 5.67 after the experiment (Table 3). Application of organic manures, inorganic fertilizers, their interactions and additional treatments had significant influence on pH of the soil.

A reduction in soil pH with increasing levels of inorganic fertilizer was observed. This might be due to the hydrolysis of urea to NH_4^+ in soil and its further conversion to NO_3^- (Tisdale and Nelson, 1993). This result is agreement with the findings of Khan *et al.* (1997).

Maximum pH of 5.67 (Fig.5) was observed in vermicompost with their additonal dose (T_{12}). Wormcasts are closer to neutral pH range than the surrounding soil and the possible factors that act on pH may be the excretion of NH_4^+ and excretions from calciferous glands (Lee, 1985). Conversion of

organic N to NH_3 and further to NH_4^+ temporarily reduces the pool of H^+ ions in soil.

Earth worms significantly raised the pH of the humus and the effect of earth worm on the soil pH was probably due to an increase in concentration of ammoniacal nitrogen (Binkley and Richter, 1987; Haimi and Huhta (1990). Bhawalkar and Bhawalkar (1993) also reported that pH of the intestinal content of earth worm is remarkably stable around neutral to slightly alkaline. The calciferous glands in them fix $CaCo_3$ and prevent any fall in pH (Wallwork, 1983 and Kale and Krishnamoorthy, 1980).

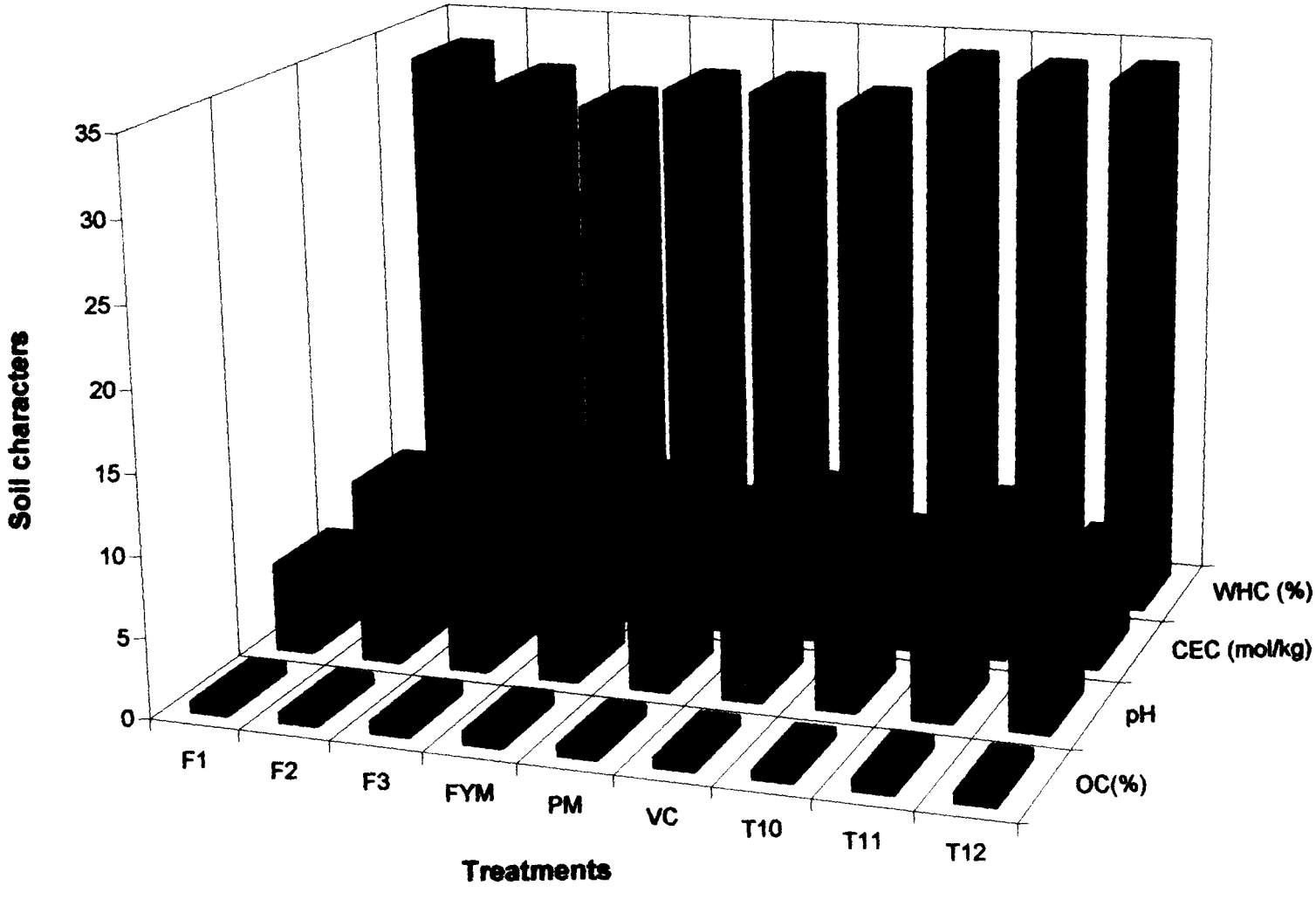
Among organic manures, farmyard manure application resulted in the lowest acidity of 5.38 in soil. Application of farmyard manure decrease the exchangeable and soluble Al in the soil due to the chelation by organic molecules (Patiram, 1996). This is in confirmity with the findings of Nambiar (1994).

5.3.2 Organic carbon

The initial organic carbon content of the soil was 0.43 per cent and as seen from the Table 3 that organic carbon was increased by the application of organic and inorganic fertilizers.

The organic carbon content was highest in farmyard manure applied plots compared to poultry manure and vermicompost applied plots (Fig.5). Farmyard manure has a wider C : N ratio of 20 : 1 compared to poultry manure (10 : 1) and vermicompost (8 : 1). The C : N ratio is an important

Fig 5. Effect of organic sources and levels of inorganic fertilizers on soil characters



parameter that determines the extent of decomposition of organic matter (Anina, 1995). As composting proceeds, the micro flora uses the carbon for their energy building up and the nitrogen for cell building. The C : N ratio narrows down with time. Since the nitrogen remains in the system, some portion of the carbon is released as CO_2 (Gaur and Sadasivan, 1993). This result is confirmity with the findings of Gattani *et al.* (1976) and Udayasoorian *et al.* (1988).

Significant increase in organic carbon content of the soil was observed with increased levels of inorganic fertilizers. Inorganic compounds serve as sources of N for microorganisms. Application of inorganic compounds increase the population of microorganisms in the soil. These microorganism assimilate CO_2 from the atmosphere for their energy requirement (Alexander, 1976). This might be the reason for increased organic carbon content in the soil.

5.3.3 Cation exchange capacity

The cation exchange capacity of the soil after the experiment was significantly influenced by the application of organic and inorganic fertilizers. Plots applied with vermicompost showed highest value of cation exchange capacity (8.46 mol kg^{-1}) than farmyard manure and poultry manure. If the organic manure has a narrow C:Nratio, early decomposition occur and it resulted in an increased humus in soil (Tisdale and Nelson, 1993). Besides this property of the worms present in the soil produce large quantity of humus content in the soil. The large available surface area of humus particles have

many cation exchange sites that adsorb nutrients for eventual plant use (Miller and Donahue, 1992). Similar findings on cation exchange capacity was reported by Anina (1995). The favourable influence of vermicompost might be the reason for higher cation exchange capacity in soil.

Application of higher levels of inorganic fertilizers resulted in higher levels of cation exchange capacity. The exchangeable cations are replaced by NH_4^+ and K^+ ions and the cation exchange sites become saturated with NH_4^+ and K^+ due to the application of inorganic fertilizers (Tisdale and Nelson, 1993).

5.3.4 Water holding capacity

From the results of analysis of data on water holding capacity presented in Table 3, it could be observed that the mean values obtained for water holding capacity ranged from 30.29 to 33.88 per cent due to the application of organic manures. This finding is in support of the view of Khaleel *et al.*(1981) who stated that higher organic matter addition can increase the organic carbon content of the soil which resulted in an increased water holding capacity of the soil. In this study it can be inferred that addition of farmyard manure and poultry manure had a significant influence on the water holding capacity of the soil. The role of farmyard manure and poultry manure on water holding capacity was mainly due to its influence on porosity of the soil. Addition of farmyard manure and poultry manure might have resulted in uniform distribution of micro pores. Similar result was also reported by Rose (1990).

Significant reduction in water holding capacity was noted with the higher levels of inorganic fertilizers. Application of chemical fertilizers reduced the aggregate stability of the soil and resulted in poor water holding capacity of the soil. This is in confirmity with the findings of Sarkar *et al.* (1989) and Nambiar (1994).

5.3.5 NPK content of the soil

The data on soil nutrient status (Table 3) clearly indicated that different organic manures and fertilizer levels had not influenced the available N content of the soil. However, significant difference was observed in P and K content of the soil by the application of chemical fertilizers. This may be due to the residual effect of P and K by the application of their highest dose.

5.4 Uptake studies

5.4.1 NPK content of plant parts and fruits

The nitrogen content in plant parts and fruits (Table 4) increased with increasing levels of fertilizers. It can be seen from the Table 5 that there was a gradual increase in the N uptake with increasing levels of inorganic fertilizers The enhanced uptake of nitrogen has contributed to the higher contents of nitrogen in plant parts and fruits (Jassal *et al.*, 1972).

The results indicated that among different organic manures maximum N and K contents in fruits and P content in plant parts and fruits and K content in fruit were obtained by the application of poultry manure. These increases in N, P and K contents may be due to the high P content in poultry manure (1.016%)

compared to that in farmyard manure (0.20%) and in vermicompost (0.48%). In the present study higher content of P might have helped for the increase in N and K absorption by the plant as reported by Prabhakumari (1992) who observed a positive and significant N X P and P X K interaction. Similar result was observed by Singh *et al.* (1973).

In the case of additional treatments, vermicompost application was found to be better than farmyard manure and poultry manure application for getting maximum K content in plants and fruits. Higher K content in vermicompost (1.80 per cent) might have helped in the accumulation of high K content in plant and fruits.

5.4.2. NPK uptake of plants

Effect of different organic sources and levels of inorganic fertilizers failed to show any significant influence on NPK uptake of plants (Table 5). This may be due to the non significant effect in the root weight and dry matter production of plants applied with organic and inorganic fertilizers. However, substitution of farmyard manure instead of chemical fertilizers showed significant uptake of P by the plants. Minhas and Sood (1994) reported that farmyard manure application was beneficial in enhancing the uptake of phosphorus.

5.5 Quality characters

5.5.1 Moisture content of the fruit

It is evident from the data (Table 6) that organic sources, levels of fertilizers, their interactions and additional treatments had no significant effect

on moisture content of the fruit. However, the plants supplied with farmyard manure alone (T_{10}) produced fruits with highest moisture content. It can be seen from the Table 7 that there was a positive correlation between moisture content of the fruits with water holding capacity of the soil. The higher moisture content of the fruit may be due to the increased water holding capacity of the soil which enabled the plants to absorb and hold water in the fruits in a better way than other treatments.

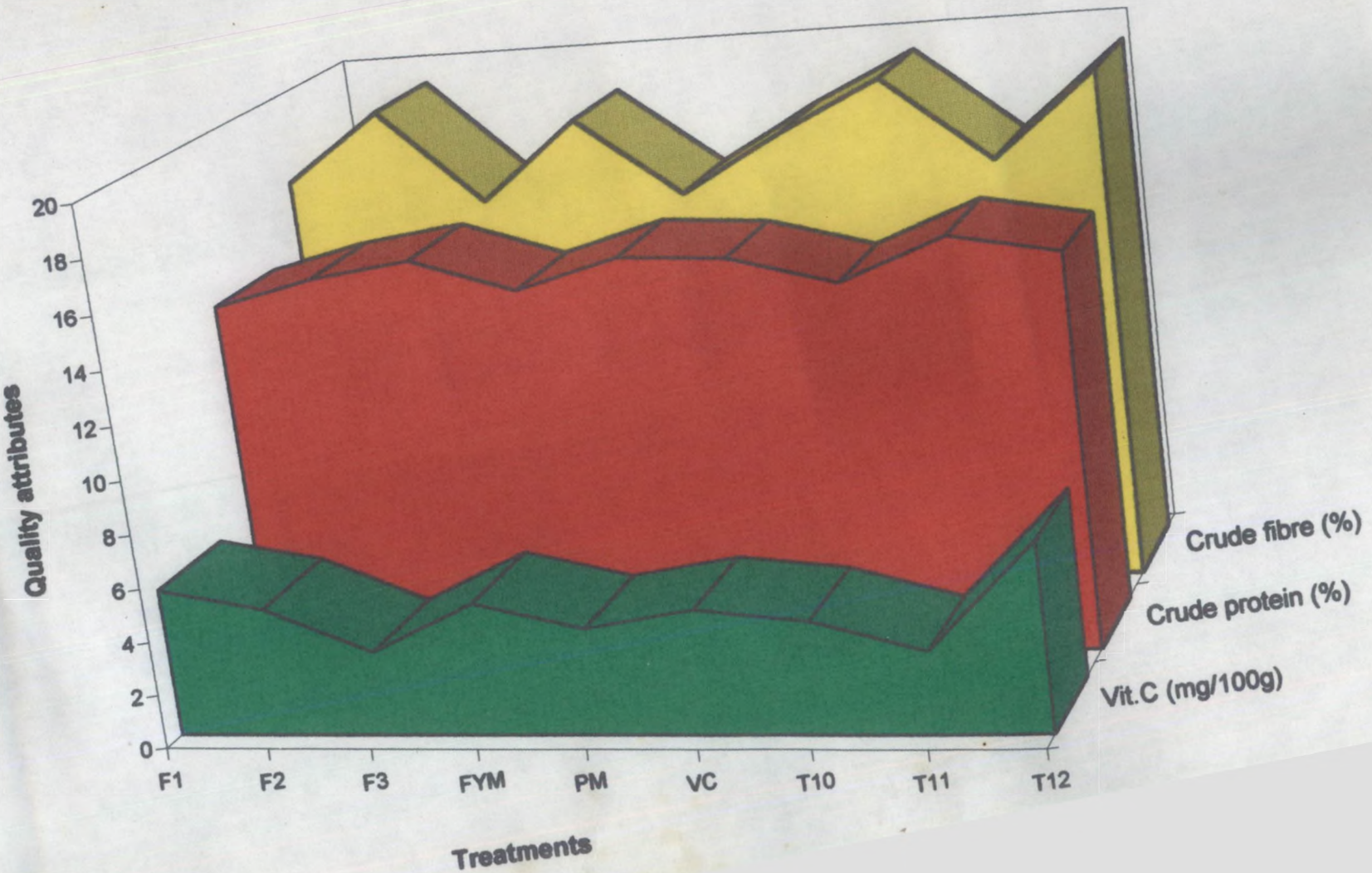
5.5.2 Total soluble solids (TSS)

The fertilizer application at different levels showed a significant effect on total soluble solids of the fruits (Table 6). A decreasing trend in total soluble solids with increasing levels of NPK application was observed. Similar reduction in the total soluble solids with the application of higher quantities of chemical fertilizers have been reported by Khan *et al.*(1997). However application of different organic manures had no marked influence on total soluble solids of the fruits in the present study.

5.5.3 Ascorbic acid (Vit.C)

Observations of Table 6 reveals that increasing levels of inorganic fertilizers resulted in decreased content of ascorbic acid in fruits. This is in confirmity with the findings of Belichki (1988). Application of organic forms of manures showed a definite advantage in this aspect over the inorganic fertilizers. Fruits obtained from farmyard manure treated plots showed maximum content of Vit. C compared to poultry manure and vermicompost. The above result was in agreement with the findings of Kansal *et al.* (1981).

Fig 6. Effect of organic sources and levels of inorganic fertilizers on quality of fruits



Among additional treatments, substitution of vermicompost for chemical fertilizers showed highest ascorbic acid content of 6.82 mg 100^{-1}g (Fig.6). Fritz and Habben (1972) reported, increase in ascorbic acid content in vegetables with increased K fertilization. Presence of relatively high percentage of K in wormcast compared to farmyard manure and poultry manure might have contributed to the higher content of Vit. C in fruits.

5.5.4 Acidity

In the plots applied with lowest level of chemical fertilizers, the acidity of fruit was found to be less (Table 6). Similar result was reported by Rao (1994).

Significant difference in the acidity of fruit was observed in this study with organic manure application. Lowest level of acidity was observed with fruits obtained from vermicompost applied plots. This might be due to the neutralisation of organic acids in the tissues with N and K fertilization (Tisdale and Nelson, 1993). Vermicompost containing high percentage of K compared to farmyard manure and poultry manure. This might be the reason for the reduced acidity in fruits recorded in the present study.

5.5.5 Crude protein

The result presented in Table 6 revealed that highest crude protein content of 15.17 per cent was observed in plots applied with full NPK among the treatments with inorganic fertilizers. This might be due to the favourable

effect of nitrogen on aminoacid synthesis. Similar trend was reported by Singh *et al.* (1973) and Sujatha and Krishnappa. (1995) in potato.

Fruits obtained from poultry manure applied plots had high crude protein content (14.94 per cent) than farmyard manure (13.88 per cent) and vermicompost (14.72 per cent) applied plots. Poultry manure contained 60 per cent of its nitrogen as uric acid and this is converted to ammonical form and the same could be absorbed by the plants in a better way at the reproductive stage of the crop. The result is in confirmity with the findings of Singh *et al.* (1973)

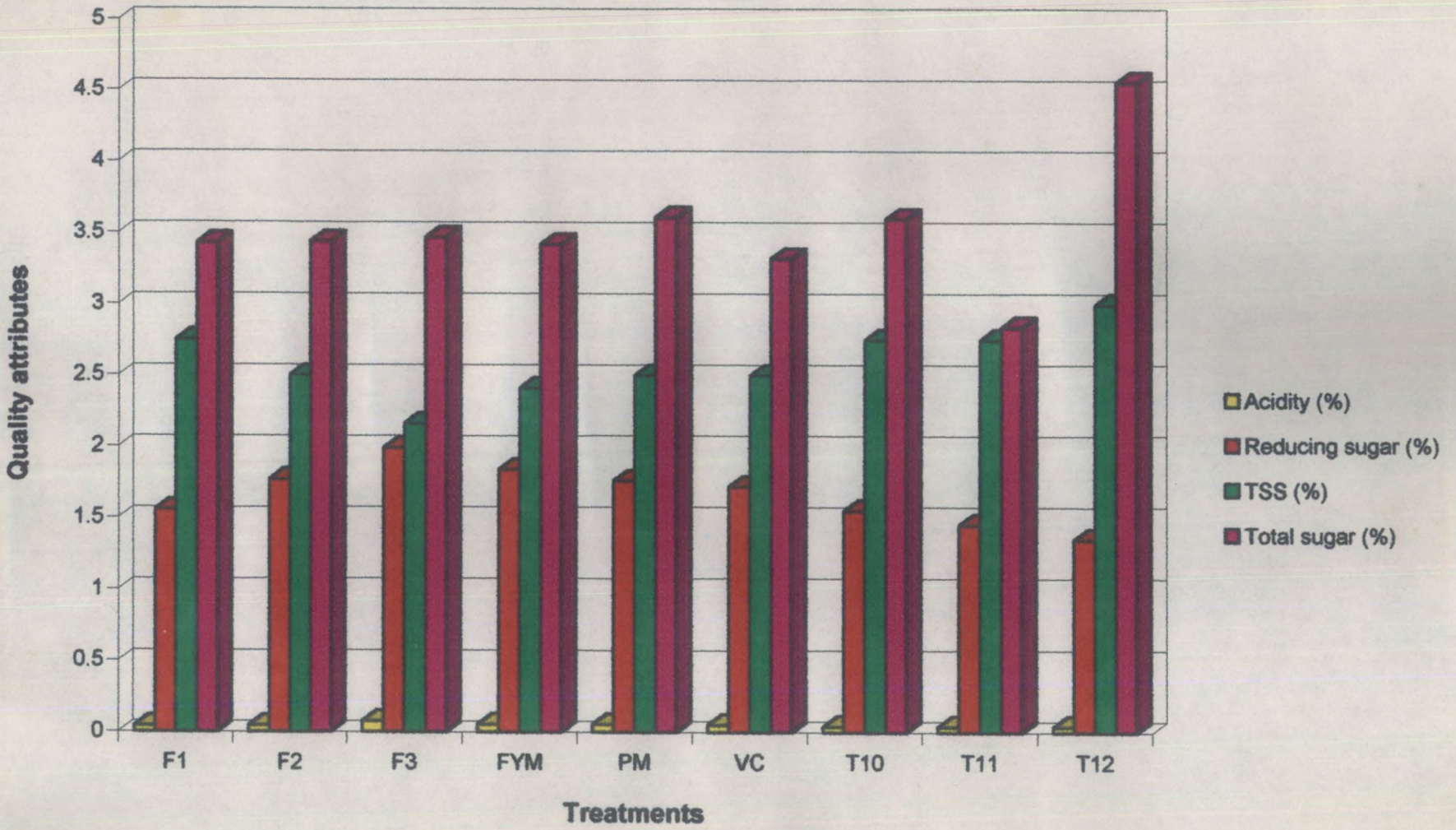
5.5.6 Crude fibre

Crude fibre content of the fruit was not influenced by organic sources, its interaction with inorganic fertilizers and additional treatments. Inorganic fertilizers alone exerted an appreciable influence of the crude fibre content of the fruits. As nutrient levels increased, crude fibre content of the fruit also increased (Table 6) up to 3/4 NPK level. Beyond this level there was a decline in crude fibre content in fruits. Different organic sources had no significant influence on the crude fibre content of the fruit.

5.5.7 Reducing sugar

Reducing sugar content of the fruits can be changed through fertilization. Application of higher levels of chemical fertilizers increased the reducing sugar contents in fruits (Fig.7). Higher levels of nitrogen can decrease the availability of sucrose synthase and increased the activity of hydrolytic enzymes. This could enhance the accumulation of soluble

Fig 7. Effect of organic sources and levels of inorganic fertilizers on quality of fruits



carbohydrate especially monosaccharides and hence higher levels of reducing sugar. (Nitsos and Evans, 1969). This might be the reason for increased reducing sugar content in fruits recorded at higher levels of chemical fertilizers. The same result is in confirmity with the findings of Peter (1997). Application of organic sources did not show any significant variation in reducing sugar content of the fruits .

5.5.8 Total sugar

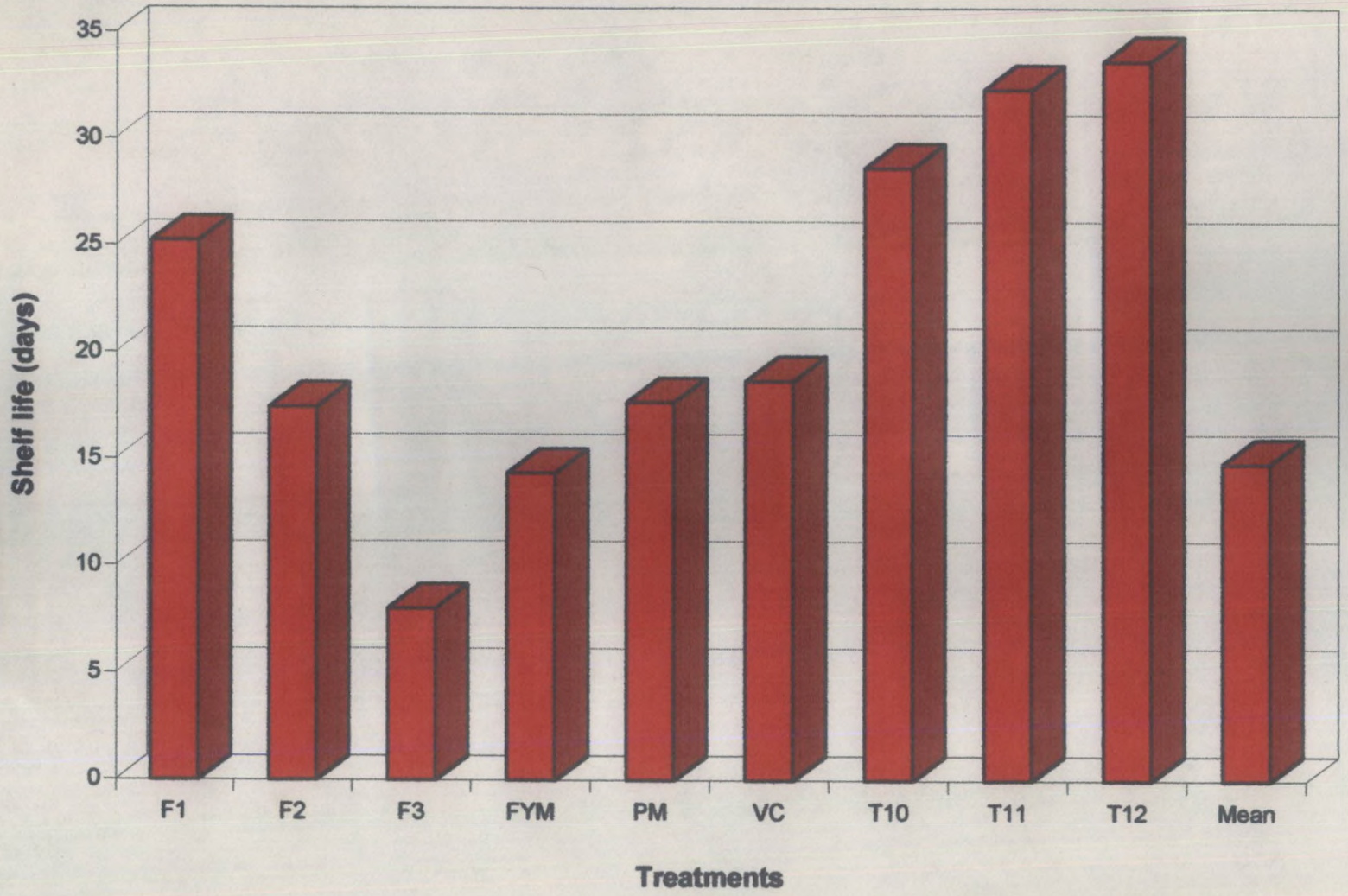
Fertilizer levels had no significant influence on the total sugar content of the fruit. However total sugar content in fruits increased with inorganic fertilizer levels, because reducing sugar is a fraction of total sugar and increasing levels of chemical fertilizers increase the reducing sugar content of the fruit. This might be the reason for high total sugar content in fruits obtained from higher levels of chemical fertilizer applied plots. This finding is in agreement with the view of Sujatha and Krishnappa (1995) in potato.

Organic manures had significant influence on the total sugar content of the fruits. Maximum total sugar (3.61 per cent) was observed with plots treated with poultry manure. This could be due to the early availability of nitrogen in poultry manure applied plots which enhanced the synthesis and translocation of carbohydrate to the fruits and subsequent conversion of carbohydrate to sugars.

5.5.9 Shelf life

The data in Table 6 and Fig.8 revealed that increasing levels of inorganic fertilizers reduced the keeping quality of the fruits. This might be

Fig. 8 Effect of organic sources and levels of inorganic fertilizers on shelf life of the fruit



due to the favourable effect of nitrogen on acidity and reducing sugar content of fruits. These two parameters showed a negative correlation with shelf life of the fruits.

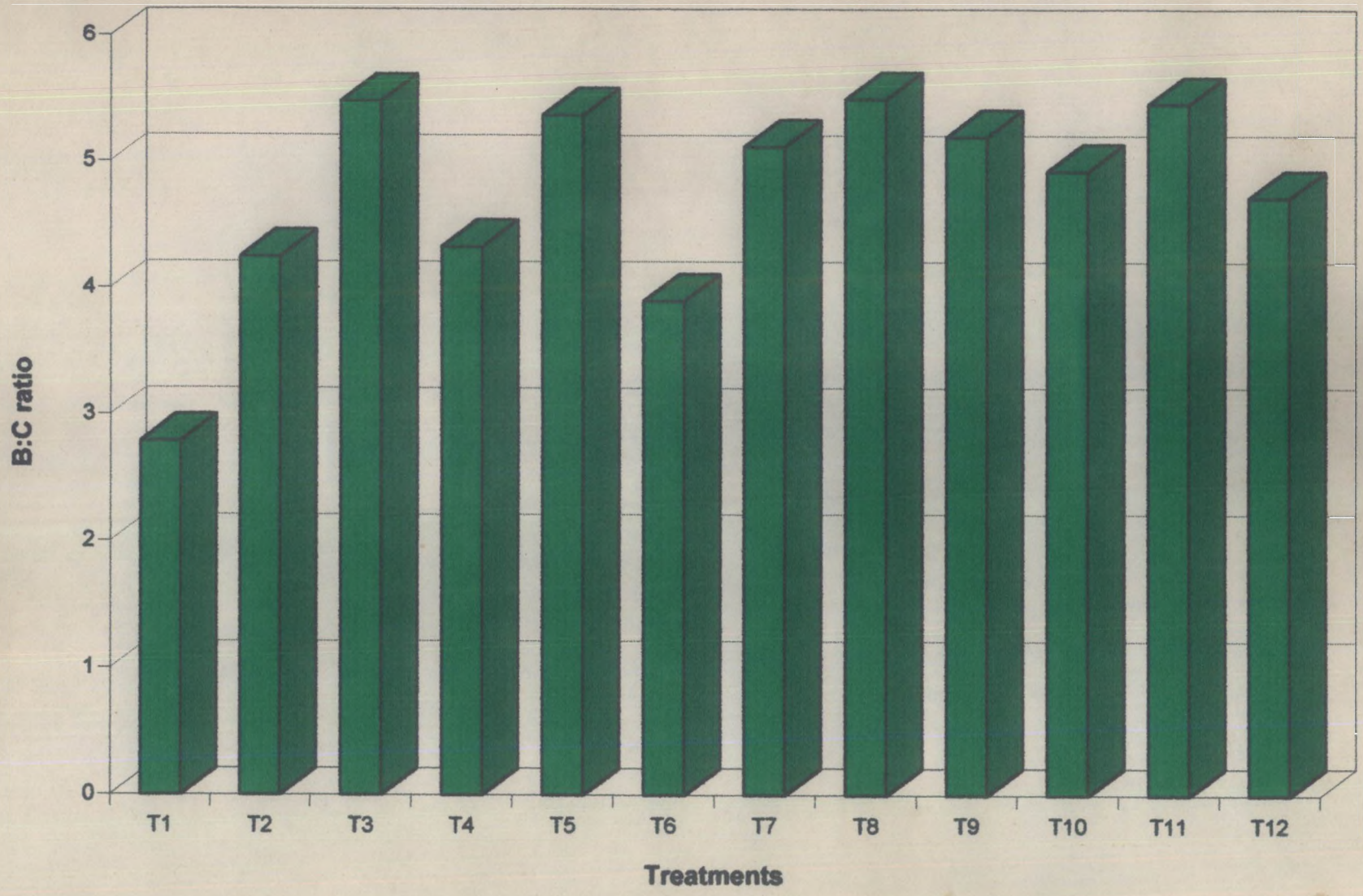
The results indicated the effect of vermicompost on keeping quality of the fruits than farmyard manure and poultry manure (Fig.8). Application of vermicompost alone or in combination with chemical fertilizers showed a significant effect on keeping quality of the fruits. Khamkar (1993) conclusively proved the better keeping quality of vegetables in vermicompost applied plots compared to chemical fertilizer applied plots. The better keeping quality of the fruit might be due to the high K content in vermicompost. Fritz and Habben (1972) reported that K fertilizers increase the durability of the fruit by lowering the activity of enzymes which breakdown carbohydrate.

From the correlation studies (Table 7) it was observed that ascorbic acid and total soluble solids of the fruits have a positive correlation with shelf life. Plants treated with vermicompost produce fruits with highest levels of ascorbic acid content (6.82mg 100^{-1}g). Fruits with high Vit.C content is associated with good keeping quality due to the effective antioxygenic property of ascorbic acid. These results are in confirmity with the findings of Wiley (1960).

5.8 Economics of cultivation

The installation of drip irrigation system for snake gourd cultivation per hacter required an additional investment of Rs. 30,000/- which when

Fig. 9 Effect of organic sources and levels of inorganic fertilizers on B:C ratio



apportioned over ten years (approximate life span of a drip system) and computed for two crops a year, workedout to Rs. 1.500/- per crop.

Result in Appendix II indicated that highest gross income of Rs. 2,90.500 ha^{-1} can be realised from the treatment farmyard manure alone (T_{10}) followed by package of practice recommendations of Kerala Agricultural University . However, it can be seen from the Fig.9 that maximum B:C ratio of 5.5 was observed with plots treated with vermicompost compared to farmyard manure and poultry manure. Usually the organic inputs are very costly and in practice it is difficult and laborious for the farmer to apply these in large quantities. But vermicompost is a potential organic source and can be prepared in small farm holding in simpler ways using family labour. The total expenditure for preparing one kg vermicompost was about 0.30 Rs by recycling of the available waste materials in the farm and using family labour. Hence, its use will reduce the cost of cultivation substantially. But the treatment with vermicompost alone (T_{12}) showed decline in yield of the crop and hence the B : C ratio was reduced to 4.72. While, plots applied with vermicompost in combination with chemical fertilizers showed a significant increase in yield of the crop with higher B:C ratio ranging from 5.12 to 5.5. In conclusion combination of vermicompost along with 3/4 NPK level was the most economical dose over all the treatments.

SUMMARY

6. SUMMARY

The study entitled **'Evaluation of organic and inorganic sources of nutrients on the yield and quality of snake gourd (*Trichosanthes anguina* L.)'** was carried out at the Instructional Farm attached to the College of Agriculture, Vellayani during Jan. - May 1997. The main objectives of the study were to investigate the potential of using farmyard manure, poultry manure, vermicompost and fertilizers and the extent to which the organic manure can substitute chemical fertilizers, for increasing the yield and improving the quality of fruits.

The trial was conducted as a factorial experiment in randomised block design with twelve treatments (Nine treatment combinations and three additional treatments) and three replications. The treatments consisted of (T_1) Farmyard manure + 1/2 NPK, (T_2) Farmyard manure + 3/4 NPK, (T_3) Farmyard manure + full NPK (POP), (T_4) Poultry manure + 1/2 NPK, (T_5) Poultry manure + 3/4 NPK, (T_6) Poultry manure + full NPK, (T_7) Vermicompost + 1/2 NPK, (T_8) Vermicompost + 3/4 NPK, (T_9) Vermicompost + full NPK, (T_{10}) Farmyard manure + Farmyard manure to substitute full NPK, (T_{11}) Poultry manure + Poultry manure to substitute full NPK and (T_{12}) Vermicompost + Vermicompost to substitute full NPK.

The data generated were analysed, presented in tables and discussed in the previous chapters. The findings of the study are summarised below.

1. Yield attributing characters viz. length of the fruits, weight of the fruits and number of fruits per plant were highest in farmyard manure alone applied (T_{10}) plots.
2. Organic manure along with their additional treatment dose to completely substitute chemical fertilizer application had appreciable influence on the yield of the crop. The organic manure, levels of inorganic fertilizers and their interactions didn't produce any marked difference on the yield of the crop.
3. Growth characters viz., weight of the root plant^{-1} and dry matter production ha^{-1} were highest in farmyard manure alone applied plots.
4. The nitrogen content in plant parts and fruits increased with increasing levels of chemical fertilizers.
5. Different organic sources and levels of chemical fertilizers failed to show any significant effect on N uptake of the plant. However, increased levels of chemical fertilizers increased N uptake of the plants.
6. The organic form of manures showed a definite advantage over inorganic fertilizers on quality of the fruit. Total soluble solids, Vit. C and total sugars were highest in fruits obtained from vermicompost applied plots.
7. Increasing levels of inorganic fertilizers reduced the keeping quality of fruits. Increased shelf life of 33.26 days was observed in vermicompost applied plots.
8. All treatments fetched good profit. The maximum B:C ratio of (5.5) was obtained by the application of vermicompost with 3/4 NPK.

From the results, it can be noticed that by the integration of

vermicompost with chemical fertilizers, a marked increase in yield and improvement in quality along with a low financial input could be achieved and the same will be a boon to the vegetable farming community.

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* Original not seen

APPENDICES

APPENDIX I

Weather conditions (weekly means) during the cropping period (January to May 1997)

Standard week	Period		Temperature (^{0}C)		Rainfall (mm.)	Relative humidity (Per cent)
	From	To	Maximum	Minimum		
1	1-1-1997	7-1-1997	33.30	21.50	-	76.00
2	8-1-1997	14-1-1997	32.90	20.88	-	78.20
3	15-1-1997	21-1-1997	33.10	21.08	-	77.40
4	22-1-1997	28-1-1997	31.70	19.45	-	72.70
5	29-1-1997	4-2-1997	33.20	20.08	-	70.20
6	5-2-1997	11-2-1997	33.50	21.74	-	71.20
7	12-2-1997	18-2-1997	32.50	20.20	-	72.20
8	19-2-1997	25-2-1997	33.00	22.09	-	71.40
9	26-2-1997	4-3-1997	33.20	22.12	-	72.14
10	5-3-1997	11-3-1997	32.90	22.50	-	71.28
11	12-3-1997	18-3-1997	33.10	22.80	-	75.92
12	19-3-1997	25-3-1997	33.30	24.00	4.8	73.60
13	26-3-1997	1-4-1997	32.98	23.65	-	72.57
14	2-4-1997	8-4-1997	33.01	24.51	5.6	77.07
15	9-4-1997	15-4-1997	33.10	24.40	9.8	71.50
16	16-4-1997	22-4-1997	33.70	24.68	-	71.28
17	23-4-1997	29-4-1997	32.86	24.68	21.0	71.00
18	30-4-1997	6-5-1997	33.08	24.68	3.7	74.86
19	7-5-1997	13-5-1997	32.13	23.91	153.0	79.42

Appendix II

Economics of production (ha^{-1})

Treatments	Cost of production excluding treatments (Rs)	Additional cost of treatments (Rs)	Total cost of production (y) (Rs)	Fruit yield (t ha^{-1})	Gross return (x) (Rs)	Net return (x - y) (Rs)	B : C
M_1F_1	32180.93	17966.72	50147.65	28.05	140250	90103.00	2.79
M_1F_2	32180.93	17984.22	50165.15	42.70	213250	163084.80	4.25
M_1F_3	32180.93	18518.72	50699.65	55.62	278000	227300.30	5.48
M_2F_1	32180.93	12517.03	44697.96	38.83	193750	149052.04	4.33
M_2F_2	32180.93	12534.53	44715.46	48.28	240500	195784.54	5.37
M_2F_3	32180.93	13068.78	45249.71	37.25	176750	131500.29	3.90
M_3F_1	32180.93	3839.00	36019.93	36.94	184500	148480.07	5.12
M_3F_2	32180.93	3964.00	36044.93	39.69	198250	162205.07	5.50
M_3F_3	32180.93	4389.00	36569.93	38.20	190750	154180.07	5.20
T_{10}	32180.93	26707.12	58888.05	57.25	290500	231611.95	4.93
T_{11}	32180.93	16775.00	48955.00	53.50	267500	218545.00	5.46
T_{12}	32180.93	7629.00	39809.93	37.66	188000	148190.07	4.72

Wage rate - Rs 103.56 day^{-1}
Farmyard manure - Rs. 680 t^{-1})
Poultry manure - Rs. 1350 t^{-1}
Vermicompost - Rs. 300 t^{-1}

Urea - Rs. 4.8 kg^{-1}
Mussorie rock phosphate - Rs. 1.75 kg^{-1}
Muriate of Potash - Rs. 4.40 kg^{-1}

APPENDIX - III

Analysis of variance table

Water holding capacity				
SOURCE	DF	S.S	M.S.S	F
Replication	2	0.96875	0.484375	2.408299
Treatments	8	36.61328	4.57666	22.75502**
M	2	2.494141	1.24707	6.200398**
F	2	31.23242	15.61621	77.64335**
M.F	4	2.886719	0.7216797	3.58817*
Treated Vs. Additional treatments	1	29.4961		146.6537**
Between Additional treatments	2	0.1337891	6.689453E-02	0.3325977
Error	22	4.424801	0.2011275	
Total	35	71.63672		

** Significant at 1 per cent
* Significant at 5 per cent

ABSTRACT

EVALUATION OF ORGANIC AND INORGANIC SOURCES OF NUTRIENTS ON YIELD AND QUALITY OF SNAKE GOURD

(Trichosanthes anguina L.)

By

PHEBE JOSEPH

Abstract of Thesis

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ABSTRACT

An experiment was conducted at the Instructional Farm attached to the College of Agriculture, Vellayani during January to May 1997 with the objectives of finding out the potential of using farmyard manure, poultry manure, vermicompost and fertilizers and the extend to which organic manures can be substituted for fertilizers for increasing yield and improving the quality of snake gourd (*Trichosathes anguina* L.). Three sources of organic manures, three levels of chemical fertilizers and three additional treatments (organic sources + organic sources to substitute NPK) were tested for their efficiency in 3 X 3 + 3 factorial RBD with three replications.

The results of the study revealed that yield attributing characters like length of the fruit, weight of the fruit and number of fruits per plant were highest in plots applied with farmyard manure + farmyard manure to substitute NPK. The organic manures, levels of inorganic fertilizers and their interactions didn't produce any marked difference in the yield of the crop. But significant difference was observed among additional treatments. Among additional treatments, plots applied with farmyard manure was found to be the best, (57250 kg ha^{-1}) which was on par with poultry manure (53500 kg ha^{-1}).

Growth characters viz. weight of the roots $plant^{-1}$ and dry matter production ha^{-1} were also highest in farmyard manure alone applied plots.

Application of chemical fertilizers significantly improve the nitrogen content in plant parts and fruits. Highest nitrogen content of plant and fruit was observed with full NPK levels (70 : 25 : 25 kg NPK ha^{-1}).

Different organic sources, levels of chemical fertilizers and their interactions failed to show any significant effect on N uptake of the plant. However increased levels of fertilizers increased the uptake of N.

The organic forms of manures showed a definite advantage over inorganic fertilizers on the quality of the fruit. Among quality attributes, significantly higher values for Total Soluble Solids (TSS), vit.C., total sugars and increased shelf life were observed in fruits obtained from vermicompost applied plots.

When the economics of production was worked out, it was observed that all treatments were able to fetch more profit, and the maximum B : C of 5.5 was observed by the application of vermicompost with 3/4 NPK.

The present study revealed that integration of vermicompost with chemical fertilizers was beneficial for increasing the yield and improvement in quality along with a low financial input.