IMPACT OF ORGANIC SOURCES OF PLANT NUTRIENTS ON YIELD AND QUALITY OF BRINJAL

By

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THESIS

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DECLARATION

I hereby declare that the thesis entitled "**IMPACT OF ORGANIC SOURCES OF PLANT NUTRIENTS ON YIELD AND QUALITY OF BRINJAL**" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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Introduction

1. INTRODUCTION

Vegetables are considered as protective foods which form an integral part of our diet. Brinjal (*Solanum melongena* L.), otherwise called as aubergine, egg plant, garden egg or guinea squash is one of the most common tropical fruit vegetables. The crop is considered as indigenous to India, and its cultivation and use are commonplace in the country. It is used primarily as a cooked vegetable and various cuisines prepared from brinjal are relished by many in the country. It invariably finds a place in the homesteads of Kerala.

The nutritive value of brinjal is almost equal to tomato with an average nutritive value of 2.14. The fruit contains 1.4 g protein, 0.3 g fat, 0.3 g minerals, 1.3 g fibre, 4.0 g carbohydrates, 2.0 mg potassium, 47 mg phosphorus and 0.9 mg iron per 100 g of fruit. It is also believed to have considerable medicinal properties.

The value of any vegetable is in its quality attributes. Organically produced vegetables are considered wholesome and valuable in therapeutic as well as from health point of view.

Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. Various organic farming practices such as crop rotations, use of crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral bearing rocks and aspects of biological pest control are followed to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests (Splittstoesser, 1990).

The sharp growth in agricultural production in India in the last three decades has taken place due to the increasing use of pesticides and higher levels of fertilizers along with improved varieties. But it has now been realised that increase in production was achieved at the cost of soil health and environmental safety. Chemical fertilizers do not supply humus and have adverse effects on physical, chemical and biological properties of soil. Application of pesticides indiscriminately leaves their terminal residues in grains, grain products, fruits and vegetables causing several health hazards. India, with utmost 4 per cent of the world cropped area has a share of around 3.75 per cent of world pesticides consumption. The market share of pesticides in crop segments during 1993 shows that 13 per cent of the total pesticides use for agriculture in the country goes for vegetables. In India, the average pesticide consumption is to the tune of 500 g ha^{-1} on an active ingredient basis and the pesticides use forecast is to reach 97,000 tonnes for agricultural purposes by 2000

A.D. (Madras Fertilizers, 1995). This portends an alarming situation causing great concern to all of us.

Now a stage has come in which the soil fertility has started decreasing, crop becomes more vulnerable to pests and diseases, and fertilizer use for increasing production has reached a point of no response. Hence a major transition is taking place in recent years in the world agricultural scenario that is encouraging and urging organic farming.

Pointing the hazards of excessive use of chemicals in agriculture, Swaminathan (1993) cautioned that agricultural research priorities, strategies and public policies will have to be changed to achieve ecological, economic and social sustainability.

Hence, it has now become necessary to keep a close watch on the effect of continuous application of fertilizers, pesticides and weedicides so as to safeguard the productivity of soil as well as the purity of atmosphere.

Recycling of plant residues and other organic wastes is healthy and is accepted being natural.

The total annual waste biomass of India is about 2500 million tonnes, which includes municipal solid wastes, agricultural residues, cattle manure, poultry manure and bio wastes of agrobased industries (Tandon, 1995). All these can be effectively utilized for organic recycling.

By adopting organic farming the post harvest losses of vegetables can be reduced to a considerable extent. The perishability of vegetables can be reduced or shelf life can be prolonged. But scientific information on these aspects in vegetables especially in brinjal is very scanty. To make up this lacunae the present experiment was taken with the following objectives.

1. To find out the response of organic manures on productivity of brinjal.

2. To investigate the effect of different manures on the quality and storability of produce.

3. To estimate the effect of organic manures on the chemical properties of soil.

4. To work out the economics of organic plant nutrition with respect to brinjal.

5. To make suitable recommendations for brinjal production under organic farming system.

Review of Literature

2. REVIEW OF LITERATURE

The importance of organic foods or health foods is now well understood and acknowledged widely. The organically produced foods are superior to conventionally produced ones in many ways, because these are produced from soils balanced by the action of worms, microorganisms and decomposing animal manure. Such foods are considered to be the cleanest and the most wholesome of all.

Research results available on the effects of organic manuring on yield attributes, quality of produce, seed characters and soil properties are briefly reviewed hereunder. Since the research findings on organic farming of brinjal is very limited, that related to vegetables in general are reviewed.

2.1 Growth components

Brinjal being a fruit vegetable responds well to the fertility and physical and chemical properties of soil (Haworth, 1961).

Nilson (1979) reported that the organic fertilizers produced the highest dry matter content in carrots, but the lowest dry matter content in cabbage and leek.

According to Cerna (1980), FYM favourably affected the formation of vegetative organs, total dry weight and plant height of capsicum.

Sumiati (1988) reported that the highest plant height, root length, leaf area index and net assimilation rate in broccoli seedlings with 1:1 mixture of stable manure and soil supplemented with NPK + metal K.

Nair (1988) reported that plant height and number of branches per plant were increased with increasing levels of nitrogen along with FYM in chilli. The best results obtained with the application of 15 t ha^{-1} of FYM + 175:40:20 kg ha^{-1} of N, P and K.

Hilman and Suwandi (1989) obtained the highest leaf area, stem diameter and plant height in tomato with 30 t ha^{-1} of sheep manure.

Sorin and Tanaka (1991) observed that in pot trials with spinach seedlings, growth was increased by the application of dried cattle manure, saw dust or bark composted with chicken manure at 15 g per plant containing 500 g soil.

Singh and Singh (1992) noted that increasing levels of nitrogen increased the height and number of branches per plant in tomato.

Poopathi (1994) reported that there existed significant difference between treatments of organic manures for plant height under pot culture studies while it was not significant under field conditions in tomato.

Lu and Edwards (1994) observed that all the collard seedlings were killed within seven days after transplanting when poultry litter was applied at 53 or 106 g kg^{-1} soil. However, the percentage of seedlings that survived decreased linearly as poultry litter increased from 0 to 26 g kg^{-1} soil. In non limed soil, the dry weight of leaves increased linearly with increasing poultry litter application. In the second cabbage crop after collard, the dry weights were the highest in the plots where poultry litter was applied at 26 and 53 g kg^{-1} soil.

According to Igbokwe *et al.* (1996) the plant growth was lesser in organic farming system when compared to the chemical intensive conventional system of growing tomatoes in Mississippi.

Roe *et al.* (1997a) reported that the plant height and stem diameter in bell pepper was better when compost was applied along with fertilizers. They also found that composts increased plant height and root weight of tomato and cucumbers.

Sukumar (1997) reported that NPK levels and cuttings had a significant impact on various growth characters of amaranthus. The plant height and green yield increased with increasing levels of NPK. But the extent of increase was more with respect to nitrogen application.

Parmar *et al.* (1998) reported that the plant height and root nodulation in vegetable pea (*Pisum sativum* var. *arvense*) was improved with the application of FYM alone and in the presence of NPK.

Ravindran and Prasad (1998) observed that the dry matter accumulation was increased with increase in levels of nitrogen at all stages of plant growth in french bean. The nitrogen fertilization increased the rate of photosynthate accumulation which finally resulted in increased dry matter prodcution.

2.2 Earliness

According to Ivanic (1957) higher levels of nitrogen delayed flowering, and prolonged growing season in chillies.

Kunju (1970) reported that there was no significant difference in number of days required for the first flower opening due to an increase in the levels of nitrogen, phosphorus or potassium.

Khan and Suryanarayana (1977) noted that nitrogen application made little difference in reducing the flowering time in chillies.

According to Bhatnagar and Pandita (1979), higher levels of nitrogen application delayed flowering and fruit ripening in tomato.

Nair (1988) reported that higher rates of nitrogen along with FYM induced earliness in chilli var. KAU cluster.

Singh and Singh (1992) also observed that increasing levels of nitrogen delayed flowering and maturity of fruits in tomato.

Auclair *et al*. (1995) reported that the organically grown tomatoes showed delayed ripening when grown on peat moss and shrimp compost than when grown on composted cattle manure. Hydroponically grown fruits ripened earlier.

2.3 Fruit characters

Attia and Nassar (1958) reported an increase in average fruit size with the application of pigeon manure in water melon.

Abusaleha and Shanmugavelu (1988) reported that the number of fruits, length and girth of fruit and total yield in bhindi were significantly influenced by the application of poultry manure in combination with ammonium sulphate than other combinations with farm yard manure and horse manure.

Prezotti *et al.* (1989) found that the application of poultry manure increased the fruit size in tomato.

Singh and Singh (1992) obtained bigger sized fruits with higher levels of nitrogen in tomato. According to them, the number of fruits per plot, marketable fruits per plant and number and yield of unmarketable fruits per plant were increased in linear fashion with the nitrogen levels.

Hilman and Suwandi (1989) observed that among sheep, horse and cow manures applied to tomato, the highest yield of 2.16 kg per plant was obtained with sheep manure at 30 t ha^{-1}. This also gave the highest yield of class I grade fruits, that is, fruits which were more than or equal to 60 g weight.

Silva Junior and Vizzotto (1990) obtained biggest fruits in tomato by the application of 20 t ha^{-1} of poultry manure along with fertilizers.

Annanurova *et al.* (1992) reported that addition of FYM to basic NPK fertilizers increased the number and mean weight of tomato fruits.

According to Lata and Singh (1993) the maximum value for fruit length, fruit diameter, number of fruits per plant and fresh weight of fruits per plant was obtained in chilli with the highest level of nitrogen applied to them.

In onions and shallots the number of bulbs per unit area as well as the bulb size was increased by the application of palm oil mill effluent in the bris soils of Malaysia (Zaharah *et al.*, 1994).

Maynard (1995) obtained increased fruit size for tomato crop grown in compost amended plots.

Roe *et al.* (1997b) reported an increase in fruit size of cucumber and pepper with the use of compost.

2.4 Yield

Chinnasamy (1967) reported that the best results could be obtained with combined application of FYM and groundnut cake in tomato yield.

Schwenmer (1975) reported the application of organic fertilizer viz. supermanurial 3 plus and humobil resulted in increased yields by about 6.5 per cent over those obtained with mineral fertilization in celery and red cabbage.

Sevec *et al.* (1976) observed that there was no difference in yield of tomato when plants were supplied with organic or inorganic nitrogen fertilizer. But they clearly indicated that it was possible to obtain high yields with organic fertilizers if sufficient amounts of nutrients were made available to the plants.

Prietas *et al.* (1981) observed that application of FYM and NPK fertilizers increased the tomato production.

Khaflewsk (1984) reported that the application of liquid manure (drained from cowdung) at 50-100 m^3 ha^{-1} or FYM at 20-60 t ha^{-1} increased the marketable yields in cucumber by 13.8 per cent and 16.9 per cent respectively.

Asiegbu and Vzo (1984) observed that number of fruits per plant increased with FYM application in brinjal. In the case of onion, the percentage of grade one bulbs increased with FYM application.

Anez and Javira (1984) found that when poultry manure was applied at 0, 20 or 40 m^3 ha^{-1} to lettuce, the yield increased from 0.66 to 0.88 and 0.90 kg per plant respectively.

Joseph (1985) reported that maximum yield and maximum number of fruits per plant were obtained with 1½ times the standard dose of NPK (70:25:25 kg ha^{-1}) with 75 per cent nitrogen in organic form in oriental pickling melon.

Florescu and Chirala (1985) observed that the best results were obtained with pig compost at 40 t ha^{-1} as basal application and 20 t ha^{-1} as top dressing in green house cucumber production.

Omori and Sugimoto (1987) found that the yield of many of the vegetable crops increased in direct proportion to the quantity of cattle manure and chicken manure applied to the crops.

Ragimova (1987) observed that FYM at 20 t ha^{-1} with $N:P_2O_5:K_2O$ at 90:90:60 kg ha^{-1} with Mn+Cu+Mo produced the highest yield in cucurbits.

Guadi *et al.* (1988) found that application of stable manure at the rate of 10 t ha^{-1} increased fresh yield of garlic from 12.2 kg per 4.5 m^2 in the control to 15.2 kg per 4.5 m^2.

Jose *et al.* (1988) observed in brinjal that the highest yield of 51 t ha^{-1} was obtained from plants receiving 50 kg N ha^{-1} either as poultry manure or as urea in a comparative trial on the effect of organic Vs inorganic form of N in brinjal.

According to Nair (1988), high ratio of both organic and inorganic fertilizers increased fruit yield in chilli Var. KAU Cluster. The maximum yield of chilli was obtained with 15 t ha^{-1} of FYM+175:40:25 kg ha^{-1} of N, P and K in inorganic form.

Prezotti *et al.* (1989) observed that application of poultry manure increased the yields and fruit size of tomato.

Silva Junior and Vizzotto (1989) were able to get the highest yield of 53 t ha^{-1} of good quality tomatoes when poultry manure at 20 t ha^{-1} was applied along with inorganic fertilizers. But without poultry manure the yield declined to 46.2 t ha^{-1}.

In cabbage, Subhan (1989) obtained the highest yields of 101.7 and 101.4 t ha^{-1} with maize compost at 30 t ha^{-1} and rice compost at 20 t ha^{-1} respectively. But with sheep manure at 25 t ha^{-1}, the yield was only 93.01 t ha^{-1}.

Lu and Bai (1989) reported that processed chicken manure application increased the yield of cauliflower and rape by 21.8 and 153.4 per cent respectively compared with control.

A judicial combination of organic manure and inorganic fertilizers for higher tomato yields had been reported by Montagu and Goh (1990).

Nicouland *et al.* (1990) studied the yield and nutrient uptake by lettuce as influenced by lime, mineral and organic fertilization and they found that the yield was the highest with poultry manure application at 36 or 24 t ha^{-1}.

In onion cv. Piralopes, the yield obtained were 23.8, 21.8 and 17.7 t ha^{-1} with mineral, organic and no fertilization respectively (Galbiati and Castellane, 1990).

Maynard (1991) conducted a trial with spent mushroom compost and poultry manure compost at Windsor in sandy terrace soil on nine vegetable crops. He observed that, with poultry manure at 50 t $acre^{-1}$, the yields of all crops except lettuce were equal to or greater than those obtained with inorganic fertilizers. The yields of egg plant, peppers and tomatoes were also improved by poultry manure at 25 t $acre^{-1}$. The addition of fertilizer to poultry manure at 25 t $acre^{-1}$ increased the yield in all crops.

Florescu *et al.* (1991) reported that composted urban waste at 30 t ha^{-1} produced highest yield for cucumbers when compared to 50 t ha^{-1} of the same or FYM at 50 t ha^{-1}.

Singogo *et al.* (1991) observed that lucerne (*Medicago sativa*) plus manure could increase the fruit yield of musk melon which can be on par with the highest rate of synthetic fertilizers.

Caicio *et al.* (1991) reported increase in plant growth and fruit yields of sweet pepper (Var. California Wonder) by the incorporation of sorghum alone or in combination with *Dolichos lab lab*.

Ranganna *et al.* (1991) observed that biogas spent sludge application resulted in higher mean yields than FYM application in chilli and french bean.

Kropiz (1992) found that the yields were higher in cabbages, onions and carrots in plots receiving FYM + NPK compared to inorganic fertilizers alone.

According to Gardini *et al.* (1992), the highest yield of tomatoes and spinach were obtained with poultry manure and mineral fertilizers at the highest nutrient content.

Hernandez *et al.* (1992) opined that yield of lettuce could be significantly increased with the application of fresh sewage sludge and composted wastes.

Panditha and Bhah (1992) obtained highest yield of marketable spears (22.4 q ha^{-1}) in asparagus with 1:1:1 mixture of sand, soil and FYM.

Padem and Alan (1992) reported that the marketable yield in cabbage can be increased with increasing nitrogen concentration when irrigation is also sufficient.

Ozores-Hampton and Bryan (1993) reported that the yield was increased in brinjal and bell pepper with mature municipal solid waste compost at 40 and 60 t $acre^{-1}$ in sandy soil. In snap bean they observed yield increase only with lower rates of the manure, especially in calcareous soil.

Ahmed (1993) reported that the yields of tomato was the highest with FYM at 19.01 t ha^{-1} followed by coir pith as compared to the control plots. Warman (1993) observed that the yield of tomato increased with increasing levels of liquid pig manure, poultry manure or cattle manure in glass house.

Oikch and Asiegbu (1993) assessed four organic manures and NPK fertilizers, each at four rates under field conditions for their comparative effects on tomato growth and yield. They observed that the fruit yields were the best with swine or poultry manure applied at 10 t ha^{-1}.

Brown *et al.* (1993) observed that an increase in the application rate of broiler litter generally resulted in a linear increase in the yield of snap melon.

Sharaifa and Haltas (1993) noted that the highest yield for both sole crop and intercrop of maize, soybean and watermelon were obtained from plots receiving highest levels of poultry manure. No significant difference in yield of cabbage was recorded among plots receiving layer and broiler poultry manure as nitrogen source (Rubeiz *et al.*, 1993).

Hochmuth *et al.* (1993) found that the yield obtained with the highest rate of poultry manure was same as that obtained with 1.0 and 1.4 t ha^{-1} of conventional NPK fertilizers.

Lata and Singh (1993) also reported that the fresh and dry pod yield of chilli was the highest with the highest level of nitrogen applied to it (180 kg ha^{-1}).

Poopathi (1994) reported that the application of the organic manures combined with recommended dose of inorganic fertilizers was the best in improving the growth and fruit yield in CO-3 variety of tomato under field conditions. Similar trend had been observed under pot culture experiments also.

Faria *et al.* (1994) observed that the yield of different vegetable crops increased with increase in the rate of chicken manure and spent mushroom compost compared to the control plots receiving mineral fertilizers.

According to Obreza and Reeder (1994), the yield of tomato was increased with the mature municipal solid waste compost and biosolid compost at 6 and 12 t $acre^{-1}$ in the sandy soils. However, in the case of watermelon, they did not get any response with the same dose of compost. But when the rate of application was raised to 33 and 50 t $acre^{-1}$ they obtained 59 per cent increase in yield. Similarly Ozores-Hampton *et al.* (1994) could not get any response with these composts either in tomato or in squash when applied in the calcareous soil.

According to Maynard (1994) the yields of capsicums, tomatoes and cauliflowers were equal or greater for the plots receiving chicken manure compost than the plots receiving NPK fertilizers. Spent mushroom compost produced the yields of aubergins, tomatoes and spring cauliflowers equal to those with NPK fertilizers.

Kitamura and Nakane (1994) compared the application of organic fertilizer after pinching with liquid fertilizer with irrigation water in green house tomato culture. Fertigation reduced the amount of N applied by 33 per cent and increased fruit size.

When palm oil mill effluent was applied to onions and shallots in bris soils of Malaysia, the onion yields increased significantly from 0.78 to 7.14 t ha^{-1} with an increase in the manure application rate from 0 to 32 t ha^{-1}. In Shallots the manure application at 0, 32, 64 and 96 t ha^{-1} resulted in yields of 3.52, 6.39, 7.64 and 8.66 t ha^{-1} respectively (Zaharah *et al.*, 1994).

In an integrated multidisciplinary study where ecological characteristics and productivity were compared for commercial farms categorized as organic or conventional, based on their use of synthetic fertilizers and pesticides or reliance on organic soil amendments and biological pest control, it was found that the yield and pest damage in these two methods were on par (Drinkwater *et al.* (1995). These two production systems could not therefore be distinguished based on the yield or insect pest damage.

Bryan *et al.* (1995) observed that the yield was increased with municipal solid waste compost in tomato and squash when applied at 60 and 120 t $acre^{-1}$.

In tomato, marketable yield of 65 t ha^{-1} was obtained with broiler litter while commercial fertilizer applied plots recorded only 52 t ha^{-1} (Brown *et al.*, 1995).

According to Maynard (1995) application of 25 t $acre^{-1}$ of municipal solid waste increased the average yield of fruits in tomato compared to unammended plots which in turn was due to an increase in number of fruits per plant as well as the increased weight of individual fruits.

Sellen *et al.* (1995) noted that in tomatoes, green beans, cabbages and Spanish onions the yields were significantly lower in organic fields than those from conventional production systems. Decrease ranged from 8 per cent for green beans to 45 per cent for tomatoes.

Kaniyama *et al.* (1995) reported that the yield in cabbages and sweet corn were the highest when chemical fertilizers were applied with FYM.

Arenfalk and Hagelskjaer (1995) obtained the highest marketable yields in vegetables with mineral fertilizers or poultry manure when compared to composted FYM or composted household refuse. But they also opined that use of several types of organic fertilizers would be better than relying on a sole source of nutrients.

Jiang *et al.* (1996) observed that, compared with the use of nutrient solution, organic manure increased tomato yield in soilless culture. According to them the use of solid organic manure provides a good nutrient supply and is economically sound.

Igbokwe *et al.* (1996) reported that the yield potential of tomatoes were lower in organic farming system when compared to the conventional and transitional farming systems.

Roe *et al.* (1997b) reported that composts from various municipal solid waste feed stocks combined with low rates of fertilizer generally produced higher pepper yields. Residual compost increased yields of a subsequent cucumber crop.

Sukumar (1997) obtained highest green yield with highest level of N (150 kg ha^{-1}) in amaranthus.

Dubey *et al.* (1998) observed that tuber yield in potato had increased with increasing levels of irrigation and nitrogen in Lahaul valley of Himachal Pradesh.

Ozores-Hampton *et al.* (1998) reported that amending soil with mature composted waste materials increased the growth and yield of vegetable crops grown in Florida. However, a beneficial response could not always occur, and the magnitude of the response is often not predictable.

2.5 Quality of produce

The question whether vegetable supplied with organic fertilizer obtain a better quality and higher nutritive value than those grown conventionally with mineral fertilizers is of growing interest in many advanced countries.

Attia and Nassar (1958) reported that application of pigeon manure increased the fruit size and sugar content in water melon.

Singh *et al.* (1970) reported a gradual increase in moisture, Vit.C and protein content in cauliflower curd with increased levels of poultry manure.

Valsikova (1983) observed favourable influence of organic fertilization on ascorbic acid content in sweet pepper fruits.

Yoshida *et al.* (1984) reported that there was no significant difference in fruit quality parameters such as reducing sugars, organic acid and Vitamin C between the tomatoes grown organically and inorganically.

According to Joseph (1985) the lowest rotting percentage of oriental pickling melon was registered when the crop was grown with FYM and wood ash alone. Organic form of manures showed a definite advantage over inorganic fertilizers in respect of the storability of oriental pickling melon.

Oteveira *et al.* (1985) noted that termite nets alone at 50-100 g per plant or in association with chicken manure at 530 g per plant increased the weight of lettuce as well as improved the quality of produce.

According to Doikova *et al.* (1986) the highest total nitrogen and nitrate content was seen in the green fruits of capsicum, especially when FYM was used as a source of nitrogen.

Perchova and Prugar (1986) observed that application of FYM positively affected nitrification process in the soil and nitrate accumulation in the crop. These effects were influenced by FYM quality and the growing conditions in different cropping seasons.

Termine *et al.* (1987) reported that the dry matter production, ascorbic acid content and mineral contents were not affected by the application of different organic manures like blood meal, sheep manure compost and wood chip compost in turnips and leeks.

The beneficial effect of green manure incorporation has been reported as it enhanced the nitrogen and plant nitrate content in lettuce (Neyrod, 1987).

According to Nair (1988), an increase in level of NPK along with FYM enhanced the number and weight of unmarketable fruits after 10 days of storage from harvest of green chillies.

Meir-Proeger *et al.* (1989) observed that compost from biogenic waste gave superior results for qualities like organoleptic quality, storage quality, contents of desirable nutrients like Vit. C and sugars and undesirable constituents in crops like tomato, beet root and cabbage.

In tomato Dhanalakshmi (1989) observed an increase in ascorbic acid content due to the application of *Azospirillum*.

Singh *et al.* (1989) observed that green manuring greatly enhanced plant growth, bulb yield and TSS in onion.

Lindner in 1989 noted that organically grown lettuce had a nitrate content of 14.2 per cent compared to 14.6 per cent in the conventional farming.

Montagu and Goh (1990) observed no difference in fruit quality between the tomatoes grown organically and inorganically. But the rate of N fertilizer applied significantly decreased Vitamin C content and fruit visual quality. They also reported that the depth of colour in tomato fruits increased significantly on application of blood and bone compost.

Florescu *et al*. (1991) found that fruits grown with urban waste compost had higher vitamin C, carbohydrate, K and Mg, less dry matter and less acidity than fruits grown with FYM.

Pimpini *et al*. (1992) reported that application of mineral fertilizers or poultry manure at the lower rate gave the best scores of processing suitability in potatoes.

Vogtmann *et al*. (1993) opined that composts prepared from kitchen and yard wastes positively affected food quality, improved storage performance and produced superior sensory quality in tomatoes. Composts significantly reduced nitrates and improved the nitrate to vitamin C ratio of vegetables.

According to Lata and Singh (1993) the ascorbic acid content of fresh red pods was decreased by higher levels of nitrogen in chilli variety Pant C-1.

Yadav *et al.* (1993) reported that increasing levels of nitrogen, phosphorus and potassium brought significant improvement in total soluble solids and specific gravity of pointed gourd, but vitamin C content was unaffected by these treatments.

Poopathi in 1994 reported that there was no difference in fruit quality between tomatoes grown organically and inorganically except the ascorbic acid content. Ascorbic acid content was increased in organically grown tomato fruits, when plants applied with FYM, *Azospirillum* and Phosphobacteria. He observed no difference in the response between field and pot culture experiments.

Gento (1994) reported that samples of lettuces grown organically contained 948 ppm nitrate which was 10 per cent less than for lettuces grown with inorganic N fertilizers.

Arenfalk and Hagelskjaer (1995) made a comparison of the effect of dried poultry manure, fresh and composted FYM, composted household refuse and a compound mineral fertilizer on the yield and quality of leek and white cabbage. From the trial it was concluded that poultry manure and mineral fertilizer gave the highest marketable yields but they tended to reduce the vitamin C content when compared to others.

Auclair *et al.* (1995) opined that vitamin C content of conventionally or hydroponically grown tomatoes was significantly higher than that of organically grown tomatoes. Fruit mineral composition was affected by none of these treatments. Fruit taste and texture were comparable for the three production methods.

Jiang *et al.* (1996) reported that, compared with the use of nutrient solution, organic manure increased fruit reducing sugar and vitamin C contents and decreased fruit organic acid content.

Roe *et al.* (1997a) reported that the percentage of pepper fruit culls increased by 31 per cent with addition of compost without fertilizer and decreased by 77 per cent and 41 per cent with the 50 per cent and 100 per cent fertilizer rate respectively.

Sukumar (1997) obtained significantly increased nitrate content in amaranthus with an increase in the level of nitrogen. The highest nitrate content of 0.65 per cent was recorded in the treatment supplied with 150 kg N ha^{-1} in the inorganic form. The oxalate content decreased significantly with the increase in nitrogen levels and nitrogen at 150 kg ha^{-1} recorded the lowest oxalate content of 4.84 per cent in this experiment.

2.6 Seed characters

Lenka *et al.* (1989) reported that satisfactory seed yield in okra was obtained with 100 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1}.

According to Vijayakumar *et al.* (1989), the highest yield per plant (429 g) of ribbed gourd was obtained with 10 kg FYM + 9:15:5 g NPK per pit as basal dose and 10 g N per pit at first flowering and 8 g N + 3 g K per pit as top dressing at 20 and 40 days after first flowering.

Soliman *et al.* (1991) observed that the seed yield and 100 seed weight in common bean were increased with the application of chicken manure along with foliar sprays of 200 ppm $ZnSO_4$. The experiment was conducted at Barrage Horticultural Research Station in Egypt.

Nataraj *et al.* (1992) reported that the nitrogen rates and picking levels did not significantly affect the seed quality parameters like 100 seed weight, seed diameter, percentage of germination and field emergence in okra.

Fageria *et al.* (1992) reported that 75 kg N ha^{-1} could be taken as optimum for the normal plant growth and higher seed yield of okra under hill conditions of Himachal Pradesh.

In a field experiment with kharif onion in Faizabad district, it was observed that application of 120 kg N ha^{-1} produced significantly higher yield while response between 120 to 160 kg N ha^{-1} and 160 to 200 kg N ha^{-1} were insignificant (Singh *et al.*, 1994).

Sharma *et al.* (1994) observed that the seed yield, 100 seed weight, and germination percentage of seeds were significantly higher with 250 kg N ha^{-1} in cauliflower at Katrain.

Singh and Singh (1994) observed that an increase in the level of nitrogen led to significant increase in seed yield per plant, seed yield per hectare and 100 seed weight in cauliflower at Durgapura, Jaipur. They obtained the maximum seed yield of 401.78 kg ha^{-1} with the application of 120 kg N ha^{-1}.

Sukumar (1997) opined that increase in nitrogen level could bring about increase in seed yield in amaranthus. Nitrogen at 150 kg ha^{-1} recorded the highest yield of 1467.4 kg ha^{-1} and it was concluded that neither the nutrients, nor the cuttings has significant effect on 100 seed weight seed germination and seedling vigour in amaranthus.

2.7 Pest and disease incidence

Infestation by pests and diseases was reduced by the use of various soil amendments in vegetables. But reports are also there to show that the damage by pests and diseases are unaffected by the application of organic or inorganic fertilisers.

Various amendments like composted bark, cattle manure, poultry manure, sewage sludge and composted wool waste were found to suppress the club root disease caused by *Plasmodiophora brassicae* in field grown chinese cabbage (Kinoshita *et al.*, 1984).

According to Chindo and Khan (1986), the nematode (*Meloidogyne incognita*) damage in tomato was lessened with increasing levels of poultry manure.

Seo (1986) reported that the Fusarium wilt in cucumber could be suppressed by 30-35 per cent with the application of organic matter.

The effect of solar energy and green manures on the control of southern blight of tomato was observed by Tu *et al.* (1987). They found that the addition of green manure gave increased control of the disease compared to plastic covering alone.

Prezotti *et al.* (1989) reported that the best reduction of the incidence of blossom end rot of tomato was obtained with poultry manure + lime stone.

Mutitu *et al.* (1988) observed that the Fusarium yellow caused by *Fusarium oxysporum* fsp. *phaseoli* on bean can be reduced by the application of FYM.

Fayad and Swelan (1989) observed that the application of triple phosphate along with cattle manure reduced the nematode populations in tomato.

Stephan *et al.* (1989) studied the effect of organic amendments, nematicide and solar heating in reducing the nematode attack in egg plant. They observed that the organic amendments were least effective against nematodes.

In sweet pepper, the incidence of root rot was reduced by the application of chicken manure and compost of sugarcane baggase, saw dust and ash at 2:1:1 (Corrales *et al.*, 1990).

According to Alan (1991) using the saw dust of mango and ammonium sulphate significantly reduced the population of plant parasitic nematodes in carrot, radish, table beet and turnip.

Hochmuth *et al.* (1993) reported that internal tip burn of cabbage was increased with the rate of manuring in 1990, but it was not so in 1991 with the application of poultry manure.

According to Khan (1994), organic amendments like groundnut cake, cotton seed cake, soyabean cake, poultry manure, sheep manure, cow dung, raw sewage sludge and cassava peelings reduced the nematode infestation in okra.

Stephan (1995) reported that the horse manure significantly reduced the attack of meloidogyne incognita in tomato.

Drinkwater *et al.* (1995) reported that the conventional system and organic system of tomato cultivation cannot be distinguished based on level of arthropod pest damage or fruit yield.

2.8 Effect on fertility status of soil

Soil fertility is defined as the status of soil in relation to the amount and availability to plants of elements necessary for plant production (Canada Department of Agriculture, 1972). All fertile soils have an adequate supply of organic matter. Soil organic matter, a key component of soils, affects many reactions that occur in soil. It plays an important role in the soil-plant system, and organic matter containing N, P, K, Ca, Mg and S plus their chemical, physical and biochemical reactions are critical to plant growth.

McIntosh and Varney (1973) found that cultivation and cropping of unmanured plots reduced organic N and C by 8.7 and 17.7 per cent respectively. In such case an annual application of 44 t ha^{-1} of fresh dairy manure was required to maintain the soil organic matter.

Kaddons and Morga (1986) reported that hydraulic conductivity, water retention, N, P, K and organic carbon were increased with increasing rates of spent mushroom compost and FYM. FYM significantly increased the levels of Zn and Mn in the plant tissues.

Kinoshita *et al.* (1986) reported that soil N, P, K, Mg and Ca were increased with the quantity and number of applications of pig manure mixed with saw dust.

Vityakom and Seripong (1988) observed that cattle manure significantly increased the uptake of P and K.

Yamada and Kamata (1989) found that application of cattle manure increased total C and N, available N, available P and K, porosity and decreased soil density.

Bohme *et al.* (1990) reported that long term use of organic manures increased yield over years and N, P and K requirement per kilogram of fruit decreased with increasing yield.

Warman (1990) observed that chicken and dairy manure increased soil pH, thus reducing the availability of Mg, while pig manure showed the opposite effect.

According to Choe *et al.* (1991) rice straw application improved bulk density and porosity of soil compared to compost and chemical fertilizers.

Rubeiz *et al.* (1993) reported that physical properties of soil like bulk density, electrical conductivity, nitrate and P contents were not affected by layer and broiler poultry manures as a source of N for cabbage production.

Yang *et al.* (1994) reported from Taiwan that the soil pH was increased by the application of organic manures like pig and chicken faeces, animal and plant residues and municipal residues. On the other hand the Japanese scientists Kitamura and Nakane (1994) observed that application of conventional organic fertilizers reduced soil pH and increased soil electrical conductivity.

Lu and Edwards (1994) observed that the specific conductance of soil increased linearly with increasing poultry litter application rates for all growth periods of collard. Poultry litter and liming both significantly influenced soil

NH_4-N. When poultry litter was incorporated at 53 or 106 g kg^{-1} soil, the soil NH_4-N ranged from 158 to 178 mg kg^{-1} in limed soil and from 115 to 165 mg kg^{-1} in non-limed soil.

Kamiyama *et al*. (1995) reported that soil pH, CaO and MgO contents were increased when fertilized with chemical fertilizers alone and in combination with FYM.

Drinkwater *et al*. (1995) reported that N mineralization potential was higher in organic farms.

According to Igbokwe *et al*. (1996) soil extractable nutrient contents and soil organic matter were generally highest in transitional (with more organic manure and less inorganic fertilizers) and organic farming systems. The pH was highest with the organic farming system.

Roe *et al*. (1997b) concluded that, soil samples taken at the end of an organic farming trial in chillies indicated increased P, K, Mg, ca and pH in plots applied with compost.

2.9 Nutrient uptake by plants

The uptake of nutrients varies according to the variety, soil type, cultural practices followed and the nutrients applied (Anand, 1973). He observed that the leaf N, P, K levels had direct influence on fruit yield in tomato.

Deiz (1989) reported that nitrogen uptake by wheat was much greater in the manure, compost or peat treatments than in the inorganic control.

Uptake of minerals into fruits and leaves depends not only on soil contents of minerals, but also on factors such as soil pH and soil organic matter content (Stilwell, 1993).

Lu and Edwards (1994) found that the leaf N of collard increased quadratically with increasing poultry litter application rate. The same is the case with two successive cabbage crops after collard. The concentration of P in collard plants increased linearly from 8 to 14 g kg^{-1} as poultry litter rate increased from 0 to 26 g kg^{-1}.

According to Poopathi (1994) the nutrient contents of plants as judged in the respective plant parts like leaves was higher at flowering and harvesting stages, when applied with both organic and inorganic fertilizers. The response was same in field and pot experiments.

Yang *et al.* (1994) observed that application of organic fertilizers enhanced the metal uptake of *Brassica chinensis*, which again depended on the composition and types of metals in the organic fertilizer.

Auclair *et al.* (1995) reported that organically grown tomato fruits had higher Ca, Cu, Fe, P and Zn contents.

Pieri-La-de *et al.* (1996) were of opinion that there were few correlations between concentration of the elements in plants and in the corresponding soil.

In a trial conducted at Beijing with solid organic manure in tomatoes, it was observed that the NPK uptake was in the ratio of 1:0.25:1.141 during the whole growing period (Jiang *et al.*, 1996).

Dubey *et al.* (1998) conducted a trial to study the response of potato to irrigation and nitrogen level in Lahaul Valley of Himachal Pradesh. They observed that total uptake of N, P and K by tuber and haulms were maximum in the treatment applied with highest level of N (150 kg ha^{-1}).

Materials and Methods

3. MATERIALS AND METHODS

The present investigation on "Impact of organic sources of plant nutrients on yield and quality of brinjal" was carried out in the Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikkara during 1993-1997.

3.1 Site, soil and climate

The crops were raised in the vegetable research farm of the Department of Olericulture, located at an elevation of 22.5 m above MSL and between 10°32'N latitude and 76°16'E longitude. The area enjoys a warm humid tropical climate.

The soil of the experimental site belongs to sandy loam in texture and acidic in reaction.

The area lies in a tropical monsoon climate with more than 80 per cent of the rainfall getting distributed through South-West and North-East monsoon showers. The normal weather of the area and the weather conditions prevailed during the experimental period are presented in Appendix-I.

3.2 Experimental material

The brinjal variety Surya was used for the experiment. This variety is resistant to bacterial wilt incited by

Ralstonia solanacearum (Smith) Yabuuchi *et al.* and is high yielding with purple coloured fruits.

3.3 Manures and fertilizers

The manures used were farm yard manure and poultry manure and fertilizers used were urea, factomphos and muriate of potash.

3.4 Experimental method

Experimental design adopted was randomised block design with three replications. There were 50 plants in a plot with ten rows of five plants each. Spacing adopted was 75 x 60 cm. The layout of the experiment is given in Fig.1.

The manurial and fertilizer doses were based on the Package of Practices Recommendations (KAU, 1989) for brinjal. As per this recommended dose of FYM was 20 t ha^{-1} and NPK was 75:40:25 kg ha^{-1}. The treatments were fixed based on the assumption that FYM contain 0.4 per cent N and poultry manure contain 1.2 per cent N and the total N requirement of the plants were worked out accordingly. On this basis FYM was applied at two levels. FYM as per Package of Practices Recommendations i.e., 20 t ha^{-1} and 38.5 t ha^{-1} (equivalent to 20 t ha^{-1} FYM + 75 kg N ha^{-1}). Poultry manure was also applied at two levels 6.67 t ha^{-1} (equivalent to 20 t ha^{-1} of FYM) and

Experiment I

T_{10}	T_7	T_5	T_8	T_9	T_6	T_3	T_1	T_4	T_2	R_1
T_8	T_5	T_9	T_7	T_6	T_{10}	T_2	T_4	T_1	T_3	R_2
T_6	T_9	T_7	T_8	T_{10}	T_5	T_4	T_2	T_3	T_1	R_3

Experiment II

T_7	T_{10}	T_8	T_5	T_6	T_9	T_1	T_3	T_2	T_4	R_1
T_5	T_8	T_7	T_9	T_{10}	T_6	T_4	T_2	T_3	T_1	R_2
T_9	T_6	T_8	T_7	T_5	T_{10}	T_2	T_4	T_1	T_3	R_3

Fig.I Lay out plan of the experimental site

12.92 t ha^{-1} (equivalent to 20 t ha^{-1} FYM + 75 kg N ha^{-1}). The exact quantity of organic manures were arrived at by analysis of the manures before use (Appendix-II).

There were two sets of treatments which formed two separate experiments. In the first experiment, the nitrogen levels in the treatments were fixed on reckoning with the residual nitrogen in the soil so as to keep the N status same at the beginning of every succeeding crop. In the second experiment the same treatments were applied for each succeeding crop without reckoning the residual fertility.

EXPERIMENT-I

3.5 Treatment

T_1 FYM at 20 t ha^{-1}

T_2 FYM at 38.5 t ha^{-1}

T_3 Poultry manure at 12.92 t ha^{-1}

T_4 Poultry manure at 6.67 t ha^{-1}

T_5 Package of practices recommendations of KAU ie. 20 t ha^{-1} of FYM + NPK at 75:40:25 kg ha^{-1}

T_6 Poultry manure at 6.67 t ha^{-1} + NPK at 75:40:25 kg ha^{-1}

T_7 Fertilizers equivalent to NPK content in 38.5 t ha^{-1} of FYM

T_8 Fertilizers equivalent to NPK content in 20 t ha^{-1} of FYM

T_9 Fertilizers equivalent to NPK content in 12.92 t ha^{-1} of poultry manure

T_{10} Fertilizers equivalent to NPK content in 6.67 t ha^{-1} of poultry manure

The same plots were used for the succeeding seasons.

EXPERIMENT II

Included all the treatments in experiment I but without reckoning residual nitrogen after every crop. In this experiment also same plots were used for the succeeding crop.

3.6 Design and layout

Design	:	Randomised Block Design
Replications	:	3
Gross plot size	:	22.5 m^2
Net plot size	:	10.8 m^2
Number of plants in net plot	:	24
Spacing	:	0.75x0.60 m

3.7 Field culture

3.7.1 Land preparation and planting

The experimental area was ploughed twice, weeds were removed and the land was levelled before layout. Ridges were prepared at 75 cm apart and 35 days old seedlings were transplanted at 60 cm spacing. During summer season in place of ridges, furrows were formed and transplanting was done in these furrows. The transplanted seedlings were given temporary shade, for 2-4 days during summer period.

The organic manures were applied in two equal split doses, one as basal dose before planting and the second after 20-25 days of transplanting. The fertilizers were applied as per Package of Practices Recommendations (KAU, 1989).

3.7.2 Aftercultivation

The crops were hand weeded regularly to keep them free of weeds. Light earthing up was done along with top dressing of manures and fertilizers. During summer, irrigation was given at 3-4 days interval.

3.7.3 Plant protection

No serious diseases were observed during the experimentation period.

The major pests found attacking the crop were shoot and fruit borer and epilachna beetle, which were controlled manually to a large extent by hand picking and killing of the maggots. In severe cases they were controlled by spraying 0.3 per cent neem kernel suspension or 4 per cent neem leaf extracts. Sucking insects like jassids and aphids were controlled by the application of neem oil emulsion 3 per cent with garlic.

3.7.4 Harvesting

Fruits were harvested at the usual vegetable harvesting stage at which it retained the glossy appearance.

3.8 Observations

8.3.1 Growth components

a. Plant height of at first harvest

Plant height at first harvest was recorded in six plants per plot and the average was taken. Measurement was taken from the base to the growing tip of the plant and expressed in cm.

b. Branches per plant

Number of branches of six plants per plot was counted towards the end of the crop and the average was taken.

3.8.2 Earliness and yield attributes

a. Index to earliness

Index to earliness was calculated as per the method suggested by Bartlett (1937).

Bartlett's Index to earliness

$$(BI) = \frac{(Y_1 xn) + (Y_2 xn-1) + (Y_3 xn-2) + \ldots\ldots (Y_n x1)}{Y \times n}$$

where

Y = Total yield of all the harvests

n = Total number of harvests

Yn = Yield of harvest at nth time

b. Number of fruits per plant

Total number of fruits from six plants per plot were counted and their average was calculated to get the number of fruits per plant.

c. Volume of fruit

Volume of five average sized fruits per plot was recorded using water displacement method by immersing them in 1 litre measuring jar. Then their average was calculated to get the volume of fruit and expressed in cm^3.

d. Yield per plant

Weight of fruits per plant was recorded in six plants after each harvest and the average was calculated to get the fruit yield per plant and expressed in gram.

e. Yield per plot

Weight of fruits per plot was found out after each harvest and these were added to get the total yield per plot and expressed in kg.

f. Number of harvests

The total number of harvests for each treatment was recorded.

g. Crop duration

Number of days taken from transplanting to last harvest in each treatment was recorded.

3.8.3 Quality of produce

a. Ascorbic acid content

Ascorbic acid content of fruits at vegetable harvest stage was estimated volumetrically by titration with 2,6-dichlorophenol indophenol dye (Sadasivam and Manickam, 1992). The value was expressed as milligram per 100 g of fruit.

b. Moisture

Moisture content was estimated gravimetrically by drying the samples in hot air oven at 80°C. Drying was continued till the samples attained constant weight. Moisture content was expressed in per cent (Ranganna, 1979).

c. Total soluble solids

Total soluble solids were found out by a pocket refractometer and were expressed as per cent.

d. Acidity

Titrable acidity was estimated as per the A.O.A.C. method (1975).

e. Reducing and total sugars

Reducing and total sugars were determined adopting the method suggested by A.O.A.C. (1975).

f. Flesh thickness

Ten fruits at vegetable harvest stage were randomly selected from each treatment and the flesh thickness was found out using screw gauge and expressed in mm.

g. Enzyme activity

Phosphorylase enzyme estimation

Phosphorylase enzyme of the seed was estimated according to the method described by Linskens *et al.* (1964).

Preparation of reagents

1. Extraction buffer

Tris HCl	-	4.24 mg
Citric acid	-	0.523 mg
Vitamin C	-	1.057 mg
Cysteine HCl	-	1.042 mg
PVP	-	10 ppm
ß mercaptoethanol	-	2 μm

The above formulation was dissolved in 50 ml distilled water. Adjusted pH to 7 and made upto 100 ml.

2. 5 per cent starch

Dissolved 2.5 g soluble starch in 50 ml distilled water. Starch solution was prepared fresh for each analysis.

3. 0.26 M GI-P pH 6.0

Dissolved 0.968 g of GI-P in 10 ml of distilled water and adjusted the pH to 6.

4. Stopping reagent

Dissolved 2.5 g ammonium molybdate in 100 ml distilled water. Added 10 ml of 5N H_2SO_4 and 710 ml of distilled water for preparing stopping reagent.

5. ANSA (1 amino 2 naphthol 4 sulphonic acid) reagent

Twelve grams of sodium metabisulphite was well powdered in a mortar to which 1.2 g sodium sulphate was added and continued powdering. Then 200 mg of ANSA was added to it and again ground to a fine powder. Finally the above mixture was dissolved in 100 ml distilled water.

6. 5N H_2SO_4

To 300 ml distilled water added 70 ml concentrated H_2SO_4. This was cooled and the volume made upto 500 ml.

7. 0.018 M ammonium molybdate

Dissolved 11.125 g ammonium molybdate in 500 ml distilled water.

Extraction

One gram leaf sample was macerated in chilled mortar and pestle along with 10 ml extraction buffer. The extract was centrifuged at 15,000 rpm at 5°C for 20 minutes. The supernatant enzyme solution was used for further analysis.

Procedure

To 1 ml of enzyme solution, added 0.25 ml starch and 0.2 ml GI-P and kept at room temperature. After 30 minutes, 7.15 ml stopping reagent, 0.9 ml 5 N H_2SO_4 and 0.5 ml ANSA were added in a sequence and kept it as such for 10 minutes and read the absorbance at 660 nm. Phosphorylase enzyme activity was expressed in terms of OD value.

h. **Organoleptic test**

Acceptability trials of the brinjal fruit were conducted using the scoring method (Swaminathan, 1974). Five quality attributes like appearance, colour, texture, taste and flavour were included as the quality attributes. Each of the above mentioned quality was assessed by a five point hedonic scale.

The judges were requested to taste one sample and score it. They were requested to taste the second sample after rinsing their mouth. Each quality attribute was assessed by the panel members after testing the same samples several times, if needed. The panel members were permitted to take their own time and to judge the samples leisurely.

The testing was done in the afternoon between 3 pm and 4 pm, since this time is considered as the ideal time for conducting the acceptability studies (Swaminathan, 1974).

3.8.4 Percentage of unmarketable fruits after 5 and 7 days of storage

Fifteen fruits were selected randomly from each replication for different treatments and they were stored in paper plates in open conditions, after recording their initial weight. Then unmarketable fruits were weighed on 7th day and 10th day of storage and the percentage of unmarketable fruits calculated. Since all fruits were unmarketable on 10th day, the observation were taken on 5th and 7th days from third crop onwards.

3.8.5 Seed characters

a. Seed yield per plant

Three plants each in all the plots were retained without harvesting for vegetable purpose. All the fruits in these plants were allowed to ripen and the ripe fruits were harvested, seeds extracted, dried and then weighed and the average calculated to get the seed yield per plant. Seed yield was expressed as grams per plant.

b. Number of seeds per fruit

Five ripe fruits each were harvested, seed extracted, dried, number counted and their average calculated to get the number of seeds per fruit.

c. Weight of seeds per fruit

Weight of the above seeds were recorded and their average wieght was calculated to get the weight of seeds per fruit which was expressed as g per fruit.

d. **100 seed weight**

Hundred seeds were randomly counted from fruits of each plot and their weight was recorded.

e. **Germination per cent**

Hundred seeds were randomly selected and they were sown in sand. Moisture necessary for germination was given by sprinkling water and the germinated seeds were counted and the final count was taken on the 10th day. Total number of seeds germinated gave the germination per cent.

3.8.6 Pest and disease incidence

Major pests noticed were epilachna beetle and shoot and fruit borer. The number of plants affected by these pests in each plot was counted and their percentage was worked out serious diseases were not seen in the crop.

3.8.7 Soil properties

Soil samples were collected from each plot before starting the first crop and there after for every succeding crop. The samples were analysed for pH, organic carbon, total N, available P and available K as detailed in the Table 1.

Table 1. Details of the methods used for chemical analysis of the soil

Characteristics of soil	Soil solution	Extraction period (min)	Extractant used	Method of estimation	Instrument used	References
pH (H_2O)	1:2.5	-	-	Direct reading	pH meter	Jackson (1958)
Organic carbon	-	-	-	Walkley-Black	Titrimetric	Jackson (1958)
Total N	-	-	-	Microkjeldahl	Titrimetric	Jackson (1958)
Available P	1:10	5	Bray-1	Ascorbic acid blue	Spectrophotometer	Jackson (1958)
Available K	1:10	5	Neutral normal ammonium acetate	Direct reading after dilution	Flame photometer	Jackson (1958)

3.8.8 Plant analysis

a. Dry matter production

Hundred days after transplanting the shoot portion was separated along with leaves and fruits. The roots were carefully recovered from soil by removing the adhering soil particles using running water. The dry weight of shoot including fruits and roots was recorded separately after drying in a hot air oven at 70°C±2° till constant weights were obtained.

b. Estimation of nitrogen, phosphorus and potassium

The oven dried leaves, fruits and stem samples were ground in Wiley mill fitted with stainless steel blades and passed through 40 mesh sieve. The samples were analysed for macro nutrients as detailed below.

Nitrogen was estimated by microkjeldahl method (Jackson, 1958). For the analysis of other elements, diacid extracts were prepared by digesting 1 g of the sample in 15 ml of 2:1 concentrated nitric per chloric acid mixture (Johnson and Ulrich, 1959). Aliquots of the digests were taken for the analysis of total P and K.

Phosphorus was determined colorimetrically by vanadomolybdo phosphoric yellow colour method (Jackson, 1958).

The yellow colour was read in a spectrophotometer (spectronic-20) at a wave length of 470 nm. Potassium was estimated using flame photometer (EEL make).

3.8.9 Statistical analysis

Data were analysed as per MSTATC package available at computer centre, College of Veterinary and Animal Sciences, Mannuthy. Treatments were grouped using Duncan's Multiple Range Test.

The organoleptic parameters were analysed using the Fried mans two-way analysis of variance by ranks (Siegel, 1956). Stability analysis was done following the model proposed by Eberhart and Russell (1966) and modified by Rawlo and Das (1978) and Prabhakaran and John (1992).

Results

4. RESULTS

The results of the present study are described below:

4.1 Growth components

4.1.1 Plant height at first harvest

a. Experiment I

Data on the effect of treatments on plant height at first harvest are presented in Table 2a.

In the first crop, the plant height at first harvest showed significant difference between treatments. The treatment T_3 recorded the maximum average height (57.89 cm) which was significantly higher than the mean heights of T_1, T_2, T_5 and T_{10}. The minimum height (43.72 cm) was recorded in the treatment T_1 which was significantly lower than T_3, T_6, T_7 and T_8.

In the second crop, the maximum height was observed in T_6 (42.17 cm) followed by T_3 (41.61 cm) and both of them were at par. The treatment T_1 recorded significantly lower plant height (33.67 cm) as compared to other treatments.

Table 2a. Effect of organic and inorganic plant nutrition on plant height at first harvest (cm) in experiment I

Treat- ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	43.72^{d}	33.67^{d}	32.57^{ef}	32.53^{ef}	30.97^{f}	32.50^{e}
T_2	50.11^{cd}	35.33^{cd}	35.00^{d}	35.83^{cd}	34.50^{cd}	36.27^{c}
T_3	57.89^{a}	41.60^{a}	42.63^{a}	42.53^{a}	41.57^{a}	43.10^{a}
T_4	50.94^{ab}	39.33^{ab}	39.03^{bc}	38.77^{b}	36.97^{b}	38.87^{b}
T_5	48.67^{bc}	40.11^{ab}	34.33^{de}	34.07^{de}	33.20^{de}	34.33^{d}
T_6	52.01^{ab}	42.17^{a}	37.93^{c}	38.47^{b}	37.00^{b}	39.03^{b}
T_7	54.83^{ab}	38.00^{bc}	40.43^{ab}	37.73^{bc}	35.97^{bc}	36.77^{c}
T_8	52.05^{ab}	37.61^{bc}	34.07^{de}	33.97^{de}	31.70^{f}	32.12^{e}
T_9	52.89^{ab}	39.94^{ab}	38.63^{bc}	37.73^{bc}	36.10^{b}	37.23^{c}
T_{10}	46.95^{cd}	37.28^{bc}	31.57^{f}	31.70^{f}	37.80^{ef}	31.53^{e}

Treatments with the same superscript form one homogeneous group

In the third crop maximum plant height was recorded in treatment T_3 (42.63 cm) which was significantly higher than that of all other treatments except T_7 (40.43 cm). Here the minimum height was recorded in T_{10} (31.57 cm).

In crops IV, V and VI also the tallest plants were produced in T_3 (42.53 cm, 41.57 cm and 43.10 cm respectively). These values were significantly higher than that of other treatments. In crop IV the minimum height was recorded in T_{10} (31.70 cm) whereas in 5th crop minimum height was recorded in T_1 (30.97) which was on par with T_8 and T_{10}.

b. Experiment II

The data on the effects of treatments on plant height at first harvest in this experiment are presented in Table 2b.

In the first crop, the plant height at first harvest did not differ significantly due to treatments. But from second crop onwards the plant height showed significant difference between treatments. In all the crops, the highest level of poultry manure (155 kg N ha^{-1}) recorded the maximum plant height at first harvest (41.45 cm, 41.17 cm, 43.17 cm, 42.10 cm and 43.57 cm in crops II, III, IV, V and VI respectively).

Minimum height was observed in T_1 in crops II and IV (31.89 cm and 32.3 cm respectively), T_{10} in crop III

Table 2b. Effect of organic and inorganic plant nutrition on plant height at first harvest (cm) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	48.55 [a]	31.89 [f]	32.40 [ef]	32.30 [d]	31.30 [f]	33.03 [e]
T_2	48.95 [a]	33.56 [ef]	35.57 [cd]	36.10 [c]	34.53 [d]	36.80 [c]
T_3	54.83 [a]	41.45 [a]	42.17 [a]	43.17 [a]	42.10 [a]	43.57 [a]
T_4	52.39 [a]	38.00 [bc]	38.77 [b]	39.23 [b]	37.47 [b]	39.20 [b]
T_5	52.33 [a]	38.61 [abc]	35.77 [cd]	35.80 [c]	33.30 [de]	34.67 [d]
T_6	50.11 [a]	40.45 [ab]	38.13 [b]	38.47 [b]	36.93 [bc]	39.13 [b]
T_7	54.44 [a]	36.39 [cde]	40.73 [a]	38.73 [b]	35.93 [c]	36.83 [c]
T_8	51.28 [a]	34.79 [de]	34.07 [de]	33.33 [d]	31.27 [f]	32.23 [e]
T_9	52.00 [a]	36.46 [cd]	36.10 [c]	38.03 [b]	36.13 [bc]	36.73 [c]
T_{10}	48.00 [a]	34.80 [de]	31.93 [f]	33.27 [d]	31.93 [ef]	32.27 [e]

Treatments with the same superscript form one homogeneous group

Plate 1. Field view of treatment receiving FYM at 80 kg N ha^{-1}

Plate 2. Field view of treatment receiving FYM at 155 kg N ha^{-1}

Plate 3. Field view of treatment receiving PM at 155 kg N ha^{-1}

Plate 4. Field view of treatment receiving PM at 80 kg N ha^{-1}

Plate 5. Field view of treatment receiving FYM + inorganic fertilizers

Plate 1

Plate 2

Plate 3

Plate 4

Plate 5

Plate 6. Field view of treatment receiving PM + inorganic fertilizers

Plate 7. Field view of treatment receiving fertilizers equivalent to NPK in higher level of FYM

Plate 8. Field view of treatment receiving fertilizers equivalent to NPK in lower level of FYM

Plate 9. Field view of treatment receiving fertilizers equivalent to NPK in higher level of PM

Plate 10. Field view of treatment receiving fertilizers equivalent to NPK in lower level of PM

Plate 6

Plate 7

Plate 8

Plate 9

Plate 10

(31.92 cm), and T_8 in crop V and VI (31.27 cm and 32.3 cm respectively).

4.1.2 Number of branches per plant

a. Experiment I

Data on the effects of treatments on the number of branches per plant are presented in Table 3a.

In the first crop, the observations on number of branches per plant showed significant difference between treatments. The maximum number of branches was recorded in the treatment T_6 (18.11) which was followed by T_9 (17.68) and T_3 (17.61). The minimum number of branches was recorded in T_1 (11.33) which was significantly fewer than that of all other treatments except T_5 and T_8.

In the second and third crops also number of branches was more in T_6 (17.89 and 17.96 respectively) closely followed by T_3 (17.83 each) and in both the treatments branching was significantly more than that of other treatments.

Minimum number of branches was observed in T_1 (13.17 and 13.28 respectively).

In the 4th crop, maximum number of branches was recorded in T_3 (18.11) which was significantly higher than that of all

Table 3a. Effect of organic and inorganic plant nutrition on number of branches per plant in experiment I

Treat- ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	11.33 e	13.17 d	13.28 d	13.06 f	13.17 de	13.78 cd
T_2	14.5 cd	15.17 bc	15.55 bc	16.22 d	13.94 cd	15.44 b
T_3	17.61 ab	17.83 a	17.83 a	18.11 a	16.33 a	17.78 a
T_4	16.00 bc	16.11 b	16.11 bc	16.28 cd	14.17 bcd	15.94 b
T_5	13.16 de	15.61 b	13.50 d	14.29 e	12.00 ef	13.83 c
T_6	18.11 a	17.89 a	17.96 a	17.22 b	15.33 ab	17.22 a
T_7	15.17 c	15.22 bc	15.22 c	15.72 d	13.17 de	15.83 b
T_8	12.16 e	11.72 e	13.33 d	13.06 f	11.89 f	12.89 d
T_9	17.68 ab	15.72 b	17.06 ab	16.97 bc	15.00 bc	16.00 b
T_{10}	15.84 bc	14.50 c	16.00 bc	13.12 f	13.11 de	13.11 cd

Treatments with the same superscript form one homogeneous group

other treatments. Minimum number of branches was produced in T_1 and T_8 (13.06 each).

In the 5th and 6th crops also the maximum number of branches was produced by T_3 (16.33 and 17.78 respectively) which was on par with T_6 (15.33 and 17.22 respectively). All other treatments produced significantly lesser number of branches, the least being in T_8 (11.89 and 12.89 respectively).

b. **Experiment II**

Data on this character for various treatments are presented in Table 3b.

As in experiment I, here also, number of branches per plant showed significant difference between treatments. In all the crops the highest level of poultry manure recorded maximum number of branches per plant, i.e., 20.71, 17.89, 19.49, 20.22, 17.50 and 17.72 in crops I to VI respectively. Minimum number of branches were recorded in T_8 showing values 13.28, 12.85, 13.49, 13.39, 11.78 and 12.94 in crops I to VI respectively, but T_8 was on par with T_{10}.

Table 3b. Effect of organic and inorganic plant nutrition on number of branches in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	14.50^{def}	13.22^{c}	14.60^{ef}	14.28^{f}	12.28^{g}	12.89^{f}
T_2	13.49^{ef}	15.55^{b}	15.27^{de}	16.22^{d}	13.61^{ef}	14.89^{d}
T_3	20.71^{a}	17.89^{a}	19.49^{a}	20.22^{a}	17.50^{a}	17.72^{a}
T_4	16.39^{bcd}	15.78^{b}	16.55^{cd}	17.11^{cd}	14.89^{cd}	15.67^{c}
T_5	13.61^{ef}	15.83^{b}	14.39^{ef}	14.94^{ef}	12.83^{efg}	13.94^{e}
T_6	18.34^{b}	17.67^{a}	18.10^{b}	18.17^{b}	16.11^{b}	16.78^{b}
T_7	15.28^{cdef}	15.61^{b}	15.60^{de}	15.06^{e}	13.91^{de}	15.72^{c}
T_8	13.28^{f}	12.85^{c}	13.49^{f}	13.39^{g}	11.78^{g}	12.94^{f}
T_9	17.28^{bc}	15.89^{b}	17.39^{bc}	17.61^{bc}	15.11^{bc}	15.84^{c}
T_{10}	15.61^{cde}	13.67^{c}	15.56^{de}	14.06^{fg}	12.78^{fg}	13.00^{f}

Treatments with the same superscript form one homogeneous group

4.2 Index to earliness

a. Experiment I

Data on the effects of treatments on the index to earliness are presented in Table 4a.

It could be observed that the index to earliness was not altered with the sources and levels of nutrients supplied. But a slight earliness could be seen in all the crops supplied with higher level of N.

b. Experiment II

Table 4b depicts the data on the effects of treatments on index to earliness in experiment II.

Here also significant difference in index to earliness could not be observed between treatments.

4.3 Yield attributes

4.3.1 Number of fruits per plant

a. Experiment I

Data on the effects of various treatments on the number of fruits per plant are presented in Table 5a.

Table 4a. Effect of organic and inorganic plant nutrition on index to earliness in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	0.515[a]	0.520[a]	0.535[a]	0.520[a]	0.515[a]	0.520[a]
T_2	0.520[a]	0.535[a]	0.545[a]	0.530[a]	0.525[a]	0.535[a]
T_3	0.545[a]	0.535[a]	0.540[a]	0.535[a]	0.530[a]	0.540[a]
T_4	0.535[a]	0.530[a]	0.535[a]	0.530[a]	0.525[a]	0.535[a]
T_5	0.525[a]	0.525[a]	0.535[a]	0.525[a]	0.525[a]	0.530[a]
T_6	0.530[a]	0.530[a]	0.540[a]	0.535[a]	0.535[a]	0.540[a]
T_7	0.530[a]	0.530[a]	0.540[a]	0.530[a]	0.535[a]	0.540[a]
T_8	0.515[a]	0.520[a]	0.525[a]	0.520[a]	0.520[a]	0.525[a]
T_9	0.530[a]	0.535[a]	0.535[a]	0.530[a]	0.535[a]	0.540[a]
T_{10}	0.515[a]	0.520[a]	0.520[a]	0.515[a]	0.520[a]	0.520[a]

Treatments with the same superscript form one homogeneous group

Table 4b. Effect of organic and inorganic plant nutrition on index to earliness in experiment II

Treat- ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	0.500^a	0.530^a	0.515^a	0.520^a	0.525^a	0.520^a
T_2	0.535^a	0.540^a	0.530^a	0.535^a	0.540^a	0.535^a
T_3	0.540^a	0.540^a	0.540^a	0.535^a	0.545^a	0.535^a
T_4	0.530^a	0.535^a	0.535^a	0.530^a	0.535^a	0.530^a
T_5	0.530^a	0.535^a	0.525^a	0.525^a	0.530^a	0.530^a
T_6	0.535^a	0.540^a	0.535^a	0.530^a	0.535^a	0.535^a
T_7	0.540^a	0.540^a	0.530^a	0.535^a	0.535^a	0.535^a
T_8	0.525^a	0.525^a	0.515^a	0.520^a	0.525^a	0.515^a
T_9	0.535^a	0.540^a	0.530^a	0.535^a	0.540^a	0.540^a
T_{10}	0.520^a	0.525^a	0.515^a	0.520^a	0.525^a	0.520^a

Treatments with the same superscript form one homogeneous group

In the first crop, the number of fruits per plant showed no significant difference between treatments. However, maximum number of fruits (11.66) was recorded by T_3 and minimum (9.38) by T_1.

In the second crop significant difference was noticed in the number of fruits produced between different treatments. The maximum number of fruits was produced by T_3 (16.33) followed by T_6 (15.94). Minimum number of fruits was produced by T_{10} (7.16) and T_8 (7.61). The number of fruits produced was significantly fewer in these two treatments as compared to other treatments.

In the 3rd, 4th, 5th and 6th crops, plants applied with poultry manure at the highest level (T_3) recorded maximum number of fruits per plant (17.50, 19.34, 17.00 and 19.34 respectively). The lowest number of fruits was produced by T_{10} in crop III (8.94), crop V (8.95) and crop VI (13.17) while in crop IV, T_8 produced minimum number of fruits (13.39). T_3 recorded significant increase over control and the increase worked out to be 48.45 per cent in crop II, 36.39 per cent in crop III, 27.99 per cent in crop IV, 36 per cent in crop V and 26.16 per cent in crop VI.

b. **Experiment II**

Data on number of fruits per plant due to various treatments are presented in Table 5b.

Table 5a. Effect of organic and inorganic plant nutrition on member of fruits per plant in experiment I

Treatments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	9.38^{a}	13.11^{bcd}	13.45^{b}	14.22^{de}	13.17^{c}	14.67^{e}
T_2	9.44^{a}	14.56^{abc}	16.28^{a}	17.39^{b}	15.61^{b}	17.44^{b}
T_3	11.66^{a}	16.33^{a}	17.50^{a}	19.34^{a}	17.00^{a}	19.34^{a}
T_4	10.77^{a}	15.44^{ab}	16.22^{a}	17.44^{b}	15.44^{b}	17.11^{bc}
T_5	9.72^{a}	11.00^{de}	12.83^{bc}	15.11^{cd}	12.50^{c}	15.33^{de}
T_6	10.72^{a}	15.94^{ab}	13.17^{b}	18.72^{a}	15.00^{b}	19.00^{a}
T_7	11.00^{a}	12.67^{cde}	12.00^{bc}	15.56^{c}	11.33^{d}	15.78^{d}
T_8	9.56^{a}	7.61^{f}	9.33^{d}	13.39^{e}	9.22^{e}	13.28^{f}
T_9	12.05^{a}	10.44^{e}	11.45^{c}	16.83^{b}	11.22^{d}	16.17^{cd}
T_{10}	9.44^{a}	7.16^{f}	8.94^{d}	13.89^{e}	8.95^{e}	13.17^{f}

Treatments with the same superscript form one homogeneous group

Table 5b. Effect of organic and inorganic plant nutrition on fruits per plant in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	5.78^{c}	10.00^{d}	13.45^{c}	14.11^{de}	13.39^{g}	14.89^{d}
T_2	10.28^{ab}	10.45^{cd}	15.28^{b}	16.50^{b}	16.56^{b}	17.28^{d}
T_3	12.39^{ab}	14.78^{a}	17.83^{a}	18.89^{a}	17.00^{a}	19.67^{a}
T_4	12.33^{ab}	13.05^{b}	16.17^{b}	16.00^{bc}	15.44^{b}	17.00^{b}
T_5	14.39^{a}	10.94^{cd}	13.28^{c}	13.50^{e}	13.11^{c}	15.56^{cd}
T_6	13.39^{a}	11.67^{bc}	13.67^{c}	16.28^{bc}	15.00^{b}	18.95^{a}
T_7	12.05^{ab}	11.67^{bc}	12.11^{d}	15.11^{cd}	11.44^{d}	15.94^{c}
T_8	10.22^{ab}	7.38^{e}	9.67^{e}	13.11^{ef}	9.27^{e}	13.17^{e}
T_9	11.72^{ab}	9.94^{d}	11.22^{d}	15.72^{bc}	11.33^{d}	15.89^{c}
T_{10}	8.50^{bc}	7.15^{e}	9.00^{e}	11.83^{f}	9.44^{e}	13.11^{e}

Treatments with the same superscript form one homogeneous group

In the second experiment, number of fruits per plant showed significant difference between treatments in all the crops taken. In the first crop there was significant increase in number of fruits in T_5 and T_6 (14.39 and 13.39 respectively) which were at par. The lowest number of fruits was recorded in T_1 (5.78) which was significantly lower than all other treatments barring T_{10}. But from crop II onwards significantly higher number of fruits was produced by T_3 and minimum number by T_{10}. The number of fruits produced by T_3 was 14.78, 17.83, 18.89, 17.00 and 19.67 in crops II to VI respectively. The fruits produced by T_{10} in crops II to VI were 7.15, 9.00, 11.83, 9.44 and 13.11 respectively.

4.3.2 Volume of fruit

a. Experiment I

Data on the effects of treatments on the volume of fruits are presented in Table 6a.

In the first crop, volume of fruits showed significant difference between treatments. Treatment T_6 (68 cm^3) was significantly superior to T_1, T_2, T_9 and T_{10} with regard to fruit volume. Other treatments were at par. In the second crop T_3 and T_6 recorded maximum volume (61.33 cm^3 each) of fruits. They were significantly better than other treatments barring T_4 and T_5.

Table 6a. Effect of organic and inorganic plant nutrition on volume of fruit (cm^3) in experiment I

Treat-ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	49.67^{c}	50.00^{d}	50.33^{c}	50.00^{d}	49.33^{d}	53.33^{e}
T_2	49.78^{c}	52.33^{d}	51.00^{c}	51.67^{d}	50.67^{d}	55.33^{d}
T_3	59.33^{abc}	61.33^{a}	61.33^{a}	60.00^{ab}	60.67^{a}	60.33^{a}
T_4	61.55^{abc}	60.33^{ab}	60.33^{a}	58.33^{b}	59.00^{ab}	57.67^{c}
T_5	63.33^{ab}	60.67^{ab}	61.00^{a}	58.33^{b}	58.67^{b}	58.33^{bc}
T_6	68.00^{a}	61.33^{a}	62.33^{a}	60.67^{a}	60.33^{a}	59.67^{ab}
T_7	60.67^{abc}	56.67^{c}	56.00^{b}	54.67^{c}	55.00^{c}	55.33^{d}
T_8	66.00^{a}	56.67^{c}	55.33^{b}	55.67^{c}	53.67^{c}	52.33^{e}
T_9	51.67^{bc}	57.67^{bc}	55.67^{b}	56.00^{c}	54.33^{c}	55.33^{d}
T_{10}	58.00^{abc}	52.00^{d}	52.00^{c}	52.00^{d}	50.67^{d}	52.00^{e}

Treatments with the same superscript form one homogeneous group

In the third and fourth crops plants in T_6 recorded maximum fruit volume (62.33 cm^3 and 60.67 cm^3 respectively) and it was on par with T_3. It was significantly superior to the control T_5 in crop IV and the increase was to the extent of 4.01 per cent. In the fifth and sixth crops plants in T_3 recorded maximum fruit volume of 60.67 cm^3 and 60.33 cm^3 respectively.

It was on par with T_6 and both of them were significantly superior to control. Here the increase was to the tune of 3.41 per cent in crop V and 3.43 per cent in crop VI.

b. **Experiment II**

Data on the effects of treatments on the volume of fruits in experiment II are presented in Table 6b.

In the first crop, volume of fruits did not show any significant difference between treatments. From second crop onwards the highest level of poultry manure T_3 (155 kg N ha^{-1}) recorded significantly higher volume of fruit (64.67 cm^3, 64.67 cm^3, 62.00 cm^3, 62.33 cm^3 and 60.67 cm^3 respectively for crop I to crop VI). The lowest volume of fruit was recorded by T_1 (54.43 cm^3) in the first crop and by T_{10} from 2nd to 6th crop (55.67 cm^3, 55.33 cm^3, 55.33 cm^3, 51.00 cm^3 and 52.67 cm^3 respectively).

Table 6b. Effect of organic and inorganic plant nutrition on volume of fruit (cm^3) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	54.43^{a}	51.00^{g}	52.00^{e}	51.00^{d}	49.67^{g}	53.67^{d}
T_2	65.44^{a}	53.00^{fg}	55.33^{d}	56.67^{c}	54.33^{de}	55.67^{c}
T_3	60.83^{a}	64.67^{a}	64.67^{a}	62.00^{a}	62.33^{a}	60.67^{a}
T_4	66.00^{a}	61.33^{bc}	63.00^{ab}	60.33^{ab}	59.67^{bc}	58.00^{b}
T_5	62.17^{a}	62.67^{abc}	63.33^{a}	58.67^{abc}	59.00^{bc}	58.33^{b}
T_6	67.67^{a}	63.33^{ab}	64.00^{a}	62.00^{a}	60.33^{ab}	60.00^{a}
T_7	61.33^{a}	60.00^{cd}	60.00^{c}	58.33^{bc}	57.67^{c}	55.33^{c}
T_8	71.00^{a}	57.00^{de}	56.67^{d}	56.33^{c}	52.67^{ef}	52.00^{e}
T_9	64.33^{a}	60.33^{bc}	60.33^{bc}	60.33^{ab}	55.00^{d}	55.00^{cd}
T_{10}	68.33^{a}	55.67^{ef}	55.33^{d}	55.33^{c}	51.00^{fg}	52.67^{e}

Treatments with the same superscript form one homogeneous group

4.3.3 Yield per plant

a. Experiment I

Data on the effects of treatments on yield per plant are presented in Table 7a.

There was no significant difference between treatments on the per plant yield in the first crop. However, maximum yield was recorded by the treatment T_3 (764.45 g) and minimum by T_1 (433.89 g). In the second crop significant difference was noticed. Maximum yield per plant was recorded by T_3 (775.0 g) followed by T_6 (633.7 g). Among the various treatments T_3 was significantly superior to all other treatments. The superiority of T_3 had followed in all crops with the yields of 828.95 g, 916.60 g, 912.10 g and 908.0 g in crops III, IV, V and VI respectively. Thus the maximum yield was obtained with the highest level of poultry manure. The increase in yield over control was to the tune of 62.2 per cent in crop II, 34.46 per cent in crop III, 31.92 per cent in crop IV, 34.59 per cent in crop V and 29.84 per cent in crop VI. The minimum yield was recorded by T_{10} (338.8 g, 421.5 g, 586.1 g, 571.4 g and 591.2 g in crops II, III, IV, V and VI respectively).

b. Experiment II

Data on yield per plant due to different treatments are presented in Table 7b.

Table 7a. Effect of organic and inorganic plant nutrition on yield per plant (g) in experiment I

Treat- ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	433.89^{a}	552.8^{bcd}	645.4^{c}	672.0^{c}	657.30^{d}	678.6^{e}
T_2	508.61^{a}	597.8^{bc}	723.1^{b}	777.2^{b}	739.80^{c}	797.3^{bc}
T_3	764.45^{a}	775.0^{a}	828.95^{a}	916.6^{a}	912.1^{a}	908.0^{a}
T_4	569.17^{a}	597.2^{bc}	776.30^{ab}	783.60^{b}	770.80^{c}	790.0^{c}
T_5	451.17^{a}	477.8^{de}	616.50^{cd}	694.8^{c}	677.7^{d}	699.3^{de}
T_6	568.33^{a}	633.7^{b}	634.60^{cd}	878.0^{a}	862.2^{b}	855.2^{ab}
T_7	597.39^{a}	608.3^{bc}	577.90^{de}	687.8^{c}	674.2^{d}	743.2^{cd}
T_8	522.78^{a}	400.0^{ef}	445.50^{f}	590.5^{d}	582.2^{d}	610.2^{f}
T_9	600.56^{a}	516.7^{cd}	548.7^{e}	708.4^{c}	690.3^{d}	723.1^{de}
T_{10}	518.33^{a}	338.8^{f}	421.5^{f}	586.1^{d}	571.4^{e}	591.2^{f}

Treatments with the same superscript form one homogeneous group

Plate 11. Single plant receiving FYM at 80 kg N ha^{-1}

Plate 12. Single plant receiving FYM at 155 kg N ha^{-1}

Plate 13. Single plant receiving FYM + inorganic fertilizers

Plate 14. Single plant receiving PM at 155 kg N ha^{-1}

Plate 15. Single plant receiving PM at 80 kg N ha^{-1}

Plate 11

Plate 12

Plate 13

Plate 14

Plate 15

Plate 16. Single plant receiving PM + inorganic fertilizers

Plate 17. Single plant receiving fertilizers equivalent to NPK in lower level of FYM

Plate 18. Single plant receiving fertilizers equivalent to NPK in higher level of FYM

Plate 19. Single plant receiving fertilizers equivalent to NPK in higher level of PM

Plate 20. Single plant receiving fertilizers equivalent to NPK in lower level of PM

Plate 16

Plate 17

Plate 18

Plate 19

Plate 20

Here also significant difference was not noticed in yield per plant due to treatments in the first crop. But from second crop onwards the treatments showed significant difference in yield per plant. The highest level of poultry manure (155 kg N ha^{-1}) recorded maximum yield (727.8 g, 844.9 g, 877.9 g, 895.1 g and 894.3 g respectively for 2nd to 6th crop). Minimum yield was recorded by T_{10} in crops II to VI (364.4 g, 421.9 g, 537.5 g, 568.0 g and 580.7 g respectively).

4.3.4 Yield per plot

a. Experiment I

Table 8a depicts the effects of different treatments on yield per plot.

In the first crop, there was no significant difference between treatments with regard to per plot yield. Maximum yield was recorded against T_3 (13.99 kg) and minimum in T_1 (6.61 kg). In the second crop the yield per plot showed significant difference between treatments. Maximum yield per plot was recorded for T_3 (17.93 kg) which was significantly better than all other treatments. A significantly lower yield was recorded in T_{10} (8.13 kg). The same result was registered in crop III, IV, V and VI. The maximum yields recorded in T_3 were 16.30 kg, 17.38 kg, 17.60 kg and 17.57 kg in crops III, IV, V and VI respectively. In crop II and III minimum yields

Table 7b. Effect of organic and inorganic plant nutrition on yield per plant (g) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	315.28^{a}	463.9^{de}	612.6^{e}	643.3^{cd}	661.4^{de}	669.5^{e}
T_2	568.33^{a}	487.8^{cde}	701.5^{c}	747.3^{b}	751.4^{c}	784.2^{b}
T_3	683.61^{a}	727.8^{a}	844.9^{a}	877.9^{a}	895.1^{a}	394.3^{a}
T_4	699.17^{a}	636.1^{b}	743.5^{b}	759.7^{b}	761.3^{c}	753.8^{bc}
T_5	725.28^{a}	576.3^{bc}	635.2^{de}	616.7^{cd}	661.2^{de}	691.8^{de}
T_6	763.33^{a}	637.8^{b}	652.3^{d}	743.1^{b}	813.2^{b}	858.4^{a}
T_7	624.73^{a}	619.6^{b}	565.3^{f}	661.2^{c}	648.6^{e}	717.1^{cd}
T_8	608.05^{a}	409.3^{f}	454.7^{g}	596.8^{d}	578.6^{f}	591.2^{f}
T_9	463.06^{a}	598.2^{cd}	528.5^{f}	719.3^{b}	688.8^{d}	712.7^{d}
T_{10}	400.28^{a}	364.4^{f}	421.9^{g}	537.5^{e}	568.0^{f}	580.7^{f}

Treatments with the same superscript form one homogeneous group

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Table 8a. Effect of organic and inorganic plant nutrition on yield per plot (kg) in experiment I

Treatments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	6.61^{a}	13.26^{bcd}	12.91^{c}	13.51^{c}	13.33^{d}	13.77^{c}
T_2	8.32^{a}	13.68^{bcd}	14.20^{b}	15.15^{b}	14.93^{c}	15.35^{b}
T_3	13.99^{a}	17.13^{a}	16.30^{a}	17.38^{a}	17.60^{a}	17.57^{a}
T_4	12.19^{a}	14.33^{bc}	15.17^{ab}	15.53^{b}	15.30^{c}	15.54^{b}
T_5	9.13^{a}	11.67^{de}	12.07^{cd}	13.81^{c}	13.43^{d}	13.84^{c}
T_6	10.02^{a}	15.20^{b}	13.62^{c}	17.53^{a}	16.86^{b}	17.44^{a}
T_7	8.73^{a}	14.77^{bc}	11.66^{de}	13.49^{c}	13.05^{d}	13.50^{c}
T_8	8.70^{a}	9.63^{ef}	8.85^{f}	11.66^{d}	11.60^{e}	11.42^{d}
T_9	8.96^{a}	12.52^{cd}	10.90^{e}	14.12^{c}	13.46^{d}	13.00^{c}
T_{10}	7.90^{a}	8.13^{f}	8.31^{f}	11.69^{d}	11.88^{e}	11.62^{d}

Treatments with the same superscript form one homogeneous group

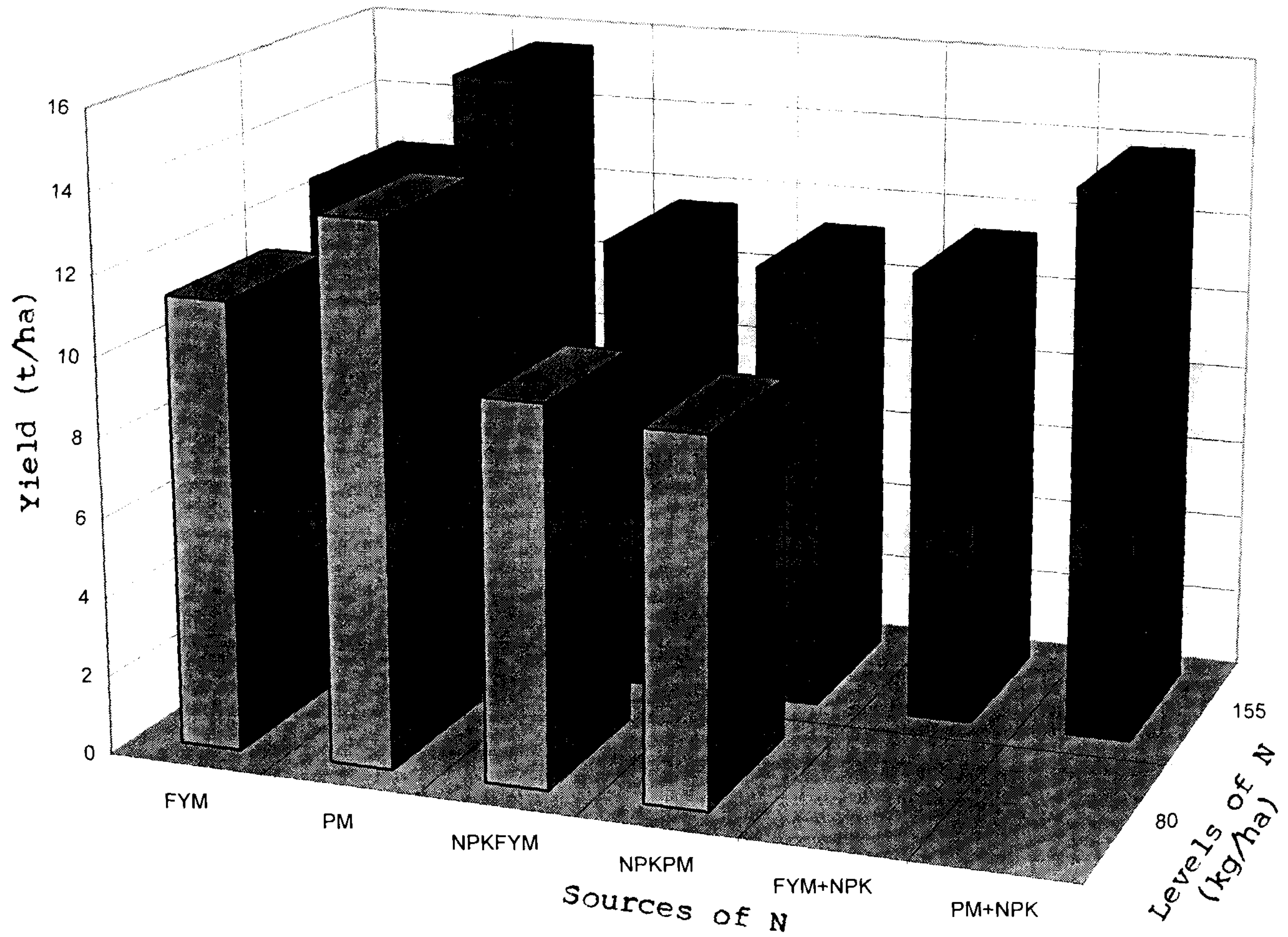

FIG. 2 YIELD OF BRINJAL AS INFLUENCED BY DIFFERENT SOURCES AND LEVELS OF N

were recorded in T_{10} (8.13 kg and 8.31 kg respectively) while in crop IV, V and VI minimum yields were recorded by T_8 (11.66 kg, 11.60 kg and 11.42 kg respectively).

b. Experiment II

In this experiment, the nitrogen levels and their sources significantly influenced the yield per plot in brinjal (Table 8b). In crop I maximum yield was recorded by T_6 (14.62 kg plot^{-1}) which was on par with T_3 and T_5. From 2nd to 6th crop T_3 recorded maximum yield which was significantly superior to other treatments. T_3 recorded yields of 17.08 kg, 15.18 kg, 17.23 kg, 17.48 kg and 17.63 kg per plot in crops II to VI respectively. Minimum yield was recorded by T_1 (6.16 kg) in first crop while T_{10} recorded minimum yield in 2nd to 6th crops (8.78 kg, 8.36 kg, 10.92 kg, 11.12 kg and 11.52 kg respectively).

4.3.5 Number of harvests

a. Experiment I

The number of harvests showed significant difference between treatments in all the crops (Table 9a).

In all the six crops number of harvests was maximum for T_3. This ranged from 7.7 in crop V to 9.0 in crop I and II. Minimum number of harvests was observed in T_8 and T_{10} (5.3 in

Table 8b. Effect of organic and inorganic plant nutrition on yield per plot (kg) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	6.16^{c}	11.09^{de}	12.14^{cde}	12.93^{c}	13.18^{de}	13.28^{c}
T_2	9.91^{abc}	11.71^{de}	13.62^{abc}	14.80^{b}	14.38^{c}	15.34^{b}
T_3	13.66^{a}	17.08^{a}	15.18^{a}	17.23^{a}	17.48^{a}	17.63^{a}
T_4	12.81^{ab}	15.67^{b}	14.69^{ab}	14.95^{b}	14.49^{c}	15.53^{b}
T_5	14.49^{a}	13.91^{bc}	12.73^{cd}	12.27^{cd}	13.29^{d}	13.91^{c}
T_6	14.62^{a}	15.32^{b}	13.24^{bcd}	14.68^{b}	16.08^{b}	17.41^{a}
T_7	10.93^{abc}	14.88^{b}	11.52^{de}	13.02^{c}	12.69^{e}	13.56^{c}
T_8	9.06^{abc}	10.25^{ef}	9.51^{fg}	11.57^{de}	11.64^{f}	11.79^{d}
T_9	7.51^{bc}	12.52^{cd}	10.84^{ef}	14.07^{b}	13.58^{d}	13.21^{c}
T_{10}	7.73^{bc}	8.78^{f}	8.36^{g}	10.92^{e}	11.12^{f}	11.52^{d}

Treatments with the same superscript form one homogeneous group

crop I, II and III and 5.0 in crop IV and VI and 4.7 in crop V).

b. Experiment II

Data on the effects of treatments on the number of harvests in experiment II are presented in Table 9b.

Results showed that application of different sources and levels of nutrients significantly influenced the number of harvests in all the crops except the first one. In the first crop all treatments were at par. From crop II onwards treatment which received higher level of poultry manure recorded significantly more number of harvest (8.67, 9.33, 8.67, 7.67 and 8.33 respectively). Treatments which recorded less number of harvests were T_8 and T_{10}.

4.3.6 Crop duration

a. Experiment I

Table 10a shows the effect of treatments on crop duration.

There was significant difference between treatments with regard to crop duration. Treatments T_3 and T_6 showed significantly longer duration (150.7 days and 148.7 days respectively) whereas T_1 recorded significantly shorter duration (121 days).

Table 9a. Effect of organic and inorganic plant nutrition on number of harvests in experiment I

Treatments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	6.7[bcd]	6.7[bcd]	6.7[bcd]	6.7[bcd]	6.0[cd]	6.7[cd]
T_2	6.7[bcd]	6.7[bcd]	7.3[bc]	7.3[bc]	6.3[bc]	7.3[bc]
T_3	9.0[a]	8.3[a]	9.0[a]	8.7[a]	7.7[a]	8.7[a]
T_4	7.3[bc]	7.3[ab]	7.7[ab]	7.7[ab]	6.7[bc]	7.7[b]
T_5	7.3[bc]	7.0[bc]	6.7[bcd]	6.3[cd]	5.3[de]	6.7[cd]
T_6	8.0[ab]	7.7[ab]	8.0[ab]	7.3[bc]	7.0[ab]	7.7[b]
T_7	6.0[cd]	7.3[ab]	6.0[cd]	6.0[de]	5.3[de]	6.3[d]
T_8	5.3[d]	5.7[de]	5.3[d]	5.0[e]	4.7[e]	5.0[e]
T_9	6.0[cd]	6.0[cde]	6.0[cd]	6.0[de]	5.3[de]	6.3[d]
T_{10}	5.3[d]	5.3[e]	5.3[d]	5.0[e]	4.7[e]	5.0[e]

Treatments with the same superscript form one homogeneous group

Table 9b. Effect of organic and inorganic plant nutrition on number of harvests in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	7.67[a]	6.33[cd]	6.67[cd]	6.33[c]	6.33[bcd]	6.33[c]
T_2	7.67[a]	7.00[bc]	7.67[bc]	7.33[b]	6.67[abc]	7.00[bc]
T_3	8.67[a]	8.67[a]	9.33[a]	8.67[a]	7.67[a]	8.33[a]
T_4	7.67[a]	7.67[b]	8.33[ab]	7.67[b]	6.67[abc]	7.33[b]
T_5	8.33[a]	7.33[b]	7.00[cd]	6.33[c]	5.67[cde]	6.33[c]
T_6	9.00[a]	7.67[b]	8.33[ab]	7.33[b]	7.00[ab]	7.67[ab]
T_7	7.67[a]	7.33[b]	6.33[de]	6.33[c]	5.67[cde]	6.33[c]
T_8	7.67[a]	6.00[de]	5.33[e]	5.33[d]	4.67[e]	5.33[d]
T_9	7.33[a]	6.00[de]	6.33[de]	6.33[c]	5.33[de]	6.33[c]
T_{10}	7.67[a]	5.33[e]	5.33[e]	5.00[d]	4.67[e]	5.00[d]

Treatments with the same superscript form one homogeneous group

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In the second crop also significant difference was recorded between treatments. Treatments T_3 and T_6 recorded significantly longer duration (148.3 days each) as compared to all other treatments. In this crop, crop duration was minimum for T_{10} (121.7 days).

In crops III, IV, V and VI crop duration was maximum for T_3 (148.3 days, 149 days, 143.3 days and 148.3 days respectively), but it was on par with T_6 in all these crops. Minimum crop duration was recorded by T_1 in first crop (121 days) and T_{10} (121.7 days, 123.3 days, 123 days, 121.7 days and 125 days respectively for crops II to VI).

b. **Experiment II**

Data relating to duration of the crop in this experiment are presented in Table 10 b.

In the first crop poultry manure (6.67 t ha^{-1}) along with NPK at 75:40:25 kg ha^{-1} recorded maximum duration (149.3 days) followed by T_3 (148.3 days) but their effects were at par. Significantly shorter duration (121.7 days) was registered by T_1 and T_{10}.

In crops II to VI, T_3 recorded maximum duration (148.3 days, 150 days, 150.7 days, 143.3 days and 146.7 days respectively). T_3 was on par with T_6 in crops I, II, V and VI. Significantly shorter duration was recorded by T_8 and T_{10}.

Table 10a. Effect of organic and inorganic plant nutrition on duration of crop (days) in experiment I

Treatments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	121.0^{f}	130.0^{c}	131.7^{c}	132.7^{c}	130.7^{c}	133.0^{de}
T_2	125.3^{e}	133.3^{c}	133.3^{c}	134.3^{c}	132.3^{c}	135.3^{cd}
T_3	150.7^{a}	148.3^{a}	148.3^{a}	149.0^{a}	143.3^{a}	148.3^{a}
T_4	144.3^{b}	141.7^{b}	141.7^{b}	140.0^{b}	136.7^{b}	136.7^{c}
T_5	147.3^{ab}	143.3^{b}	140.0^{b}	135.0^{c}	129.3^{c}	136.7^{c}
T_6	148.7^{a}	148.3^{a}	146.7^{a}	146.0^{a}	141.0^{a}	143.3^{b}
T_7	136.7^{c}	133.3^{c}	131.7^{c}	132.3^{c}	128.3^{c}	131.7^{e}
T_8	129.3^{d}	125.0^{d}	123.3^{d}	125.0^{d}	120.0^{d}	125.0^{f}
T_9	126.7^{de}	131.7^{c}	133.3^{c}	133.3^{c}	128.3^{c}	131.8^{e}
T_{10}	125.0^{e}	121.7^{d}	123.3^{d}	123.0^{d}	121.7^{d}	125.0^{f}

Treatments with the same superscript form one homogeneous group

Table 10b. Effect of organic and inorganic plant nutrition on duration of crop (days) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	121.7^{d}	128.3^{cd}	131.7^{d}	132.3^{c}	131.0^{cd}	132.3^{c}
T_2	129.0^{c}	131.7^{c}	135.0^{cd}	133.7^{c}	133.3^{cd}	135.0^{bc}
T_3	148.3^{a}	148.3^{a}	150.0^{a}	150.7^{a}	143.3^{a}	146.7^{a}
T_4	146.7^{a}	141.7^{b}	141.7^{b}	143.3^{b}	135.0^{bc}	136.7^{b}
T_5	146.0^{a}	131.7^{c}	138.3^{bc}	136.7^{c}	128.3^{de}	135.0^{bc}
T_6	149.3^{a}	140.0^{b}	146.7^{a}	142.7^{b}	140.0^{ab}	143.3^{a}
T_7	138.3^{b}	131.7^{c}	131.7^{d}	131.7^{c}	128.3^{de}	131.7^{c}
T_8	128.3^{c}	123.3^{de}	123.3^{e}	123.3^{d}	121.7^{f}	126.7^{d}
T_9	128.3^{c}	131.7^{c}	133.3^{d}	131.7^{c}	128.3^{de}	132.3^{c}
T_{10}	121.7^{d}	121.7^{e}	123.3^{e}	124.3^{d}	123.3^{ef}	125.0^{d}

Treatments with the same superscript form one homogeneous group

4.4 Quality parameters

4.4.1 Ascorbic acid content

a. Experiment I

Data on the effect of treatments on ascorbic acid content of fruits are given in Table 11a.

In the first crop, the ascorbic acid content showed significant variation between treatments. Maximum ascorbic acid content of 11.33 mg 100 g^{-1} was recorded by T_3. Treatments T_1 and T_3 were significantly superior to T_9 and T_{10}.

In the second crop also ascorbic acid content in fruits showed significant difference between treatments. Maximum ascorbic acid content was elicited in T_3 and T_6 (11 mg 100 g^{-1} each) but they were superior to T_9 and T_{10} only. All other treatments were at par.

In crops III, IV and VI significantly higher ascorbic acid content was recorded in T_3 (11.33 mg 100 g^{-1} in crop III and 12 mg 100 g^{-1} each in crops IV and VI) and minimum in T_5, T_8 and T_{10} (9.33 mg 100 g^{-1} each). In crop V maximum ascorbic acid content was observed in T_3 and T_6 (11.33 mg 100 g^{-1} each) and minimum in T_8 and T_{10} (8.67 mg 100 g^{-1} each).

Table 11a. Effect of organic and inorganic plant nutrition on ascorbic acid content of fruits (mg/100 g) in experiment I

Treatments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	10.67^{a}	10.33^{a}	10.00^{ab}	10.00^{b}	10.00^{ab}	10.67^{abc}
T_2	10.00^{ab}	10.00^{ab}	10.67^{ab}	10.67^{ab}	10.67^{a}	11.33^{ab}
T_3	11.33^{a}	11.00^{a}	11.33^{a}	12.00^{a}	11.33^{a}	12.00^{a}
T_4	10.00^{ab}	10.00^{ab}	10.00^{ab}	10.67^{ab}	10.67^{a}	10.67^{abc}
T_5	10.00^{ab}	10.33^{a}	9.33^{b}	9.33^{b}	10.00^{ab}	9.33^{c}
T_6	9.33^{abc}	11.00^{a}	10.67^{ab}	10.67^{ab}	11.33^{a}	10.67^{abc}
T_7	10.67^{a}	10.67^{a}	10.00^{ab}	10.00^{b}	10.00^{b}	10.00^{abc}
T_8	9.33^{abc}	9.67^{abc}	9.33^{b}	9.33^{b}	8.67^{b}	9.33^{c}
T_9	8.00^{bc}	8.33^{bc}	10.00^{ab}	10.00^{b}	10.00^{ab}	10.00^{bc}
T_{10}	7.33^{c}	8.00^{c}	9.33^{b}	9.33^{b}	8.67^{b}	9.33^{c}

Treatments with the same superscript form one homogeneous group

b. **Experiment II**

Data presented in Table 11b shows the effects of treatments on ascorbic acid content of fruits.

Maximum ascorbic acid content was recorded in T_3 (11.33 mg 100 g^{-1}, 11 mg 100 g^{-1}, 10.67 mg 100 g^{-1}, 11.33 mg 100 g^{-1}, 11.33 mg 100 $g^{-1}$and 12.00 mg 100 g^{-1} respectively) closely followed by T_6. Organic treatments were on par with each other. Minimum ascorbic acid content was recorded by T_8 and T_{10} (8.00 mg 100 g^{-1}, 8.33 mg 100 g^{-1}, 8.67 mg 100 g^{-1}, 8.67 mg 100 g^{-1}, 8.67 mg 100 g^{-1} and 9.33 mg 100 g^{-1} respectively from crop I to VI).

4.4.2 Moisture content of fruits

a. **Experiment I**

Data on this character due to various treatments are presented in Table 12a.

Moisture content of fruits was not significantly altered by the influence of treatments in all the six crops studied. But comparatively higher moisture content of fruits was noted in treatments applied with higher levels of N as compared to their corresponding lower levels.

Table 11b. Effect of organic and inorganic plant nutrition on ascorbic acid content of fruits (mg 100 g^{-1}) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	8.67^{c}	10.33^{ab}	9.33^{a}	9.33^{bc}	10.00^{ab}	10.00^{bc}
T_2	10.67^{ab}	10.00^{abc}	10.67^{a}	10.67^{ab}	10.67^{a}	11.33^{ab}
T_3	11.33^{a}	11.00^{ab}	10.67^{a}	11.33^{a}	11.33^{a}	12.00^{a}
T_4	10.67^{ab}	10.33^{ab}	10.00^{a}	10.67^{ab}	10.67^{a}	10.67^{abc}
T_5	9.33^{bc}	10.00^{ab}	10.00^{a}	9.33^{bc}	10.00^{ab}	9.33^{c}
T_6	10.67^{ab}	11.33^{a}	10.67^{a}	10.67^{ab}	11.33^{a}	10.67^{abc}
T_7	11.33^{a}	10.33^{ab}	9.33^{a}	9.33^{bc}	10.00^{ab}	10.00^{bc}
T_8	9.33^{bc}	9.67^{bcd}	8.67^{a}	8.67^{c}	8.67^{b}	9.33^{c}
T_9	8.00^{c}	8.67^{cd}	9.33^{a}	10.00^{abc}	10.00^{ab}	10.00^{bc}
T_{10}	8.00^{c}	8.33^{d}	8.67^{a}	8.67^{c}	8.67^{b}	9.33^{c}

Treatments with the same superscript form one homogeneous group

Table 12a. Effect of organic and inorganic plant nutrition on moisture content (%) of fruits in experiment I

Treat- ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	91.53^{ab}	91.43^{b}	91.60^{c}	91.63^{cd}	91.00^{c}	91.67^{c}
T_2	91.90^{a}	91.60^{ab}	91.77^{ab}	91.93^{ab}	91.17^{bc}	91.97^{a}
T_3	91.87^{a}	91.87^{a}	92.00^{a}	91.97^{ab}	91.73^{a}	92.00^{a}
T_4	91.37^{b}	91.67^{ab}	91.63^{c}	91.57^{d}	91.20^{bc}	91.57^{c}
T_5	91.93^{a}	91.73^{ab}	91.90^{ab}	91.93^{ab}	91.57^{ab}	91.93^{a}
T_6	91.93^{a}	91.73^{ab}	91.90^{ab}	91.90^{abc}	91.63^{a}	91.93^{a}
T_7	92.00^{a}	91.77^{a}	92.10^{a}	92.00^{a}	91.73^{a}	91.97^{a}
T_8	91.70^{ab}	91.57^{ab}	91.83^{ab}	91.73^{bcd}	91.10^{c}	91.33^{be}
T_9	92.03^{a}	91.80^{a}	91.97^{a}	91.87^{abc}	91.63^{a}	91.80^{ab}
T_{10}	91.76^{ab}	91.60^{ab}	91.70^{bc}	91.70^{bcd}	91.10^{c}	91.70^{bc}

Treatments with the same superscript form one homogeneous group

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b. **Experiment II**

Data depicting the effects of treatments on moisture content of fruits are presented in Table 12b.

Moisture content of fruits showed significant difference between treatments. Maximum moisture content varied with treatments in different crops. The maximum moisture content was noted in the treatments which received maximum N level (155 kg N ha^{-1}) which were at par. Significantly lower level of moisture was recorded in the treatment which received lower N level in the form of FYM (91.53 per cent, 91.47 per cent, 91.60 per cent, 91.63 per cent, 91.03 per cent and 91.70 per cent in crops I to VI respectively).

4.4.3 Total soluble solids (TSS)

a. **Experiment I**

Data relating to the effects of various treatments on total soluble solids are presented in Table 13a.

Statistical analysis of data revealed that the treatments varied significantly with regard to total soluble solids. In all the crops T_3 (4.63, 4.57, 4.63, 4.57, 4.57 and 4.60 respectively for crops I to VI) recorded maximum TSS and it was on par with T_4 and T_6. Treatments T_1, T_8 and T_{10} recorded significantly lower TSS in all the crops. It can be noted

Table 12b. Effect of organic and inorganic plant nutrition on moisture content (%) of fruits in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	91.53^{de}	91.47^{e}	91.60^{d}	91.63^{d}	91.03^{c}	91.70^{d}
T_2	91.90^{abc}	91.63^{cd}	91.93^{ab}	91.77^{bcd}	91.53^{ab}	91.97^{ab}
T_3	91.87^{abc}	91.83^{ab}	92.00^{a}	91.87^{ab}	91.83^{a}	92.00^{ab}
T_4	91.37^{e}	91.70^{bc}	91.83^{bc}	91.77^{bcd}	91.17^{bc}	91.93^{ab}
T_5	91.93^{ab}	91.83^{ab}	91.90^{ab}	91.87^{ab}	91.53^{ab}	91.97^{ab}
T_6	91.93^{ab}	91.87^{a}	92.00^{a}	91.83^{ab}	91.67^{a}	91.87^{bcd}
T_7	92.00^{a}	91.83^{ab}	91.93^{ab}	91.83^{ab}	91.63^{a}	92.10^{a}
T_8	91.70^{cd}	91.53^{de}	91.77^{bcd}	91.67^{cd}	90.07^{c}	91.73^{cd}
T_9	92.03^{a}	91.83^{ab}	91.90^{ab}	91.97^{a}	91.40^{abc}	91.90^{bc}
T_{10}	91.77^{bc}	91.50^{de}	91.73^{bcd}	91.67^{cd}	91.03^{c}	91.70^{d}

Treatments with the same superscript form one homogeneous group

Table 13a. Effect of organic and inorganic plant nutrition on total soluble solids of fruits in experiment I

Treatments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	4.27^{d}	4.33^{c}	4.30^{d}	4.37^{de}	4.33^{e}	4.37^{de}
T_2	4.17^{d}	4.27^{c}	4.43^{bc}	4.43^{cd}	4.47^{bc}	4.47^{bc}
T_3	4.63^{a}	4.57^{a}	4.63^{a}	4.57^{a}	4.57^{a}	4.60^{a}
T_4	4.57^{a}	4.53^{ab}	4.57^{a}	4.53^{ab}	4.47^{bc}	4.53^{ab}
T_5	4.43^{bc}	4.47^{b}	4.43^{bc}	4.47^{bc}	4.43^{cd}	4.43^{cd}
T_6	4.53^{ab}	4.53^{ab}	4.53^{ab}	4.53^{ab}	4.53^{ab}	4.53^{ab}
T_7	4.43^{bc}	4.53^{ab}	4.43^{bc}	4.50^{abc}	4.47^{bc}	4.50^{bc}
T_8	4.40^{c}	4.13^{d}	4.40^{cd}	4.37^{de}	4.37^{de}	4.33^{e}
T_9	4.27^{d}	4.33^{c}	4.40^{cd}	4.50^{abc}	4.47^{bc}	4.50^{bc}
T_{10}	4.17^{d}	4.07^{d}	4.33^{cd}	4.33^{e}	4.37^{de}	4.33^{e}

Treatments with the same superscript form one homogeneous group

that the TSS was more in treatments supplied with higher levels of nitrogen in different forms.

b. **Experiment II**

Data relating to total soluble solids in different treatments in experiment II are presented in Table 13b.

In all the crops T_3 recorded maximum TSS (4.6, 4.53, 4.57, 4.57, 4.53 and 4.57 respectively for crops I to VI) and it was on with T_6. Significantly lower TSS was recorded by T_{10} in different crops (4.13, 4.13, 4.30, 4.30, 4.30 and 4.33 in crops I to VI respectively).

4.4.4 Acidity of fruits

a. **Experiment I**

Data on the effect of treatments on acidity of fruits are presented in Table 14a.

In the first crop, there was significant difference between treatments for acidity of fruits. Maximum acidity was recorded against T_1, T_2 and T_7 (0.245 per cent each) and minimum acidity was recorded by T_4 (0.192 per cent). But in all other crops, the acidity of fruits did not show any significant difference between treatments.

Table 13b. Effect of organic and inorganic plant nutrition on total soluble solids of fruits in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	4.27^{de}	4.37^{c}	4.30^{d}	4.33^{e}	4.37^{cd}	4.36^{de}
T_2	4.20^{ef}	4.37^{c}	4.33^{d}	4.37^{de}	4.43^{bc}	4.47^{bc}
T_3	4.60^{a}	4.53^{a}	4.57^{a}	4.57^{a}	4.53^{a}	4.57^{a}
T_4	4.53^{ab}	4.50^{ab}	4.53^{a}	4.53^{ab}	4.50^{ab}	4.53^{ab}
T_5	4.47^{bc}	4.43^{bc}	4.47^{abc}	4.47^{bc}	4.43^{bc}	4.43^{cd}
T_6	4.53^{ab}	4.53^{a}	4.50^{ab}	4.53^{ab}	4.53^{a}	4.63^{ab}
T_7	4.43^{bc}	4.53^{a}	4.40^{bcd}	4.43^{cd}	4.43^{bc}	4.43^{cd}
T_8	4.37^{cd}	4.17^{d}	4.33^{d}	4.33^{e}	4.33^{d}	4.37^{de}
T_9	4.25^{de}	4.37^{c}	4.37^{cd}	4.43^{cd}	4.43^{bc}	4.47^{bc}
T_{10}	4.13^{f}	4.13^{d}	4.30^{d}	4.30^{e}	4.30^{d}	4.33^{e}

Treatments with the same superscript form one homogeneous group

Table 14a. Effect of organic and inorganic plant nutrition on acidity of fruits (%) in experiment I

Treat-ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	0.245[a]	0.234[a]	0.235[a]	0.224[a]	0.213[a]	0.213[a]
T_2	0.245[a]	0.234[a]	0.224[a]	0.224[a]	0.224[a]	0.235[a]
T_3	0.203[b]	0.213[a]	0.235[a]	0.224[a]	0.235[a]	0.235[a]
T_4	0.192[b]	0.213[a]	0.245[a]	0.256[a]	0.224[a]	0.245[a]
T_5	0.203[b]	0.213[a]	0.224[a]	0.224[a]	0.245[a]	0.224[a]
T_6	0.213[b]	0.224[a]	0.235[a]	0.235[a]	0.245[a]	0.224[a]
T_7	0.245[a]	0.245[a]	0.213[a]	0.213[a]	0.213[a]	0.224[a]
T_8	0.245[a]	0.213[a]	0.235[a]	0.224[a]	0.224[a]	0.213[a]
T_9	0.224[ab]	0.234[a]	0.245[a]	0.224[a]	0.235[a]	0.235[a]
T_{10}	0.213[b]	0.213[a]	0.213[a]	0.245[a]	0.235[a]	0.235[a]

Treatments with the same superscript form one homogeneous group

b. **Experiment II**

Data on acidity of fruits as affected by different treatments in experiment II are presented in Table 14b.

Results showed that there was significant difference in acidity of fruits due to treatments in crop I. The maximum acidity was recorded by T_2 and T_7 (0.245 per cent each) while the lowest acidity was recorded by T_3, T_4 and T_5 (0.203 per cent each). In the rest of the crops acidity of fruits did not differ significantly from each other.

4.4.5 Starch

a. **Experiment I**

The data on starch content of fruits for different treatments are presented in Table 15a.

The maximum starch content was recorded in the treatment receiving the highest level of FYM (T_2) in all the crops (3.45 per cent, in crops I and II and 3.46 per cent in crops III, IV, V and VI). Significantly lower starch content was registered by T_{10} (3.38 per cent, 3.39 per cent, 3.38 per cent, 3.43 per cent, 3.39 per cent and 3.39 per cent respectively in crops I to VI).

Table 14b. Effect of organic and inorganic plant nutrition on acidity of fruits (%) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	0.235[ab]	0.224[a]	0.245[a]	0.224[a]	0.213[a]	0.224[a]
T_2	0.245[a]	0.224[a]	0.224[a]	0.224[a]	0.235[a]	0.224[a]
T_3	0.203[c]	0.213[a]	0.235[a]	0.245[a]	0.235[a]	0.235[a]
T_4	0.203[c]	0.224[a]	0.224[a]	0.224[a]	0.245[a]	0.224[a]
T_5	0.203[c]	0.213[a]	0.235[a]	0.245[a]	0.235[a]	0.245[a]
T_6	0.213[b]	0.213[a]	0.235[a]	0.235[a]	0.224[a]	0.235[a]
T_7	0.245[a]	0.245[a]	0.224[a]	0.224[a]	0.213[a]	0.235[a]
T_8	0.213[b]	0.224[a]	0.213[a]	0.213[a]	0.213[a]	0.224[a]
T_9	0.234[b]	0.224[a]	0.224[a]	0.235[a]	0.235[a]	0.224[a]
T_{10}	0.213[b]	0.213[a]	0.213[a]	0.235[a]	0.235[a]	0.235[a]

Treatments with the same superscript form one homogeneous group

Table 15a. Effect of organic and inorganic plant nutrition on starch content of fruits (%) in experiment I

Treat-ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	3.41^{b}	3.41^{b}	3.44^{abc}	3.41^{ab}	3.40^{bc}	3.42^{bc}
T_2	3.45^{a}	3.45^{a}	3.46^{a}	3.46^{a}	3.46^{a}	3.46^{a}
T_3	3.40^{bc}	3.41^{b}	3.45^{ab}	3.42^{ab}	3.42^{b}	3.43^{b}
T_4	3.40^{bc}	3.40^{b}	3.43^{abc}	3.40^{b}	3.40^{bc}	3.40^{d}
T_5	3.39^{bc}	3.40^{b}	3.40^{bc}	3.40^{b}	3.40^{bc}	3.40^{d}
T_6	3.41^{b}	3.41^{b}	3.41^{abc}	3.41^{ab}	3.41^{bc}	3.41^{bcd}
T_7	3.39^{bc}	3.40^{b}	3.39^{bc}	3.39^{b}	3.39^{c}	3.40^{d}
T_8	3.39^{bc}	3.39^{b}	3.39^{bc}	3.40^{b}	3.39^{c}	3.39^{d}
T_9	3.40^{bc}	3.40^{b}	3.39^{bc}	3.41^{ab}	3.40^{bc}	3.41^{cd}
T_{10}	3.38^{c}	3.39^{b}	3.38^{c}	3.43^{ab}	3.39^{c}	3.39^{d}

Treatments with the same superscript form one homogeneous group

b. **Experiment II**

Data relating to the effects of treatments on the starch content of fruits are presented in Table 15b.

Results showed that in crops I, II and III, T_3 recorded significantly higher percentage of starch in the fruits (3.43 per cent). In the 4th crop T_7 recorded maximum starch content (3.52 per cent). In crops V and VI, T_2 recorded significantly higher levels of starch in the fruits (3.47 per cent each). The lowest levels of starch was recorded by T_{10} in all the crops (3.36, 3.39, 3.39, 3.39, 3.39 and 3.39 respectively).

4.4.6 Reducing sugar

a. **Experiment I**

The data on this character are depicted in Table 16a.

Significant difference was noticed for reducing sugar in fruits between treatments. Maximum reducing sugar was observed in the treatment receiving the highest dose of N (155 kg N ha^{-1}) in the form of FYM (3.84 per cent, 3.85 per cent, 3.86 per cent, 3.87 per cent, 3.86 per cent and 3.87 per cent in crops I to VI). Minimum reducing sugar was recorded in T_8 and T_{10} in all the crops (3.79 per cent in all crops except crop VI where it was 3.80 per cent).

Table 15b. Effect of organic and inorganic plant nutrition on starch content of fruits (%) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	3.40 ab	3.41 a	3.40 bc	3.40 ab	3.40 cd	3.41 c
T_2	3.42 a	3.42 a	3.42 ab	3.46 ab	3.47 a	3.47 a
T_3	3.43 a	3.43 a	3.43 a	3.44 ab	3.43 b	3.43 b
T_4	3.43 a	3.40 ab	3.40 bc	3.41 ab	3.42 bc	3.41 c
T_5	3.40 ab	3.40 ab	3.40 bc	3.39 b	3.39 d	3.40 cd
T_6	3.41 a	3.41 a	3.41 abc	3.40 ab	3.41 cd	3.40 cd
T_7	3.40 ab	3.40 ab	3.40 bc	3.52 a	3.39 d	3.39 d
T_8	3.39 ab	3.39 ab	3.39 c	3.40 ab	3.39 d	3.39 d
T_9	3.40 ab	3.40 ab	3.40 bc	3.40 ab	3.40 cd	3.41 c
T_{10}	3.36 b	3.39 ab	3.39 c	3.39 b	3.39 d	3.39 d

Treatments with the same superscript form one homogeneous group

Table 16a. Effect of organic and inorganic plant nutrition on the reducing sugar of fruits (%) in experiment I

Treat-ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	3.81^{ab}	3.81^{b}	3.85^{ab}	3.81^{bc}	3.81^{bc}	3.82^{bc}
T_2	3.84^{a}	3.85^{a}	3.86^{a}	3.87^{a}	3.86^{a}	3.87^{a}
T_3	3.76^{b}	3.80^{b}	3.83^{ab}	3.83^{b}	3.83^{b}	3.83^{b}
T_4	3.80^{ab}	3.80^{b}	3.83^{ab}	3.80^{bc}	3.80^{c}	3.80^{d}
T_5	3.79^{b}	3.80^{b}	3.80^{b}	3.80^{bc}	3.80^{c}	3.80^{d}
T_6	3.80^{ab}	3.80^{b}	3.80^{b}	3.80^{bc}	3.81^{bc}	3.81^{bcd}
T_7	3.80^{ab}	3.80^{b}	3.79^{b}	3.79^{c}	3.80^{c}	3.80^{d}
T_8	3.79^{b}	3.79^{b}	3.80^{b}	3.80^{bc}	3.80^{c}	3.79^{d}
T_9	3.79^{b}	3.80^{b}	3.79^{b}	3.80^{bc}	3.80^{c}	3.80^{d}
T_{10}	3.79^{b}	3.79^{b}	3.79^{b}	3.79^{c}	3.79^{c}	3.80^{d}

Treatments with the same superscript form one homogeneous group

b. **Experiment II**

Data presented in Table 16b show the effects of treatments on the reducing sugar content of fruits.

Significant difference was noted in the reducing sugar content of fruits due to various treatments in experiment II also. Maximum values for reducing sugar were recorded by T_3 in crops I, II and III (3.33 per cent each) while in crops IV, V and VI maximum reducing sugar was noted in T_2 (3.87 per cent each). The lowest percentage of reducing sugar was noted in T_8 and T_{10} (3.79 per cent each).

4.4.7 Total sugars

a. **Experiment I**

Data on the effects of treatments on the total sugar content of fruits are presented in Table 17a.

Significant difference was noticed in the total sugar content of fruits in crops II to VI, but in the first crop all the treatments were at par.

The highest total sugar content was observed in T_4 in crop I, IV and VI (5.13 per cent, 5.09 per cent, and 4.99 per cent respectively); T_2 in crop II (5.04 per cent) and T_3 in crop III and V (5.05 per cent and 5.02 per cent respectively).

Table 16b. Effect of organic and inorganic plant nutrition on the reducing sugar of fruits (%) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	3.80^{bc}	3.80^{bcd}	3.80^{bc}	3.81^{cd}	3.81^{cd}	3.81^{c}
T_2	3.82^{ab}	3.82^{ab}	3.81^{ab}	3.87^{a}	3.87^{a}	3.87^{a}
T_3	3.83^{a}	3.83^{a}	3.83^{a}	3.84^{b}	3.84^{b}	3.83^{b}
T_4	3.80^{bc}	3.80^{bcd}	3.80^{bc}	3.81^{c}	3.81^{c}	3.81^{c}
T_5	3.79^{c}	3.79^{cd}	3.80^{bc}	3.79^{cd}	3.80^{cd}	3.80^{cde}
T_6	3.81^{abc}	3.81^{abc}	3.81^{ab}	3.80^{cd}	3.81^{c}	3.80^{cde}
T_7	3.79^{c}	3.79^{cd}	3.80^{bc}	3.79^{cd}	3.80^{cd}	3.79^{de}
T_8	3.79^{c}	3.79^{cd}	3.79^{c}	3.80^{cd}	3.79^{d}	3.79^{de}
T_9	3.79^{c}	3.79^{cd}	3.80^{bc}	3.80^{cd}	3.80^{cd}	3.80^{cde}
T_{10}	3.79^{c}	3.79^{cd}	3.79^{c}	3.79^{d}	3.79^{d}	3.78^{e}

Treatments with the same superscript form one homogeneous group

Table 17a. Effect of organic and inorganic plant nutrition on total sugars of fruits (%) in experiment I

Treat-ments	Crop 1	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	5.02^{a}	5.03^{ab}	5.01^{ab}	4.97^{bc}	4.95^{bc}	4.96^{abc}
T_2	5.02^{a}	5.04^{a}	5.04^{a}	4.97^{bc}	4.98^{ab}	4.97^{ab}
T_3	5.00^{a}	5.02^{abc}	5.05^{a}	4.97^{bc}	5.02^{a}	4.97^{ab}
T_4	5.13^{a}	4.99^{abc}	5.04^{a}	5.09^{a}	4.98^{ab}	4.99^{a}
T_5	4.93^{a}	4.96^{abc}	4.94^{ab}	4.92^{c}	4.93^{bc}	4.93^{c}
T_6	5.04^{a}	5.04^{a}	5.01^{ab}	5.00^{b}	4.98^{ab}	4.96^{abc}
T_7	4.93^{a}	4.95^{abc}	4.93^{b}	4.95^{bc}	4.95^{bc}	4.95^{bc}
T_8	4.92^{a}	4.91^{bc}	4.90^{b}	4.94^{bc}	4.93^{bc}	4.94^{bc}
T_9	4.95^{a}	4.95^{abc}	4.95^{ab}	4.96^{bc}	4.96^{b}	4.95^{bc}
T_{10}	4.89^{a}	4.90^{c}	4.90^{b}	4.90^{c}	4.90^{c}	4.95^{bc}

Treatments with the same superscript form one homogeneous group

But these treatments were at par in all the crops. The lowest level of total sugars was recorded against T_{10}.

b. **Experiment II**

Data in Table 17b show the significant difference in total sugar content of fruits due to treatments. It was observed that in all the crops maximum total sugar content was recorded in the treatment receiving the highest level of FYM (155 kg N ha^{-1}) except in crop I where T_4 recorded maximum total sugars. Treatment T_2 was on par with T_3 in all the crops. In crop I, T_4 recorded maximum total sugar (5.07 per cent). In all the six crops treatments T_8 and T_{10} recorded minimum total sugar content (4.88 per cent, 4.90 per cent, 4.90 per cent, 4.90 per cent, 4.90 per cent and 4.91 per cent respectively).

4.4.8 Flesh thickness

a. **Experiment I**

Data presented in Table 18a show the effects of treatments on flesh thickness in brinjal.

Significant difference was noticed between treatments in flesh thickness of fruits. Maximum thickness was noticed in the treatment applied with highest level of N (155 kg ha^{-1}) in the form of poultry manure. It recorded a thickness of

Table 17b. Effect of organic and inorganic plant nutrition on total sugars of fruits (%) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	5.01^{ab}	5.03^{a}	5.05^{abc}	5.04^{a}	4.98^{ab}	4.96^{abc}
T_2	5.01^{ab}	5.03^{a}	5.08^{a}	5.01^{ab}	4.97^{ab}	4.98^{a}
T_3	5.01^{ab}	5.01^{a}	5.06^{ab}	5.01^{ab}	5.00^{a}	4.97^{ab}
T_4	5.07^{a}	5.02^{a}	5.01^{bcd}	5.02^{a}	4.98^{ab}	4.97^{ab}
T_5	4.95^{bc}	4.97^{a}	4.95^{bcd}	4.95^{cd}	4.92^{de}	4.94^{cd}
T_6	4.99^{ab}	5.01^{a}	5.01^{bcd}	4.97^{bc}	5.00^{a}	4.97^{ab}
T_7	4.95^{bc}	4.96^{a}	4.95^{bcd}	4.95^{cd}	4.95^{bc}	4.95^{cd}
T_8	4.88^{c}	4.90^{a}	4.90^{d}	4.90^{d}	4.93^{cd}	4.93^{d}
T_9	4.95^{bc}	4.97^{a}	4.95^{bcd}	4.95^{cd}	4.97^{b}	4.95^{cd}
T_{10}	4.90^{bc}	4.90^{a}	4.90^{d}	4.90^{d}	4.90^{e}	4.91^{e}

Treatments with the same superscript form one homogeneous group

Table 18a. Effect of organic and inorganic plant nutrition on flesh thickness of fruits (mm) in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	4.23^{e}	4.23^{d}	4.23^{d}	4.23^{e}	4.13^{e}	4.27^{d}
T_2	4.47^{cd}	4.37^{c}	4.47^{b}	4.50^{c}	4.33^{cd}	4.53^{bc}
T_3	4.80^{a}	4.63^{a}	4.63^{a}	4.87^{a}	4.57^{a}	4.88^{a}
T_4	4.60^{abc}	4.53^{ab}	4.55^{ab}	4.57^{bc}	4.43^{bc}	4.60^{bc}
T_5	4.63^{abc}	4.57^{ab}	4.57^{ab}	4.57^{bc}	4.37^{cd}	4.57^{bc}
T_6	4.73^{ab}	4.63^{a}	4.60^{ab}	4.70^{b}	4.50^{ab}	4.67^{b}
T_7	4.53^{bc}	4.50^{b}	4.47^{b}	4.47^{c}	4.33^{cd}	4.47^{c}
T_8	4.27^{de}	4.27^{cd}	4.26^{cd}	4.30^{de}	4.27^{d}	4.30^{d}
T_9	4.20^{ef}	4.37^{c}	4.48^{b}	4.43^{cd}	4.33^{cd}	4.50^{c}
T_{10}	4.00^{f}	4.23^{d}	4.22^{d}	4.00^{f}	4.10^{e}	4.03^{e}

Treatments with the same superscript form one homogeneous group

4.80 mm, 4.63 mm, 4.63 mm, 4.87 mm, 4.57 mm and 4.88 mm in crops I to VI respectively. Minimum thickness was recorded in T_{10} lin all the crops (4 mm, 4.23 mm, 4.22 mm, 4.0 mm, 4.1 mm and 4.03 mm in crops I to VI).

b. **Experiment II**

Data on Table 18b show the effects of treatments on flesh thickness of fruits recorded in this experiment.

Significant difference was noted in flesh thickness due to treatments in all the crops. Here also treatment receiving the highest level of N in the form of poultry manure (155 kg N ha^{-1}) recorded maximum thickness of flesh in all the crops (4.83 mm, 4.63 mm, 4.79 mm, 4.78 mm, 4.57 mm and 4.70 mm in 1st to 6th crops respectively). Minimum thickness was observed in T_{10} (3.97 mm, 4.03 mm, 4.03 mm, 4.03 mm, 4.13 mm and 4.03 mm in crops one to six respectively).

4.4.9 Phosphorylase enzyme activity

Based on the enzyme analysis (Tabl 19), it could be observed that the treatments having lower specific activity of phosphorylase enzyme (upto 0.195) contributed for lower yield. Eventhough the phosphorylase activity was moderate in certain treatments such as T_1, T_5, T_8 and T_{10}, the specific activity was low resulting in the lower yield. similarly the higher phosphorylase activity showed a resistance to the pests like

Table 18b. Effect of organic and inorganic plant nutrition on flesh thickness of fruits (mm) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	4.23^{de}	4.27^{f}	4.23^{e}	4.27^{d}	4.17^{e}	4.27^{e}
T_2	4.37^{cd}	4.37^{e}	4.50^{c}	4.43^{c}	4.33^{cd}	4.53^{ab}
T_3	4.83^{a}	4.63^{a}	4.79^{a}	4.78^{a}	4.57^{a}	4.70^{a}
T_4	4.57^{b}	4.50^{cd}	4.57^{bc}	4.60^{b}	4.43^{bc}	4.57^{ab}
T_5	4.57^{b}	4.53^{bc}	4.57^{bc}	4.53^{bc}	4.37^{bcd}	4.53^{ab}
T_6	4.63^{b}	4.60^{ab}	4.69^{b}	4.63^{b}	4.47^{ab}	4.67^{a}
T_7	4.47^{bc}	4.47^{cd}	4.47^{c}	4.43^{c}	4.33^{cd}	4.47^{b}
T_8	4.23^{de}	4.17^{g}	4.30^{de}	4.23^{d}	4.13^{e}	4.27^{c}
T_9	4.17^{e}	4.43^{de}	4.43^{cd}	4.27^{d}	4.30^{d}	4.47^{b}
T_{10}	3.97^{f}	4.03^{h}	4.03^{f}	4.03^{e}	4.13^{e}	4.03^{d}

Treatments with the same superscript form one homogeneous group

Table 19. Phosphorylase enzyme activity and specific activity adn the corresponding yield in brinjal as influenced by organic inorganic plant nutrition

Treatments	Enzyme activity	Specific activity	Yield/plot (kg)
T_1	0.257	0.189	12.23
T_2	0.285	0.197	13.61
T_3	0.389	0.208	16.80
T_4	0.375	0.205	14.68
T_5	0.257	0.179	12.33
T_6	0.346	0.208	14.94
T_7	0.254	0.184	12.53
T_8	0.184	0.177	10.31
T_9	0.247	0.184	12.16
T_{10}	0.259	0.183	9.920

shoot and fruit borer and epilachna beetle in treatments receiving organic manures alone.

4.4.10 Organoleptic qualities

The data on the acceptability score of fruits as affected by different treatments are presented in Table 20.

Statistical analysis by Friedman's Two Way Analysis of Variance by Ranks (Siegel, 1956) revealed that there was significant variation in the quality attributes of the brinjal fruits obtained from different treatments. From Table 20 it was found that the highest score for appearance (3.6) was for T_6 while T_5 (2.6) had the lowest score. The treatment T_{10} had the highest score (3.6) for colour while T_2 and T_5 scored the lowest (2.8 each). The scores for flavour also varied significantly with the highest score of 3.6 in T_4 closely followed by T_3 (3.4). Here the lowest score was shared by T_8 and T_{10} (2.6 each). In the case of texture also T_4 had the highest score (3.4) and T_9 recorded the lowest (2.6). In the case of taste attribute also significant difference was noticed between treatments. T_4 was having the maximum score of 3.6, closely followed by T_3 (3.4), and T_5 had the lowest score of 2.6.

The total score for the different quality attributes did not show significant variations between the different treatments. However, treatment T_4 scored the maximum value

Table 20. Mean scores of the acceptability tests of fruits as influenced by different sources and levels of nutrients

Treatments	Appearance	Colour	Flavour	Texture	Taste	Total
T_1	3.2	3.2	3.0	3.2	3.0	15.6
T_2	3.0	2.8	2.8	3.0	3.0	14.6
T_3	3.4	3.4	3.4	3.2	3.4	16.8
T_4	3.4	3.2	3.6	3.4	3.6	17.2
T_5	2.6	2.8	2.8	3.0	2.6	13.8
T_6	3.6	3.4	2.8	2.8	3.0	15.8
T_7	3.0	3.2	3.2	2.8	2.8	15.0
T_8	3.0	3.0	2.6	3.2	3.2	15.0
T_9	3.2	3.2	2.4	2.6	2.8	14.2
T_{10}	3.2	3.6	2.6	3.2	3.2	15.8

(17.2) closely followed by T_3 (16.8) and minimum score was obtained for T_5, the control (13.8).

4.5 Storage characters

4.5.1 Percentage of unmarketable fruits after 5, 7 and 10 days of storage

a. Experiment 1

The data on the effects of treatments on percentage of unmarketable fruits are presented in Table 21a and 22a.

Significant difference was noted between treatments on their influence on the storage life of fruits. After five days of storage under ambient conditions, maximum per cent of unmarketable fruits was observed in T_9, ie. the treatment receiving maximum amount of nutrients in inorganic form. Same is the case after seven days of storage. In both the cases it could be seen that the percentage of unmarketable fruits was significantly higher in the treatments applied with inorganic fertilizers alone as compared to the fruits obtained from treatments applied with organic manures alone. After ten days of storage, all the fruits were unmarketable irrespective of the sources or levels of N.

Table 21a. Effect of organic and inorganic sources of plant nutrition on percentage of unmarketable fruits after five days of storage in experiment I

Treat-ments	Crop III	Crop IV	Crop V	Crop VI
T_1	38.33^{c}	41.67^{de}	46.33^{d}	41.67^{cd}
T_2	43.00^{c}	42.33^{de}	47.00^{cd}	42.33^{cd}
T_3	38.33^{c}	40.67^{e}	46.00^{d}	42.00^{cd}
T_4	41.67^{c}	40.67^{e}	45.67^{d}	41.00^{d}
T_5	43.00^{c}	43.33^{d}	48.67^{c}	43.67^{c}
T_6	41.33^{c}	41.33^{de}	46.33^{d}	42.67^{cd}
T_7	55.33^{b}	56.00^{ab}	61.33^{a}	57.33^{a}
T_8	52.67^{b}	52.33^{c}	57.33^{a}	52.33^{a}
T_9	65.33^{a}	57.33^{a}	62.33^{a}	57.67^{a}
T_{10}	64.00^{a}	54.67^{bc}	58.33^{b}	55.33^{a}

Treatments with the same superscript form one homogeneous group

Table 22a. Effect of organic and inorganic plant nutrition on the percentage of unmarketable fruits after seven days of storage in experiment I

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	58.33 [cd]	59.00 [cd]	61.00 [c]	61.67 [cde]	66.33 [de]	62.00 [de]
T_2	46.67 [d]	60.00 [cd]	61.00 [c]	62.33 [cd]	67.00 [d]	65.33 [d]
T_3	55.00 [cd]	54.00 [d]	55.67 [c]	57.00 [e]	62.00 [f]	62.67 [de]
T_4	45.00 [d]	54.33 [d]	55.67 [c]	58.00 [de]	63.00 [cf]	60.00 [e]
T_5	80.33 [ab]	62.67 [c]	62.00 [c]	66.00 [c]	71.00 [c]	63.33 [c]
T_6	68.63 [bc]	60.67 [cd]	60.33 [c]	61.00 [de]	66.00 [def]	68.00 [cd]
T_7	93.33 [a]	78.67 [b]	89.33 [a]	89.00 [a]	93.00 [a]	71.33 [a]
T_8	82.67 [ab]	75.00 [b]	82.00 [b]	84.00 [b]	88.33 [b]	85.33 [b]
T_9	93.33 [a]	90.00 [a]	93.33 [a]	91.00 [a]	93.00 [a]	86.67 [a]
T_{10}	85.00 [a]	90.00 [a]	90.67 [a]	88.67 [a]	89.67 [b]	84.67 [b]

Treatments with the same superscript form one homogeneous group

Plate 21-23 A view of the storage study of fruits (5 days after storage)

Plate 21

Plate 22

Plate 23

b. **Experiment II**

The data on the effects of treatments on percentage of unmarketable fruits are presented in Table 21b and 22b.

The percentage of unmarketable fruits after five days of storage showed significant difference between treatments. Maximum per cent of unmarketable fruits was recorded in T_9 in all crops. After seven days of storage also T_9 recorded maximum percentage of unmarketable fruits in all crops except in crop II. In crop II, T_{10} recorded maximum unmarketable fruits after seven days (90.67 per cent). The minimum per cent of unmarketable fruits was recorded by T_4 in crops I, II and VI (40.00, 50.67 and 60.00 per cent respectively) while it was minimum in T_1 in crop III (59.00 per cent). In crops IV and V T_3 recorded minimum per cent of unmarketable fruits (59.67 and 64.67 per cent respectively). In general, it can be observed that the per cent of unmarketable fruits was significantly more in treatments receiving inorganic fertilizers alone (T_7, T_8, T_9 and T_{10}).

After 10 days of storage it was observed that all the fruits were unmarketable irrespective of treatments.

Table 21b. Effect of organic and inorganic sources of plant nutrition on percentage of unmarketable fruits after five days of storage in experiment II

Treat-ments	Crop III	Crop IV	Crop V	Crop VI
T_1	41.33^{c}	40.33^{de}	45.33^{de}	42.00^{de}
T_2	42.33^{c}	41.33^{de}	46.33^{de}	43.00^{de}
T_3	38.33^{c}	38.67^{e}	43.67^{e}	42.33^{de}
T_4	41.33^{c}	40.33^{de}	45.33^{de}	41.00^{e}
T_5	43.00^{c}	43.00^{d}	48.00^{d}	44.00^{d}
T_6	41.67^{c}	41.67^{d}	46.67^{d}	43.00^{de}
T_7	56.33^{b}	57.33^{ab}	62.33^{ab}	58.33^{a}
T_8	53.00^{b}	53.67^{c}	59.00^{c}	52.33^{c}
T_9	65.00^{a}	58.67^{a}	63.00^{a}	57.67^{a}
T_{10}	56.00^{a}	55.67^{bc}	59.67^{bc}	55.33^{b}

Treatments with the same superscript form one homogeneous group

Table 22b. Effect of organic and inorganic plant nutrition on percentage of unmarketable fruits after seven days of storage in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	62.00 [c]	56.33 [cd]	59.00 [d]	61.67 [de]	66.67 [c]	63.00 [de]
T_2	56.67 [c]	59.33 [c]	60.67 [d]	62.00 [de]	67.00 [c]	65.33 [d]
T_3	55.00 [c]	58.00 [c]	59.33 [d]	59.67 [e]	64.67 [c]	62.77 [de]
T_4	40.00 [d]	50.67 [d]	60.67 [d]	63.00 [de]	68.00 [c]	60.00 [e]
T_5	88.67 [ab]	60.33 [c]	61.67 [d]	64.33 [d]	68.67 [c]	69.67 [c]
T_6	81.67 [b]	58.67 [c]	60.00 [d]	61.67 [de]	66.33 [c]	66.33 [cd]
T_7	93.33 [a]	77.67 [b]	81.67 [c]	84.33 [bc]	89.33 [b]	87.00 [a]
T_8	82.67 [ab]	76.67 [b]	82.33 [bc]	82.67 [c]	86.67 [b]	84.00 [b]
T_9	93.33 [a]	89.67 [a]	90.00 [a]	89.33 [a]	93.00 [a]	88.67 [a]
T_{10}	84.00 [ab]	90.67 [a]	85.67 [b]	86.67 [ab]	88.33 [b]	85.33 [ab]

Treatments with the same superscript form one homogeneous group

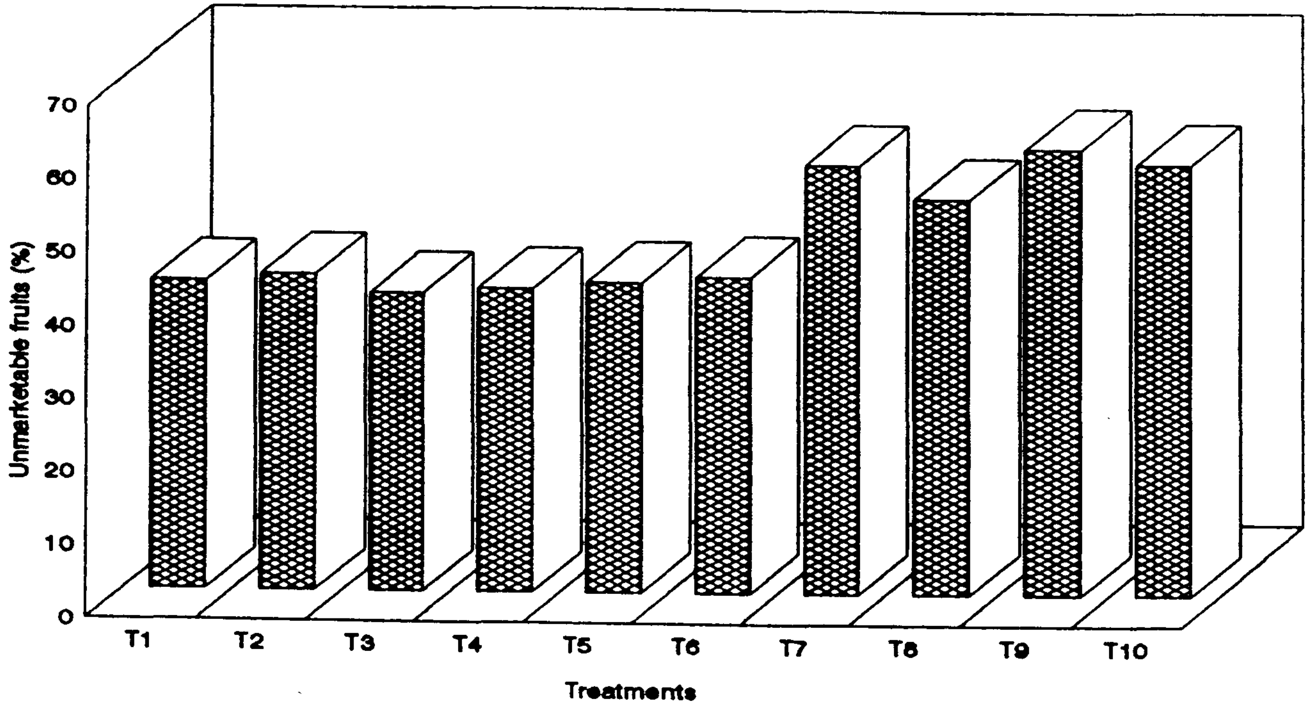


Fig. 3 EFFECT OF ORGANIC AND INORGANIC PLANT NUTRITION ON PER CENT OF UNMARKETABLE FRUITS AFTER FIVE DAYS OF STORAGE

T1-FYM (80 kg N/ha); T2-FYM (155 kgN/ha); T3-PM (155 kg N/ha); T4-PM (80 kg N/ha);
T5-FYM+NPK (155 kg N/ha); T6-PM+NPK (155 kg N/ha); T7-NPK equivalent to T2
T8-NPK equivalent to T1; T9-NPK equivalent to T3; T10-NPK equivalent to T4

4.6 Seed characters

4.6.1 Number of seeds per fruit

a. Experiment I

Data on the effect of different treatments on number of seeds per fruit are presented in Table 23a.

In all the crops number of seeds per fruit recorded significant difference between treatments. Maximum number of seeds per fruit was recorded against T_3 which was significantly superior to all other treatments. The lowest number of seeds was recorded in T_{10} in all the six crops. In T_3 the number of seeds ranged from 588.7 in crops I to 701.0 in crop V showing a progressive increase. The number of seeds recorded by T_{10} was 350.7, 411.7, 391.7, 399.3, 426.0 and 403.0 in crops I to VI.

b. Experiment II

The data on the effects of treatments on the number of seeds per fruit in this experiment are presented in Table 23b.

The results showed that poultry manure at higher level significantly increased the number of seeds per fruit in all the six crops (701.7, 693, 625, 671.7, 700.3 and 705 respectively in crops I to VI respectively). The lower number

Table 23a. Effect of organic and inorganic plant nutrition on number of seeds per fruit in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	381.3 de	421.0 fg	441.0 de	415.0 ef	447.3 de	428.7 de
T_2	458.7 bc	475.7 bc	462.0 bc	476.0 bc	497.0 bc	506.3 b
T_3	588.7 a	612.0 a	615.7 a	675.0 a	701.0 a	698.7 a
T_4	477.0 b	470.3 bc	481.0 b	484.0 b	495.3 bc	494.7 bc
T_5	411.0 cd	442.0 def	418.3 de	429.3 def	461.7 cde	453.3 d
T_6	471.7 b	489.7 b	470.7 bc	478.3 bc	503.3 b	504.3 b
T_7	441.7 bc	445.0 de	442.7 cd	447.0 cde	459.7 cde	462.4 cd
T_8	445.3 bc	426.7 efg	414.3 de	415.3 ef	431.1 e	417.0 e
T_9	455.3 bc	464.0 cd	449.0 bcd	463.0 bcd	477.0 bcd	461.0 cd
T_{10}	350.7 e	411.7 g	391.7 e	399.3 f	426.0 e	403.0 e

Treatments with the same superscript form one homogeneous group

Table 23b. Effect of organic and inorganic plant nutrition on number of seeds per fruit in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	404.3^{de}	427.7^{e}	430.3^{cde}	419.7^{cd}	445.7^{efg}	429.7^{d}
T_2	467.7^{cd}	483.0^{cd}	459.3^{bc}	494.3^{b}	499.7^{bc}	498.3^{b}
T_3	701.7^{a}	693.0^{a}	625.0^{a}	671.7^{a}	700.3^{a}	705.0^{a}
T_4	533.3^{b}	503.0^{bc}	459.3^{bc}	481.7^{b}	503.0^{b}	494.3^{b}
T_5	465.0^{cd}	487.7^{bcd}	423.3^{cde}	428.3^{cd}	465.3^{cde}	463.7^{c}
T_6	649.7^{a}	510.0^{b}	470.3^{b}	484.7^{b}	506.0^{b}	503.7^{b}
T_7	547.3^{b}	476.7^{d}	449.3^{bcd}	447.3^{c}	463.3^{def}	458.3^{c}
T_8	489.7^{bc}	439.3^{e}	414.0^{de}	405.3^{d}	429.7^{fg}	419.0^{de}
T_9	465.0^{cd}	474.0^{d}	482.7^{b}	448.3^{c}	484.3^{bcd}	460.3^{c}
T_{10}	375.3^{e}	415.0^{e}	398.7^{e}	404.7^{d}	425.3^{g}	410.3^{e}

Treatments with the same superscript form one homogeneous group

of seeds per fruit was observed in the treatment receiving inorganic nutrients alone, with the lowest number in the lowest level (T_{10}).

4.6.2 Weight of seeds per fruit

a. Experiment I

Data on the effect of treatments on weight of seeds per fruit are presented in Table 24a.

The results showed that there was significant difference in seed yield per fruit due to treatments. Significantly higher seed yield per fruit was recorded in T_3 in all the six crops (2.13 g, 2.15 g, 2.33 g, 2.46 g, 2.38 g and 2.42 g respectively). Data showed that increase in N levels increased the weight of seeds per fruit irrespective of the sources of N. Lower seed yield was recorded in T_{10} (1.37 g, 1.53 g, 1.45 g, 1.44 g, 1.52 g and 1.47 g respectively in crops I to VI). The percentage increase of T_3 over control was 24.56 in crop I, 27.22 in crop II, 42.07 in crop III, 46.43 in crop IV, 43.37 in crop V and 41.38 in crop VI.

b. Experiment II

Data presented in Table 24b show the effects of treatments on the weight of seeds per fruit in experiment II.

Table 24a. Effect of organic and inorganic plant nutrition on weight of seeds per fruit (g) in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	1.56 [d]	1.62 [de]	1.61 [de]	1.60 [d]	1.64 [ef]	1.61 [d]
T_2	1.80 [bc]	1.86 [b]	1.82 [bc]	1.85 [b]	1.90 [b]	1.91 [b]
T_3	2.13 [a]	2.15 [a]	2.33 [a]	2.46 [a]	2.38 [a]	2.42 [a]
T_4	1.87 [b]	1.85 [b]	1.87 [b]	1.88 [b]	1.84 [bc]	1.87 [b]
T_5	1.71 [bcd]	1.69 [cd]	1.64 [de]	1.68 [cd]	1.66 [de]	1.74 [c]
T_6	1.86 [b]	1.92 [b]	1.84 [bc]	1.85 [b]	1.84 [bc]	1.92 [b]
T_7	1.67 [cd]	1.65 [cd]	1.69 [cde]	1.64 [cd]	1.67 [de]	1.65 [cd]
T_8	1.66 [cd]	1.62 [de]	1.57 [ef]	1.43 [e]	1.54 [f]	1.45 [e]
T_9	1.73 [bcd]	1.73 [c]	1.75 [bcd]	1.73 [c]	1.73 [cd]	1.93 [b]
T_{10}	1.37 [e]	1.53 [e]	1.45 [f]	1.44 [e]	1.52 [f]	1.47 [e]

Treatments having same superscript form one homogeneous group

Table 24b. Effect of organic and inorganic plant nutrition on on weight of seeds per fruit (g) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	1.66^{de}	1.66^{f}	1.69^{de}	1.60^{c}	1.60^{d}	1.61^{d}
T_2	1.90^{bc}	1.84^{cd}	1.76^{bc}	1.90^{b}	1.82^{bc}	1.92^{b}
T_3	2.75^{a}	2.39^{a}	2.37^{a}	2.57^{a}	2.37^{a}	2.42^{a}
T_4	2.09^{b}	1.96^{b}	1.73^{bcd}	1.87^{b}	1.83^{bc}	1.93^{b}
T_5	1.82^{cd}	1.85^{c}	1.61^{cde}	1.63^{c}	1.75^{c}	1.75^{c}
T_6	2.52^{a}	1.99^{b}	1.82^{b}	1.88^{b}	1.90^{b}	1.95^{b}
T_7	1.93^{bc}	1.76^{de}	1.77^{bc}	1.66^{c}	1.74^{c}	1.66^{cd}
T_8	1.84^{cd}	1.63^{f}	1.59^{de}	1.45^{d}	1.53^{d}	1.46^{e}
T_9	1.83^{cd}	1.75^{e}	1.78^{b}	1.65^{c}	1.78^{bc}	1.93^{b}
T_{10}	1.50^{e}	1.54^{g}	1.48^{e}	1.46^{d}	1.52^{d}	1.44^{e}

Treatments with the same superscript form one homogeneous group

Progressive increase in the levels of N (155 kg N ha^{-1}) application significantly increased the weight of seeds per fruit than their corresponding lower level (80 kg N ha^{-1}). Here also the maximum seed weight per fruit was observed in T_3 (2.75 g, 2.39 g, 2.37 g, 2.57 g, 2.37 g and 2.42 g in crops I to VI respectively). Minimum seed weight per fruit was recorded against T_{10} (1.50 g, 1.54 g, 1.48 g, 1.46 g, 1.52 g and 1.44 g in crops I to VI respectively).

4.6.3 Seed yield per plant

a. **Experiment I**

Data on the effects of treatments on seed yield per plant are presented in Table 25a.

In the first crop there was no significant difference in seed yield per plant due to treatments. But from second crop onwards seed yield showed significant difference between treatments. In all the crops T_3 recorded maximum seed yield per plant (25.7 g, 25.81 g, 27.12 g, 27.19 g, 25.56 g and 27.24 g in Crops I to VI respectively). Significantly lower seed yield was recorded in T_{10}, but it was on par with T_8. Compared to control (T_5) the increase in seed yield of T_3 was to the tune of 34.84 per cent, 28.73 per cent, 45.33 per cent, 47.53 per cent, 49.72 per cent and 49.83 per cent respectively in crops I to VI.

Table 25a. Effect of organic and inorganic plant nutrition on seed yield per plant (g) in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	14.70[a]	14.90[d]	14.87[ef]	14.85[d]	14.37[d]	15.58[e]
T_2	18.03[a]	16.84[cd]	18.99[bcd]	19.52[c]	18.87[c]	19.88[cd]
T_3	25.70[a]	25.81[a]	27.12[a]	27.19[a]	26.56[a]	27.24[a]
T_4	20.05[a]	20.12[bc]	19.91[b]	20.45[bc]	19.04[c]	20.91[bc]
T_5	19.06[a]	20.05[bc]	18.66[bcd]	18.43[c]	17.72[c]	18.18[d]
T_6	23.03[a]	23.32[ab]	22.06[b]	22.14[b]	21.33[b]	22.14[b]
T_7	19.87[a]	18.03[cd]	19.45[bc]	19.33[c]	17.47[c]	19.27[cd]
T_8	17.08[a]	17.19[cd]	14.44[ef]	14.65[d]	13.67[d]	14.78[ef]
T_9	14.67[a]	17.21[cd]	15.60[cde]	19.10[c]	18.15[c]	19.41[cd]
T_{10}	14.11[a]	15.65[d]	12.21[f]	12.42[d]	12.62[d]	13.13[f]

Treatments with the same superscript form one homogeneous group

b. **Experiment II**

Data depicting the effects of treatments on seed yield per plant are presented in Table 25b.

Seed yield per plant showed significant difference between treatments in experiment II also. Maximum seed yield was recorded in T_3 in all the six crops (34.77 g, 27.65 g, 33.58 g, 26.73 g, 26.46 g and 26.83 g for crops I to VI respectively. Significantly lower seed yield was noted in T_{10} (14.34 g, 16.09 g, 14.55 g, 13.48 g, 12.85 g and 13.05 g respectively).

4.6.4 **Hundred seed weight**

a. **Experiment I**

Data on the effect of treatments on 100 seed weight are given in Table 26a.

Data show that there was no significant difference in 100 seed weight due to treatments in any of the crops taken. Hundred seed weight ranged between 0.363 g and 0.390 g. But the sources of N or levels of N did not evince any significant difference in 100 seed weight between the treatments.

Table 25b. Effect of organic and inorganic plant nutrition on seed yield per plant (g) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	13.13^{d}	15.39^{f}	16.83^{d}	15.31^{f}	13.99^{e}	15.50^{e}
T_2	22.14^{b}	21.13^{cd}	22.93^{c}	19.83^{cd}	19.27^{cd}	19.89^{c}
T_3	34.77^{a}	27.65^{a}	33.58^{a}	26.73^{a}	26.46^{a}	26.83^{a}
T_4	23.07^{b}	23.60^{bc}	22.04^{c}	20.65^{bc}	19.55^{c}	20.78^{c}
T_5	25.32^{b}	20.31^{de}	21.38^{c}	18.67^{de}	17.91^{cd}	18.55^{d}
T_6	32.87^{a}	26.31^{ab}	29.20^{b}	21.84^{b}	21.50^{b}	22.27^{b}
T_7	23.13^{b}	20.52^{cde}	17.49^{d}	17.86^{e}	17.57^{d}	17.51^{d}
T_8	20.74^{bc}	17.84^{ef}	15.89^{d}	14.76^{fg}	13.63^{e}	13.30^{f}
T_9	15.84^{cd}	20.28^{de}	16.54^{d}	18.58^{de}	18.18^{cd}	17.60^{d}
T_{10}	14.34^{d}	16.09^{f}	14.55^{d}	13.48^{g}	12.85^{e}	13.05^{f}

Treatments with the same superscript form one homogeneous group

Table 26a. Effect of organic and inorganic plant nutrition on 100 seed weight (g) in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	0.383[a]	0.387[a]	0.383[a]	0.380[a]	0.380[a]	0.387[a]
T_2	0.387[a]	0.387[a]	0.386[a]	0.373[a]	0.373[a]	0.377[a]
T_3	0.380[a]	0.387[a]	0.380[a]	0.380[a]	0.380[a]	0.377[a]
T_4	0.390[a]	0.390[a]	0.373[a]	0.380[a]	0.377[a]	0.380[a]
T_5	0.380[a]	0.383[a]	0.373[a]	0.380[a]	0.380[a]	0.383[a]
T_6	0.370[a]	0.387[a]	0.387[a]	0.383[a]	0.383[a]	0.387[a]
T_7	0.367[a]	0.367[a]	0.380[a]	0.380[a]	0.380[a]	0.390[a]
T_8	0.377[a]	0.377[a]	0.373[a]	0.373[a]	0.377[a]	0.380[a]
T_9	0.363[a]	0.363[a]	0.367[a]	0.377[a]	0.377[a]	0.373[a]
T_{10}	0.370[a]	0.367[a]	0.377[a]	0.373[a]	0.377[a]	0.380[a]

Treatments with the same superscript form one homogeneous group

b. Experiment II

Data presented in Table 26b show the difference in 100 seed weight due to treatments.

In crop I significant difference was observed between treatments with respect to 100 seed weight. Maximum weight was recorded by T_4 (0.390 g) which was on par with T_1, T_2, T_3 and T_6. In all other crops the treatments were at par for this parameter.

4.6.5 Germination per cent

a. Experiment I

Data on the effect of treatments on germination per cent are given in Table 27a.

It can be observed from the table that the germination per cent registered significant difference between treatments in all the crops.

Eventhough T_3 recorded maximum germination in all the crops (67.67 per cent, 72.67 per cent, 71.67 per cent, 66.67 per cent, 69.33 per cent, 71.33 per cent in crops I to VI respectively), it was on par with T_2 and T_4. Minimum germination was recorded by T_8 and T_{10} which were at par.

Table 26b. Effect of organic and inorganic plant nutrition on 100 seed weight (g) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	0.387^{b}	0.385^{a}	0.390^{a}	0.380^{a}	0.383^{a}	0.83^{a}
T_2	0.383^{ab}	0.380^{a}	0.385^{a}	0.377^{a}	0.377^{a}	0.377^{a}
T_3	0.387^{ab}	0.385^{a}	0.380^{a}	0.383^{a}	0.373^{a}	0.373^{a}
T_4	0.390^{a}	0.380^{a}	0.377^{a}	0.377^{a}	0.377^{a}	0.380^{a}
T_5	0.377^{b}	0.380^{a}	0.373^{a}	0.380^{a}	0.380^{a}	0.390^{a}
T_6	0.387^{ab}	0.390^{a}	0.377^{a}	0.383^{a}	0.377^{a}	0.387^{a}
T_7	0.360^{c}	0.383^{a}	0.380^{a}	0.383^{a}	0.387^{a}	0.383^{a}
T_8	0.367^{bc}	0.377^{a}	0.377^{a}	0.380^{a}	0.380^{a}	0.380^{a}
T_9	0.363^{bc}	0.380^{a}	0.383^{a}	0.377^{a}	0.373^{a}	0.377^{a}
T_{10}	0.370^{bc}	0.377^{a}	0.377^{a}	0.373^{a}	0.377^{a}	0.370^{a}

Treatments with the same superscript form one homogeneous group

Table 27a. Effect of organic and inorganic plant nutrition on germination percentage of fruits in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	65.67^{ab}	69.33^{bc}	67.33^{bc}	66.00^{ab}	69.33^{ab}	67.67^{bc}
T_2	67.33^{a}	71.67^{a}	70.67^{ab}	67.67^{a}	69.67^{a}	71.00^{a}
T_3	67.67^{a}	72.67^{a}	71.67^{a}	66.67^{a}	69.33^{ab}	71.33^{a}
T_4	67.67^{a}	72.00^{a}	70.67^{ab}	67.67^{a}	68.67^{abc}	69.00^{b}
T_5	64.67^{b}	69.00^{bc}	67.00^{bc}	66.33^{ab}	67.00^{cd}	67.33^{bc}
T_6	66.00^{ab}	69.67^{b}	68.67^{b}	66.00^{ab}	67.33^{bcd}	68.67^{b}
T_7	63.67^{b}	66.33^{e}	66.33^{cd}	63.67^{b}	64.67^{f}	66.33^{cd}
T_8	63.67^{b}	66.00^{e}	64.67^{d}	63.33^{b}	65.33^{def}	64.67^{de}
T_9	65.67^{ab}	68.00^{cd}	67.00^{bc}	67.00^{ab}	65.67^{def}	67.67^{bc}
T_{10}	64.00^{b}	66.67^{de}	64.67^{d}	64.00^{ab}	65.00^{ef}	64.33^{e}

Treatments with the same superscript form one homogeneous group

b. **Experiment II**

Data on the effects of treatments in experiment II on germination per cent are presented in Table 27b.

The germination per cent was significantly influenced by treatments. In the first crop T_6 recorded the maximum germination per cent (71.33 per cent) while in all other crops T_3 recorded the maximum germination (72.67 per cent, 72.33 per cent, 69 per cent, 69.33 per cent, 71.33 per cent respectively). Further, the germination per cent of T_2, and T_6 were on par with T_3. Minimum germination per cent was recorded by T_{10} (65.33, 66.33, 66.67, 65.33, 64.00 and 64.33 respectively in crops I to VI).

4.7 Pest and disease incidence

4.7.1 Shoot and fruit borer

a. **Experiment I**

The shoot and fruit borer (*Leucinodes orbonalis*) attack was observed from four weeks after planting. The percentage of attack is presented in Table 28a. From the observations it could be seen that the maximum attack was in the treatments receiving inorganic fertilizers alone at higher level (T_7 and T_9 - 155 kg N ha^{-1}) and also in the treatment applied with higher level of poultry manure (T_3). Shoot and fruit borer

Table 27b. Effect of organic and inorganic plant nutrition on the germination per cent of seeds in experiment II

Treat- ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	66.67 [bcd]	70.33 [ab]	70.50 [ab]	66.67 [a]	67.00 [bc]	68.00 [cd]
T_2	68.33 [abc]	72.33 [a]	72.17 [a]	68.33 [a]	68.67 [ab]	71.00 [ab]
T_3	69.33 [ab]	72.67 [a]	72.33 [a]	69.00 [a]	69.33 [a]	71.33 [a]
T_4	67.67 [bcd]	72.00 [a]	72.17 [a]	66.00 [a]	67.00 [bc]	69.33 [bc]
T_5	68.33 [abc]	68.67 [bc]	70.33 [ab]	69.00 [a]	68.33 [ab]	68.00 [cd]
T_6	71.33 [a]	71.67 [a]	72.00 [a]	69.67 [a]	69.00 [ab]	69.00 [c]
T_7	65.33 [cd]	66.67 [c]	68.33 [bc]	64.67 [a]	65.67 [cd]	66.33 [de]
T_8	66.67 [bc]	66.00 [c]	66.33 [c]	66.33 [a]	65.33 [cd]	64.67 [ef]
T_9	64.67 [d]	68.00 [bc]	68.00 [bc]	65.00 [a]	64.67 [d]	66.67 [d]
T_{10}	65.33 [cd]	66.33 [c]	66.67 [c]	65.33 [a]	64.00 [d]	64.33 [f]

Treatments with the same superscript form one homogeneous group

Table 28a. Effect of organic and inorganic plant nutrition on shoot and fruit borer attack (per cent) in experiment I

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	15.78^{cd}	16.67^{bc}	18.01^{de}	17.34^{d}	17.34^{c}	20.24^{c}
T_2	14.90^{cd}	14.90^{bc}	15.56^{e}	18.90^{cd}	19.57^{c}	20.24^{c}
T_3	24.91^{ab}	26.46^{a}	26.46^{ab}	28.02^{a}	26.46^{ab}	29.58^{ab}
T_4	21.12^{abc}	21.12^{abc}	21.79^{cd}	23.35^{b}	21.79^{bc}	24.91^{bc}
T_5	28.02^{a}	28.02^{a}	24.91^{abc}	22.91^{b}	23.35^{abc}	26.46^{ab}
T_6	12.45^{d}	14.01^{c}	18.12^{de}	18.68^{cd}	19.57^{c}	20.24^{c}
T_7	22.68^{abc}	24.91^{a}	24.91^{abc}	23.35^{b}	26.46^{ab}	29.58^{ab}
T_8	17.12^{bcd}	17.23^{bc}	21.79^{cd}	19.57^{cd}	21.79^{bc}	24.91^{bc}
T_9	26.46^{a}	28.02^{a}	28.02^{a}	29.58^{a}	28.02^{a}	31.13^{a}
T_{10}	21.79^{abc}	21.79^{ab}	23.35^{bcd}	21.79^{bc}	23.35^{abc}	24.91^{bc}

Treatments with the same superscript form one homogeneous group

attack was significantly lower in treatments applied with FYM alone irrespective of their levels (T_1 and T_2). Attack was also less in the treatment which received poultry manure along with NPK fertilizers at the rate of 75:40:25 kg ha^{-1}.

b. **Experiment II**

Table 28b shows the difference in the percentage incidence of shoot and fruit borer in experiment II.

It was observed that thoughout the experimental period the borer attack was significantly higher in T_9, i.e., the treatment receiving higher level of N (155 kg ha^{-1}) in the form of inorganic fertilizers alone. Significantly lower pest attack was observed in the treatments applied with FYM (T_1 and T_2) and also in the plots applied with poultry manure and NPK fertilizers at the rate of 75:40:25 kg ha^{-1}.

4.7.2 Epilachna beetle

a. **Experiment I**

Data on the percentage of incidence of epilachna beetle (Hanosepilachna spp.) are presented in Table 29a.

The data show that there was significant difference in the incidence of pest attack due to treatments. It could be observed that significantly more incidence was on T_7 and T_9, i.e., the treatments applied with higher levels of N (155

Table 28b. Effect of organic and inorganic plant nutrition on shoot and fruit borer attack (per cent) in experiment II

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	15.57[c]	16.45[d]	18.01[de]	18.68[cd]	18.01[c]	20.24[d]
T_2	17.12[bc]	17.12[d]	17.12[de]	20.24[bcd]	21.79[bc]	21.79[cd]
T_3	28.02[a]	26.46[ab]	28.02[ab]	26.46[ab]	24.91[ab]	26.46[abc]
T_4	29.58[a]	28.02[a]	21.79[cd]	21.79[bcd]	21.79[bc]	24.91[abc]
T_5	28.02[a]	26.46[ab]	24.91[bc]	24.91[abc]	26.46[a]	28.02[ab]
T_6	14.01[c]	16.45[d]	16.45[e]	17.12[d]	18.68[c]	21.79[cd]
T_7	22.68[ab]	24.91[abc]	24.91[bc]	24.91[abc]	24.91[ab]	28.02[ab]
T_8	20.24[bc]	20.24[cd]	23.35[bc]	21.79[bcd]	20.24[c]	23.35[bcd]
T_9	29.58[a]	28.02[a]	31.13[a]	29.58[a]	28.02[a]	29.58[a]
T_{10}	23.35[ab]	21.79[bcd]	21.79[cd]	23.35[abc]	21.79[bc]	23.35[bcd]

Treatments with the same superscript form one homogeneous group

Table 29a. Effect of organic and inorganic plant nutrition on epilachna beetle attack (per cent) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	16.67^{d}	19.45^{cd}	17.91^{c}	16.67^{e}	16.67^{c}	17.91^{cd}
T_2	19.45^{cd}	20.83^{cd}	19.45^{bc}	20.83^{de}	19.45^{bc}	17.91^{cd}
T_3	22.08^{cd}	19.45^{cd}	20.83^{bc}	22.08^{cd}	19.45^{bc}	19.45^{bc}
T_4	17.91^{d}	16.67^{d}	17.91^{c}	19.45^{de}	17.91^{c}	16.67^{d}
T_5	20.83^{cd}	22.08^{bc}	20.83^{bc}	23.74^{bc}	22.08^{b}	20.83^{bc}
T_6	22.08^{bc}	22.08^{bc}	20.83^{bc}	20.83^{de}	22.08^{b}	19.45^{bc}
T_7	29.17^{a}	26.25^{a}	29.17^{a}	26.25^{ab}	27.79^{a}	26.25^{a}
T_8	23.74^{bc}	25.02^{ab}	22.08^{b}	25.02^{bc}	23.74^{b}	23.74^{b}
T_9	26.25^{ab}	27.79^{a}	27.79^{a}	29.17^{a}	27.79^{a}	26.25^{a}
T_{10}	20.83^{d}	22.08^{bc}	23.74^{b}	22.08^{cd}	22.08^{b}	23.74^{b}

Treatments with the same superscript form one homogeneous group

kg ha^{-1}) as inorganic fertilizers alone. Significantly lower percentage of incidence was observed in the treatments consisting of organic manures alone, i.e., T_1, T_2, T_3 and T_4. In the organic treatments itself, the lowest percentage of pest attack was observed in the treatments receiving lower levels (80 kg N ha^{-1}) of FYM and poultry manure (T_1 and T_4).

b. **Experiment II**

Data relating to the incidence of epilachna beetle due to different treatments in experiment II are presented in Table 29b.

Significant difference was noted for the incidence of pest attack between treatments in this case also. Maximum incidence was observed in treatments T_7 and T_9 in the six crops taken. The per cent of pest attack ranged between 26.25 and 29.17 in these two treatments. Minimum pest incidence was noted in T_1 and T_4, i.e., the treatments applied with lower levels of FYM and poultry manure. As compared to inorganic treatments, the pest incidence was significantly lower in the organic treatments irrespective of their levels.

Table 29b. Effect of organic and inorganic plant nutrition on epilachna beetle attack (per cent) in experiment I

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	16.67^{a}	17.91^{e}	19.45^{cd}	17.91^{d}	16.67^{d}	17.91^{d}
T_2	20.83^{bc}	19.45^{de}	20.83^{c}	19.45^{cd}	19.45^{bc}	20.83^{bc}
T_3	20.83^{bc}	22.08^{cd}	20.83^{c}	22.08^{bc}	19.45^{bc}	22.08^{b}
T_4	17.91^{c}	19.45^{de}	16.67^{d}	19.45^{cd}	17.91^{cd}	17.91^{d}
T_5	22.02^{b}	22.02^{cd}	20.83^{c}	22.08^{bc}	23.74^{ab}	20.83^{bc}
T_6	22.08^{b}	20.83^{de}	22.08^{b}	20.83^{cd}	20.83^{bc}	19.45^{cd}
T_7	27.79^{a}	29.17^{a}	26.25^{a}	27.79^{a}	27.79^{a}	26.25^{a}
T_8	23.74^{b}	25.02^{bc}	22.08^{b}	23.74^{ab}	23.74^{ab}	25.02^{a}
T_9	26.25^{a}	27.79^{ab}	26.25^{a}	27.79^{a}	27.79^{a}	26.25^{a}
T_{10}	22.08^{b}	23.74^{bc}	20.83^{c}	25.02^{ab}	23.74^{ab}	22.08^{b}

Treatments with the same superscript form one homogeneous group

4.8 Soil properties

4.8.1 Organic carbon

a. Experiment I

The results on the effect of treatments on organic carbon content of soil are presented in Table 30a.

The data showed that there was no significant difference in soil organic carbon content between treatments upto the starting of crop III. But from fourth crop onwards significant difference was noted in organic carbon content of soil applied with different treatments. In soil samples taken after crops IV to VI, T_3 (155 kg N ha^{-1} in the form of poultry manure) recorded maximum organic carbon content (1.25 per cent, 1.26 per cent, 1.28 per cent and 1.29 per cent respectively). All the organic treatments like T_1, T_2 and T_4 were on par with T_3 for this character. After the last crop, all the plots applied with organic manures were having significantly higher organic carbon content than the treatments which received inorganic fertilizers alone viz. T_7, T_8, T_9 and T_{10}.

b. Experiment II

The data on the effects of treatments on organic carbon content of the soil are presented in Table 30b.

Table 30a. Organic carbon content (%) soil as influenced by organic and inorganic plant nutrition in experiment I

Treatments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	1.13^{a}	1.17^{a}	1.17^{a}	1.20^{ab}	1.23^{ab}	1.23^{a}	1.23^{a}
T_2	1.17^{a}	1.19^{a}	1.19^{a}	1.21^{ab}	1.24^{a}	1.25^{a}	1.25^{a}
T_3	1.20^{a}	1.23^{a}	1.24^{a}	1.25^{ab}	1.26^{a}	1.28^{a}	1.29^{a}
T_4	1.15^{a}	1.19^{a}	1.20^{abc}	1.22^{bc}	1.24^{b}	1.26^{a}	1.26^{a}
T_5	1.09^{a}	1.10^{a}	1.13^{a}	1.12^{ab}	1.12^{ab}	1.06^{a}	1.14^{a}
T_6	1.12^{a}	1.15^{a}	1.16^{a}	1.18^{ab}	1.20^{ab}	1.20^{a}	1.21^{a}
T_7	1.22^{a}	1.18^{a}	1.16^{a}	1.12^{abc}	1.17^{abc}	1.05^{b}	0.99^{ab}
T_8	1.15^{a}	1.11^{a}	1.10^{a}	1.07^{bc}	1.05^{cd}	1.04^{b}	1.00^{ab}
T_9	1.17^{a}	1.13^{a}	1.12^{a}	1.09^{abc}	1.12^{bc}	1.02^{b}	0.99^{ab}
T_{10}	1.02^{a}	1.00^{a}	0.99^{a}	0.99^{c}	0.99^{d}	0.98^{b}	0.97^{b}

Treatments with the same superscript form one homogeneous group

Table 30b. Organic carbon content (%) of soil as influenced by organic and inorganic plant nutrition in experiment II

Treatments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	1.13^{a}	1.08^{a}	1.10^{a}	1.13^{abc}	1.14^{abc}	1.15^{abc}	1.16^{a}
T_2	1.18^{a}	1.21^{a}	1.22^{a}	1.24^{a}	1.26^{ab}	1.28^{a}	1.29^{a}
T_3	1.13^{a}	1.15^{a}	1.17^{a}	1.19^{abc}	1.21^{abc}	1.22^{ab}	1.25^{a}
T_4	1.19^{a}	1.23^{a}	1.24^{a}	1.26^{a}	1.28^{a}	1.28^{a}	1.28^{a}
T_5	1.25^{a}	1.23^{a}	1.23^{a}	1.24^{ab}	1.24^{ab}	1.25^{a}	1.25^{a}
T_6	1.07^{a}	1.09^{a}	1.10^{a}	1.12^{abc}	1.13^{abc}	1.13^{abc}	1.13^{a}
T_7	1.12^{a}	1.11^{a}	1.11^{a}	1.09^{abc}	1.08^{bcd}	1.07^{bc}	1.05^{b}
T_8	1.15^{a}	1.08^{a}	1.07^{a}	1.05^{bc}	1.03^{cd}	1.02^{c}	1.00^{b}
T_9	1.04^{a}	1.04^{a}	1.04^{a}	1.03^{c}	1.02^{d}	1.00^{c}	0.99^{b}
T_{10}	1.20^{a}	1.13^{a}	1.12^{a}	1.10^{abc}	1.08^{bcd}	1.06^{bc}	1.05^{b}

Treatments with the same superscript form one homogeneous group

The results showed that neither the sources nor the varying levels of nutrients affected the organic carbon content of soil upto the sample taken before third crop. But from the soil sample taken before fourth crop onwards significant difference was noted according to the sources and levels of nutrients added. This was due to the accumulation of continued application of manures and fertilizers. There was gradual increase in the organic carbon content of soil in the treatments consisted of organic manures while the treatments involving inorganic fertilizers alone, had a decreasing trend.

4.8.2 Total nitrogen

a. Experiment I

The Table 31a depicts the effect of treatments on soil N. Total nitrogen in the soil did not show any significant difference between treatments upto the fourth crop (the soil collected before the fourth crop). But significant difference in total N was observed in the soil after the fourth, fifth and sixth crops. In the soil sample after the fourth crop, T_2 (155 kg N ha^{-1} in the form of FYM) recorded maximum total N (0.134 per cent) which it was on par with all the organic treatments, and treatments applied with organic + NPK fertilizers (T_5 and T_6). In the soil sample collected after crop V, T_3 (the highest level of poultry manure) recorded

Table 31a. Total nitrogen content of soil (%) as influenced by organic and inorganic plant nutrition in experiment I

Treat- ments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	0.121^{a}	0.126^{a}	1.131^{a}	1.128^{a}	0.128^{ab}	0.135^{a}	0.138^{ab}
T_2	0.125^{a}	0.128^{a}	0.135^{a}	0.135^{a}	0.135^{a}	0.137^{a}	0.138^{ab}
T_3	0.122^{a}	0.127^{a}	0.130^{a}	0.133^{a}	0.132^{a}	0.138^{a}	0.143^{a}
T_4	0.116^{a}	0.119^{a}	0.121^{a}	0.129^{a}	0.128^{ab}	0.135^{a}	0.135^{ab}
T_5	0.119^{a}	0.123^{a}	0.127^{a}	0.134^{a}	0.128^{ab}	0.126^{abc}	0.129^{bcd}
T_6	0.119^{a}	0.125^{a}	0.127^{a}	0.129^{a}	0.129^{a}	0.131^{ab}	0.132^{abc}
T_7	0.124^{a}	0.126^{a}	0.123^{a}	0.120^{a}	1.007^{bcd}	0.119^{bcd}	0.119^{cde}
T_8	0.121^{a}	0.120^{a}	0.122^{a}	0.121^{a}	0.114^{cd}	0.115^{cd}	0.117^{de}
T_9	0.122^{a}	0.121^{a}	0.125^{a}	0.123^{a}	0.116^{bcd}	0.115^{cd}	0.113^{e}
T_{10}	0.121^{a}	0.120^{a}	0.124^{a}	0.122^{a}	0.112^{d}	0.114^{d}	0.113^{e}

Treatments with the same superscript form one homogeneous group

maximum total N of 0.138 per cent and here also organic treatments were at par. In the soil sample collected after crop VI also T_3 (155 kg N ha^{-1}) recorded maximum total N content (0.143 per cent) and there was significant difference between organic and inorganic groups of treatments.

b. Experiment II

The data on the effects of treatments on the total nitrogen content of soil for this experiment are depicted in Table 31b.

Total nitrogen content of soil was significantly influenced by the sources and levels of N in the soil sample collected after the fourth, fifth and sixth crops. But upto the fourth crop there was no significant difference in total nitrogen content. There was gradual increase in total N reflected from crop I to VI in organic treatments and this increase was maximum for T_3 (0.116 per cent to 0.137 per cent). On the other hand there was gradual decrease in total nitrogen content in the treatments receiving inorganic fertilizers alone and maximum decrease was observed in T_{10} (0.121 per cent to 0.111 per cent).

Table 31b. Total nitrogen of soil (%) as influenced by organic and inorganic plant nutrition in experiment II

Treat-ments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	0.114^{a}	0.117^{a}	0.118^{a}	0.116^{a}	0.119^{bc}	0.128^{ab}	0.128^{abc}
T_2	0.119^{a}	0.123^{a}	0.130^{a}	0.131^{a}	0.135^{a}	0.135^{a}	0.135^{ab}
T_3	0.116^{a}	0.124^{a}	0.125^{a}	0.129^{a}	0.128^{ab}	0.133^{a}	0.137^{a}
T_4	0.111^{a}	0.112^{a}	0.118^{a}	0.127^{a}	0.128^{ab}	0.133^{a}	0.133^{ab}
T_5	0.118^{a}	0.122^{a}	0.129^{a}	0.130^{a}	0.121^{bc}	0.126^{abc}	0.133^{ab}
T_6	0.117^{a}	0.124^{a}	0.131^{a}	0.127^{a}	0.126^{ab}	0.133^{a}	0.135^{ab}
T_7	0.114^{a}	0.119^{a}	0.121^{a}	0.129^{a}	0.121^{bc}	0.124^{abc}	0.124^{bcd}
T_8	0.123^{a}	0.121^{a}	0.121^{a}	0.118^{a}	0.112^{c}	0.113^{cd}	0.114^{d}
T_9	0.118^{a}	0.126^{a}	0.124^{a}	0.122^{a}	0.121^{bc}	0.117^{bcd}	0.117^{cd}
T_{10}	0.121^{a}	0.121^{a}	0.124^{a}	0.121^{a}	0.112^{c}	0.110^{d}	0.111^{d}

Treatments with the same superscript form one homogeneous group

4.8.3 Available phosphorus

a. Experiment I

The Table 32a explains the effect of different treatments on available P in the soil.

After crops I, II and III there was no significant difference in available P due to application of different treatments as reflected from the soil samples. No definite trend was noticed in the available P in treatments applied with different sources and levels of N. But in soils taken after crops IV, V and VI there was significant difference in available P between treatments. Maximum value was recorded for T_3 in all these soil samples, but it was on par with T_2 and T_6 in all the cases. This showed that poultry manure and FYM at higher levels and poultry manure + NPK fertilizers were influencing for higher levels of available P in the soil.

b. Experiment II

The effects of treatments on available P content of soil are presented in Table 32b.

Significant difference was not noticed in the soil for the available P content during first two crops. But the continuous application of P through manures and their equivalent levels of nutrients as fertilizers brought about

Table 32a. Available P content of soil (kg ha^{-1}) as influenced by organic and inorganic plant nutrition in experiment I

Treatments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	14.35^{a}	14.87^{a}	14.76^{a}	14.74^{ab}	15.25^{ab}	14.89^{bc}	15.56^{ab}
T_2	14.78^{a}	15.08^{a}	15.53^{a}	15.48^{a}	15.76^{ab}	16.37^{a}	15.85^{ab}
T_3	14.63^{a}	14.85^{a}	15.34^{a}	15.87^{a}	16.30^{a}	16.52^{a}	16.58^{a}
T_4	14.44^{a}	14.67^{a}	14.90^{a}	14.71^{bc}	15.08^{bc}	15.33^{ab}	15.30^{bc}
T_5	15.02^{a}	14.83^{a}	15.11^{a}	15.20^{ab}	14.96^{bc}	15.17^{ab}	15.20^{bc}
T_6	14.81^{a}	14.94^{a}	15.23^{a}	15.39^{ab}	15.51^{ab}	15.70^{ab}	15.78^{ab}
T_7	14.76^{a}	14.70^{a}	14.53^{a}	14.22^{bc}	14.24^{cd}	13.93^{cd}	13.52^{cd}
T_8	14.43^{a}	13.22^{a}	13.64^{a}	13.62^{c}	13.34^{d}	12.96^{d}	10.45^{e}
T_9	15.12^{a}	15.87^{a}	15.32^{a}	15.38^{ab}	15.27^{bc}	14.56^{bc}	13.97^{cd}
T_{10}	14.98^{a}	14.08^{a}	13.77^{a}	13.57^{c}	13.38^{d}	12.43^{d}	11.86^{de}

Treatments with the same superscript form one homogeneous group

Table 32b. Available P content of soil (kg ha^{-1}) as influenced by organic and inorganic plant nutrition in experiment II

Treatments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	14.18^{a}	14.21^{a}	14.32^{a}	14.48^{cd}	14.67^{bc}	14.88^{bc}	14.90^{bc}
T_2	14.20^{a}	14.46^{a}	14.69^{a}	14.82^{b}	14.78^{b}	14.93^{bc}	15.27^{b}
T_3	14.16^{a}	14.46^{a}	14.73^{a}	14.91^{ab}	15.22^{a}	15.41^{a}	15.58^{a}
T_4	14.26^{a}	14.39^{a}	14.51^{a}	14.62^{bc}	14.67^{bc}	14.79^{cd}	14.90^{bc}
T_5	14.81^{a}	14.93^{a}	14.98^{a}	14.96^{ab}	14.99^{ab}	15.05^{ab}	15.10^{bc}
T_6	14.76^{a}	14.92^{a}	15.13^{a}	15.17^{a}	15.25^{a}	15.30^{a}	15.28^{b}
T_7	14.43^{a}	14.44^{a}	14.38^{a}	14.35^{cd}	14.36^{cd}	14.31^{de}	14.29^{cd}
T_8	14.83^{a}	14.78^{a}	14.56^{a}	14.22^{d}	14.05^{d}	13.92^{e}	13.67^{de}
T_9	14.88^{a}	14.67^{a}	14.72^{a}	14.66^{bc}	14.49^{cd}	14.36^{de}	14.30^{cd}
T_{10}	14.38^{a}	14.31^{a}	14.17^{a}	13.98^{e}	13.66^{e}	13.41^{f}	12.98^{e}

Treatments with the same superscript form one homogeneous group

significant difference in available P level in the soil. Application of P through organic manures led to a significantly higher status of available P in the soil while addition of P through inorganic fertilizers alone, at lower rate led to a lower status of available P in the soil. The treatment applied with higher level of poultry manure recorded maximum increase in available P content of soil (14.16 kg ha^{-1} to 15.58 kg ha^{-1}).

4.8.4 Available potassium

a. Experiment I

Data relating to available potassium are presented in Table 33a.

The results showed that there was no significant difference in available potassium due to different treatments till crop V. But after crops V and VI significant difference was noted between treatments for available K as reflected from the soil sample. Maximum available K was recorded in T_3 (282.4 kg ha^{-1} and 273.8 kg ha^{-1} respectively). T_3 was on par with T_1, T_2, T_4 and T_6. But it contained significantly more available K as compared to treatments receiving inorganic fertilizers alone.

Table 33a. Available K content of soil (kg ha^{-1}) as influenced by organic and inorganic plant nutrition in experiment I

Treat-ments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	222.8^{a}	219.3^{a}	221.3^{a}	223.5^{a}	230.6^{a}	244.2^{ab}	242.3^{ab}
T_2	224.0^{a}	230.2^{a}	236.8^{a}	240.3^{a}	248.4^{a}	252.0^{ab}	261.2^{a}
T_3	237.5^{a}	247.2^{a}	247.4^{a}	251.5^{a}	257.5^{a}	282.4^{a}	273.8^{a}
T_4	237.6^{a}	236.3^{a}	236.2^{a}	238.2^{a}	242.3^{a}	245.6^{ab}	244.3^{ab}
T_5	230.8^{a}	233.6^{a}	230.5^{a}	231.2^{a}	229.6^{a}	226.8^{b}	220.6^{bc}
T_6	235.2^{a}	238.4^{a}	238.6^{a}	239.3^{a}	240.1^{a}	248.2^{ab}	246.3^{ab}
T_7	229.5^{a}	230.2^{a}	227.5^{a}	225.6^{a}	223.1^{a}	218.2^{b}	219.7^{bc}
T_8	232.1^{a}	229.3^{a}	221.3^{a}	220.5^{a}	215.7^{a}	214.4^{b}	207.5^{c}
T_9	228.7^{a}	232.4^{a}	230.4^{a}	229.6^{a}	225.4^{a}	221.0^{b}	218.4^{bc}
T_{10}	237.5^{a}	233.2^{a}	226.1^{a}	218.3^{a}	215.6^{a}	213.2^{b}	208.4^{c}

Treatments with the same superscript form one homogeneous group

b. Experiment II

Data on the effects of treatments on available K are given in Table 33b.

Application of different sources and levels of nutrients had no significant effect on the available K content of soil upto the fourth crop. But after the fourth, fifth and sixth crops, maximum available K content was observed in T_3 (253.4 kg ha^{-1}, 257.8 kg ha^{-1} and 262.2 kg ha^{-1} respectively). But the treatments applied with inorganic fertilizers alone led to a significantly lower status of available K.

4.8.5 pH of soil

a. Experiment I

Data relating to pH of soil are presented in Table 34a.

Repeated application of organic and inorganic forms of nutrients did not cause any significant difference in pH of soil between treatments.

b. Experiment II

In experiment II also significant difference in pH of soil was not observed between treatments (Table 34b).

Table 33b. Available K content of soil (kg ha^{-1}) as influenced by organic and inorganic plant nutrition in experiment II

Treatments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	223.6^{a}	219.7^{a}	221.6^{a}	224.8^{a}	229.5^{cd}	235.3^{bc}	238.7^{bc}
T_2	223.9^{a}	228.9^{a}	235.2^{a}	239.4^{a}	246.9^{b}	253.1^{a}	258.5^{a}
T_3	228.6^{a}	239.2^{a}	244.1^{a}	249.6^{a}	253.4^{a}	257.8^{a}	262.2^{a}
T_4	236.5^{a}	234.1^{a}	236.3^{a}	237.9^{a}	241.8^{b}	244.7^{b}	245.5^{b}
T_5	229.8^{a}	232.8^{a}	231.6^{a}	232.3^{a}	228.6^{cd}	227.7^{cd}	225.2^{cd}
T_6	234.6^{a}	234.9^{a}	236.4^{a}	237.2^{a}	239.1^{bc}	239.9^{bc}	240.3^{bc}
T_7	231.3^{a}	230.0^{a}	228.5^{a}	228.9^{a}	225.8^{cd}	223.1^{de}	221.4^{cd}
T_8	232.5^{a}	229.4^{a}	222.8^{a}	218.6^{a}	217.9^{d}	211.6^{e}	208.2^{d}
T_9	229.4^{a}	229.1^{a}	227.9^{a}	226.8^{a}	225.2^{cd}	222.3^{de}	220.4^{cd}
T_{10}	233.2^{a}	229.8^{a}	224.3^{a}	220.6^{a}	216.4^{d}	212.8^{e}	208.9^{d}

Treatments with the same superscript form one homogeneous group

Table 34a. pH of soil as influenced by organic and inorganic plant nutrition in experiment I

Treatments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	4.950^a	4.825^a	4.835^a	4.830^a	4.890^a	4.875^a	4.885^a
T_2	4.850^a	4.725^a	4.785^a	4.815^a	4.795^a	4.810^a	4.820^a
T_3	5.050^a	4.950^a	4.935^a	4.910^a	4.905^a	4.920^a	4.915^a
T_4	4.795^a	4.675^a	4.825^a	4.795^a	4.805^a	4.800^a	4.785^a
T_5	4.850^a	4.755^a	4.805^a	4.855^a	4.820^a	4.840^a	4.845^a
T_6	4.950^a	4.895^a	4.905^a	4.900^a	4.895^a	4.885^a	4.875^a
T_7	5.025^a	4.995^a	4.825^a	4.895^a	4.925^a	4.900^a	4.930^a
T_8	4.900^a	4.900^a	4.895^a	4.910^a	4.905^a	4.895^a	4.885^a
T_9	4.975^a	4.925^a	4.905^a	4.925^a	4.900^a	4.905^a	4.910^a
T_{10}	4.825^a	4.820^a	4.825^a	4.820^a	4.815^a	4.825^a	4.805^a

Treatments with the same superscript form one homogeneous group

Table 34b. pH of soil as influenced by organic and inorganic plant nutrition in experiment II

Treatments	S_1	S_2	S_3	S_4	S_5	S_6	S_7
T_1	4.850[a]	4.795[a]	4.785[a]	4.815[a]	4.790[a]	4.815[a]	4.820[a]
T_2	4.955[a]	4.865[a]	4.875[a]	4.850[a]	4.890[a]	4.875[a]	4.880[a]
T_3	4.950[a]	4.955[a]	4.965[a]	4.920[a]	4.935[a]	4.960[a]	4.940[a]
T_4	4.850[a]	4.755[a]	4.805[a]	4.860[a]	4.845[a]	4.855[a]	4.845[a]
T_5	4.825[a]	4.795[a]	4.800[a]	4.785[a]	4.795[a]	4.815[a]	4.785[a]
T_6	4.955[a]	4.925[a]	4.910[a]	4.930[a]	4.945[a]	4.925[a]	4.930[a]
T_7	4.975[a]	4.925[a]	4.945[a]	4.925[a]	4.900[a]	4.910[a]	4.925[a]
T_8	4.910[a]	4.900[a]	4.890[a]	4.905[a]	4.985[a]	4.900[a]	4.895[a]
T_9	4.950[a]	4.895[a]	4.905[a]	4.915[a]	4.890[a]	4.875[a]	4.885[a]
T_{10}	4.850[a]	4.725[a]	4.780[a]	4.820[a]	4.795[a]	4.810[a]	4.805[a]

Treatments with the same superscript form one homogeneous group

4.8.6 Bulk density

a. Experiment I

Bulk density of soil collected from plots after all the six crops in experiment I and II are presented in Table 35.

Significant difference was noted in bulk density between treatments. The treatments receiving inorganic fertilizers alone were at par and those treatments consisted of organic manures alone were also at par. Treatments comprised of the fertilizers alone were having significantly higher bulk density as compared to organic treatments and the controls (T_5 and T_6). Maximum bulk density was recorded by T_8 (1.36 g cc^{-1}) closely followed by T_7 (1.35 g cc^{-1}). Minimum bulk density was recorded by T_4 and T_6 (1.15 g cc^{-1})

b. Experiment II

In experiment II also bulk density was significantly lower as a result of the application of organic manures indicating the improvement in physical properteis of soil through organic matter addition. The bulk density of soil in the plots receiving inorganic fertilizers alone were at par and they were significantly higher as compared to the treatments involving organic manures alone.

Table 35. Bulk density (g cc^{-1}) of soil as influenced by organic and inorganic plant nutrition in experiment I and II

	Experiment I	Experiment II
T_1	1.21^{c}	1.17^{d}
T_2	1.23^{bc}	1.25^{bc}
T_3	1.19^{c}	1.19^{d}
T_4	1.15^{c}	1.19^{d}
T_5	1.22^{bc}	1.20^{cd}
T_6	1.15^{c}	1.20^{cd}
T_7	1.35^{a}	1.32^{a}
T_8	1.36^{a}	1.28^{ab}
T_9	1.32^{ab}	1.32^{a}
T_{10}	1.32^{ab}	1.30^{ab}

Treatments with the same superscript form one homogeneous group

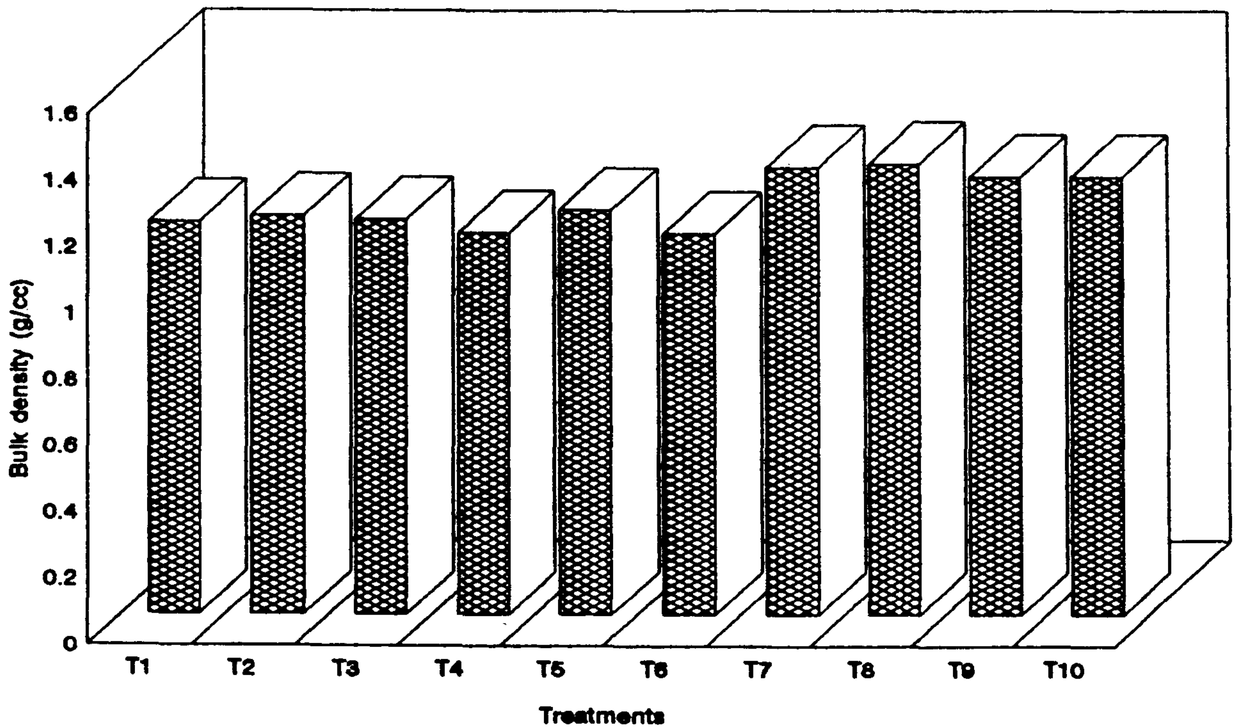


Fig. 4 EFFECT OF ORGANIC AND INORGANIC PLANT NUTRITION ON BULK DENSITY OF SOIL AFTER SIX CROPS

T1-FYM (80 kg N/ha); T2-FYM (155 kgN/ha); T3-PM (155 kg N/ha); T4-PM (80 kg N/ha)
T5-FYM+NPK (155 kg N/ha); T6-PM+NPK (155 kg N/ha); T7-NPK equivalent to T2
T8-NPK equivalent to T1; T9-NPK equivalent to T3; T10-NPK equivalent to T4

4.9 Plant analysis

4.9.1 Total dry matter

a. Experiment I

The data on total dry matter content of plant as affected by different treatments are given in Table 36a.

Results showed that application of different sources and different levels of N influenced the total dry matter production significantly in all the crops. Maximum dry matter was produced in T_3 (91.27 g, 94.77 g, 114 g, 90.57 g, 97.27 g and 100.80 g respectively in crops I to VI). Significantly lower dry matter was recorded in T_{10} (53.67 g, 58.70 g, 58.73 g, 56.03 g, 53.93 g) in all the crops except crop IV where T_8 recorded minimum dry matter (57.9 g). These two treatments were at par in all the crops.

b. Experiment II

Data showing the effects of treatments on dry matter production in experiment II are presented in Table 36b.

The data show that nitrogen levels and sources differed significantly in dry matter production per plant. Highest dry matter yield of 106.2 g plant^{-1} was observed in T_6 in the first crop while from second crop onwards T_3 recorded highest dry

Table 36a. Effect of organic and inorganic plant nutrition on total dry matter (g $plant^{-1}$) in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	66.40^{b}	63.47^{def}	70.33^{d}	64.27^{cd}	68.73^{cd}	59.60^{d}
T_2	71.17^{b}	71.87^{bc}	83.83^{c}	65.90^{bc}	78.63^{c}	78.67^{bc}
T_3	91.27^{a}	94.77^{a}	114.00^{a}	90.57^{a}	97.27^{a}	100.80^{a}
T_4	72.80^{b}	70.73^{bcd}	70.60^{d}	68.97^{bc}	67.47^{de}	76.83^{c}
T_5	72.10^{b}	77.00^{b}	75.07^{d}	65.80^{bc}	64.57^{def}	71.77^{c}
T_6	89.03^{a}	93.33^{a}	99.43^{b}	71.20^{b}	83.13^{b}	85.53^{b}
T_7	70.60^{b}	68.42^{cde}	70.90^{d}	68.30^{bc}	68.50^{d}	70.33^{c}
T_8	57.80^{c}	61.73^{ef}	59.60^{e}	57.90^{e}	58.07^{ef}	61.20^{d}
T_9	71.47^{b}	68.10^{cde}	71.67^{d}	68.50^{bc}	72.83^{cd}	70.53^{c}
T_{10}	53.67^{c}	58.70^{f}	58.73^{e}	58.33^{de}	56.03^{f}	53.93^{d}

Treatments with the same superscript form one homogeneous group

Table 36b. Effect of organic and inorganic plant nutrition on total dry matter (g $plant^{-1}$) in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	66.17^{de}	58.10^{d}	40.00^{ef}	60.60^{d}	67.57^{c}	60.90^{e}
T_2	71.80^{cd}	71.07^{c}	83.00^{cd}	68.03^{c}	81.27^{b}	75.50^{c}
T_3	95.57^{ab}	107.20^{a}	107.40^{a}	97.00^{a}	96.80^{a}	104.10^{a}
T_4	72.60^{cd}	68.83^{c}	86.17^{bc}	64.57^{c}	70.27^{c}	71.53^{cd}
T_5	82.67^{bc}	72.87^{bc}	74.60^{de}	66.73^{c}	67.30^{c}	71.77^{cd}
T_6	106.20^{a}	81.17^{b}	94.90^{b}	76.73^{b}	84.63^{b}	81.47^{b}
T_7	76.60^{cd}	68.70^{c}	72.93^{de}	67.47^{c}	68.83^{c}	67.33^{d}
T_8	66.67^{d}	64.60^{cd}	58.83^{fg}	59.33^{d}	60.83^{d}	57.27^{ef}
T_9	75.87^{cd}	68.47^{c}	73.73^{de}	67.43^{c}	69.93^{c}	69.23^{d}
T_{10}	53.47^{e}	58.57^{d}	57.67^{g}	58.90^{d}	56.83^{d}	54.80^{f}

Treatments with the same superscript form one homogeneous group

matter production (107.2 g $plant^{-1}$, 107.4 g $plant^{-1}$, 97 g $plant^{-1}$, 96.8 g $plant^{-1}$ and 104.1 g $plant^{-1}$ respectively). Lowest dry matter production was recorded in T_{10} in all the crops.

4.9.2 Dry matter of root system

a. Experiment I

The effects of treatments on the dry matter of root system are presented in Table 37a.

Results indicated that there was significant influence of treatments on the dry matter of root system. Significantly higher root dry matter was produced in T_3 in all the five crops, which ranged between 17.20 g and 19.93 g. In crop II, T_6 recorded maximum root dry matter (22.3 g). Lower root dry matter was recorded in T_8 and T_{10} which were at par.

b. Experiment II

The results on the effects of treatments on dry matter of root system in experiment II are depicted in Table 37b.

The data clearly show that the sources and levels of N significantly influenced the root dry matter production. Maximum dry matter of root was observed in T_3 followed by T_6. Minimum root production was noted in T_{10} which was on par with

Table 37a. Effect of organic and inorganic plant nutrition on dry matter of root system (g plant^{-1}) in experiment I

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	16.37^{bc}	12.53^{ef}	14.27^{d}	14.10^{bc}	15.73^{cd}	15.00^{bc}
T_2	16.63^{b}	16.23^{bcd}	15.90^{bc}	13.90^{bc}	16.97^{bc}	16.27^{b}
T_3	18.33^{a}	18.23^{b}	19.93^{a}	17.20^{a}	19.17^{a}	19.63^{a}
T_4	14.80^{cd}	14.33^{cde}	14.37^{cd}	14.77^{b}	15.53^{cd}	15.40^{bc}
T_5	14.20^{de}	16.87^{bc}	14.27^{b}	12.40^{cd}	15.70^{cd}	13.77^{cd}
T_6	15.83^{bcd}	22.30^{a}	17.20^{b}	13.43^{bc}	18.93^{ab}	15.83^{d}
T_7	15.90^{bc}	15.40^{bcd}	13.90^{d}	12.70^{bcd}	14.77^{de}	13.87^{cd}
T_8	12.53^{ef}	10.60^{f}	11.23^{e}	11.10^{d}	12.90^{ef}	11.57^{ef}
T_9	14.97^{bcd}	13.40^{def}	14.00^{d}	12.87^{bcd}	14.63^{de}	12.97^{de}
T_{10}	11.47^{f}	10.80^{f}	11.37^{e}	11.00^{d}	11.17^{f}	11.27^{f}

Treatments with the same superscript form one homogeneous group

Table 37b. Effect of organic and inorganic plant nutrition on dry matter of root system (g $plant^{-1}$) in experiment II

Treat- ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	13.33^{fg}	13.13^{cd}	14.80^{c}	13.00^{def}	16.20^{c}	13.70^{de}
T_2	15.90^{cd}	16.97^{b}	17.60^{b}	15.73^{a}	17.30^{abc}	15.23^{bc}
T_3	18.35^{b}	23.37^{a}	20.47^{a}	15.47^{ab}	19.03^{a}	20.67^{a}
T_4	16.20^{cd}	14.67^{bc}	15.53^{b}	15.63^{ab}	17.33^{ab}	14.87^{bcd}
T_5	15.23^{de}	14.30^{bc}	14.43^{c}	13.37^{bc}	16.43^{bc}	14.93^{bcd}
T_6	25.20^{a}	15.20^{bc}	16.93^{b}	14.13^{abc}	18.60^{ab}	15.80^{b}
T_7	17.43^{bc}	14.67^{bc}	14.03^{c}	13.53^{bc}	13.90^{d}	14.37^{cde}
T_8	12.23^{gh}	12.70	11.10^{cd}	10.87^{d}	12.87^{f}	10.93^{def}
T_9	14.07^{ef}	14.03^{c}	14.27^{c}	13.20^{cde}	13.93^{d}	13.10^{e}
T_{10}	11.43^{h}	10.70^{d}	10.87^{d}	11.07^{f}	11.57^{e}	10.87^{f}

Treatments with the same superscript form one homogeneous group

T_8, i.e., the treatments comprised of inorganic fertilizers alone at lower level of N (80 kg ha^{-1}).

4.9.3 Shoot root ratio

a. Experiment I

Data on the effect of treatments on shoot root ratio are presented in Table 38a.

Significant difference was observed in shoot root ratio between treatments. In crop I and III maximum value was recorded by T_6 (5.62 and 5.57 respectively) while in crops II and V, T_3 recorded wider ratio (5.11 and 5.07 respectively). In crop IV, T_7 recorded wider ratio of 5.38 and in crop VI, T_9 recorded a ratio of 5.44. In general it could be observed that higher levels of N, in whichever forms it might be, recorded a wider ratio as compared to their corresponding lower levels of N. So also treatments consisted of FYM recorded a narrower shoot root ratio.

b. Experiment II

Data on shoot root ratio for this part of experiment are shown in Table 38b.

It could be seen from the table that the sources and levels of N significantly influenced the shoot root ratio of the crop. But no definite trend could be observed between

Table 38a. Effect of organic and inorganic plant nutrition on shoot root ratio in experiment I

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	4.39^{d}	5.10^{a}	4.95^{c}	4.58^{b}	4.39^{cd}	4.15^{e}
T_2	4.46^{d}	5.17^{a}	4.94^{c}	4.76^{b}	4.64^{bc}	4.83^{cd}
T_3	4.97^{bc}	5.11^{a}	5.47^{ab}	5.31^{a}	5.07^{a}	5.07^{bcd}
T_4	4.71^{bcd}	4.97^{ab}	4.91^{c}	4.68^{b}	4.40^{cd}	4.42^{e}
T_5	5.09^{b}	4.81^{abc}	5.27^{abc}	5.32^{a}	4.20^{d}	5.16^{abc}
T_6	5.62^{a}	4.86^{ab}	5.57^{a}	5.30^{a}	4.63^{bc}	5.26^{ab}
T_7	4.45^{d}	4.89^{ab}	5.10^{bc}	5.38^{a}	4.64^{bc}	5.07^{bcd}
T_8	4.62^{cd}	4.45^{bc}	5.16^{bc}	5.22^{a}	4.50^{cd}	4.87^{cd}
T_9	4.79^{bcd}	4.96^{ab}	5.11^{bc}	5.32^{a}	4.98^{ab}	5.44^{a}
T_{10}	4.69^{bcd}	4.27^{c}	5.17^{bc}	5.31^{a}	5.02^{ab}	4.79^{d}

Treatments with the same superscript form one homogeneous group

Table 38b. Effect of organic and inorganic plant nutrition on shoot root ratio in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	4.61^{cd}	4.23^{d}	4.73^{b}	4.78^{c}	4.17^{d}	4.46^{d}
T_2	4.51^{d}	4.23^{d}	4.74^{b}	4.33^{d}	4.70^{bc}	4.96^{abc}
T_3	5.22^{ab}	4.82^{bc}	5.32^{a}	5.25^{ab}	5.09^{a}	5.19^{ab}
T_4	4.48^{d}	4.70^{cd}	4.91^{ab}	4.30^{d}	4.71^{dc}	4.81^{c}
T_5	5.10^{b}	5.14^{ab}	5.17^{ab}	4.99^{bc}	4.10^{d}	4.81^{c}
T_6	4.80^{bc}	5.33^{a}	5.40^{a}	5.43^{a}	4.59^{c}	5.19^{ab}
T_7	4.43^{d}	4.54^{cd}	5.20^{ab}	4.98^{bc}	4.95^{ab}	4.69^{cd}
T_8	5.44^{a}	5.08^{ab}	5.16^{ab}	5.01^{bc}	4.74^{bc}	5.24^{a}
T_9	4.92^{bc}	4.88^{bc}	5.16^{ab}	5.11^{ab}	5.01^{ab}	5.29^{a}
T_{10}	4.67^{cd}	5.16^{b}	4.99^{ab}	5.04^{bc}	4.91^{ab}	4.90^{bc}

Treatments with the same superscript form one homogeneous group

treatments. In general, the treatments comprised of FYM exhibited a narrower shoot root ratio.

4.9.4 Total nitrogen uptake

a. Experiment I

Total N uptake influenced by different treatments are presented in Table 39a.

The maximum N uptake occurred in the treatment which received highest level of poultry manure (28.56 kg ha^{-1}, 34.07 kg ha^{-1}, 40.20 kg ha^{-1}, 37.70 kg ha^{-1}, 38.37 kg ha^{-1} and 36.59 kg ha^{-1} for crops I to VI respectively). Minimum N uptake was recorded in the treatment applied with lower level of N (80 kg ha^{-1}) in the form of inorganic fertilizers alone. The data showed that increasing levels of N increased the N removal by brinjal significantly by the crop.

b. Experiment II

Observations on the pattern of N uptake in experiment II are presented in Table 39b.

Source and levels of N exerted a significant effect on the total N uptake. Increasing levels of N, increased the N removal significantly. Maximum N removal was observed in T_3, i.e., the treatment comprised of higher level of poultry

Table 39a. N uptake by total plant (kg ha^{-1}) as influenced by organic and inorganic plant nutrition in experiment I

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	23.50^{bc}	22.65^{cd}	27.55^{cd}	26.22^{bc}	26.57^{bc}	25.22^{bc}
T_2	25.25^{ab}	24.61^{bc}	29.42^{bc}	29.50^{ab}	29.74^{ab}	31.18^{ab}
T_3	28.56^{a}	34.07^{a}	40.20^{a}	37.70^{a}	38.37^{a}	36.59^{a}
T_4	27.99^{a}	28.73^{ab}	28.97^{bc}	27.71^{ab}	27.54^{bc}	30.96^{ab}
T_5	24.02^{bc}	25.20^{bc}	27.99^{cd}	23.48^{cd}	23.80^{cd}	26.23^{bc}
T_6	28.63^{a}	30.40^{ab}	33.50^{ab}	28.39^{ab}	29.75^{ab}	29.78^{ab}
T_7	26.04^{ab}	26.35^{bc}	26.61^{cd}	26.08^{bc}	26.00^{bc}	26.88^{bc}
T_8	18.71^{c}	20.21^{d}	20.05^{e}	19.64^{d}	19.68^{d}	20.80^{c}
T_9	24.63^{ab}	24.55^{bc}	25.45^{de}	24.48^{cd}	25.77^{cd}	26.02^{bc}
T_{10}	17.22^{c}	20.28^{d}	18.83^{e}	18.90^{d}	18.19^{d}	18.21^{c}

Treatments with the same superscript form one homogeneous group

Table 39b. N uptake of plants (kg ha^{-1}) as influenced by organic and inorganic plant nutrition in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	25.85^{ef}	22.70^{de}	27.35^{de}	25.67^{bc}	26.40^{cd}	26.79^{cd}
T_2	25.98^{ef}	25.72^{bc}	30.03^{cd}	29.63^{b}	29.41^{bc}	30.94^{b}
T_3	33.73^{ab}	37.84^{a}	37.91^{a}	34.24^{a}	36.17^{a}	36.75^{a}
T_4	28.85^{cd}	27.35^{b}	34.24^{b}	29.63^{b}	30.92^{bc}	28.42^{bc}
T_5	29.55^{bc}	26.05^{bc}	26.66^{de}	25.00^{bc}	24.77^{de}	25.65^{cd}
T_6	36.07^{a}	27.57^{b}	32.87^{bc}	29.46^{b}	30.44^{bc}	29.67^{bc}
T_7	29.08^{bc}	26.08^{bc}	27.69^{de}	26.37^{bc}	26.13^{cd}	25.56^{cd}
T_8	22.35^{fg}	21.66^{e}	19.72^{e}	19.89^{d}	20.39^{ef}	19.20^{ef}
T_9	27.12^{cd}	24.47^{cd}	26.35^{de}	24.82^{cd}	24.99^{de}	24.74^{de}
T_{10}	17.21^{g}	18.85^{f}	18.56^{e}	18.96^{d}	18.29^{f}	17.64^{f}

Treatments with the same superscript form one homogeneous group

manure. The maximum uptake of N in T_3 ranged between 33.73 kg ha^{-1} and 37.91 kg ha^{-1}.

4.9.5 Total phosphorus uptake

a. Experiment I

Total P uptake in different crops and different treatments are presented in Table 40a.

Indirect addition of P through organic manures and their equivalent fertilizers caused a significantly higher uptake of P. Maximum P uptake was recorded in T_3 (155 kg N ha^{-1} as poultry manure) and minimum in T_{10}. Maximum P uptake was in the range of 4.58 kg ha^{-1} to 6.60 kg ha^{-1} which occurred in T_3 while the minimum P uptake in T_{10} ranged between 1.87 kg ha^{-1} and 2.67 kg ha^{-1}.

b. Experiment II

Data presented in Table 40b show that there was significant difference in P uptake due to different sources and levels of nutrients applied. Indirect addition of P occurred when manures and fertilizers were added for N. Maximum P removal took place in the treatment applied with higher level of poultry manure in all the six crops taken (4.79 kg ha^{-1}, 4.48 kg ha^{-1}, 6.57 kg ha^{-1}, 5.50 kg ha^{-1}, 6.23 kg ha^{-1} and 6.52 kg ha^{-1} respectively). Minimum P uptake was

Table 40a. P uptake in brinjal (kg ha^{-1}) as influenced by the organic and inorganic plant nutrition in experiment I

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	2.90 e	2.77 de	4.01 c	3.43 cd	3.98 d	3.91 d
T_2	3.55 bc	3.85 b	5.21 b	4.02 bc	4.66 bc	4.74 bc
T_3	4.58 a	5.08 a	6.60 a	5.59 a	5.82 a	6.21 a
T_4	3.64 b	3.01 cd	3.90 cd	4.27 b	4.00 d	4.14 d
T_5	3.45 bc	3.53 bc	3.84 cd	3.51 cd	4.14 cd	4.32 cd
T_6	4.28 a	4.06 b	5.47 b	4.44 b	4.87 b	4.98 b
T_7	3.18 cd	3.03 cd	3.34 e	3.49 cd	3.20 e	3.26 e
T_8	2.45 f	2.40 ef	2.79 f	2.26 e	2.17 f	2.13 f
T_9	3.14 de	3.12 cd	3.52 de	3.40 d	3.04 e	3.12 e
T_{10}	2.26 f	2.20 f	2.67 f	2.14 e	1.88 f	1.87 f

Treatments with the same superscript form one homogeneous group

Table 40b. P uptake in brinjal (kg ha^{-1}) as influenced by the organic and inorganic plant nutrition in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	2.86^{de}	2.76^{de}	3.88^{c}	3.23^{d}	3.91^{c}	4.01^{c}
T_2	3.36^{bc}	3.90^{b}	5.18^{b}	3.91^{c}	4.64^{d}	4.83^{b}
T_3	4.79^{a}	4.48^{a}	6.57^{a}	5.50^{a}	6.23^{a}	6.52^{a}
T_4	3.63^{b}	3.05^{cd}	4.95^{b}	3.65^{cd}	4.55^{b}	4.63^{bc}
T_5	3.62^{b}	3.50^{bc}	3.79^{c}	3.34^{cd}	4.25^{bc}	4.36^{bc}
T_6	4.78^{a}	3.99^{ab}	4.82^{b}	4.58^{b}	4.82^{b}	4.90^{b}
T_7	3.43^{bc}	2.96^{cd}	3.58^{c}	3.45^{cd}	3.14^{d}	3.20^{d}
T_8	2.66^{e}	2.38^{ef}	2.75^{d}	2.28^{e}	2.13^{e}	2.21^{e}
T_9	3.11^{cd}	3.12^{cd}	3.61^{c}	3.18^{d}	2.90^{d}	3.00^{d}
T_{10}	2.25^{f}	2.21^{f}	2.70^{d}	2.29^{e}	1.87^{e}	1.90^{e}

Treatments with the same superscript form one homogeneous group

Table 41a. K uptake in brinjal (kg ha^{-1}) as influenced by the organic and inorganic plant nutrition in experiment I

Treat-ments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	27.50^{c}	26.85^{c}	28.15^{cd}	27.03^{c}	28.88^{cd}	28.12^{de}
T_2	30.08^{b}	31.10^{bc}	38.88^{ab}	36.46^{ab}	36.69^{b}	37.20^{b}
T_3	36.20^{a}	39.85^{a}	41.63^{a}	39.88^{a}	42.53^{a}	42.16^{a}
T_4	31.15^{ab}	33.19^{b}	34.14^{b}	32.15^{bc}	34.17^{b}	34.22^{bc}
T_5	29.60^{bc}	30.35^{bc}	31.89^{bc}	30.95^{bc}	33.83^{bc}	32.28^{cd}
T_6	32.13^{ab}	33.94^{b}	35.20^{b}	34.28^{b}	35.27^{b}	34.17^{bc}
T_7	31.50^{ab}	32.08^{bc}	33.44^{b}	32.64^{bc}	33.16^{bc}	32.87^{cd}
T_8	27.13^{c}	26.14^{c}	27.18^{d}	26.11^{c}	27.82^{d}	26.19^{e}
T_9	32.15^{ab}	33.69^{b}	34.29^{b}	33.98^{b}	34.34^{b}	33.46^{bc}
T_{10}	26.25^{c}	26.33^{c}	27.05^{a}	26.48^{c}	27.65^{d}	26.55^{e}

Treatments with the same superscript form one homogeneous group

recorded in T_{10} (2.25 kg ha^{-1}, 2.21 kg ha^{-1}, 2.70 kg ha^{-1}, 2.29 kg ha^{-1}, 1.87 kg ha^{-1} and 1.90 kg ha^{-1} in crops I to VI respectively).

4.9.6 Total potassium uptake

a. Experiment I

Total potassium uptake as affected by different treatments are given in Table 41a.

Significantly higher potassium uptake was recorded against T_3 in all the crops taken (36.20 kg ha^{-1}, 39.85 kg ha^{-1}, 41.63 kg ha^{-1}, 39.88 kg ha^{-1}, 42.53 kg ha^{-1} and 42.16 kg ha^{-1}). Minimum uptake was recorded by the treatments T_8 and T_{10} which were applied with lower levels of fertilizers.

b. Experiment II

Table 41b depicts the total potassium uptake in different treatments in experiment II.

Here also uptake of potassium by plants showed significant difference between treatments. Maximum uptake was recorded against the treatment T_3 (treatment applied with poultry manure at 155 kg N ha^{-1}), while minimum uptake was recorded in T_8 and T_{10}.

Table 41b. K uptake in brinjal (kg ha^{-1}) as influenced by the organic and inorganic plant nutrition in experiment II

Treatments	Crop I	Crop II	Crop III	Crop IV	Crop V	Crop VI
T_1	26.73^{c}	27.28^{c}	28.08^{cd}	28.13^{c}	27.69^{c}	27.43^{d}
T_2	31.65^{bc}	31.78^{b}	36.48^{b}	38.62^{ab}	36.88^{b}	36.69^{b}
T_3	39.85^{a}	39.47^{a}	42.43^{a}	41.64^{a}	41.94^{a}	42.87^{a}
T_4	33.47^{b}	32.86^{b}	34.26^{b}	34.27^{b}	33.28^{bc}	34.13^{bc}
T_5	30.68^{bc}	29.97^{bc}	33.58^{bc}	31.55^{bc}	32.42^{bc}	32.88^{c}
T_6	33.37^{b}	32.86^{b}	35.37^{b}	35.86^{b}	34.10^{bc}	34.65^{bc}
T_7	32.61^{b}	31.93^{b}	33.42^{bc}	33.69^{bc}	32.67^{bc}	33.10^{bc}
T_8	27.22^{c}	27.68^{c}	27.16^{d}	27.48^{c}	26.20^{c}	27.11^{d}
T_9	33.05^{b}	32.87^{b}	34.14^{b}	34.93^{b}	34.15^{bc}	35.10^{bc}
T_{10}	27.13^{c}	26.28^{c}	27.08^{d}	27.23^{c}	26.00^{c}	27.21^{d}

Treatments with the same superscript form one homogeneous group

4.10 Stability analysis for important characters

Stability analysis was carried out as per the method proposed by Eberhart and Russell (1966) for different characters viz. plant height at first harvest, number of fruits per plant, yield per plot, crop duration and seed yield per plant. the data pertaining to the experiments I and II are presented in Table 42a and b respectively.

4.10.1 Plant height at first harvest

a. Experiment I

Pooled analysis of the data on plant height showed that plants applied with the highest quantity of poultry manure (T_3) exhibited maximum average height. The stability parameters of the treatment T_6 did not deviate from the accepted norms, ie. b(i)=1 and $S^2d(i)=0$. Therefore this treatment showed more or less average stability in addition to maximum average plant height but next to T_3.

b. Experiment II

In experiment II also T_3 exhibited maximum average plant height. The treatments having the highest level of FYM (T_2), the lowest level of poultry manure (T_4), and the lowest level of inorganic fertilizers (T_{10}) were relatively more stable. But T_{10} had minimum plant height.

Table 42a. Stability parameters for plant height at first harvest, number of fruits per plant, yield per plot, duration of crop and seed yield per plant in experiment I

Treatments	Plant height at first harvest			Number of fruits per plant			Yield per plot			Duration of crop			Seed yield per plant		
	Mean	b(i)	$S^2d(i)$	Mean	b(i)	$S^2d(i)$	Mean	b(i)	$S^2d(i)$	Mean	b(i)	$S^2d(i)$	Mean	b(i)	$S^2d(i)$
T_1	34.33	0.78	0.34	13.00	0.70	4.64	12.23	1.37	4.66	129.83	0.54	96.00	14.88	0.79	0.29
T_2	37.84	0.98	6.73	15.12	1.13	10.62	13.61	1.35	2.77	132.33	0.23	63.23	18.69	0.11	6.08
T_3	44.89	1.04	10.16	16.86	1.13	6.3	16.80	0.93	1.37	148.00	1.35	3.96	26.60	1.03	2.46
T_4	40.65	0.84	1.55	15.41	0.91	7.40	14.68	0.64	1.12	140.17	1.25	23.63	20.08	1.44	0.27
T_5	37.45	0.97	11.58	12.75	0.95	0.44	12.33	0.93	0.87	138.61	3.03	69.93	18.68	0.95	2.55
T_6	41.10	0.92	3.74	14.76	1.47	3.03	14.94	1.56	2.27	145.67	1.54	10.13	22.34	1.12	1.62
T_7	40.62	1.16	11.23	13.05	0.84	3.39	12.53	0.97	5.26	132.33	1.25	13.89	18.90	0.95	3.66
T_8	37.25	1.40	2.64	10.40	0.88	7.55	10.31	0.64	2.60	124.61	1.36	18.69	15.30	1.90	7.95
T_9	40.09	0.90	0.78	13.03	1.02	10.34	12.16	0.98	1.04	130.83	0.61	32.18	17.36	1.43	16.57
T_{10}	35.14	1.00	10.06	10.26	0.97	10.31	9.92	0.83	7.21	123.28	0.37	9.19	13.36	1.51	6.80

Table 42b. Stability parameters for plant height at first harvest, number of fruits per plant, yield per plot, duration of crop and seed yield per plant in experiment II

Treat-ments	Plant height at first harvest			Number of fruits per plant			Yield per plot			Duration of crop			Seed yield per plant		
	Mean (cm)	b(i)	$S^2d(i)$	Mean	b(i)	$S^2d(i)$	Mean (kg)	b(i)	$S^2d(i)$	Mean (days)	b(i)	$S^2d(i)$	Mean (g)	b(i)	$S^2d(i)$
T_1	35.41	1.27	1.74	11.94	1.33	15.60	11.46	1.85	6.89	12.96	-0.44	83.13	15.03	-0.11	8.20
T_2	37.58	0.90	6.26	14.39	1.32	7.19	13.29	1.34	5.99	132.94	-0.02	26.31	20.87	0.72	2.26
T_3	44.55	0.81	3.34	16.43	1.35	12.87	16.50	1.20	1.47	147.89	1.34	10.98	29.34	1.05	1.88
T_4	40.84	0.91	1.03	14.99	0.78	2.30	14.69	0.64	1.68	140.83	1.83	48.39	21.61	0.78	2.48
T_5	38.41	1.11	9.23	13.46	0.41	7.50	13.43	-0.23	2.99	136.00	3.12	54.25	20.36	1.46	4.00
T_6	40.54	0.76	4.00	14.82	1.06	4.63	15.22	0.71	5.70	143.67	1.82	24.87	25.66	2.56	5.28
T_7	40.68	1.17	11.70	13.06	0.75	5.18	12.77	0.77	4.82	132.22	1.30	31.15	19.01	1.06	9.60
T_8	36.16	1.20	3.48	10.64	0.76	11.83	10.59	0.80	0.93	124.44	0.89	21.03	16.03	1.50	4.73
T_9	38.91	0.87	1.96	12.14	1.29	3.81	11.95	1.77	2.43	130.00	0.12	66.46	17.84	-0.34	10.49
T_{10}	35.37	1.00	4.63	9.84	0.95	2.32	9.78	1.15	2.67	123.06	0.02	7.87	14.03	0.50	3.75
Mean	38.845			13.170			12.970			134.061			19.977		

4.10.2 Number of fruits per plant

a. Experiment I

Maximum number of fruits per plant was recorded in T_3. The performance of T_3 and T_6 were sufficiently consistent in different crops as compared to other treatments.

b. Experiment II

In this experiment also T_3 recorded the maximum number of fruits per plant. But T_6 and T_{10} showed relatively higher stability. Performance of T_3 was not sufficiently consistent in different crops as compared to other treatments.

4.10.3 Yield per plot

a. Experiment I

Pooled analysis of data on yield per plot revealed that maximum yield was recorded from plots applied with the highest level of poultry manure (T_3). Stability parameters corresponding to T_3 did not deviate much from their expected values since b(i)=0.93 and S^2d(i)=1.37. Although T_9 showed comparatively high stability as compared to other treatments, it cannot be recommended because of relatively poor yield performance.

b. **Experiment II**

In this experiment also T_3 recorded the maximum yield and was also consistent with values b(i)=1.20 and $S^2d(i)$=1.47.

4.10.4 Duration of crop

a. **Experiment I**

Maximum crop duration was recorded against T_3. But none of the treatments showed stability with regard to crop duration.

b. **Experiment II**

In experiment I also maximum crop duration was recorded in T_3. But its performance was not sufficeintly consistent in different crops.

4.10.5 Seed yield per plant

a. **Experiment I**

Pooled analysis of data showed maximum seed yield per plant in T_3 followed by T_6 and T_4. Stability parameters corresponding to T_3 did not deviate much from their expected values (b(i)=1.03 and $S^2d(i)$=2.46).

b. Experiment II

Results of experiment II also showed maximum seed yield and sufficient consistency in T_3.

4.11 Estimates of slope and intercept for soil characteristics

Table 43 shows the effects of treatments on the intercept and slope of soil characteristics during six successive cropping periods. A progressive increase in organic carbon, total nitrogen, available phosphorus and available potassium was observed in the organic treatments whereas in the case of inorganic fertilizers applied treatments a negative trend could be seen.

4.12 Economics of brinjal production under organic manuring

The data in the Table 44 show that brinjal cultivation under organic manuring could be an economically profitable proposition. The income of the farmer was substantially increased by the application of poultry manure both at 80 kg N ha^{-1} and 155 kg N ha^{-1} compared to FYM at the same N level. Poultry manure at higher level resulted in the realisation of Rs.1.52 for every rupee invested (B/C ratio is 1.52). This

Table 43. Estimates of intercrpt and slope of soil characteristics as influenced by organic and inorganic nutrients

Treat-ments	Organic carbon		Total nitrogen		Available phosphorus		Available potassium	
	Inter-cept	Slope	Inter-cept	Slope	Inter-cept	Slope	Inter-cept	Slope
T_1	1.14	0.017	0.12	0.003	14.47	0.149	216.54	4.200
T_2	1.17	0.015	0.13	0.002	14.90	0.215	223.97	5.957
T_3	1.21	0.014	0.12	0.003	14.64	0.362	236.46	6.764
T_4	1.16	0.018	0.12	0.004	14.48	0.146	235.27	1.600
T_5	1.10	0.002	0.12	0.002	14.96	0.038	233.85	1.011
T_6	1.13	0.015	0.12	0.002	14.83	0.168	235.04	1.943
T_7	1.23	-0.034	0.12	-0.001	14.87	-0.198	231.04	1.943
T_8	1.14	-0.023	0.12	-0.001	14.46	-0.456	231.81	-3.900
T_9	1.17	-0.027	0.12	-0.002	15.73	-0.219	232.85	-2.096
T_{10}	1.01	-0.007	0.12	-0.002	14.84	-0.466	236.52	-4.219

Table 44. Economics of brinjal production under organic and inorganic manuring (Rs. ha^{-1})

Treatments	Cost of cultivation (Rs.)	Gross return (Rs.)	Net return (Rs.)	B/C ratio
T_1	36000	45320	9320	1.26
T_2	41550	54480	12930	1.31
T_3	39752	60440	20688	1.52
T_4	35602	54060	18458	1.51
T_5	37508	46680	9172	1.24
T_6	37010	54960	17950	1.48
T_7	33365	46440	13075	1.39
T_8	31857	38200	6343	1.20
T_9	33093	45040	11947	1.36
T_{10}	31585	36760	5175	1.16

was closely followed by poultry manure at 80 kg N ha^{-1} resulting in a benefit cost ratio of 1.51.

4.13 Two-way analysis for contrast between organic and inorganic groups

Statistical analysis for studying the contrast between the organic and inorganic treatments in brinjal, it was observed that significant superiority of organic treatments over inorganic treatments existed throughout the experiment. The superiority was expressed in biometric characters, yield contributing characters, quality of produce, storage life of fruits and seed characters.

Discussion

5. DISCUSSION

The green revolution launched in India during 1960's increased the production of food grains substantially through the use of improved crop varieties and higher levels of fertilizer inputs and plant protection chemicals. Now the extensive and often excessive use of these inputs have gained increasing concern among farmers, as well as environmental groups. This had led to the thought of a non-chemical farming or organic farming which attempts to provide a balanced environment in which the soil fertility and control of pests and pestillence can be achieved with organic forms of energy and resources.

In vegetable production organic farming has more significance as it forms an integral part of our balanced nutrition. The untoward effect of unscientific use of plant protection chemicals causing health hazards are undisputed facts today. Recently an awareness had been created on the usefulness of organic farming especially in vegetables by the efforts of different organisations, institutions, individuals and media.

The results of the present investigation on "Impact of organic sources of plant nutrients on yield and quality of brinjal" taken up in this backdrop are discussed below:

5.1 Growth components

The growth characters of brinjal plants were undoubtedly influenced by the fertility status of the soil. The quantitative traits and growth parameters like plant height, number of branches per plant, total dry matter production, total leaf area etc. contribute for the total yield potential in any horticultural crop. In the present study, it was observed that increase in N levels increased the height of plants at first harvest. Application of poultry manure either alone or in combination with fertilizers was more effective in increasing the plant height in all the six crops raised. The plant height was significantly increased by the application of poultry manure and the influence of poultry manure and N levels on the number of branches per plant was pronounced throughout the experiment. In all the six crops poultry manure, either alone (T_3-155 kg N ha^{-1}) or in combination with fertilizers (T_6-155 kg N ha^{-1}) produced maximum number of branches per plant. The role of N in favouring the growth and development especially through organic source has been well documented (Wallace, 1971 and Sorin and Tanaka, 1991). The organic sources used were cattle manure and poultry manure. Singh and Singh (1992) and Poopathi (1994) observed that increasing levels of nitrogen led to increased plant height and number of branches per plant in tomato.

5.2 Yield attributes

The number and volume of fruits were significantly influenced by the sources and levels of nitrogen used. Maximum number and volume of fruits was effected by the highest level of poultry manure (T_3-155 kg N ha^{-1}) and poultry manure along with recommended doses of fertilizers (T_6-155 kg N ha^{-1}). The same response was shown with regard to yield per plant and yield per plot. There was progressive improvement for these characters from first to sixth crop even with the lower level of FYM (T_1-80 kg N ha^{-1}). This can be ascribed to the slow release of nutrients resulted from the organic source and through decomposition. The increase in fruit size in watermelon was reported by Attia and Nassar in 1958 with the application of pigeon manure and similar observation on the increase in fruit size and yield with the application of poultry manure was also reported by Abusaleha and Shanmugavelu (1988) in bhindi, Prezotti *et al.* (1989), Silva and Vizzotto (1990) and Brown *et al.* (1995) in tomato. Yield increase was also reported in lettuce by Anez and Javira (1984) with the application of poultry manure. The fact that nitrogen released from poultry manure is readily available to the plants and uric acid contained in the poultry manure, having 60 per cent N, which is in the ammoniacal form helps in the efficient utilization by the plants (Smith, 1950). This will naturally result in the better plant growth and yield. This improvement can also be attributed to the rapid decomposition of poultry manure as compared to FYM.

The yield per plot of brinjal was the highest with the application of highest level of N (155 kg ha^{-1}) in the form of poultry manure. The increase of yield was to the extent of 53.23 per cent, 53.64 per cent, 35.05 per cent, 25.85 per cent, 31.05 per cent and 26.95 per cent in crops I to VI respectively over the control. The highest yield was reflected at 155 kg N ha^{-1} in all the sources of N, than their corresponding lower levels (80 kg N ha^{-1}). Incorporation of poultry manure and FYM at 80 kg N ha^{-1} produced yield either more or equal to the yield obtained with 155 kg N ha^{-1} applied as urea in all the six crops taken.

Expression of full yield potential at higher levels of nutrients was reported by Gnanakumari and Sathyanarayanan (1971) who obtained the highest number and maximum weight of brinjal fruits and consequently the highest yields by the application of N, P and K at 280 kg ha^{-1} each. The favourable effect of organic sources of nutrients was also manifested in the present study. The report by Maynard, 1994 further endorses that yield of egg plants were equal or greater in plots receiving chicken manure compost than that receiving NPK fertilizers.

It has been well proved that for realisation of higher yield by expressing the full potentialities of a genotype, higher nutrition is essentially needed. And organic sources of nutrients help to improve better uptake resulting in higher yield. This is due to the fact that organic manures would provide favourable physical, chemical and biological conditions for better growth and fruit development which in turn would result in increased fruit yield. The works of Subbiah (1983), Srinivas (1983) and Narasappa *et al.* (1985) and Lata and Singh (1993) in chilli stand testimony to this and corroborate the present finding in brinjal.

5.3 Number of harvests and duration of crop

Number of harvests ranged between 5.1 (T_{10}) and 8.6 (T_3). Duration of the crop varied between 123.28 days (T_{10}) and 147.98 days (T_3). The maximum number of harvests and maximum duration were recorded by T_3 (155 kg N ha^{-1}). This shows that the crops applied with poultry manure at higher level registered more duration and hence more number of harvests. This show up that the economic life or productive period of the crop is prolonged with the application of poultry manure alone. The higher yield of brinjal under higher dose of N in the form of poultry manure can be well attributed to significantly more number of harvests and more duration of the crop.

5.4 Quality parameters

Brinjals are not usually considered as a good source of vitamins. The fruits are reported to contain Vitamin C ranging from 4.3 to 28 mg 100 g^{-1} (Kalra *et al.*, 1988). In the present study the ascorbic acid content varied between 11.33 and 12 mg 100 g^{-1} in fruits applied with the highest level of poultry manure (155 kg N ha^{-1}) or a combination of poultry manure and NPK fertilizers (80 kg N ha^{-1} as poultry manure+75 kg N as urea). Minimum ascorbic acid content was recorded in the treatments which comprised of lower level of N, in the inorganic form (T_8 and T_{10}). In the present study the ascorbic acid content was significantly higher in treatments involving higher levels of N (155 kg N ha^{-1}) as compared to lower levels of N (80 kg ha^{-1}) irrespective of the sources of nutrients. But sources of nutrients did not evince any significant difference between organic and inorganic means. This is in conformity with the findings of Yoshida *et al.* (1984) and Montagu and Goh (1990). Comparatively higher moisture content of fruits was noted in the treatments supplied with higher levels of N eventhough, it was not significant. This was in conformity with the findings of Singh *et al.* (1970) that a gradual increase in moisture, vitamin C and protein content in cauliflower curd with increased levels of poultry manure.

In the case of TSS the maximum value was recorded in treatments consisted of poultry manure, either alone (T_3 and

T_4) or in combination with inorganic fertilizers (T_6). Lower TSS was registered in treatments involving lower levels of N in inorganic form. Singh *et al.* (1989) observed an increased TSS content in onion with green manuring. Singh and Singh (1992) also reported higher TSS with increase in N levels in tomato. This was also confirmed by Yadav *et al.* (1993) in pointed gourd.

The acidity of fruits was not influenced by sources or levels of N. A similar observation was made by Yoshida *et al.* (1984).

The starch content of fruits was altered by sources of nutrients. The maximum value was registered in the treatment receiving the highest level of FYM (T_2-155 kg N ha^{-1}) and the lowest value was for the treatment involving the lowest level of N in the form of inorganic fertilizers. The findings of Padmam (1992) who obtained higher starch content in rice (57.85 per cent) with the application of cattle manure as compared to ammonium sulphate alone (52.57 per cent) is a parallel case and supports the present observation.

The content of reducing sugars was influenced by the treatments. The highest level of N in the form of FYM recorded the maximum reducing sugar and minimum in the treatment involving the lowest level of N. This is in conformity with the findings of Meir-Proeger (1989) and Jiang *et al.* (1996) in tomato.

Total sugars content also showed significant difference between treatments. From the present study it can be well recognized that the organically grown brinjal fruits contained more total sugars as compared to those grown with inorganic fertilizers.

The gradual release of nitrogen when organic manure is applied takes place which will be available during reproductive phase also to meet the requirement. Thus it ensures better quality of produce on account of sugars and starch. Besides N there will be release of carbon which also promotes better synthesis of sugars.

In the case of flesh thickness of fruits treatment consisted of higher level of N in the form of poultry manure (T_3) resulted in the maximum value and the lower level of N in the form of inorganic fertilizers (T_{10}) recorded minimum value.

Phosphorylase enzyme is considered to be the first glycolytic enzyme which plays an important role in the metabolism of plant. It is necessary for the release of energy needed for growth and developments in plants. The inhibiting factors of phosphorylase enzyme may have contributed for the lower phosphorylase activity in inorganic treatments. In fertilizers elemental form of nutrients might have made a negative effect in the metabolism of the plant.

Organoleptic test of fruits showed significant different between sources of nutrients and levels of N. The lowest level of N in the form of poultry manure (T_4-80 kg N ha^{-1}) recorded the highest score for flavour, texture and taste. Taking the total score for all the attributes together, T_4 (lower level of poultry manure -80 N ha^{-1}) recorded the maximum value. However, the lowest level of N in the form of mineral fertilizers recorded the highest score for colour. Pimpini *et al.* (1992) noted that application of mineral fertilizers or poultry manure at the lower rate gave the best scores for processing suitability in potatoes. But the findings of Auclair *et al.* (1995) did not show any difference in taste and texture in conventionally or hydroponically or organically grown tomatoes.

5.5 Storage life

It could be observed that the storage life of harvested produce was more in the case of fruits from plots applied with organic manures alone. Rapid loss of harvested produce was seen in the case of fruits from plots supplied with inorganic fertilizers. Joseph (1985) also found the same reaction in oriental pickling melon.

5.6 Seed characters

Agronomic optimals viz., appropriate sowing time and adequate nitrogen fertilization (Pandey *et al.*, 1980 and Rastogi *et al.*, 1987) appear to be the most decisive parameters for improving the seed yield.

In the present study maximum number of seeds per fruit was recorded in T_3 showing a progressive increase from 588.7 in crop I to 701 in crop V. Significantly higher seed yield per fruit was also recorded by T_3. Here the data showed that the higher weight of seeds per fruit was recorded in treatments applied with higher levels of N, irrespective of its sources. These observations were in conformity with the findings of Soliman *et al.* (1991) in common bean. Singh and Singh (1994) also observed that an increase in the level of N led to significant increase in seed yield. Biochemical changes accompanying embryogenesis and seed development are characterised by vigorous anabolic processes, resulting in the formation of new cells, tissues and organs rich in proteins, nucleic acids, carbohydrates and fats. During seed filling the demand for carbonaceous and nitrogenous molecules is high. These can explain the increased yield of seeds with increase in the level of applied nitrogen especially when supplied in the form of organic manures (Noggle and Fritz, 1983).

5.7 Incidence of pests

Increasing level of N in the form of inorganic fertilizers was found to increase the vulnerability of brinjal crop to the incidence of the shoot and fruit borer and the epilachna beetle. Increased N supply in the form of inorganic fertilizers stimulates early vegetative growth while in organic manured plots the decomposition and mineralisation of manure is required to make the nutrients available to the plants. This stimulation of early vegetative growth render the plants more susceptible to shoot attack. Under such favourable conditions, the borer population might have increased progressively on shoots causing damage to fruits as well in due course of time. In case of the foliage feeding epilachna beetle also, under stimulation of early growth phase susceptibility might have increased due to improved nutritional status of foliage. Since need based botanical applications were undertaken in the experiment along with manual control, the data collected in this investigation reflect the impact of such interventions also. The general trend is, however, very clearly brought out in the investigation.

5.8 Soil properties

Soil fertility is defined as the status of the soil in relation to the amount and availability of elements necessary for crop production (Canada Department of Agriculture, 1972). A fertile soil has to meet the current and future needs of cultivated plants. In a fertile soil, the function of organic matter is both direct and indirect. The direct role is concerned with the provision of plant nutrients viz. the process of decomposition and mineralization; its indirect role is associated with its effect on the physico-chemical properties of the soil.

In the present study continuous application of manures and fertilizers had influenced the organic carbon content of the soil significantly after three crops. In the initial three crops significant increase in organic carbon was not noticed. Thereafter the treatments applied with organic manures effected significntly higher carbon content in the soil as compared to those receiving inorganic fertilizers alone (Fig. 5 and 6). This can be attributed to the higher addition of organic matter through manures. In the present study treatment applied with higher level of poultry manure (155 kg N ha^{-1}) recorded maximum organic carbon in the soil. But it was on par with other organic manured plots. Observation on similar lines were reported by Ridley and Hedlin (1968), McIntos and Varney (1973), Lu and Edwards (1994), Igbokwe *et al.* (1996) and Parmar *et al.* (1998).

The study showed that there was a gradual increase in the total introgen content of soil in plots applied with organic

Fig. 5 EFFECT OF FARM YARD MANURE AND ITS EQUIVALENT FERTILIZERS ON ORGANIC CARBON OF SOIL OVER TIME

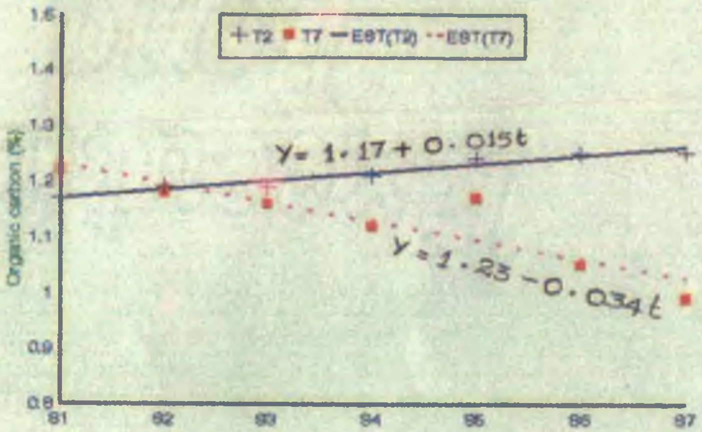


Fig. 7 EFFECT OF FARM YARD MANURE AND ITS EQUIVALENT FERTILIZERS ON TOTAL SOIL N OVER TIME

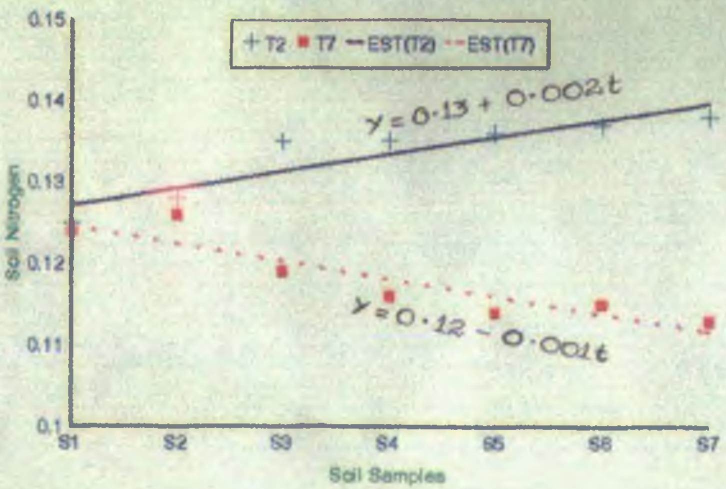


Fig. 6 EFFECT OF POULTRY MANURE AND ITS EQUIVALENT FERTILIZERS ON ORGANIC CARBON OF SOIL OVER TIME

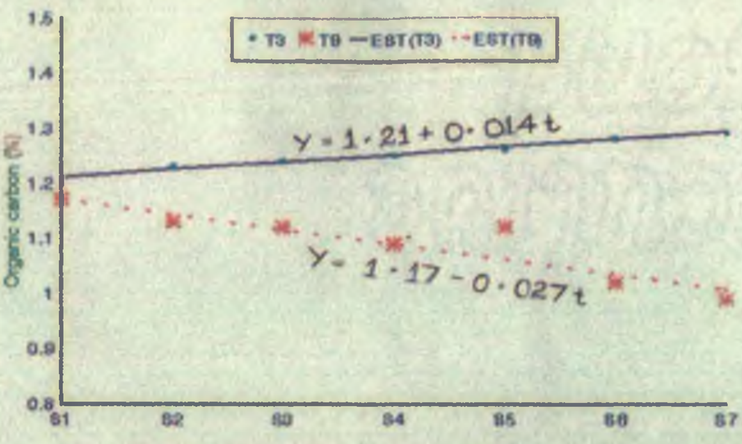
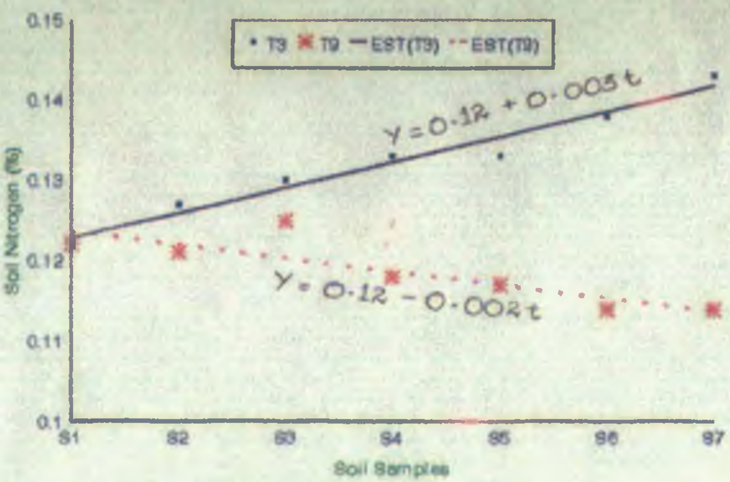


Fig. 8 EFFECT OF POULTRY MANURE AND ITS EQUIVALENT FERTILIZERS ON TOTAL SOIL N OVER TIME



manures. Similar results in building up of N in the soil has been reported by Kaddans and Morga (1986), Yamada and Kamata (1989).

Application of manures did not show any significant difference in nitrogen level of soil instantly. When the slope was computed for the increase in nitrogen levels it was noted that the treatments consisting of poultry manure at 80 kg and 155 kg ha^{-1} had the maximum slope of 0.003 while it was minimum and decreasing (-0.002) in the case of treatments comprised of inorganic fertilizers alone at lower level (Fig.8). Farm yard manure, even if handled carefully, loses a large proportion of its nutrients by volatalization as NH_3 and by leaching as NO_3. But in poultry manure upto 60 per ent of organic N is in the form of uric acid which will decompose slowly to NH_3 and CO_2 by aerobic organisms (Eno, 1966). Before the organic fraction of N is used by plants, it must be mineralized into inorganic forms (Wilkinson, 1979). In the case of poultry manure the volatilization of NH_3 was reduced due to the conversion of NH_3 to the NH_4-N which could be absorbed by succeeding crops also. The supriority of poultry manure in this respect may have contributed for the higher level of total N in plots applied with poultry manure.

As in the case of total N, available P in the soil also showed a gradual increase as a result of continuous application of different organic manures (Fig.9 and 10). This

Fig. 9 EFFECT OF FARM YARD MANURE AND ITS EQUIVALENT FERTILIZERS ON AVAILABLE P OVER TIME

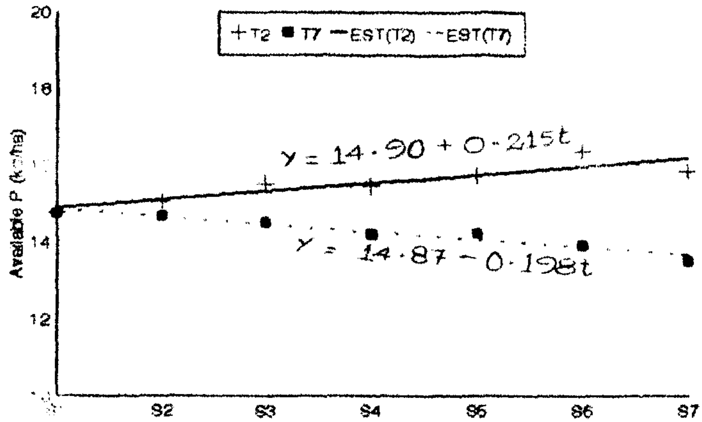


Fig.11 EFFECT OF FARM YARD MANURE AND ITS EQUIVALENT FERTILIZERS ON AVAILABLE K OVER TIME

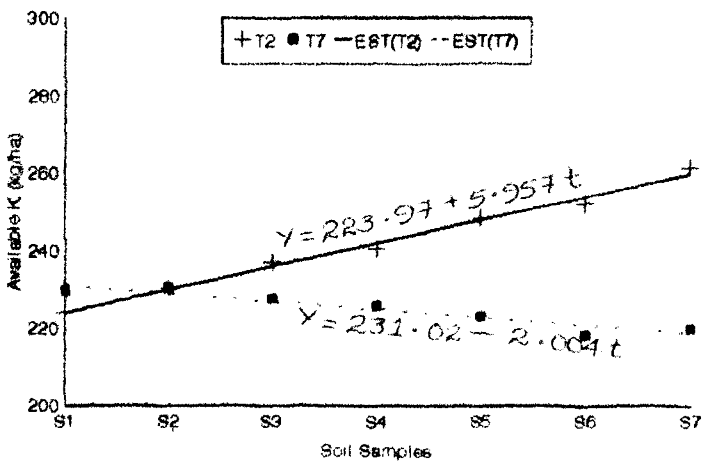


Fig. 10 EFFECT OF POULTRY MANURE AND ITS EQUIVALENT FERTILIZERS ON AVAILABLE P OVER TIME

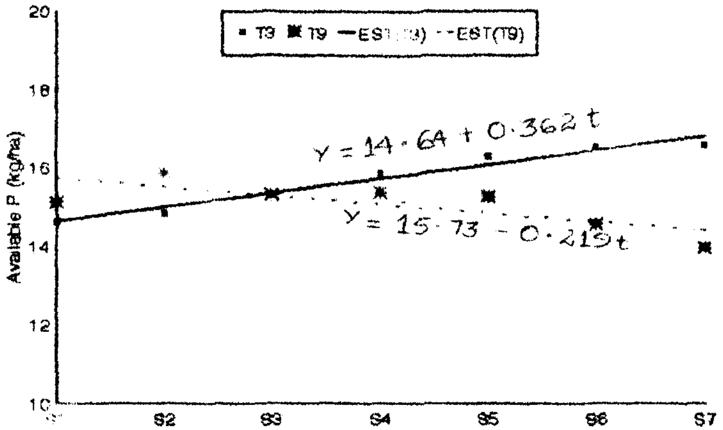
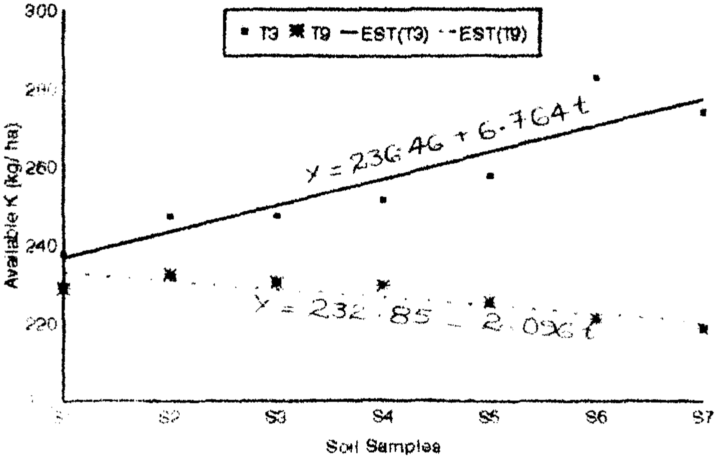


Fig. 12 EFFECT OF POULTRY MANURE AND ITS EQUIVALENT FERTILIZERS ON AVAILABLE K OVER TIME



agrees with the reports of Yamada and Kamata (1989) and Roe *et al.* (1997). The cumulative build up of available P from the residual P in the soil after each crop might be due to the mineralisation of P from organic manures. This happens consequent to the chelation of Fe and Al in soil by organic acids released from various organic sources. In fact application of 20 t and 38.5 t of FYM, would result in indirect addition of 30 kg ha^{-1} and 77 kg ha^{-1} respectively of P in the soil. Similarly addition of poultry manure at 6.67 t ha^{-1} and 12.92 t ha^{-1} result in the supply of P to the extent of 46.69 kg ha^{-1} and 90.79 kg ha^{-1} respectively. Therefore the observed increase in available P content would have come from the indirect supply of P through FYM as well as poultry manure. It was already reported by Wilkinson (1979) that heavy application of poultry manure to crop lands had caused excessive build up of P. Prasad (1994) also reported that P status of soil increased with increasing level of fertilizer application due to lower utilization of P by crop from the applied source, resulting in building of soil P status.

The increase in available k content of soil also might have occurred from the indirect addition of K through FYM and poultry manure. The observed delay in build up might possibly be due to the lack of sufficient exchange sites in the soil especially when soils are of lateritic nature. Over a period of two years, situation would have improved to provide exchange sites on account of continuous additions of organic manures. More over the organic colloids have greater capacity to hold cations on the exchange surface. The results of the presnt study indicate that application of organic manures is essential to maintain a significantly higher level of available K in the soil (Fig.11 and 12). Similar results were reported by Chauhan *et al.* (1979), Kaddons and Morga (1986), Padmam (1992) and Roe *et al.* (1997).

Soil organic matter is reported to be responsible directly or indirectly in making the physical environment of soil improved. Estimation of bulk density of soil suitable for crop growth after completing all the crops clearly showed that it was significantly lower in treatments comprised of organic manures as compared to the treatments wherein only inorganic fertilizers were included (Fig.4). Reductions in bulk density and improvement of porosity on addition of compost or other forms of organic matter had been documented by Chung *et al.* (1988) and Choe *et al.* (1991).

5.9 Plant analysis

The dry matter production was significantly influenced by increasing levels of N application as well as their sources. Nitrogen enhances cell division and elongation which results in better vegetative growth while phosphorus improves the root growth of plants. Both of these may have contributed for the better total as well as root dry matter production with higher level of poultry manure in the present investigation. The increased plant height, number of branches per plant and yield may have contributed for the increased dry matter content in this treatment. The nitrogen addition and its increased uptake might have increased the rate of photosynthate accumulation which has finally resulted in enhancing the matter production by the plant. Similar observations were reported by Nilson (1979), Cerna (1980), Nair (1988), Singh and Singh (1992) and Ravinandan and Prasad (1998) with higher levels of N.

According to Anand (1973) the uptake of nutrients varies with the variety, soil type, cultural practices followed and the nutrients applied. In the present study treatments having poultry manure at higher level and poultry manure along with NPK fertilizers @ 75:40:25 kg N ha^{-1} were found to have more N uptake. It was reported that upto 60 per cent of organic N in poultry excreta is in the form of uric acid, which will decompose slowly to NH_3 and CO_2 by aerobic organisms (Eno, 1966). It was also reported that 70 per cent of organic nitrogen present in poultry manure was mineralised during 28 days of incubation (Lu, 1993). More than 50 per cent of N in poultry manure is water soluble (Wilkinson *et al.*, 1971). These factors may have helped in the increased uptake of N from poultry manure. The increased N uptake in the organic manured treatments was also reported by Deiz (1989) and Lu (1993).

P as well as K uptake was also found to be maximum in the treatment comprised of higher level of poultry manure. This may be due to the high dry matter content of plants supplied with higher dose of poultry manure. Indirect addition of P and K through poultry manure application may have led to excessive build up of soil P and K and subsequent uptake in plants. Since the plants for analysis was taken 100 days after transplanting, the manures would have obtained sufficient time for decomposition and mineralisation. In the case of inorganic fertilizers alone, there was no addition of micro nutrients, while FYM and poultry manure can have a balanced supply of micro and macro nutrients. This could have helped in the increased uptake of P and K.

5.10 Stability analysis

The analysis of stability of yield contributing characters showed that poultry manure at higher level had relatively higher stability with regard to almost all yield contributing characters. So also this treatment gave maximum yield. Treatment supplied with lower level of N in the form of inorganic fertilizers was also stable, but the yield in this treatment was very poor T_5, which was the control treatment being relatively unstable with regard to yield contributing characters. Hence the treatment consisting of higher level of poultry manure can be recommended for cultivation.

5.11 Economics of organic manuring

The economics of organic manuring and fertilizer application showed that the application of poultry manure @ 155 kg N ha^{-1} was economically profitable with a reward of 52 paise per rupee involved within a period of five months. This was achieved mainly due to the higher productivity and lesser quantity of poultry manure needed as compared to FYM.

The investigations unambiguously showed the beneficial effects of organic sustenance of vegetable crops especially brinjal in terms of higher productivity, better storability and the quality of produce besides improving soil fertility. The cost effectiveness of using poultry manure in brinjal production is also reflected in the study.

Any conclusive results on the aspect of manuring reckoning the residual N status was not obtained as the N level in soil was significantly influenced only after a lapse of four crops. Hence this aspect has to be continued further to get conclusive results.

Summary

6. SUMMARY

The present investigation, `Impact of organic sources of plant nutrients on yield and quality of brinjal' was undertaken in the Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikkara, during the period 1993 to 1997. The investigation was aimed at finding the response of organic manures on productivity of brinjal, investigating the effect of different manures on the quality and storability of produce, estimating of the effect of organic manures on the chemical properties of soil, working out the economics of organic plant nutrition and making suitable recommendations for brinjal production under organic farming system. The results obtained and the salient conclusions drawn are summarised below:

1. The influence of repeated application of manures and fertilizers on the growth components of brinjal like plant height at first harvest and number of branches per plant were significant. Both of these characters were improved with the application of higher level of poultry manure.

2. Influence of continued applications of manures and fertilizers on the yield attributes were also significant. Maximum number of fruits were recorded by

higher level of poultry manure (155 kg N ha^{-1}) while the volume of fruit was highest for poultry manure alone as well as poultry manure + NPK fertilizers at 75:40:25 kg ha^{-1}. Yield per plant as well as yield per plot was maximum for the treatment applied with higher level of poultry manure.

3. In all the six crops taken, poultry manure (155 kg N ha^{-1}) application significantly increased the number of harvests as compared to others. The crop duration was also significantly extended for poultry manure applied alone and for those applied with poultry manure along with NPK @ 75:40:25 kg ha^{-1}.

4. The effect of different sources and levels of N on quality parameters of fruits was significant throughout the experiment. Maximum ascorbic acid content as well as total soluble solids was obtained with higher level of poultry manure (155 kg N ha^{-1}). The starch content as well as reducing sugar content of fruits was maximum with higher levels of FYM and poultry manure. But in the case of total sugars, all the organic treatments were at par. Acidity of fruits was not significantly influenced by either organic or inorganic treatments. Moisture content of fruits increased with increasing levels of N either in organic form or inorganic form. Flesh thickness of brinjal fruit was increased with higher level of poultry

manure which was significantly more than the inorganic treatments.

5. The acceptability tests revealed that the appearance, flavour, texture and taste of cooked fruits were more relished in the treatment receiving lower level of poultry manure alone. But in the case of colour, the preference was for fruits from the treatment applied with inorganic fertilizers alone at lower level.

6. Influence of organic and inorganic nutrient sources was significant in the shelf life of brinjal fruits. After five days and seven days of storage, maximum per cent of unmarketable fruits were observed in the plants received with inorganic fertilizers alone and minimum in plants given with organic manures alone.

7. Seed characters like number of seeds per fruit, weight of seeds per fruit, seed yield per plant and germination per cent of seeds were influenced by sources and levels of N. But 100 seed weight was not influenced by different manures and fertilizers. All the above referred characters were maximum in plants applied with higher level of poultry manure.

8. Application of inorganic fertilizers alone at higher levels (155 kg N ha^{-1}) and also the poultry manure at higher level increased the attack of shoot and fruit

borer throughout the cropping period. Borer attack could be reduced with the application of FYM alone, irrespective of their levels of application. Attack of the epilachna beetle was also influenced by organic and inorganic nutrient sources. Here also maximum attack was noted in plants receiving inorganic fertilizers at higher levels of N while, lower incidence was noted with the application of organic manures alone.

9. Chemical as well as physical properties of soil was influenced by the organic and inorganic treatments. There was slow build up of organic carbon, total nitrogen, available phosphorus and available potassium in soil with the continuous application of higher doses of organic manures while the application of inorganic fertilizers led to a decrease in the above nutrients. Bulk density of soil was also reduced with the application of organic manures alone.

10. Total dry matter and dry matter of root system was maximum for higher level of poultry manure. As a result the total uptake of N, P and K were also maximum for the plants applied with higher level of poultry manure.

11. Poultry manure at higher level showed average stability with regard to almost all yield contributing characters.

12. Brinjal cultivation with the application of poultry manure alone at the level at which it can supply 155 kg N ha^{-1} was found to be economically viable and it could reward an amount of 52 paise per rupee incurred within a period of five months.

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Appendices

Appendix-I

Meteorological data during the cropping period (July 1993 to November 1997) at College of Horticulture, Vellanikkara

Year/ month	Temperature °C		Rainfall (mm)	Relative humidity (%)		Sunshine hours
	Maximum	Minimum		1	2	
1993						
July	28.5	22.9	661.6	93	80	2.4
August	29.6	23.4	287.3	95	78	4.8
September	30.6	23.1	285.3	93	68	6.4
October	30.7	23.4	519.0	91	74	4.8
November	31.5	23.6	76.6	82	64	5.8
December	31.6	23.1	18.0	76	55	7.5
1994						
January	32.9	22.6	19.4	74	42	9.1
February	34.8	23.1	1.7	79	38	8.7
March	36.2	23.7	21.0	79	38	9.3
April	34.9	24.4	165.2	88	59	8.0
May	33.6	24.7	124.2	88	61	8.0
June	28.9	22.9	955.1	96	83	2.1
July	28.6	22.4	1002.1	96	85	1.4
August	30.0	22.8	209.2	95	75	3.6
September	31.8	23.2	240.5	92	64	7.3
October	32.3	22.7	358.2	92	68	6.7
November	31.8	23.3	125.3	77	58	8.1
December	32.2	22.2	0.0	71	45	10.6
1995						
January	32.9	22.4	0.0	76	41	9.6
February	35.4	23.4	0.5	79	41	10.0
March	37.6	23.8	2.8	83	37	9.3
April	36.6	24.9	118.7	87	55	9.1
May	33.5	23.9	370.5	91	65	6.5
June	31.6	23.1	500.4	94	77	3.7
July	29.9	23.2	854.7	96	81	2.1
August	30.6	23.7	448.7	94	78	3.7
September	30.1	23.5	282.5	94	70	6.1
October	33.2	23.2	110.4	91	65	8.3
November	31.3	22.5	88.4	91	69	6.5
December	32.5	21.3	0.0	71	43	10.3

Contd.

Appendix 1 (Contd.)

Year/ month	Temperature °C		Rainfall (mm)	Relative humidity (%)		Sunshine hours
	Maximum	Minimum		1	2	
1996						
January	33.1	22.4	0.0	71	35	9.4
February	34.7	23.4	0.0	72	34	9.9
March	36.4	24.3	0.0	82	37	9.3
April	34.6	25.0	152.0	87	59	8.3
May	32.8	25.2	95.4	91	63	7.7
June	30.5	23.8	400.3	94	75	4.7
July	28.8	23.1	588.7	96	83	2.7
August	29.1	23.6	310.0	95	78	3.7
September	29.2	23.7	391.6	94	74	4.3
October	30.1	22.9	219.3	93	70	6.0
November	31.5	23.6	22.1	84	59	7.1
December	30.5	21.8	60.4	80	55	6.8
1997						
January	32.0	22.9	0.0	78	45	9.6
February	33.9	21.8	0.0	82	39	9.3
March	35.7	24.0	0.0	82	37	9.6
April	35.2	24.5	8.2	83	50	9.6
May	34.4	24.5	63.0	87	57	6.7
June	31.2	23.0	720.5	93	71	5.9
July	28.6	21.8	979.2	95	84	1.9
August	29.0	22.8	636.8	95	78	3.4
September	30.6	23.4	164.0	93	71	6.8
October	32.2	23.6	194.7	88	65	7.3
November	31.6	23.2	209.7	88	67	5.3

APPENDIX-II

Nutrient contents of organic manures used in the experiment for six crops

Crops	Nutrient contents of manures (%)					
	N		P		K	
	FYM	PM	FYM	PM	FYM	PM
Crop I	0.425	1.325	0.290	0.595	0.211	0.385
Crop II	0.412	1.331	0.305	0.588	0.198	0.392
Crop III	0.405	1.330	0.295	0.605	0.215	0.386
Crop IV	0.420	1.250	0.310	0.600	0.205	0.400
Crop V	0.398	1.295	0.305	0.595	0.212	0.395
Crop VI	0.410	1.310	0.290	0.605	0.214	0.395

APPENDIX-III

Analysis of variance of plant height at first harvest

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	3.198	48.518	6.142	4.178	0.793	2.956	0.857	0.233	0.625	0.009	0.786	0.089
Treatment	9	49.372**	17.042**	21.463**	27.425**	39.548**	34.317**	3.243**	33.572**	31.339**	34.149**	39.876**	38.631**
Organic vs inorganic	1	7.037**	3.375*	3.132*	2.257	7.707**	13.802**	26.031	20.720	26.670**	38.507**	64.021**	79.207**
Error	18	20.041	15.958	3.988	2.809	1.953	1.154	1.673	0.777	0.759	0.659	0.578	0.250

APPENDIX-IV

Analysis of variance of number of branches per plant

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	0.211	2.162	0.372	1.882	0.216	3.235	0.975	0.097	0.026	1.496	0.523	0.127
Treatment	9	16.768**	17.191**	10.684**	8.739**	9.391**	10.185	10.666**	15.477**	8.234**	9.864*	9.899**	8.676
Organic vs inorganic	1	0.742	4.987*	9.792*	7.348	5.502**	5.626**	8.712*	16.934**	2.233	8.272*	3.003	5.033*
Error	18	1.328	1.670	0.409	0.527	0.843	0.593	0.175	0.287	0.487	0.382	0.203	0.196

APPENDIX-V

Analysis of variance of number of fruits per plant

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	1.967	4.450	2.811	3.426	0.316	1.517	1.042	0.308	0.435	0.062	0.405	0.254
Treatment	9	2.991	19.618*	28.819**	16.279**	24.927**	25.069**	12.770**	12.357**	23.214**	21.341**	13.679**	14.124**
Organic vs inorganic	1	0.236	1.105	175.230**	55.237**	76.909	61.325	28.536**	35.720**	47.491**	47.560	38.811**	43.148**
Error	18	12.992	6.366	4.667	5.881	0.839	0.382	0.379	0.617	0.320	0.377	0.412	0.290

APPENDIX-VI

Analysis of variance of volume of fruit

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	46.472	34.945	38.863	22.687	12.133	7.517	1.433	0.100	4.933	0.333	0.933	1.033
Treatment	9	152.917*	66.400	52.819	62.522	61.052**	57.069**	40.207**	34.670**	53.781**	54.611**	26.107**	28.726**
Organic vs inorganic	1	53.560**	25.447**	0.375	0.375*	6.000**	4.667*	1.042	0.042	13.501**	35.042**	51.042**	70.042**
Error	18	53.768	126.569	4.861	3.300	3.541	2.382	1.619	4.026	1.081	1.811	0.896	0.626

APPENDIX-VII

Analysis of variance of yield per plot

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	3.245	2.663	2.874	3.111	0.952	0.316	0.071	0.100	0.132	0.388	0.300	0.078
Treatment	9	13.874	28.662*	23.837**	23.484**	19.506	14.227**	10.573**	12.475**	11.901**	11.111	13.830**	13.434**
Organic vs inorganic	1	17.433	20.055	75.190	36.310**	42.188**	40.197	60.352**	58.110**	46.733**	41.370**	60.452**	58.551**
Error	18	15.386	10.606	8.417	1.144	0.464	1.129	0.284	0.429	0.171	0.109	0.310	0.214

APPENDIX-VIII

Analysis of variance of number of harvest

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	4.133	0.433	1.243	1.827	0.300	0.433	0.133	0.100	0.700	0.133	0.033	0.300
Treatment	9	4.152**	0.874*	2.607**	3.022**	4.311**	5.319**	3.630**	4.133**	3.041**	2.996**	4.059**	3.096*
Organic vs inorganic	1	18.375**	0.667	8.167**	9.375**	26.042**	18.375	24.000**	28.712**	16.667**	18.375**	22.042**	18.142**
Error	18	0.652	0.396	0.367	0.333	0.633	0.396	0.319	0.433	0.330	0.430	0.293	0.263

APPENDIX-IX

Analysis of variance of duration of crop

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	9.100	7.033	8.412	7.412	13.333	2.500	2.633	4.233	4.233	18.633	13.733	2.800
Treatment	9	387.574**	407.615**	261.481**	203.333**	227.407*	237.130*	226.578**	200.578*	170.315*	140.356**	159.333**	134.504
Organic vs inorganic	1	210.042**	433.500**	651.042**	555.080*	672.042**	937.500	704.167**	634.119**	748.167**	630.375**	600.000**	631.440**
Error	18	4.952	6.515	6.667	9.886	6.852	7.130	9.300	7.233	5.493	10.300	4.400	5.948

APPENDIX-X

Analysis of variance of ascorbic acid content

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	0.933	0.400	0.512	0.481	0.933	0.533	3.733	0.400	0.133	1.600	1.733	0.133
Treatment	9	4.519*	5.052**	3.170*	2.626*	1.319	1.837	2.607*	2.089	2.607	4.444*	2.444*	2.430
Organic vs inorganic	1	16.667**	8.167*	8.167**	8.233*	8.167**	10.667	4.167	9.179	10.667**	20.167**	13.500**	12.448**
Error	18	1.674	1.141	0.967	0.767	1.230	1.570	0.919	0.844	0.874	1.156	0.844	0.874

APPENDIX-XI

Analysis of variance of total soluble solids

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	0.001	0.013	0.012	0.013	0.002	0.003	0.001	0.001	0.004	0.001	0.004	0.007
Treatment	9	0.082*	0.075**	0.096	0.064**	0.032**	0.030**	0.027**	0.020**	0.016	0.019	0.025	0.019**
Organic vs inorganic	1	0.050*	0.060	0.150**	0.120*	0.015*	0.034*	0.050**	0.032**	0.010*	0.042**	0.034**	0.041**
Error	18	0.005	0.005	0.003	0.003	0.006	0.004	0.003	0.003	0.003	0.003	0.002	0.003

APPENDIX-XII

Analysis of variance of starch content of fruits

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.001	0.000
Treatment	9	0.001*	0.001*	0.001**	0.001**	0.002*	0.001*	0.001	0.005	0.001**	0.002**	0.002**	0.001**
Organic vs inorganic	1	0.004*	0.004*	0.003**	0.002**	0.002	0.001	0.003*	0.002*	0.005**	0.008**	0.006**	0.007**
Error	18	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.006	0.000	0.000	0.001	0.000

APPENDIX-XIII

Analysis of variance of organic carbon content in soil

Source	Degree of freedom	Mean squares													
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI		Crop VII	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	0.007	0.012	0.012	0.010	0.010	0.007	0.007	0.005	0.004	0.007	0.012	0.007	0.057	0.062
Treatment	9	0.010	0.012	0.013	0.013	0.014	0.016	0.019	0.022	0.023*	0.027*	0.045*	0.340*	0.505**	0.106*
Organic vs inorganic	1	0.003	0.005	0.047*	0.033	0.064*	0.059*	0.134**	0.120**	0.147**	0.167**	0.358*	0.224*	0.418**	0.552**
Error	18	0.012	0.014	0.012	0.012	0.011	0.011	0.007	0.010	0.004	0.009	0.005	0.008	0.048	0.034

APPENDIX-XIV

Analysis of variance of total N content of soil

Source	Degree of freedom	Mean squares													
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI		Crop VII	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	0.000	0.000	9.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Treatment	9	0.0001	0.0001	0.000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001*	0.0001*	0.0001**	0.0001**	0.0001**	0.0001**
Error	18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

APPENDIX-XV

Analysis of variance of available potassium

Source	Degree of freedom	Mean squares													
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI		Crop VII	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	53.011	14.802	58.844	10.994	56.323	6.469	54.830	8.176	55.909	4.723	37.905	25.684	71.197	25.320
Treatment	9	73.642	113.733	78.654	141.567	84.782	180.851	96.188	90.986	199.556**	172.627**	280.237**	292.010**	297.699**	220.000
Organic vs inorganic	1	255.454**	151.504**	384.800**	324.870**	423.360*	486.860**	303.250*	405.010**	352.100**	483.304**	642.811**	618.010**	733.600**	760.110**
Error	18	30.602	20.801	26.426	18.628	25.405	18.718	24.754	17.047	25.924	18.682	21.553	28.355	17.126	25.023

APPENDIX-XVI

Analysis of variance of bulk density of soil

Source	Degree of Freedom	Mean squares	
		Experiment I	Experiment II
Replication	2	0.008	0.001
Treatment	9	0.020**	0.011**
Organic vs inorganic	1	0.126**	0.128**
Error	18	0.003	0.001

APPENDIX-XVII

Analysis of variance of total dry matter

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	38.217	85.267	102.529	99.080*	8.750	4.276	2.489	0.787	88.145	8.945	2.548	2.133
Treatment	9	410.890**	684.899**	458.818**	595.499**	902.001	713.294**	246.468**	379.776**	450.859**	424.154**	557.907**	598.127**
Organic vs inorganic	1	867.604**	421.682**	721.297**	754.882**	771.761**	1006.251**	504.167**	515.227**	804.167**	826.107**	912.042**	907.335**
Error	18	21.620	58.019	23.360	25.238	19.215	44.062	12.269	4.777	34.275	11.466	24.642	10.817

APPENDIX-XVIII

Analysis of variance of dry matter of root system

Source	Degree of freedom	Mean squares											
		Crop I		Crop II		Crop III		Crop IV		Crop V		Crop VI	
		Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Replication	2	0.907	1.396	2.109	10.124	0.597	0.746	0.020	0.571	6.276	2.305	1.794	0.992
Treatment	9	12.098**	52.716**	38.317**	34.271**	19.930**	26.838**	9.978**	8.974**	18.094**	19.002**	19.251**	20.650**
Organic vs inorganic	1	47.602**	27.864**	46.203**	96.400**	73.150**	152.007**	56.734**	46.760**	72.802**	116.160**	107.527**	79.935**
Error	18	0.981	0.897	3.632	2.557	0.829	0.436	1.721	1.870	1.425	1.609	0.914	0.582

IMPACT OF ORGANIC SOURCES OF PLANT NUTRIENTS ON YIELD AND QUALITY OF BRINJAL

By

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ABSTRACT OF THE THESIS

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ABSTRACT

An investigation on the "Impact of organic sources of plant nutrients on yield and quality of brinjal" was carried out at the College of Horticulture, Kerala Agricultural University, Vellanikkara during 1993-1997.

Results showed that yield attributes of brinjal like number of fruits, volume of fruits, yield per plant and yield per plot was maximum with highest level of poultry manure (155 kg N ha^{-1}).

The crop duration as well as the number of harvests were significantly increased when poultry manure was applied at the highest level (155 kg N ha^{-1}).

Quality parameters like ascorbic acid and total soluble solids were maximum with the highest level of poultry manure. The starch content as well as reducing sugar content of fruits were maximum with higher level of FYM and poultry manure while all the organic treatments were at par with regard to total sugars. Moisture content of fruits increased with increasing levels of N.

The appearance, flavour, texture and taste of cooked fruits were superior from treatment involving lower level of

poultry manure while the colour preference was for the fruits from treatments having inorganic fertilizers alone at lower level.

Maximum per cent of unmarketable fruits after five days and seven days of storage was obtained from the plants supplied with inorganic fertilizers alone and minimum in plants given with organic manures alone.

Seed characters like number of seeds per fruit, weight of seeds per fruit, seed yield per plant and germination per cent of seeds were maximum in treatments having higher level of poultry manure (155 kg N ha^{-1}).

Shoot and fruit borer attack was reduced with the application of FYM alone, while incidence of epilachna beetle was reduced with the application of FYM or poultry manure alone.

Physical as well as chemical properties of soil in terms of bulk density, organic carbon, total N, available P and K were improved with the continuous application of organic manures alone.

Total uptake of N, P and K were maximum for the plants applied with higher level of poultry manure.

Poultry manure at higher level showed average stability with regard to almost all yield contributing characters.

Brinjal cultivation was found to be more remunerative with the application of poultry manure at higher level (155 kg N ha^{-1}).