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Effect of Different Sources of Manuring on Growth, Yield and Quality of Capsicum (*Capsicum annum) cv.* California wonder under Low Cost Poly-House Condition

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Abstract: Bell pepper is a highly priced and choice vegetable, providing rich source of vitamin A, B and C. It is largely grown around urban centre and is often sold at a premium price compared to other vegetables. The crop responds to various biotic and abiotic factors, of which the growth environment and requisite nutrient supplementation are of foremost importance. The nutrient requirement can be met through chemical fertilizers, organic manures and biofertilizers which constitute the main sources of plant nutrients. However, in order to trigger off production, indiscriminate use of chemicals has been observed in many parts of the country which has questioned the nutritional security of the crop and also its adverse impact on the environment. The long term sustainable production of the crop thus needs balanced supply of essential plant nutrients in available form, which involves systematic exploitation of potential soil resources, chemical fertilizers, biofertilizers and organic manures. The use of organic manures was suggested a long time in capsicum and the efficiency of FYM, vermicompost, green manures, compost etc. are established, as its application triggers the microbial activity and results in increased mineralization of soil nutrients. There is also a positive response of crops to biofertilizer application. Nevertheless, there appears to be a degree of inconsistency of results depending upon the type of inoculants used, agro-climatic condition, method of inoculation, interaction between strains, nutrient interaction etc. It is this inconsistency of crop response which poses a problem in the popular use of Biofertilizers which needs to be tackled and their use perfected for their regular application. It is evident that capsicum responds to incorporated plant nutrients in terms of growth, yield and quality. But very few inquisitions have been carried out to determine the exact effect of individual plant nutrient sources and their combination with Biofertilizers. It was therefore felt necessary to investigate the effect of different sources of manuring on growth yield and quality of capsicum under low cost poly-house conditions. The results thus obtained in this regard as presented in previous chapter are discussed in the light of available literature and evidence as follows.
Keywords: -DAS, DMA, RBD, RDF, EC.

I. INTRODUCTION

Capsicum (*Capsicum annuum* L.) is a high value Solanaceous vegetable crop grown extensively in Karnataka, Tamil Nadu, Himachal Pradesh, Uttarakhand and Darjeeling district of West Bengal (Singh *et al.*, 1993). It has been originated in tropical South America particularly Brazil is thought to be the original home of the peppers (Shormaker and Teskey, 1955). Pepper was brought to India by the Portuguese from Brazil prior to 1885. It belongs to the “Bell group” which is economically the most important type. California Wonder is one of the oldest cultivars and represents the typical pod type. They are non-pungent. The fruits are green when immature and turn orange-red or red at maturity. The plants are vigorous, upright, prolific bearer, fruits 3-4 lobed, medium thick flesh. It is a highly priced vegetable. It is an important remunerative crop of temperate regions, growing best at a temperature ranging between 20-30^{o}C. It is cultivated both in summer and rainy seasons and serves as an off-season cash crop to the plains, where it cannot be grown during summer season due to very high temperatures. Capsicum is used either raw as salad, cooked as vegetable, pickled or processed and is appreciated worldwide for its flavor, aroma and color. Being a popular vegetable, it differs from common hot chillies in size, shape, pungency, aroma and usage. It lacks the capsaicin, the alkaloid responsible for pungency. Failure of capsicum secreting glands to develop on the placenta permit their use as salad or table purposes (Pearson, 1970). Bell pepper contains 92.4 per cent water and the food value per 100g of edible portion is energy 29 calories, protein 1.2 g, calcium 11 mg, vitamin A 870 I.U., ascorbic acid 175 mg, thiamine 0.06 mg, riboflavin 0.03 mg and niacin 0.55 mg (Joshi and Singh, 1975). In world, capsicum (including hot peppers) is grown in an area of 17,03,486 hectare with a production of 2,60,56,900 tonnes and productivity of 15.30 t/ha, while in India, it is grown in 5,761 hectares area with a production of about 53,198 tonnes and a productivity of 9.23 t/ha (Anonymous, 2014). In Rajasthan, it has a area of about 26.3 thousand hectares with a production of 368 thousand tonnes (Ghosh, 2007). Nutrition plays an important role in the growth and development of any crop including capsicum, because it is known to exhibit positive response to the application of nitrogenous, phosphoric and potassium fertilizers particularly in light soils. Biofertlizers release growth promoting substance including Auxins and vitamins, which improve germination of seeds and of seedlings. They also help in improving biological activities of desirable micro-organisms in the soil and improve plant growth, yield and quality of produce. The micro-organisms like Azotobacter are considered important not only for their nitrogen fixing efficiency, but also for their ability to produce antibacterial and antifungal compounds and growth regulators. Likewise, some phosphate solubilizing microbe like phosphotic are found to be effective in improving phosphorous use efficiency (Kumar and Srivastava, 2006). After green revolution, production of vegetables has increased to a great extent due to use of chemical fertilizers, but their indiscriminate use has led the soil sickness, ecological hazards and depletion of non-renewable sources of energy. Moreover, in the developing countries like India, the escalating prices of fertilizers are hitting small and marginal farmers. To overcome the problems of ecological imbalance and increased cost of cultivation due to continuous use of chemical fertilizers, the latest trend of growing vegetable crops is by using organic sources of nutrients like biofertilizer together with inorganic fertilizers. The basic consideration of any research thus should be to maintain soil fertility, sustaining agricultural productivity and improving farmer's profitability through judicious and efficient use of fertilizers, organic manures, Bio-fertilizers and crop residues in the light of the fact that "Soils under intensive fertilizer use has reportedly shown symptoms/signs of multi-nutrient deficiency (Singh, 2004). It was a thrust from these relevant facts and factors which provided for investigation into the varied role played by different nutrient sources on capsicum production which in turn culminated in the research on "Effect of different sources of manuring on growth, yield and quality of capsicum cv. California Wonder under low cost poly-house condition" with the following objectives:- (i) To study the effect of different manuring sources on growth, yield and quality of capsicum.(ii) To study the fertility status of soil before and after harvest. (iii) To study the economics of capsicum production for different treatments. Bell pepper is an important vegetable crop grown commercially in the hills of India during summer months. In addition to selection of suitable variety, factors like temperature, irrigation, soil fertility, fertilizer application and manuring also ensures a healthy and productive crop. Capsicum responds well to manuring and fertilizer application. It is difficult to be specific about fertilizer or manure recommendation or in that case recommendation of fertilizer and manure in combination. This is because of variation in soil types, soil fertility and system of cultivation. It is a well-known fact that the use of chemical fertilizer plays an integral role in increasing production. With a view to review the various works on capsicum and the related works on other vegetables, the following materials/literatures are presented to draw certain relevance with the experiment performed.

II. MATERIALS AND METHODS

The present investigation entitled "Effect of different sources of manuring on growth yield and quality of capsicum cv. California Wonder under low cost poly-house condition" was carried out in the Agriculture Farm, Bhagwant University, and Ajmer.

Experimental site:-The experiment was conducted in a poly-house located in the Experimental farm of Bhagwant University, Ajmer. Geographically, Ajmer is situated at 26°27' N latitude and 74°38' E longitude and at an altitude of 486 m above mean sea level. The region falls under agro-climatic Zone IIIa "Semi arid eastern plains zone" of Rajasthan. Campus during October 2015 to March 2016. The agro-climatic Zone-IIIa has semi-arid climatic conditions characterized by mild winters and moderate summers with higher relative humidity during the months of July to September. The average rainfall of the Zone-IIIa is 500 mm, most of which is received between last week of June to September. Winter showers occur occasionally.

Climatic condition:-The temperature inside the poly-house ranged from 19^{o}C in winter and 30°Cin summer at experimenting period and high Relative Humidity.

Soil condition:-The soil of the experimental site was sandy loam, well drained with mean pH of 5.1 Soil sampling was done by collecting soil sample at a soil depth of 15 cm with the help of soil auger. The result of the soil sample analysis is presented in Table 2.

A. *Experiment details*

Design- Completely Randomized Design (CRD)		
Replications-3	Plot size-1.8 m X 1.5 m	Spacing-60 cm X 50 cm

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Variety- California Wonder	Number of treatments-11

Treatments
T_1 Control
T_2- 100% NPK (100:60:60 kg ha^{-1})
T_3- Farm Yard Manure 20t ha^{-1}
T_4- Pig manure 15 t ha^{-1}
T_5- Vermicompost 10 t ha^{-1}
T_6- 50% FYM + 50% NPK
T_7- 50% Pig manure + 50% NPK
T_8- 50% Vermicompost + 50% NPK
T_9- 50% FYM + 50% NPK+ Biofertilizers (*Azospirillum* and *phosphotica*)
T_{10}- 50%Pigmanure + 50% NPK+ Biofertilizers (*Azospirillum* and *phosphotica*)
T_{11}- 50% Vermicompost+ 50% NPK+ Biofertilizers (*Azospirillum* and *phosphotica*)

Application of manures and fertilizers:- For each treatment, the quantity of equivalent organic manures and fertilizers were worked out according to the recommended dosage which was further simplified according to individual plants. The manures i.e. FYM, vermicompost, pig manure were incorporated in respective plots 20 days before planting. NPK was supplied through Urea, SSP and MOP in split doses as full dose of P, K and half dose of N at the time of transplanting and remaining half of N was applied 45 days after transplanting. Meanwhile, Biofertilizers (*Azospirillum* and *Phosphotica*) were inoculated before transplanting as seedling root dip for 30 minutes @2 kg/ha each.

Transplanting:-Thirty five days old seedlings of uniform growth pattern were uprooted from the nursery after loosening the nursery bed by irrigating it. Uprooted seedlings were then given bio-fertilizers treatment (wherever required) and transplanted in plots which were immediately irrigated.

Cultural practices:-The experiment was started on 20 October 2010. The seed were sown in seed bed of 1 m x 1 m at a depth of 1 cm. Germination took place in 10 days. Damping off occurred in some seedlings which were controlled by the application of Bavistin @ 1 g litre^{-1} of water. The seedlings were transplanted on the main field on 25 November 2010, when the seedlings attained a height of about 10-12 cm. Row to row and plant to plant spacing was kept at 60 cm x 50 cm in a plot measuring 1.8 m in length and 1.5 m in breadth, accommodating 9 plants in each plot. Operations like weeding, earthing up and irrigation were carried out at required intervals. The crops were irrigated at 2 – 3 days interval at initial growth stage. First weeding was performed 30 days after transplanting and subsequently followed at required intervals. In the process of weeding, earthing up of soil around the crop was also done in order to provide proper aeration in the root zone.

Harvesting:-Harvesting was started about 12 weeks after transplanting when they were fully green. Maturity of the fruits was determined by the fresh, firm fruits and the pedicel and calyx turning green. A close look at the fruit will show a distinct line where the pedicle is attached to the plant. Matured fruits were harvested by holding the pedicel between two fingers and snapping off upwards towards the back of the curve making a clean break.

Sampling and observation recorded:-In each replication of the treatments, five sample plants were randomly selected for recording the observation which was duly tagged.

Growth parameters:- Plant height:-Plant height was measured in centimeter from the surface of the soil to the apex of the longest leaf and the average height deduced subsequently.

Number of leaves per plant:-The number of fully opened leaves on all five sample plants of each replication of treatments was counted and their average values were estimated.

Leaf area:-Leaf area was determined with the help of a leaf area meter and their values represented in terms of square centimeter (cm^2).

Yield and yield attributes:-Fruit length:-Fruit length of five randomly picked fruits from each replication of every treatment were measured with a vernier caliper and represented in centimeter (cm).

Fruit diameter:-Diameter of five randomly selected fruits from every replication was measured with vernier caliper and results obtained were represented in terms of centimeter (cm).

Fresh weight of fruit:-Fresh weight of five randomly selected fruits from each replication were immediately measured after harvest

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with the help of an electronic balance and the average fruit weight for each treatment was worked out and represented in terms of gram (g).

Number of fruits per plant:-Numbers of fully matured fruits were counted from sample plants and the average was expressed as number of fruits per plant.

Yield per plant:-The yields of matured fruits harvested at different dates from the sample plants were recorded and their average was represented as yield per plant (g).

Yield per plot:-Yield per plot was determined by multiplying the yield per plant with number of plants per plot i.e. 9. The yield per plot was expressed in kilogram (kg.).

Projected yield per hectare:-Projected yield from the experimental plot was calculated on the basis of actual yield per plot recorded under each treatment by using the following formula.

$$X = \frac{\text{Yield per plot (kg)}}{\text{Area of the plot (cm}^2\text{)}} \times 10000$$

Where, X is the yield ha^{-1}. The data thus obtained was expressed in q ha^{-1}.

Quality parameters:-Total Soluble Solids (TSS):-Total Soluble Solid was estimated from freshly harvested fruits with a hand Refractor meter and expressed in degree Brix.

Ascorbic acid content:-Ascorbic acid was determined by using 2, 6-Dichlorophenol indophenol visual titration method as given by A.O.A.C. (1984) expressed in mg/100 g.

The formulas used were given as follows:

$$Vitamin\ c\ (\frac{mg}{100g} of\ ediblefruit) = \frac{Titrated\ volume\ \times Dye\ factor\ \times Volume\ (25ml) make\ up\ \times 100}{Aliquote\ of\ extract\ taken\ for\ estimation\ (5ml) \times Volume\ of\ sample\ taken\ for\ estimation\ (25ml)}$$

Nutrient status of the soil:-Collection of soil samples:- Soils samples were collected at random from different location of the area demarked for soil to be used for potting from a depth of 15 cm with a screw type auger. Collected samples were then mixed throughout and reduced to 500 g and sterilized, dried in the shade, ground and sieved for determination of following nutrient status.

Organic carbon:-Organic carbon was determined by Walkley and Black titration method as described by Piper (1966). The results were then presented in percentage.

Available nitrogen:-The available soil nitrogen was estimated by alkaline potassium permanganate method as suggested by Subbiah and Asija (1956) and the results were expressed in kilogram per hectare. Available phosphorus:-The available soil phosphorus (P_2O_5) was determined by Bray's method (Bray and Kurtz, 1954). The results thus obtained were expressed in kilogram per hectare.

Available potassium:-The available soil potassium (K_2O) was determined by Ammonium Acetate method (Hanway and Heidal, 1952). The results obtained were then expressed in kilogram per hectare.

Soil pH:-The pH of the soil was determined in 1:2 soil water suspension using model 1:1 120 digital meters (A.O.A.C,) 1984.

Economics of the treatment:-Economics of production for each treatment was calculated by reducing the cost of cultivation based on prevailing rates of inputs and outputs (Appendix-1). Gross income was then calculated as (yield x selling rate @ Rs.3000/q). Thereafter, net income was estimated by deducting the total cost of cultivation (fixed cost + treatment cost) from gross income of the particular treatment.

$$Cost\ benefit\ ratio = \frac{Net\ return}{Totsl\ cost\ of\ cultivation}$$

Method of statistical analysis:-The data on growth yield and quality components were subjected to Fisher's method of analysis of variance (ANOVA), where the 'F' tests was significant for comparison of the treatment means, CD values were worked out at 5% probability level. Analysis of Variance (ANOVA) Analysis of treatment for all treatments in Randomized Block Design was carried out. For testing the hypothesis the following ANOVA table was used.

Table Skeleton of ANOVA

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Source of variation	d. f.	S.S.	M.S.S.	F.cal.	F(table) at Result5%
Due to replication	(r-1)	R.S.S.	R.S.S. r-1	M.R.S.S. M.E.S.S.	
Due to treatment	(t-1)	T.S.S.	T.S.S t-1	M.T.S.S. M.E.S.S.	(r-1) (t-1)
Due to error	(r-1) (t-1)	E.S.S.	E.S.S. (r-1) (t-1)	M.E.S.S.	F(t-1) (r-1) (t-1)
Total	(rt-1)	TSS	-	-	-

Where:-	
d. f. =Degree of freedom	E.S.S. =Error sum of squares
r-replication	M.R.S.S.= Mean replication sum of squares
S.S.=Sum of squares	M.T.S.S.= Mean treatment sum of squares
T = treatment	R.S.S. = Replication sum of squares
M.S.S. =Mean sum of squares	T.S.S. = Total sum of squares
M.E.S.S.=S.E. (d) x't' error d. f. at 5% level of significance	

$$S.E.(d) = \sqrt{\frac{2 \times M.E.S.S.}{r}}$$

The significance and non-significance of the treatment effect was judged with the help of 'F' variance ratio test. Calculated 'F' value was compared with the table value of 'F' at 5% level significant. If the calculated value exceeds the table value, the effect was considered to be significant. The significant differences between the mean were tested against the critical differences at 5% level of significance. For testing the hypothesis, the ANOVA table was used.

III. RESULTS

The result of the investigation "Effect of different sources of manuring on growth yield and quality of capsicum cv. California Wonder under low cost poly-house condition" has been presented in this chapter duly supported by tables and relevant graphic illustrations.

Growth characteristics:-Plant height (cm):-The observation recorded on plant height due to various source of manuring effects at different stages of plant growth viz., 30, 45, 60, 75, 90 DAT are given in table 3 and fig. 3. It was found that all manuring sources showed superiority over control. The highest plant height of 34.15 cm, 40.15 cm, 44.95 cm, 50.25 cm and 54.46 cm was recorded in treatment T_9 (50% FYM + 50%NPK + Biofertilizers) followed by treatment T_{11} (50% Vermicompost + 50% NPK + Biofertilizers). The treatmentT_9 (50% FYM + 50% NPK + Biofertilizers) and T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) were found significantly superior overT_2 (100% NPK).

Number of leaves per plant:-Table 4 and Fig 4, presents the recorded data on number of leaves per plant under various sources of manuring. It is evident that treatment T_9 (50% FYM + 50%NPK + Biofertilizers) recorded the highest number of leaves 27.29, 27.65, 31.87, 34.58 and 38.89. The second best treatment was T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) with regard to the number of leaves. Meanwhile, least number of leaves 10.87, 13.12, 15.63, 16.92 and 18.03 was recorded by (T_1) control at different stages.

Leaf area (cm^2):-Relevant data given in table 5 and fig 5 on leaf area as influenced by different manuring sources, suggests that all treatments showed significant influence over the control (T_1) which recorded the least leaf area at all observation dates excepting at 30 DAT where the leaf area was non-significant for all treatments. Maximum leaf area 50.74 cm^2, 52.59 cm^2, 55.75 cm^2, 54.45 cm^2 and 54.60 cm^2 respectively was observed in treatment T_9 (50% FYM + 50%NPK + Biofertilizers) followed by T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) and T_{10} (50% Pig manure + 50%NPK + Biofertilizers). T_9 (50% FYM + 50% NPK + Biofertilizers) was found significantly superior over all the treatments.

Yield and yield attributes:-Fruit length (cm): The data presented in table 6 and fig 6 depicts the fruit length of capsicum as influenced by various manuring sources. Highest fruit length (8.56 cm) was recorded with the application of T_9 (50% FYM + 50%NPK + Biofertilizers) and closely followed byT_{11} (50% Vermicompost + 50% NPK + Biofertilizers) and T_{10} (50%

Pigmanure+50%NPK+ Biofertilizers). Lowest fruit length (5.16cm) was recorded in control (T_1). Treatment T_9 (50% FYM + 50%NPK + Biofertilizers), T_{10} (50% Pig manure + 50%NPK + Biofertilizer) and T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) was found significantly superior over T_2 (100% NPK).

Fruit diameter (cm):-The data in the table 6 Fig. 7 represent the fruit diameter. T_9 (50% FYM + 50% NPK + Biofertilizers) significantly influence fruit diameter and recorded maximum fruit diameter (5.63) followed by T_{11} (50% Vermicompost + 50%NPK + Biofertilizers), T_{10} (50% Pig manure +50%NPK+ Biofertilizers) The critical difference between T_9 (50% FYM + 50%NPK + Biofertilizers), T_{10} (50% Pig manure + 50%NPK + Biofertilizer) and T_{11} (50% Vermicompost + 50%NPK +Biofertilizers) was found non-significant. Theleast fruit diameter of (4.53) was recorded by T_1 (control).

Number of fruits per plant:-The data on number of fruits per plant is given in table 6 and Fig 8. It was observed that Treatment T_9 (50% FYM + 50%NPK + Biofertilizers) recorded higher number of fruits per plant (10.48) followed byT_{11} (50% Vermicompost + 50%NPK + Biofertilizers). All treatments significantly produced more number of fruits than the control (T_1) which recorded least with (4.11) fruit per plant.

Fresh weight of fruit:-The data on fresh weight of individual fruits as given in table 6 and fig 9 shows that treatment T_9 (50% FYM + 50%NPK + Biofertilizers) recorded maximum fresh weight (85.06g) which was at par with T_{11} (50% Vermicompost + 50%NPK + Biofertilizers) recording (84.27g). T_1 (control) recorded the minimum fresh weight (35.74 g).

Yield per plant (g):-The data on yield per plant as depicted in table 7 and fig 10 showed highly significant fruit yield per plant. It was observed that treatment T_9 (50% FYM + 50%NPK + Biofertilizers) influenced the highest yield per plant (891.42 g) and was superior to other treatments. The second best result (869.66 g) observed with T_{11} (50% Vermicompost + 50%NPK + Biofertilizers) which was closely followed by T_{10} (50% Pigmanure+50%NPK+ Biofertilizers). The minimum yield per plant (237.32 g) was recorded in control (T_1).

Yield per plot (kg):-Application of organic manures and inorganic fertilizers had appreciable impact on enhancing the harvesting yield of capsicum. The data recorded on yield per plot has been presented in Table 7 and fig. 11. The highest yield of 8.02 kg per plot was recorded in T_9 (50% FYM + 50%NPK + Biofertilizers) which were significantly superior to all other treatments. The minimum yield per plot (2.13 kg) was recorded in control (T_1).

Projected yield per hectare:-Application of chemical fertilizer, organic manures and biofertilizers has considerable influence on yield as compared to control, which is evident from the data presented in Table 7 and fig 12. The highest yield per hectare (297.04q) was recorded in treatment T_9 (50% FYM + 50% NPK + Biofertilizers) which was significantly superior to other treatments. The next best treatment was foundT_{11} (50% Vermicompost + 50%NPK +Biofertilizers). T_9 (50% FYM + 50% NPK + Biofertilizers), T10 (50% Pig manure + 50% NPK+ Biofertilizers) and T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) were recorded significantly higher yield over 100% NPK (T_2) the lowest projected yield was in control (T_1) with 78.89q ha^{-1}.

Quality parameters:-Total Soluble Solids (^{o}Brix):-Table 8 and Fig 13 depicted the influence of different treatments sources on total soluble solids of capsicum fruit at its maturity. It was observed that treatment T_9 (50% FYM + 50% NPK + Biofertilizers) had the maximum influence on total soluble solids (9.55^{o}Brix) significantly superior over other treatments. T_1 (Control) recorded the minimum total soluble solids of 7.10 ^{o} Brix.

Vitamin-C (mg/100g):-The data on Vitamin-C is given in table 8 and fig 14. All treatments were found significantly superior over the control (T_1). The maximum ascorbic acid content (126.31 mg/100g) was recorded in T_9 (50% FYM + 50%NPK + Biofertilizers) followed by (123.23mg/100g) in treatment T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) and T_{10} (50% Pig manure + 50% NPK + Biofertilizers). The control treatment recorded minimum ascorbic acid content (86.04 mg/100g).

Status of major nutrient, organic carbon and soil pH after harvest in soil:-From Table 9 and Fig. 15, it is evident that all treatments recorded higher available nitrogen after harvest over control. T_2 (100% NPK) showed maximum available N (326.64 kg ha^{-1}) followed by 291.65kg ha^{-1}, 289.43kg ha^{-1} in T_9 (50% FYM + 50% NPK + Biofertilizers), T_{10} (50% Pig manure + 50% NPK + Biofertilizers), respectively.The available P_2O_5 after harvest has been given in Table 9 and Fig. 16. Treatment T_9 (50% FYM + 50% NPK + Biofertilizers), recorded maximum available P_2O_5 (15.48 kg ha^{-1}) after harvest followed by T_{10} (50% Pig manure + 50% NPK + Biofertilizers) and T_{11} (50% Vermicompost + 50%NPK +Biofertilizers) respectively All treatments recorded higher P_2O_5 over control. From Table 9 and Fig. 17, it is clear that maximum available potassium after harvest 253.04 kg ha^{-1} in T_9 (50% FYM + 50% NPK + Biofertilizers), is significant over other treatments followed by 232.24kg ha^{-1} in T_{10} (50% Pig manure + 50% NPK + Biofertilizers). All treatments recorded significantly higher available potassium content after harvest over 179.21kg ha^{-1}in T_1 (Control). From the Table 9 and Fig. 18, it is evident that T_9 (50% FYM + 50% NPK + Biofertilizers) recorded maximum organic carbon (2.06%) followed by T_{10} (2.03%). However, organic carbon level in T_{10} (50% Pig manure + 50% NPK + Biofertilizers) and

T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) were at par. The analysis of the data shows that the effect of integrated nutrient application has significant influence on organic carbon level after harvest. T_1 (Control) recorded minimum organic carbon (1.76%) after harvest. From the Table 9 and Fig. 19, it is evident that T_9 (50% FYM + 50% NPK + Biofertilizers) recorded highest soil pH (5.01) after harvest which was followed by T_{10} (50% Pig manure + 50% NPK + Biofertilizers) and T_{11} (50% Vermicompost + 50% NPK + Biofertilizers) respectively. From statistical analysis it has been found that treatment differences among various treatment applications were not significant. T_1 (Control) recorded minimum soil pH (4.98) after harvest.

Economics of different treatments:-Economics of different treatments in capsicum are presented in Table 10. From the table, it is evident that the most profitable treatment was T_9 (50% FYM + 50%NPK + Biofertilizers), also showing the highest benefit cost ratio of 1:8.16 followed by T_{10} (50% Pig manure + 50% NPK + Biofertilizers). T_9 (50% FYM + 50%NPK + Biofertilizers) gave the highest net return of Rs. 793858.00, followed by Rs. 727738.00 in T_{11} (50% Vermicompost + 50% NPK + Biofertilizers). T_1 (control) recorded the least cost benefit ratio of 1:1.67 with a net return of Rs.148200.

IV. CONCLUSION AND DISCUSSION

Bell pepper is a highly priced and choice vegetable, providing rich source of vitamin A, B and C. It is largely grown around urban centre and is often sold at a premium price compared to other vegetables. The crop responds to various biotic and abiotic factors, of which the growth environment and requisite nutrient supplementation are of foremost importance. The nutrient requirement can be met through chemical fertilizers, organic manures and biofertilizers which constitute the main sources of plant nutrients. However, in order to trigger off production, indiscriminate use of chemicals has been observed in many parts of the country which has questioned the nutritional security of the crop and also its adverse impact on the environment. The long term sustainable production of the crop thus needs balanced supply of essential plant nutrients in available form, which involves systematic exploitation of potential soil resources, chemical fertilizers, biofertilizers and organic manures.The use of organic manures was suggested a long time in capsicum and the efficiency of FYM, vermicompost, green manures, compost etc. are established, as its application triggers the microbial activity and results in increased mineralisation of soil nutrients. There is also a positive response of crops to biofertilizer application. Nevertheless, there appears to be a degree of inconsistency of results depending upon the type of inoculants used, agro-climatic condition, method of inoculation, interaction between strains, nutrient interaction etc. It is this inconsistency of crop response which poses a problem in the popular use of Biofertilizers which needs to be tackled and their use perfected for their regular application. It is evident that capsicum responds to incorporated plant nutrients in terms of growth, yield and quality. But very few inquisitions have been carried out to determine the exact effect of individual plant nutrient sources and their combination with Biofertilizers. It was therefore felt necessary to investigate the effect of different sources of manuring on growth yield and quality of capsicum under low cost poly-house conditions. The results thus obtained in this regard as presented in previous chapter are discussed in the light of available literature and evidence as follows.

Growth characteristics:- It is evident from the present investigation that different types of manures viz., FYM, pig manure, vermicompost and various doses of NPK fertilization and their combinations with biofertilizers viz., *Azospirillum* and *Phosphotica* have differential positive effect on the growth attributes such plant height, number of leaves and leaf area of capsicum. In general, most of the treatment was found effective in increasing the plant growth at all stages significantly as compared to control. Plant height was recorded maximum (54.46 cm) with application of T_9 (50% FYM + 50%NPK + Biofertilizers) at all stages of observation and was found significantly superior to treatments with integration with biofertilizers as well as those treatment without any integration. Quiang *et al.* (2001) also reported that mixed organic fertilizer greatly promoted the growth and development of sweet pepper. On the other hand, Sajan *et al.* (2002) also reported that in chilli cv. Byadagi Dabba, plants inoculated with *Azotobacter, Azospirillum,* PSB and VAM in combination with 75% NP + 100% K recorded maximum plant height (100.3 cm) Similar, results were also obtained by Chumyani *et al.* (2012) and Vimera *et al.* (2012), they reported that 50%NPK + 50% FYM + Biofertilizers recorded maximum plant height in tomato and king chilli respectively. The number of leaves like other growth characters was recorded maximum with application of T_9 (50% FYM + 50%NPK + Biofertilizers) at all stages of observation. This result confirmed by Ghoname and Shaffek (2005) who reported that in sweet pepper (*Capsicum annum* L.) application of organic manure combined with biofertilizers and mineral N resulted in vigorous plant expressed as plant height, number of leaves and stem as well as shoot dry weight. Leaves are the major site of photosynthesis and play an important role in plants for its growth, development, yield and quality. Therefore, the number of leaves and leaf area are important parameters to be considered. The treatments were found superior over all other treatments at all stages of observation. Leaf area like other growth parameters was recorded maximum with the application of T_9 (50% FYM + 50%NPK + Biofertilizers) at all stages of observation. This may be due

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to slow leaf area expansion at initial growth stages when different soil nutrients are yet to be absorbed by the plant. Yadav and Vijayakumari (2003) reported that in chilli (*Capsicum annum* L.) var. Plriapplication of vermicompost along with mixture of FYM, green manure, neem cake and NPK fertilizers effectively increased various biometric parameters. Similarly, Hangarge *et al.* (2004) reported that in chilli–spinach cropping system, recommended rates of NPK and organic sources of nutrients each alone does not have any significant effect on plant growth and other biometrics. Similarly, results were also obtained by Chumyani *et al.* (2012) and Vimera *et al.* (2012), they reported that 50% NPK + 50% FYM + Biofertilizers recorded maximum leaf area in tomato and king chilli respectively. Thus, the findings of these workers were in aligned with this conclusion.

Yield and yield attributing characters:-The findings of the experiment indicated beneficial effect of integrating NPK fertilization with various organic manures as well as biofertilizers on yield and yield attributing characters of capsicum. Application of 50% FYM + 50% NPK + Biofertilizers recorded maximum result in all yield attributing characters such as fruit length (8.56 cm), fruit diameter (5.63 cm), number of fruits (10.48) and fresh weight of fruit (85.06 g). This result indicated positive effects of integrating NPK with manures as well as biofertilizers. This findings has close conformity with Harikrishna *et al.* (2002) who reported highest yield of fruits (54.32 t ha^{-1}) with treatment of FYM (25 t ha^{-1}) + 75% recommended dose of NPK + *Azospirillum* from their study on integrated nutrient from their study on integrated nutrient management on availability of nutrient in tomato. Maximum yield per plant (891.42 g), yield per plot (8.02 kg) as well as projected yield per hectare (297.04 q) were recorded highest in the treatment combination of T_9 50% FYM 50% + NPK + Biofertilizers. This can be due to corresponding response to increased yield attributing characters attained previously under this treatment combination. This has conformity with Ravanappa *et al.* (1997) who reported that in chillies higher yield can be obtained due to higher number of fruits with improved fruit yield parameters such as width, volume and weight. Again this conclusion has conformity with the findings of Sajan *et al.* (2002). Similar results have been reported by Chumyani *et al.* (2012) and Vimera *et al.* (2012) in kingchills respectively.

Quality attributes:-Quality of chilli is generally evaluated in terms of TSS and vitamin C. It is observed that combination treatment of T_9 50% FYM + 50% NPK + Biofertilizers significantly increased the TSS (9.55 º Brix) and ascorbic acid (126.31 mg/100g). Similar findings were also reported by Mahmood and Amara (2000) who found that biofertilizers application combined with 50% RDF gave the highest TSS and vitamin C content as well as nutrient content of fruit. Rofi *et al.* (2002) also concluded that application of 50% recommended dose of FYM @ 12.5 t ha^{-1} along with 50% of RDF (100:50:50 kg NPK ha^{-1}) resulted in the highest TSS (6.08%) and ascorbic acid content (26.76 mg/100g). Ghoname and Shafeek (2005) and Chumyani *et al.* (2012) observed that application of 50% NPK + 50% FYM + Biofertilizers recorded maximum TSS and vitamin C in capsicum and tomato. Vimera *et al.* (2012) also reported maximum vitamin C (117 mg/100g) by the application of 50% NPK + 50% FYM + Biofertilizers in king chilli. The comparative higher level of both TSS and vitamin C upon treatments with integration may be due to action of specific soil nutrients which may be made more readily available into the soil for plant absorption as a result of mineral fertilizer + lone organic manure 'or' with biofertilizers integration effect which in turn may activate specific enzymes for the synthesis of these compounds. It is therefore certain that specific nutrients in soil play a vital role in determining these quality parameters.

Status of major nutrients, organic carbon and pH after harvest:-The status of availability of major nutrients, organic carbon and pH after harvest as per findings revealed that application of 100% NPK gave maximum available N (326.64 kg ha^{-1}) after harvest which was followed by (291.65 kg ha^{-1}) in T_9 (50% FYM + NPK + Biofertilizers). The probable cause of high available nitrogen after harvest in 100% NPK may be due to poor soil physical structure, lack of organic manures and microbial activities thus resulting in poor utilization of N to plants at its growth stages. As such the applied N could bring about higher residual nitrogen in soil after harvest. On the other hand, application of 50% FYM + 50% NPK + Biofertilizers obtained maximum available P_2O_5 (15.48 kg ha^{-1}) and available K_2O (253.04 kg ha^{-1}) after harvest followed by (14.75 kg ha^{-1}) and (232.24 kg ha^{-1}) through the application of 50% Pig manure + 50% NPK + Biofertilizers (*Azospirillum* + *Phosphotica*). Maximum organic carbon (2.06%) and soil pH (5.01) after harvest were recorded with the application of 50% FYM + 50% NPK + Biofertilizers in T_9. The comparative higher level of P_2O_5, K_2O, organic carbon and soil pH in 50% NPK + 50% (FYM or Pig manure) + Biofertilizers after harvest may be attributed to increased microbial activities in the root zone which decomposed organic manures and also fixed unavailable form of mineral nutrients into available form in soil thereby substantiates crop requirements and also further enhances residual P and K besides improving organic carbon level and stabilizing soil pH. The effects of different sources of manuring on the general nutrient availability in the soil after harvest is better than those treatments without integration with the exception of 100% NPK which gave the highest available N after harvest. Similar results were reported by Hangarge *et al.* (2004) who reported enhanced availability of N, P, K and organic carbon content in soil under chilli – spinach cropping with integrated nutrient management system. On the other hand, Vimera *et al.* (2012) reported that available NPK and organic carbon in soil after harvest were significantly influenced by application of NPK fertilizers, organic manures and biofertilizers alone or in combination. He also reported that application of 50% FYM + 50% NPK + Biofertilizers resulted in highest available phosphorus and organic carbon.

Economics of the treatments:-It is evident from the findings that the most profitable way for cultivating chilli could be achieved by application of T_9 50% FYM + 50% NPK + Biofertilizers (*Azospirillum* + *Phosphotica*) which gave the highest net income of Rs. 793858.00 followed by Rs. 645468.00 with the application of T_{10} 50% Pig manure + 50% NPK + Biofertilizers (*Azospirillum* + *Phosphotica*). The reason of high profitability in these two modes of integration can be due to lower cost of inputs and higher yield. The treatments with integration of mineral fertilizers with either manure alone or both manure and biofertilizers were found to be more profitable which ultimately gave higher benefit cost ratio. Similar results were also reported by Sentiyangla *et al.* (2010) in radish, Chumyani *et al*. (2012) in tomato and Vimera *et al*. (2012) in king chilli. The present investigation entitled "Effect of different sources of manuring on growth, yield and quality of capsicum cv. California Wonder under low cost poly-house condition" was carried out in the experimental farm of the Experimental farm of Bhagwant University, Ajmer during the period of October 2015 to March 2016, to study the effect of various manures and Biofertilizers and its combination effect on the following objectives. (i) To study the effect of different manuring sources on growth, yield and quality of capsicum. (ii) To study the fertility status of soil before and after harvest. (iii) To study the economics of capsicum production for different treatments. The results thus obtained have been summarized below. The effect of various treatments on the mean values of growth characters in capsicum showed different variations. Growth characters with respect to plant height (34.15 cm, 40.15 cm, 44.95 cm, 50.25 cm and 54.46 cm), number of leaves (27.27, 27.65, 31.87, 34.58 and 38.89) and leaf area (50.74 cm^2, 52.59 cm^2, 55.75 cm^2, 54.45 cm^2 and 54.60 cm^2) were found maximum with integrated application of 50% FYM + 50% NPK Biofertilizers (T_9). Similarly, the effect of treatment combinations on yield and yield attributing characters were observed and found superior over control and also over those treatments without any integration. Fruit length (8.56 cm), and fruit diameter (5.63 cm), number of fruits (10.48) and fresh weight of fruit (85.06 g) were observed maximum with integrated application of 50% FYM + 50% NPK Biofertilizers (T_9).Maximum yield per plant (891.42 g), yield per plot (8.02 kg) and yield per hectare (297.04q) were also obtained with integrated application of 50% FYM + 50% NPK Biofertilizers (T_9). The highest level of TSS content (9.55 ºBrix) and ascorbic acid content (126.31 mg/100g) were also recorded with integrated application of 50% FYM + 50% NPK Biofertilizers (T_9). Maximum available N (326.64 kg ha^{-1}) in soil after crop harvest was obtained from loan application of 100% NPK (T_2). Whereas, maximum available P_2O_5 (15.48 kg ha^{-1}), K_2O (253.04 kg ha^{-1}), organic carbon (2.06%) and soil pH (5.01) in soil after harvest were also obtained from integrated application of 50% FYM + 50% NPK Biofertilizers (T_9). The economics of different treatments were calculated and highest profit (Rs 7, 93,858) and highest cost benefit ratio of 1:8.16 was obtained from the integrated application of 50% FYM + 50% NPK Biofertilizers (T_9).Thus from the present investigation it could be inferred that application of 50% FYM + 50% NPK + Biofertilizers had beneficial effect on the growth, yield, quality and net income (profit) in capsicum cultivation under low cost poly house condition.

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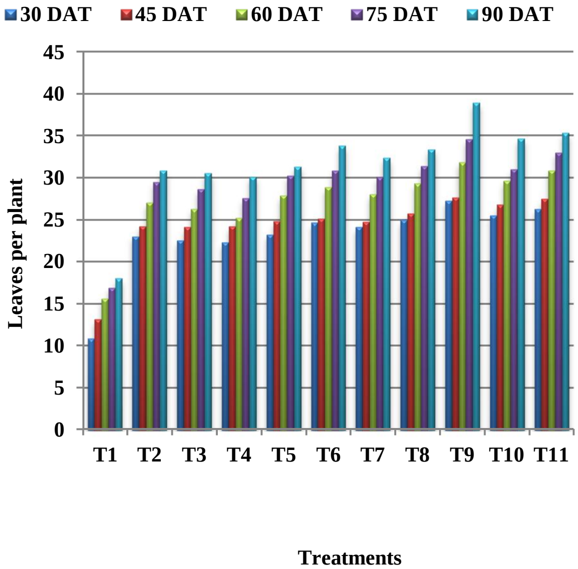

Fig. 4: Effect of different sources of manuring on leaves per plant of capsicum

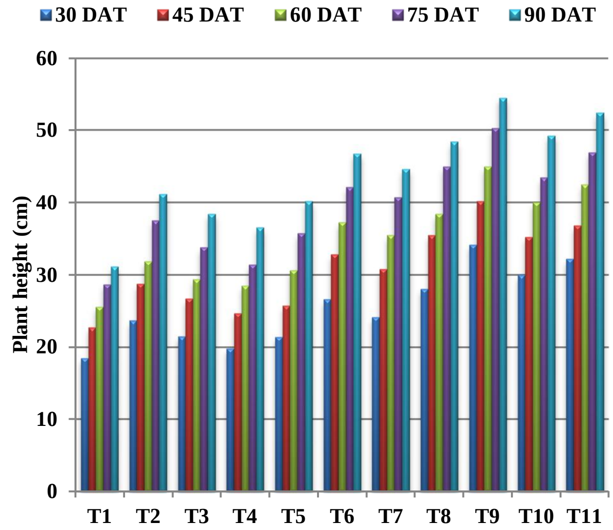

Fig. 3 : Effect of different sources of manuring on plant height of capsicum

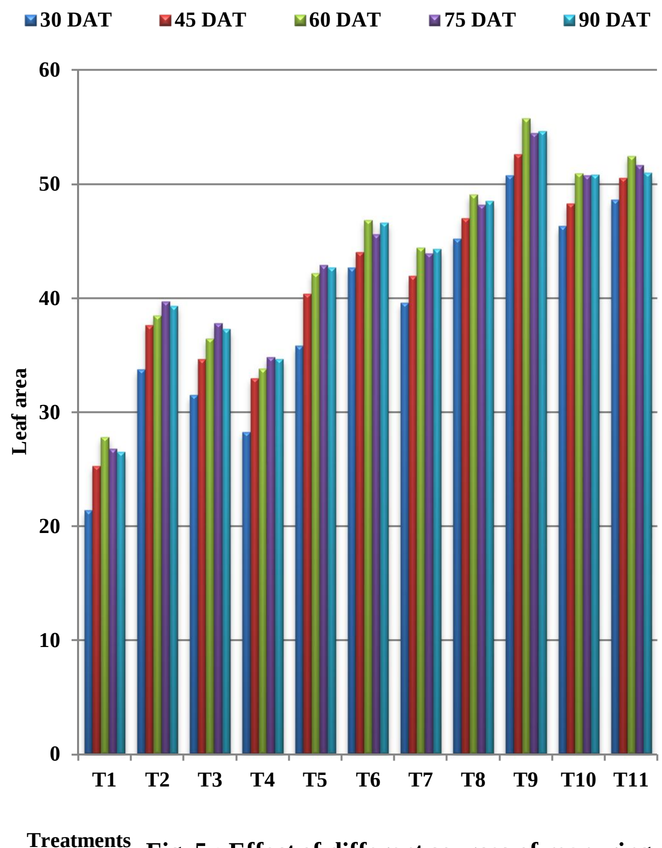

Fig. 5 : Effect of different sources of manuring on leaf area of capsicum.

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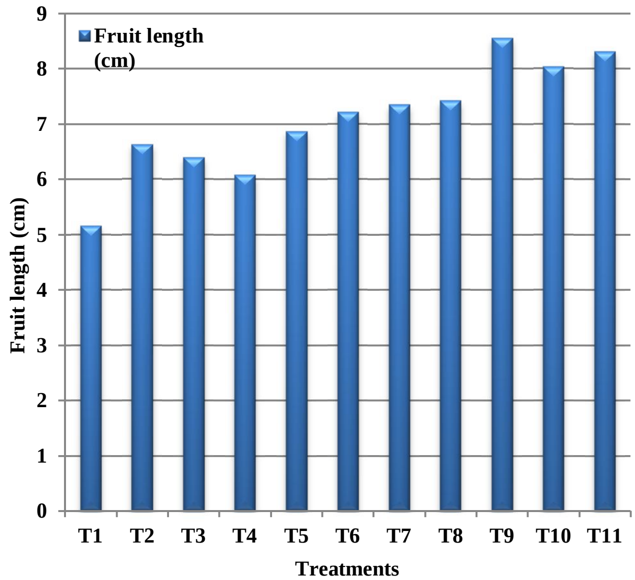

Fig. 6 : Effect of different sources of manuring on fruit length of capsicum

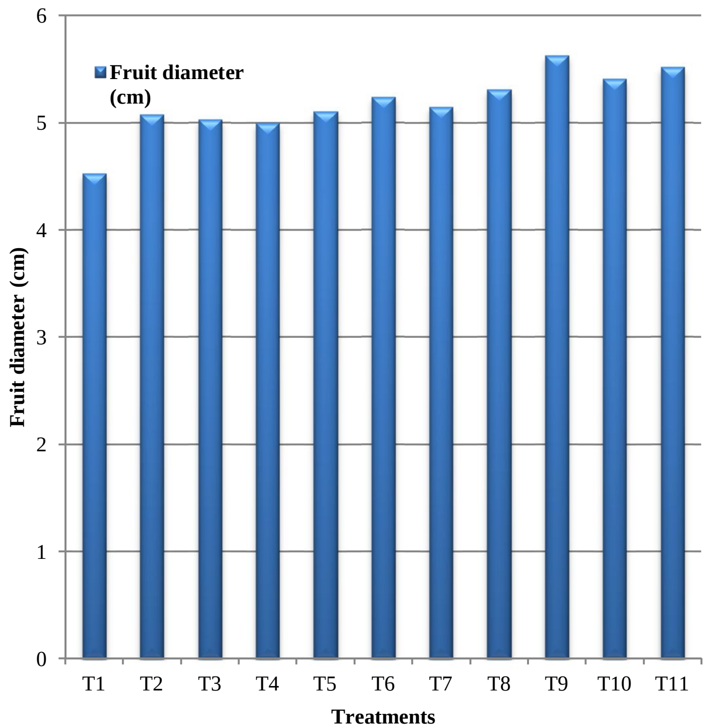

Fig. 7 : Effect of different sources of manuring on fruit diameter capsicum

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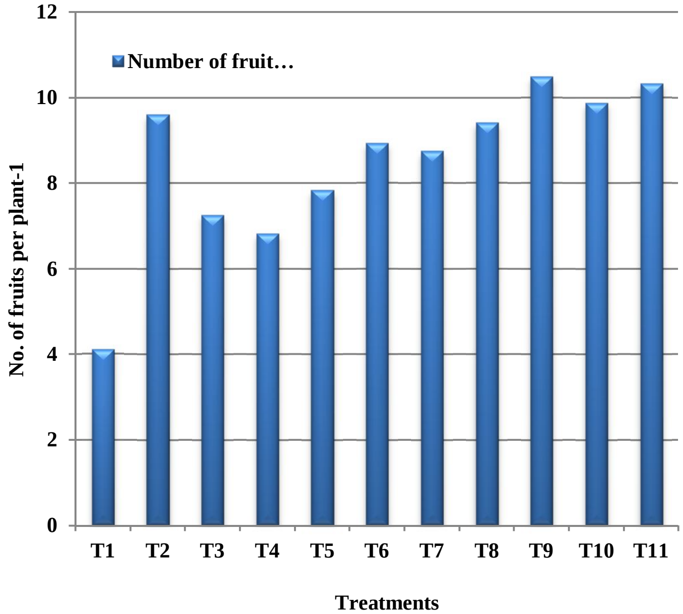

Fig. 8 : Effect of different sources of manuring and no. of fruits/plant of capsicum

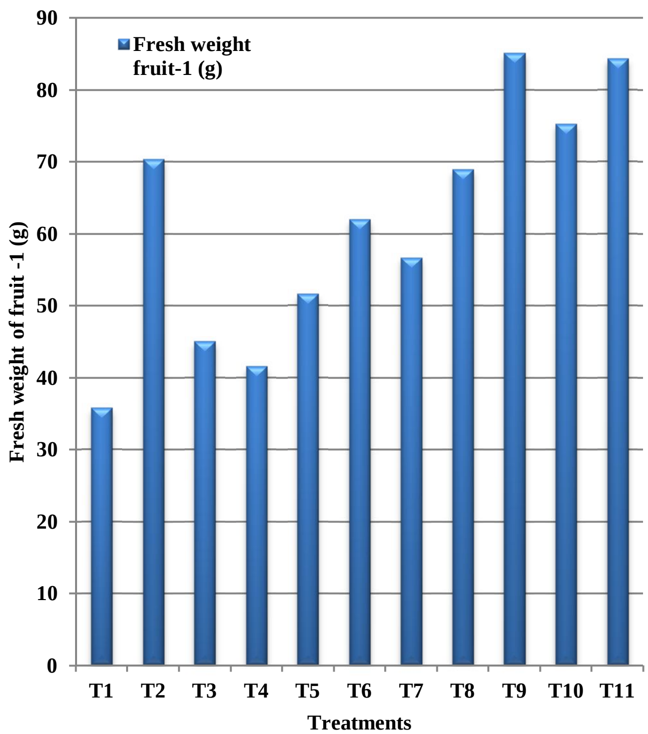

Fig. 9: Effect of different sources of manuring on fresh weight of fruits

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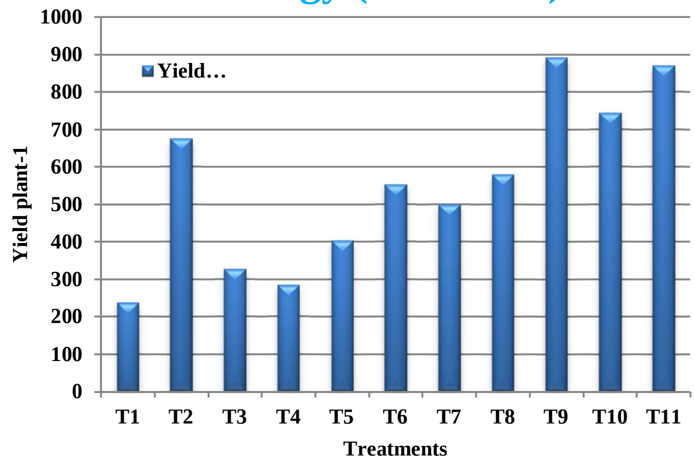

Fig. 10: Effect of different sources of manuring on capsicum

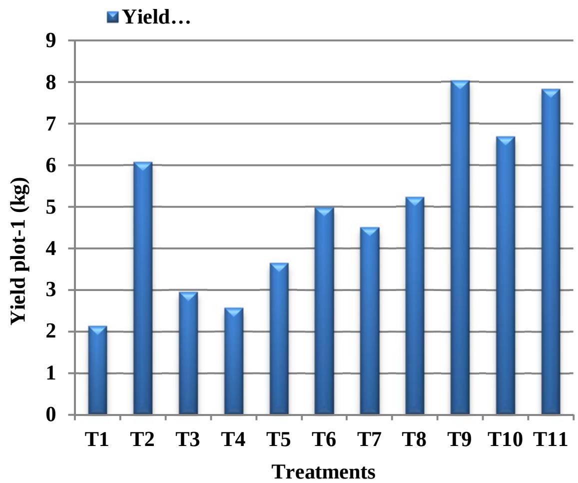

Fig. 11: Effect of different sources of manuring on capsicum

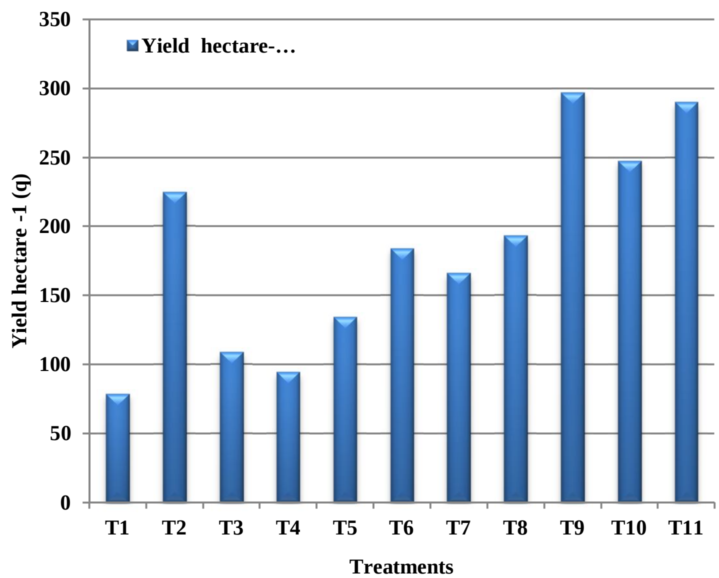

Fig. 12: Effect of different sources of manuring on capsicum

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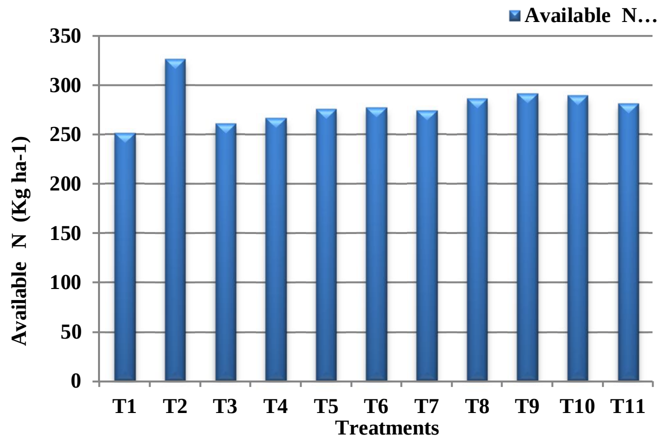

Fig. 15: Status of Nitrogen in soil after harvest

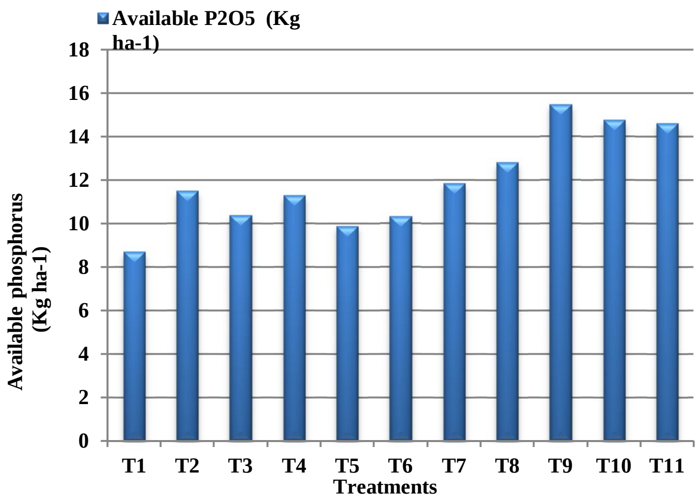

Fig. 16: Status of Phosphorus in soil after harvest

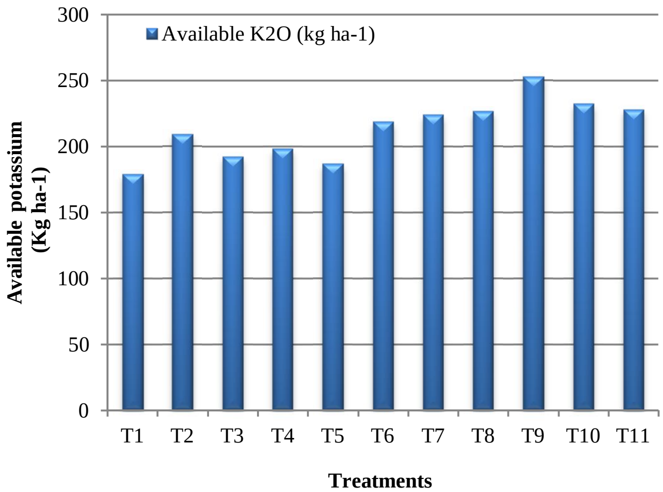

Fig. 17: Status of Potassium in soil after harvest

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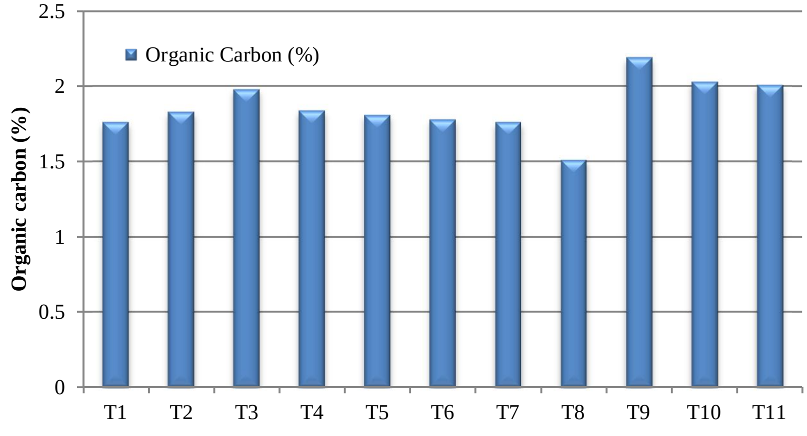

Fig. 18: Status of Organic carbon in soil after harvest

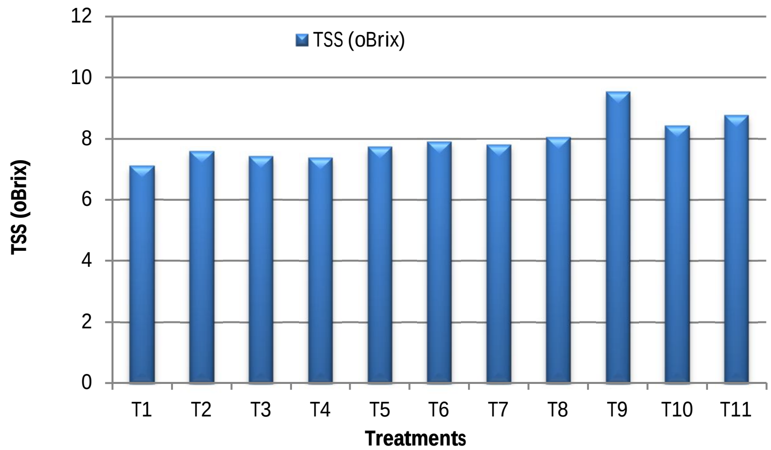

Fig. 13: Effect of different sources of manuring on capsicum

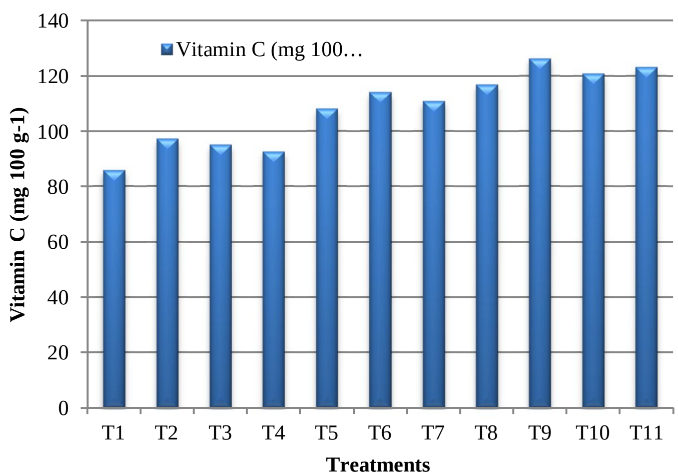

Fig. 14: Effect of different sources of manuring on capsicum

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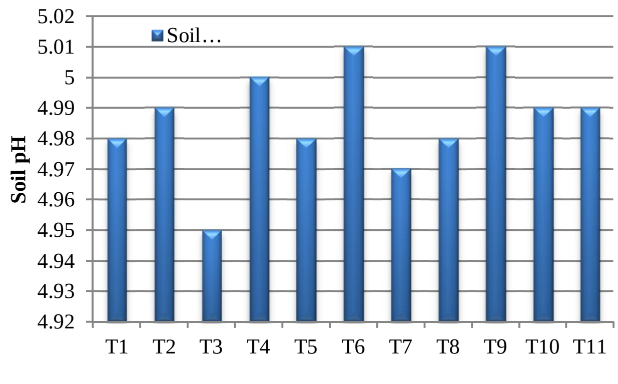

Fig. 19: pH Status after harvest

Table 2.Initial soil fertility status of experimental plots

PARAMETER	VALUE	STATUS	METHOD EMPLOYED
PH	4.9	ACIDIC	DIGITAL PH METER (SINGLE ELECTRODE METER)
ORGANIC CARBON (%)	1.85	HIGH	WALKLY AND BLACK METHOD, RAPID TITRATION METHOD (PIPER, 1966)
AVAILABLE N (KG HA^{-1})	296.43	MEDIUM	ALKALINE – POTASSIUM PERMANGANATE METHOD (SUBBIAH AND ASIJA, 1956)
AVAILABLE P_2O_5(KG HA^{-1})	11.13	MEDIUM	BRAY AND KURTZ METHOD, 1954
AVAILABLE K_2O (KG HA^{-1})	248.76	MEDIUM	FLAME PHOTOMETER (HANWAY AND HEIDAL, 1952)

Table 3- Effect of different sources of manuring on plant height of capsicum.

TREATMENTS	PLANT HEIGHT (CM)				
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
T_1 -CONTROL	18.45	22.71	25.53	28.66	31.14
T_2- 100% NPK (100:60:60 KG HA^{-1})	23.65	28.72	31.82	37.52	41.13
T_3- FARM YARD MANURE 20 T HA^{-1}	21.47	26.67	29.35	33.74	38.39
T_4- PIG MANURE 15 T HA^{-1}	19.74	24.66	28.48	31.36	36.52
T_5 -VERMICOMPOST 10 T HA^{-1}	21.38	25.71	30.60	35.70	40.17
T_6 -50% FYM + 50%NPK	26.57	32.77	37.23	42.15	46.76
T_7-50% PIGMANURE + 50%NPK	24.15	30.76	35.43	40.73	44.64
T_8 -50% VERMICOMPOST+ 50%NPK	28.02	35.50	38.37	44.93	48.41
T_9 -50% FYM + 50%NPK + BIOFERTILIZERS	34.15	40.15	44.95	50.25	54.46
T_{10} -50% PIGMANURE+50%NPK + BIOFERTILIZERS	30.00	35.21	39.96	43.42	49.24
T_{11}-50% VERMICOMPOST + 50% NPK+ BIOFERTILIZERS	32.17	36.77	42.50	46.93	52.36
SEM±	0.79	0.60	0.69	0.62	0.61
CD AT 5%	2.70	2.06	2.40	2.13	2.10

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Table 4:-Effect of different sources of manuring on leaves per plant of capsicum.

TREATMENTS	NUMBER OF LEAVES PLANT^{-1}				
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
T_1- CONTROL	10.87	13.12	15.63	16.92	18.03
T_2- 100%NPK (100:60:60 KG HA^{-1})	23.01	24.22	27.01	29.48	30.82
T_3- FARM YARD MANURE 20 T HA^{-1}	22.54	24.12	26.29	28.60	30.53
T_4 -PIG MANURE 15 T HA^{-1}	22.30	24.22	25.24	27.53	30.09
T_5-VERMICOMPOST 10 T HA^{-1}	23.24	24.82	27.87	30.24	31.32
T_6 -50% FYM + 50% NPK	24.64	25.11	28.84	30.84	33.81
T_7 -50% PIGMANURE + 50% NPK	24.11	24.72	28.03	30.09	32.34
T_8-50% VERMICOMPOST + 50% NPK	24.95	25.75	29.32	31.40	33.40
T_9 -50% FYM + 50%NPK + BIOFERTILIZERS	27.27	27.65	31.87	34.58	38.89
T_{10} -50% PIGMANURE+50%NPK + BIOFERTILIZERS	25.54	26.77	29.63	31.01	34.65
T_{11}-50%VERMICOMPOST+50%NPK+ BIOFERTILIZERS	26.28	27.49	30.82	33.01	35.31
SEM±	0.13	0.25	0.08	0.07	0.08
CD AT 5%	0.44	0.85	0.27	0.24	0.27

Table 5:- Effect of different sources of manuringon leaf area of capsicum.

TREATMENTS	LEAF AREA (CM^2)				
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
T_1- CONTROL	21.37	25.28	27.81	26.76	26.47
T_2- 100%NPK (100:60:60 KG HA^{-1})	33.72	37.61	38.47	39.70	39.30
T_3- FARM YARD MANURE 20 T HA^{-1}	31.47	34.66	36.45	37.76	37.26
T_4 -PIG MANURE 15 T HA^{-1}	28.25	32.97	33.78	34.79	34.64
T_5-VERMICOMPOST 10 T HA^{-1}	35.79	40.34	42.16	42.86	42.68
T_6 -50% FYM + 50% NPK	42.65	44.03	46.82	45.55	46.57
T_7 -50% PIGMANURE + 50% NPK	39.56	41.92	44.42	43.87	44.26
T_8-50% VERMICOMPOST + 50% NPK	45.19	46.99	49.05	48.14	48.47
T_9 -50% FYM + 50% NPK + BIOFERTILIZERS	50.74	52.59	55.75	54.45	54.60
T_{10} -50% PIGMANURE + 50% NPK + BIOFERTILIZERS	46.28	48.26	50.93	50.73	50.77
T_{11}-50%VERMICOMPOST+50% NPK + BIOFERTILIZERS	48.58	50.53	52.44	51.63	50.95
SEM±	0.17	0.19	0.31	0.44	0.37
CD AT 5%	NS	0.67	1.07	1.50	1.24

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Table 6:-Effect of different sources of manuring on yield attributes characters of capsicum.

TREATMENTS	FRUIT LENGTH (CM)	FRUIT DIAMETER (CM)	NO. OF FRUITS PLANT^{1}	FRESH WEIGHOF FRUIT^{-1} (G)
T_{1-} CONTROL	5.16	4.53	4.11	35.74
T_{2-} 100%NPK (100:60:60 KG HA^{-1})	6.63	5.08	9.60	70.30
T_{3-} FARM YARD MANURE 20 T HA^{-1}	6.40	5.03	7.25	45.00
T_{4} -PIG MANURE 15 T HA^{-1}	6.08	5.00	6.82	41.52
T_{5-}VERMICOMPOST 10 T HA^{-1}	6.87	5.11	7.83	51.57
T_{6} -50% FYM + 50% NPK	7.22	5.24	8.92	61.97
T_{7} -50% PIGMANURE + 50% NPK	7.35	5.15	8.74	56.69
T_{8}-50% VERMICOMPOST + 50% NPK	7.42	5.31	9.40	68.88
T_{9} -50% FYM + 50% NPK + BIOFERTILIZERS	8.56	5.63	10.48	85.06
T_{10} -50% PIGMANURE + 50% NPK + BIOFERTILIZERS	8.04	5.41	9.87	75.24
T_{11}-50%VERMICOMPOST+50% NPK + BIOFERTILIZERS	8.32	5.52	10.32	84.27
SEM±	0.10	0.01	0.09	0.91
CD AT 5%	0.33	0.03	0.29	3.11

Table 7:- Effect of different sources of manuring on yield of capsicum.

TREATMENTS	YIELD PLANT-^{1} (G)	YIELD PLOT^{-1} (KG)	YIELD HECTARE^{-1} (Q)
T_{1-} CONTROL	237.32	2.13	78.89
T_{2-} 100%NPK (100:60:60 KG HA^{-1})	674.88	6.07	224.81
T_{3-} FARM YARD MANURE 20 T HA^{-1}	326.25	2.94	108.88
T_{4} -PIG MANURE 15 T HA^{-1}	283.16	2.55	94.44
T_{5-}VERMICOMPOST 10 T HA^{-1}	403.37	3.63	134.44
T_{6} -50% FYM + 50% NPK	552.77	4.97	184.07
T_{7} -50% PIGMANURE + 50% NPK	499.54	4.49	166.30
T_{8}-50% VERMICOMPOST + 50% NPK	580.12	5.22	193.33
T_{9} -50% FYM + 50% NPK + BIOFERTILIZERS	891.42	8.02	297.04
T_{10} -50% PIGMANURE + 50% NPK + BIOFERTILIZERS	742.52	6.68	247.41
T_{11}-50%VERMICOMPOST+50% NPK + BIOFERTILIZERS	869.66	7.83	290.00
SEM±	11.14	0.08	2.98
CD AT 5%	38.20	0.32	3.43

Table 8:- Effect of different sources of manuring on quality parameter of capsicum

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VARIABLE COST	
COST OF SEED, 600 G @ RS. 10000/KG SEED	RS. 6,000
COST OF NURSERY RAISING, ONE MAN FOR 50 DAYS @ RS. 150/DAY/MAN	RS. 7,500
COST OF PLOUGHING, 2 TIMES @ RS. 2000	RS. 4,000
COST OF LAND PREPARATION, 50 MEN @ RS. 150/MAN	RS. 7,500
COST OF TRANSPLANTING, 50 MEN @ RS.150/ MAN	RS. 7,500
COST OF IRRIGATION, 5 TIMES @ RS. 1000/IRRIGATION	RS.5,000
COST OF CASUALTY (SEEDLING) REPLACEMENT BY 10 MEN @ RS 150/MAN	RS.1,500
INTERCULTURAL OPERATIONS, 3 TIMES BY 20 MEN @ RS. 150/MAN	RS. 9,000
COST OF PLANT PROTECTION	RS. 8,000
COST OF HARVESTING BY 50 MEN @ RS. 150/MAN	RS. 7,500
COST OF POLY HOUSE	RS 20,000
MISCELLANEOUS	RS. 5,000
TOTAL	RS. 88,500
TREATMENT COST	
T_1 - CONTROL	RS. 0.00
T_2 - 100 % NPK (100:60:60 KG HA^{-1}) COST OF N THROUGH UREA @ RS. 10/KG = RS. 2174 COST OF P_2O_5 THROUGH SSP @ RS. 10/KG = RS. 3750 COST OF K_2OTHROUGH MOP @ RS. 15/KG = RS. 1500	RS. 7,424
T_3 - FARM YARD MANURE 20T @ RS. 500/T	RS.10,000
T_4 - PIG MANURE 15T @ RS. 600/T	RS. 9,000
T_5 - VERMICOMPOST 10T @ RS. 10,000/T	RS. 1,00,000
T_6 - 50% NPK + 50% FYM	RS. 8,712
T_7 - 50% NPK + 50% PIG MANURE	RS. 8,212
T_8 - 50% NPK + 50% VERMICOMPOST	RS. 53,712
T_9 - 50% NPK + 50% FYM + BIOFERTILIZERS	RS. 8,762
T_{10}- 50% NPK + 50% PIG MANURE + BIOFERTILIZERS	RS. 8,262
T_{11}- 50% NPK + 50% VERMICOMPOST + BIOFERTILIZERS	RS. 53,762

Treatments	Cost of cultivation Rs. ha^{-1}			Yield (q ha^{-1})	Gross Income (Rs. ha^{-1}) @ Rs. 3000/q	Net income (Rs. ha^{-1})	Cost Benefit ratio
	Variable Cost (Rs.)	Treatment cost (Rs.)	Total cost (Rs.)				
T_1- Control	88500	-	88500	78.89	236700	148200	1:1.67
T_2- 100%NPK (100:60:60 kg ha^{-1})	88500	7424	95924	224.81	674430	578506	1:6.03
T_3- Farm Yard Manure 20 t ha^{-1}	88500	10000	98500	108.88	326640	228140	1:2.32
T_4 .Pig manure 15 t ha^{-1}	88500	9000	97500	94.44	283320	185820	1:1.90
T_5-Vermicompost 10 t ha^{-1}	88500	100000	188500	134.44	403320	214820	1:1.14
T_6 -50% FYM + 50% NPK	88500	8712	97212	184.07	552210	454998	1:4.68

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T_7 -50% Pigmanure + 50% NPK	88500	8212	96712	166.30	498900	402188	1:4.16
T_8-50% Vermicompost + 50% NPK	88500	53712	142212	193.33	579990	437778	1:3.08
T_9 -50% FYM + 50% NPK + Biofertilizers	88500	8762	97262	297.04	891120	793858	1:8.16
T_{10} -50% Pigmanure + 50% NPK + Biofertilizers	88500	8262	96762	247.41	742230	645468	1:6.67
T_{11}-50%Vermicompost+50% NPK + Biofertilizers	88500	53762	142262	290.00	870000	727738	1:5.11

Table 10:- Economics of the treatments (Rs. ha^{-1}).

Table 9:-Effect of different sources of manuring on the nutrient status of the soil after harvest.

TREATMENTS	AVAILABLE N (KG HA^{-1})	AVAILABLE P_2O_5 (KG HA^{-1})	AVAILABLE K_2O (KG HA^{-1})	ORGANIC CARBON (%)	SOIL PH
T_1- CONTROL	251.56	8.69	179.21	1.76	4.98
T_2- 100%NPK (100:60:60 KG HA^{-1})	326.64	11.49	209.27	1.83	4.99
T_3- FARM YARD MANURE 20 T HA^{-1}	261.18	10.39	192.38	1.98	4.95
T_4 -PIG MANURE 15 T HA^{-1}	266.78	11.28	198.42	1.84	5.00
T_5-VERMICOMPOST 10 T HA^{-1}	276.38	9.89	186.63	1.81	4.98
T_6 -50% FYM + 50% NPK	277.13	10.32	218.75	1.78	5.01
T_7 -50% PIGMANURE + 50% NPK	274.25	11.86	224.19	1.76	4.97
T_8-50% VERMICOMPOST + 50% NPK	286.56	12.82	226.46	1.51	4.98
T_9 -50% FYM + 50% NPK + BIOFERTILIZERS	291.65	15.48	253.04	2.06	5.01
T_{10} -50% PIGMANURE + 50% NPK + BIOFERTILIZERS	289.43	14.75	232.24	2.03	4.99
T_{11}-50%VERMICOMPOST+50% NPK + BIOFERTILIZERS	281.39	14.61	228.32	2.01	4.99
SE (M)±	1.19	0.08	4.63	0.07	0.04
CD 5%	4.10	0.31	15.91	0.23	0.12

Fig. 1 : General view of the farm after transplanting

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Fig. 4 : Effect of different treatment on yield of Capsicum

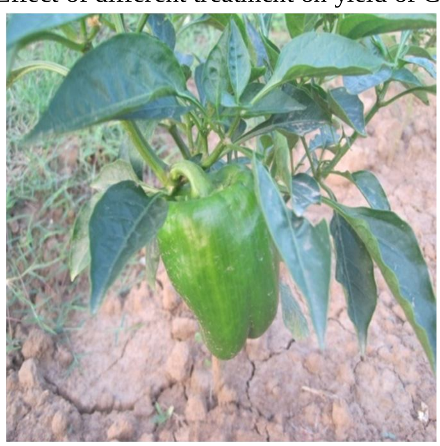

Fig. 2: T_1(Control)

Fig. 3: Individial plant from treatment T_9 (50% NPK + 50% Poultry manure) at fruit bearing stage

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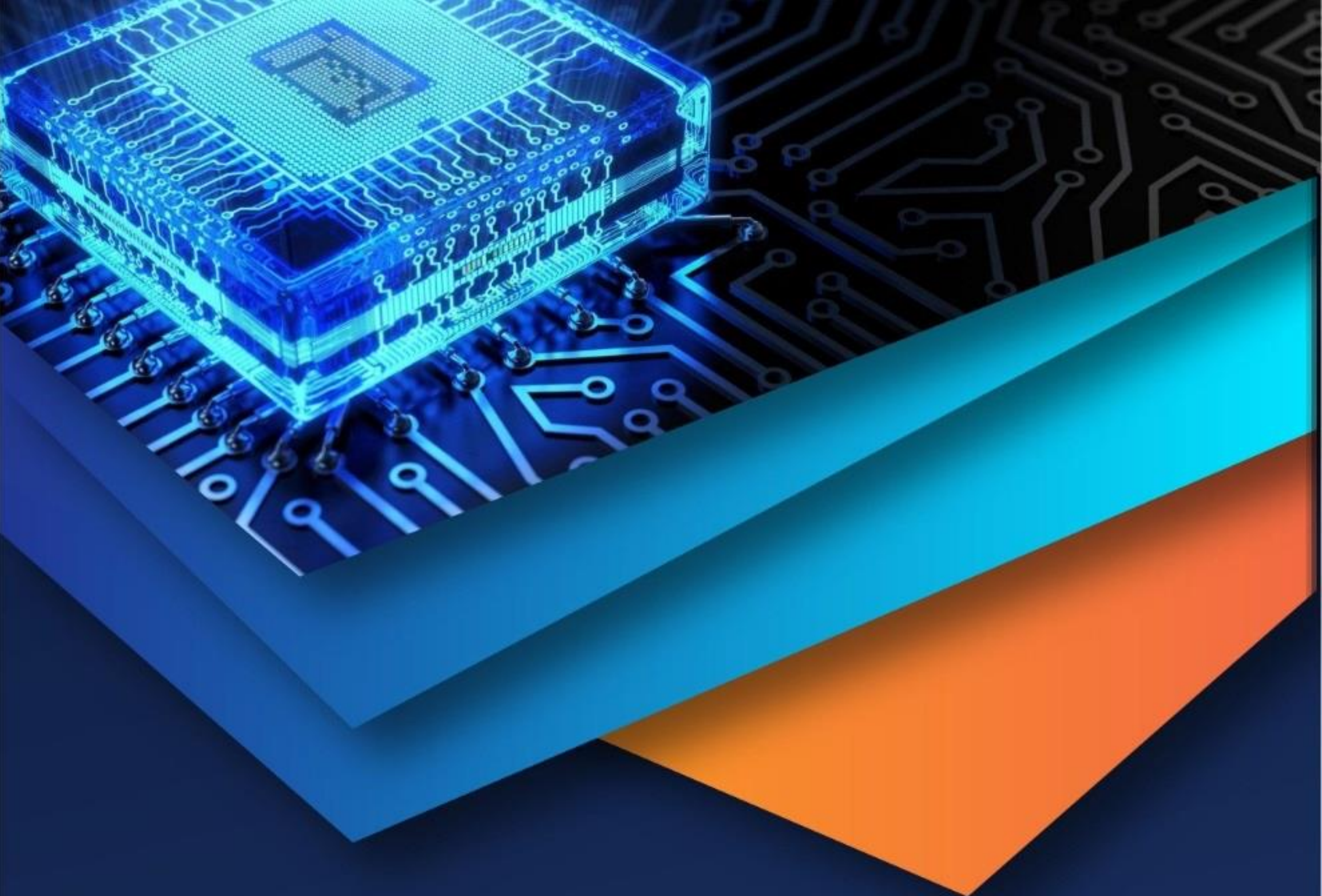

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