

Effect of organic manures and chemical fertilizers on the growth, yield and quality traits of summer squash (*Cucurbita pepo* L.)” cv. Punjab ChappanKaddu

Abstract

The present investigation was conducted during 2019 at DAV University, Jalandhar, to find out the effect of organic manures and chemical fertilizers on the growth and yield of summer squash (*Cucurbita pepo* L.) cv. Punjab Chappan Kaddu. The experiment consisted of eleven treatments and three replications. Out of these, an application of 25% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha (T₈) had a beneficial effect on minimum days to the first female flower (74.67 days), minimum days to the first fruit set (76.33), minimum days to the first fruit harvest (78.33). The maximum plant height (122.85cm) was recorded in 25% of the recommended dose of chemical fertilizer + FYM 25t/ha (T₅). 75% of the recommended dose of chemical fertilizer + EM (Effective Micro-organism) Bokashi 2.5q/ha (T₉) resulted in minimum days to male flower appearance. The maximum sex ratio (0.38), was obtained with the application of 50% of the recommended dose of chemical fertilizer + EM Bokashi 3q/ha (T₁₀). The maximum number of pickings (26) and number of fruit per plant (9.85) were obtained with the application of 50% of the recommended dose of chemical fertilizer + EM Bokashi 3q/ha (T₁₀). The maximum fruit yield per plant (2.20 kg), fruit yield per plot (26.26 kg), fruit yield per ha (405.57q) were recorded with the application of 50% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha (T₇). The maximum Total Soluble Solids (TSS) (2.40B°) were recorded with the application of 75% of the recommended dose of chemical fertilizer + FYM 20t/ha (T₃) while, the ascorbic acid was maximum (52.50mg/100g) when 25% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha (T₈) were applied. The highest net returns and benefit: cost (4.5) were obtained when 50% of recommended dose of chemical fertilizer + FYM 25t/ha (T₄) was applied.

Keywords: Summer squash, FYM, Vermicompost, EM Bokashi.

Introduction

Summer squash (*Cucurbita pepo* L.), is an important crop of the family Cucurbitaceae. It is grown during summer in tropical and subtropical conditions throughout the world. Its immature fruits are harvested for consumption as cooked vegetable and curries. It also possesses a medicinal value and thus used as medicinal plant (Majeed and Mahmoud 1988). The total global area under pumpkin, squash and gourd is 204.29 Million Hectares and global production is 2764.39 Metric Ton (Anonymous, 2018). India produces about 556.98 Metric Ton of pumpkin, squash and gourd from an area of 58.02 Million Hectares (Anonymous, 2018). In Punjab, Cucurbits occupy 5th rank in the area (17.01 thousand ha) and production (270.45 thousand ton) among different vegetable crops (Anonymous, 2019). Summer squash is a rich source of fiber, potassium, calcium, vitamin A, B and C, carotene and carbohydrates. Per 100g edible portion contains 94.8g moisture, 3.5g carbohydrates, 0.5g protein, 0.1g fat, 0.02mg thiamin, 18g vitamin C, 1mg calcium and 0.6mg iron (Dhaliwal, 2018). It also helps in preventing cancer, heart disease and asthma (Soodet *al.*, 2008).

All living beings require food for their growth and development. To meet the increasing population we need to increase agricultural production through various types of cultivations and practices, including type and method of fertilization. With the indiscreet use of fertilizers the productivity of land has been compensated. Therefore, there is a need for only safe/effective fertilization method which is low cost and environmental friendly. Equilibrium of nutrients in plant roots environment plays a vital role in plant growth and high yield crop. Organic manures sustain cropping systems through better nutrient recycling and improve the physical, chemical and biological properties of soil. Commonly used organic manures are FYM (Farm Yard Manure), vermi-compost, poultry manure, biogas slurry, urine and liquid manure etc (Kumar et al., 2018). Though a single nutrient source may not supply the

rest of the required nutrients for the plant but integrated use of all sources is required for balanced plant nutrition and it is necessary to make the judicious use of fertilizers in the right proportion for harvesting better yield. Thus it has been realized that chemical fertilizers must be integrated through more economic and eco-friendly organic manure to achieve sustainable productivity with high quality and minimum deterioration of the environment. Keeping in view the above-mentioned facts and figures the present investigation was planned to find out the effect of organic manures and chemical fertilizers on the growth, yield and quality traits on summer squash (*C. pepo* L.).

Materials and Methods

. The present experiment was laid out in Randomized Block Design and three replications. The variety grown for the investigation was Punjab Chappan Kaddu. Total eleven treatments consisting of different combinations of organic (FYM, Vermicompost and EM Bokashi) and chemical fertilizer NPK (Nitrogen Phosphorous Potash) at different levels (75% , 50% and 25% of the recommended dose of each nutrient) viz, T₁ (Absolute control), T₂ (100% of the recommended dose of fertilizer (NPK100:50:40kg/ha), T₃ (75% of the recommended dose of chemical fertilizer + FYM 20t/ha), T₄ (50% of the recommended dose of chemical fertilizer + FYM 25t/ha), T₅ (25% of the recommended dose of chemical fertilizer +FYM 25t/ha), T₆ (75% of the recommended dose of chemical fertilizer + vermi-compost10t/ha), T₇ (50% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha), T₈ (25% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha), T₉ (75% of the recommended dose of chemical fertilizer + EM Bokashi 2.5q/ha), T₁₀ (50% of the recommended dose of chemical fertilizer + EM Bokashi 3q/ha),

T₁₁ (25% of recommended dose of chemical fertilizer + EM Bokashi 3q/ha). The organic manure (FYM, Vermi-compost and EM Bokashi) and inorganic fertilizers (Urea, DAP and MOP) were applied in the experimental field as per the treatments wise and all the cultural practices were done as per the package of practices of Punjab Agricultural University. The obtained data were statically analyzed with using standard statistical method as suggested by Gomez and Gomez (1996).

Results and discussion

Analysis of Variance (ANOVA) revealed that the treatments significantly influenced all the characters viz., Plant height, days to the first male flower appearance, days to the first female flower appearance, sex ratio, days to the first fruit set, days to the first fruit harvest, number of picking, number of fruit per plant, fruit yield per plant, fruit yield per plot (kg/plot), fruit yield per hectare (q/ha), TSS and ascorbic acid except harvest duration.

1. Plant height (cm)

Plant height was reported to be significantly influenced by different combination doses of organic and inorganic nutrient sources in terms of integrated nutrient management as compared to control. Perusal of data revealed maximum plant height (122.85 cm) in T₅ which was statistically at par with T₈ (114.13cm), T₉ (109.43cm), T₁₁ (101.45cm), T₂ (101.18cm) and T₆ (100.87cm). Minimum plant height (69.85 cm) was recorded in T₁ which was significantly at par with T₁₀ (71.00cm), T₇ (72.45cm), T₄ (90.65cm) and T₃ (91.97cm).

Plant height was maximum when plants were supplied with 25% of the recommended dose of chemical fertilizer + FYM 25t/ha and minimum in control where no fertilizer was applied to plants. This may be due to the fact that the combined application of FYM and inorganic fertilizers increased the absorption of nutrients especially nitrogen which enhanced the cell division and cell elongation resulting in increased plant height (Singh *et al.* 2018). These findings corroborate the finding of Vishwakarma *et al.* (2007), Mahmoud *et al.* (2009) and Das *et al.* (2015). The findings are also in line with the findings of earlier researchers *viz.*, Martinetti and Paganini (2006), Pradhuet *et al.* (2006), Mulaniet *et al.* (2007), Azarmiet *et al.* (2009), Eifediyi and Remison (2010), Thriveniet *et al.*, (2015), Singh *et al.*(2017), Geethuet *et al.* (2018), Dash *et al.* (2018) and Baghelet *et al.* (2018) who also reported increased plant height with the use of Integrated Nutrient Management in other cucurbits.

2. Days to first male flower appearance:

The data revealed that T₉ showed minimum days to first male flower i.e 65.00. It was statistically at par with T₈ in which male flower appeared after 67.33 days and T₃ which resulted in first male flower production after 68.67 days. Maximum days to first male flower appearance (74.33) was observed in T₁ which was statistically at par with all the treatments except T₇ (71.00), T₃ (68.67) and T₈ (67.33).

T₉ (75% of the recommended dose of chemical fertilizer + EM Bokashi 2.5q/ha) resulted in minimum days to male flower appearance and the maximum days were observed in T₁. The earliness in flowering may be due to the better translocation of nutrients to the aerial parts of the plants and enhancement of the reproductive phase due to the combined effect of organic and inorganic fertilizers as compared to exclusive inorganic fertilizers (Kumura *et al.* 2019). The results are in line with the findings

of Martinetti and Paganini (2006), Ezzoet *al.* (2012), Thriveniet *al.* (2015), Vishwakarmaet *al.* (2007), Anjanappaet *al.* (2012) and Singh et al. (2017) who observed earliness with Integrated Nutrient Management.

3. Days to first female flower appearance:

Significant effect of different treatments was observed for days to the first female flower appearance. Minimum days to the first female flower (74.67) was observed in T₈ which was significantly at par with all other treatments except T₁ which produce the first female flower after 83 days. Maximum number of days to the first female flower was observed in T₁ which was significantly highest among all.

Earliness is an important character in summer squash as it will help the farmers to fetch higher price in the market. Though earliness is considered as a genetically controlled trait, other factors like environmental, cultural practices and nutrition of plants can also influence it to an appreciable extent. Among the major nutrients, Phosphorous plays a vital role in imparting earliness. The results clearly indicate better translocation of nutrients to aerial parts of the plants when fertilizers were applied in the integrated forms i.e. combination of organic and inorganic fertilizers which resulted in earlier female flower appearance in all the treatment combinations than the absolute control in which no fertilizers were applied. This might be due to the better nutritional status of the plants which was favoured by the treatments. Increased production of leaves might help to elaborate more photosynthates and induce flowering stimulus, thus affecting early initiation of a flower bud. Early vigorous growth seen in treatments with organic manures would have helped to synthesize more cytokinin by these plants which might have helped the translocation of these synthesized cytokinins as well as more quantity of available phosphorus through xylem vessels and

accumulation of cytokinin and phosphorus in these axillary buds would have favoured the plants to enter into the reproductive phase (Amrithalingam and Balakrishnan, 1988). The results are in line with the findings of Martinetti and Paganini (2006), Ezzo *et al.* (2012), Kumar *et al.* (2012), Thriveni *et al.* (2015), Vishwakarma *et al.* (2007), Anjanappa *et al.* (2012) and Singh *et al.* (2017).

4. Sex ratio:

It was observed that treatments showed significant difference for sex ratio. Highest sex ratio (0.38) was recorded in T₁₀ and T₇ which was statistically at par with T₉ and T₂ showing 0.34 sex ratio. Lowest sex ratio (0.19) was observed in T₈ which was statistically at par with T₁ showing sex ratio 0.23.

Sex ratio which is expression of the ratio of female flowers to male flowers was maximum when 75% of the recommended dose of chemical fertilizer +FYM 20t/ha or 50% of the recommended dose of chemical fertilizer +vermi-compost 15t/ha was applied to the plants. Lowest sex ratio was observed when 25% the recommended dose of chemical fertilizer + vermi-compost 15t/ha was applied. The reason behind the more number of female flowers may be due to the supply of nitrogen, phosphorous and potassium through the organic and inorganic sources of nutrients at an optimum level (Singh *et al.* 2018). It was minimum when no fertilizers were applied. The lowest sex ratio may be due to the production of almost the same number of pistillate flowers as that of staminate flowers. The results are in conformity with the finding of Anjanappa *et al.* (2012), Gill *et al.* (2012) and Singh *et al.* (2017) who also reported higher sex ratio in integrated nutrient management.

5. Days to first fruit set:

Significant difference was observed among treatments for days to first fruit set. Minimum days to first fruit set (76.33) were recorded in T₈ and T₁₀ which were statistically at par with all other treatments except T₉ producing first fruit after 78 days, T₁₁ producing fruits after 78.33 days. T₁ produced fruits after 84 days which, was significantly maximum among all the treatments. Minimum days to the first fruit set was observed when plants were supplied with 25% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha and 50% of the recommended dose of chemical fertilizer + EM Bokashi 3q/ha. Days to first fruit set shows the similar trend as shown by days to female flower appearance. The earliness might be also due to the enhanced production of growth-promoting substances like gibberellic acid, IAA (Indole Acetic Acid) by the application of vermi-compost which induces the earliness of female flower production [Sreenivas *et al.* (2000) and Kameswari *et al.* (2010)]. Bokashi is an organic fertilizer produced by fermentation of organic material such as rice bran. It contains both decomposed and undecomposed organic matter, microbial biomass and intermediate and ultimate substances produced by microbes produced during fermentation (Yamada *et al.*, 2003). The earliness in fruit setting in the plants supplied with 50% of recommended dose of chemical fertilizer + EM Bokashi 3q/ha could be due to the presence of microbes which could have enhanced the production of growth-promoting substances like gibberellic acid, IAA as observed with the application of vermi-compost. The integrated approach of nutrient application has improved earliness in fruiting as compared to unfertilized plot. These findings are in line with the finding of Arshad *et al.* (2014) and Moharana *et al.* (2017). The results of present finding

revealing earliness included the application of organic and inorganic fertilizers in an optimum level corroborate with the finding of earlier researcher Martinetti and Paganini (2006), Ezzon *et al.* (2012), Kumar *et al.* (2012), Thriveni *et al.* (2015), Vishwakarma *et al.* (2007), Anjanappa *et al.* (2012) and Singh *et al.* (2017).

6. Days to first fruit harvest:

. The results revealed that the minimum days to first fruit harvest (78.33) were recorded with treatment T₈. This was statistically at par with T₁₀ which resulted first fruit harvest after 78.67 days, T₂, T₃, T₇ and T₄ which resulted first fruit harvest after 79 days. Maximum days to first fruit harvest 87.00 were observed in T₁ which was significantly highest among all.

Least number of days to fruiting in most of the treatment combinations except T₁ where no fertilizer was applied may be attributed to the fact that the judicious integration of organic manures with inorganic fertilizers are capable of supplying an optimum level of nutrient along with favourable growing media efficient in inducing early flowering in the very treatment. These results are in close conformity with the experimental findings of Vishwakarma *et al.*, (2007) in spine gourd, Mohan *et al.*, (2016) and Singh *et al.*, (2018) in cucumber.

7. Harvest Duration

Harvest duration gives us information about the time period starting from first harvest to the last harvest. The effect of organic and inorganic fertilizer was non-significant for harvest duration. It was maximum (54.33 days) in T₅ (25% of the recommended dose of chemical fertilizer +FYM25t/ha) and T₈ (25% of the recommended dose of chemical fertilizer +Vermi-

compost15t/ha) while it was minimum (47.67 days) in T₁ (Absolute control). The non-significant effect of organic and inorganic fertilizer for harvest duration in the current study indicated that plants were provided with enough nutrients to continue fruit production irrespective of the components of different fertilizer treatments as per the potential of the cultivar.

8. Number of picking

Number of pickings signifies the frequency of harvesting. The data indicates that the treatment combination revealed significant difference for number of picking. It was noticed that T₁₀ showed maximum (26) number of picking. This was statistically at par with all the treatments except T₄ showing 17.67 pickings, T₁ resulting 15.67 pickings. Minimum (11.00) number of picking was observed in T₃ which was significantly lowest among all the treatments. More number of picking is related to earliness and more number of female flowers in a particular treatment. The reason behind the more number of female flowers in almost all the treatments may be attributed to the supply of nitrogen, phosphorous and potassium through the organic and inorganic sources of nutrients at an optimum level. These results are in close conformity with the experimental findings of Vishwakarma *et al.*, (2007) in spine gourd, Mohan *et al.*, (2016) and Singh *et al.*, (2018) in cucumber who also reported early harvesting with integrated nutrient management.

9. Number of fruit per plant

Significant differences for number of fruit per plant per picking were observed among treatments. Data revealed maximum number of fruit per plant (9.85) in T₁₀. It was statistically at par with T₄ producing 9.33 fruits per plant per picking, T₇ (9.22),

T₆ (8.23) and T₃ (8.60). The minimum number of fruits per plant per picking (3.97) was observed in T₁ which was statistically at par with T₈ (5.75), T₂ (5.67) and T₉ (5.13).

It was observed that number of fruits per plant was higher in plants which were supplied with integrated use of organic manures and chemical fertilizers than in cases where only inorganic fertilizers (T₂) were supplied and when no fertilizers were supplied (T₁). This could be due to the fact that integrated use of organic manures and chemical fertilizers increased major elements like nitrogen, phosphorous and potassium through organic manures application which might have accelerated the synthesis of chlorophyll and amino acids leading to more translocation of photosynthates from leaves to fruits resulting in increased number of fruits per plant. Enhanced number of fruits per plant with the use of organic and inorganic fertilizers in combinations were also recorded by Martinetti and Paganini (2006), Multani *et al.* (2007), Azarmi *et al.* (2009), Eifediyi and Remison (2010), Mohan *et al.* (2016) and Mohrana *et al.* (2017).

10. Fruit yield per plant (kg)

Significant difference for fruit yield per plant was observed among treatments. Perusal of data reveals maximum fruit yield (2.20 kg) in T₇ which was statistically at par with T₄ producing 1.87 kg fruit yield per plant. Minimum fruit yield per plant (0.39 kg) was observed in T₁ which was statistically at par with T₃ resulting in 0.50 kg fruits per plant.

Aggrandized yield in T₇ (50% of the recommended dose of chemical fertilizer +Vermi-compost15t/ha) (2.20 kg) may be caused due to an ample concentration of endogenous plant growth regulators like auxin, vitamins and mineral in vermi-

compost which may have contributed to superior fruit characteristics encouraging more number of fruits per plant resulting in increased fruit yield per plant. Endogenous auxins are known to stimulate more number of female flowers in the plant as revealed from the higher sex ratio in T₇, could be the reason of the maximum fruit yield per plant. The results are in close conformity with the findings of Kameswari *et al.*, (2010). Similar findings were quoted from the experimental trial conducted by Shreeniwas *et al.*, (2000) in ridge gourd, Prabhu *et al.*, (2006) and Narayanamma *et al.*, (2010) in cucumber. Likewise, the possible reason behind the higher number of fruits resulting in the highest fruit yield in T₇ may be attributed to the earliness in female flower emergence, allowing maximum number of female flowers throughout the life span leading to more number of fruits which has ultimately contributed to the highest yield in T₇. These findings are in congruence with the findings of Anjanappa *et al.*, (2012) in cucumber, Thriveni *et al.*, (2017) in bitter gourd and Singh *et al.*, (2018) in cucumber.

11. Fruit yield per plot (kg)

Treatments revealed significant difference for fruit yield per plot. Maximum fruit yield per plot (26.26 kg) was observed in T₇ which was significantly higher than all other treatments except T₄ which resulted in 22.48 kg fruit yield per plot. Minimum fruit yield per plot (4.86 kg) was found in treatment T₁ which was significantly lowest among all the treatments except T₃ producing 6.13 kg per plot yield.

.The higher yield due to integrated nutrient management was reported earlier in pumpkin by Ghayal *et al.* (2018) in cucumber, Bindiya *et al.* (2006), in sponge gourd and ridge gourd by Nair and Nair (2006), in bitter gourd by Mulani *et al.* (2007) and Sood and VidyaSagar (2008). The results are in confirmatory with the finding of earlier researchers *viz.*, Sreeniwas *et al.*

(2008), Prabhu *et al.* (2006), Azarmi *et al.* (2009), Sunaryo (2010), Narayanamma *et al.* (2010), Bindiya (2014), Das *et al.* (2015), Threveni *et al.* (2015), Mohan *et al.* (2016), Nayak *et al.* (2016), Nager *et al.* (2017), Kumar *et al.* (2017) and Kharga *et al.* 2019 who observed increased yield with the application of vermi-compost as an organic source of fertilizers.

12. Fruit yield per hectare (q/ha)

Treatments revealed significant difference for fruit yield per hectare. The highest fruit yield (405.57q) was observed in T₇ which was statistically at par with T₄ resulting 346.98 q/ha yield. Minimum fruit yield per hectare (75.13 q) was observed in Treatment T₁ which was significantly at par with T₃ resulting 94.86 q/ha yield.

As observed in fruit yield per plant and fruit yield per plot, fruit yield per hectare was maximum in plants supplied with 50% of the recommended dose of chemical fertilizer +vermi-compost15t/ha. It might be due to a balanced nutrition, better uptake of nutrients by the plants which helped for better fruit set and fruit yield. More number of fruits per plant and fruit yield per plant, fruit yield per plot ultimately resulted in the highest fruit yield per ha. The maximum yield of summer squash in present study could be due to the influence of vermi-compost in combination with NPK (nitrogen, phosphorus, and potassium) enhanced the synthesis of photosynthate by increasing the growth hormones and amino acids. These findings are in close conformity with earlier results obtained by Sreeniwas *et al.* (2008), Prabhu *et al.* (2006), Azarmi *et al.* (2009), Sunaryo (2010), Narayanamma *et al.* (2010), Kumar *et al.* (2012), Bindiya (2014), Tavali *et al.* (2014), Das *et al.* (2015), Threveni *et al.* (2015), Mohan *et al.*

(2016), Kanaiyia and Daniel (2016), Fawaz *et al.* (2016) Nayak *et al.* (2016), Nager *et al.* (2017), Kumar *et al.* (2017) and Kharga *et al.* 2019 who observed increased yield with the application of vermi-compost as an organic source of fertilizers.

13. TSS

Treatments revealed significant difference for Total Soluble Solids. It was noticed that TSS was maximum (2.40) in T₃ which was statistically at par with T₈ and T₁₁ which resulted in TSS to the tune of 2.23 and 2.20, respectively. Minimum TSS (0.73) was found in T₄ which was statistically at par with T₁ and T₅ showing TSS to the tune of 1.23 and 0.93, respectively.

Among the treatments the quality as influenced by various INM treatments in huge conduct when contrasted with control. Quality characters like TSS in summer squash fruit were enhanced in a favorable way due to application of inorganic fertilizer and organic manure in an integrated manner. Treatment combinations consisting of FYM and vermi-compost have resulted in the higher TSS content. It might be due to the fact that the combined application of FYM, vermi-compost and inorganic fertilizers might have led to a balance C: N ratio which resulted in satisfactory nutrient availability and increased plant metabolism, which ultimately lead to increased carbohydrate accumulation in fruits resulting in the higher TSS. Similar findings were reported by Thriveni *et al.* (2015), Singh *et al.* (2017) and Shree *et al.* (2018). Positive influences of substitution of inorganic fertilizer with different organic manures on TSS content have been reported by Vishwakarma *et al.* (2007). Kameswari and Narayanamma (2011) stated that the application of poultry manure along with the recommended dose of nitrogenous fertilizers and vermi-compost improved the quality characters like TSS content in ridge gourd. According to Azarmi *et al.* (2009), Kanaijia and Daniel (2016) vermi-compost had positive influences on the growth, yield and quality of

cucumber. From these reports, it is evident that the results of the present investigation are well supported by the findings of the earlier workers.

14. Ascorbic acid

It was observed that influence of organic manures and chemical fertilizers were significant for ascorbic acid. The maximum ascorbic acid (52.50 mg/100g) was observed in T₈ which was statistically at par with T₃ (41.67 mg/100g), T₁₁ (40.83mg/100g) and T₂ (38.33mg/100g). The minimum ascorbic acid (15.67) was observed in treatment T₁ which was statistically at par with T₇ (28.33mg/100g) and T₁₀ (26.23mg/100g). This might be due to the more availability of micronutrient like B, Cu, Mn, Zn etc. with the application of vermi-compost in integrated nutrient management which might have increased ascorbic acid content of fruit. These results are in accordance with the findings of Triveni *et al.* (2015) in bitter gourd, Das *et al.* (2015) in bottle gourd and Kameswari and Narayanamma (2011) in ridge gourd.

15. Relative economics

Relative economics in summer squash was calculated and presented in Table 2. Perusal of data on relative economics based on yield revealed that treatment T₇ (50% of the recommended dose of chemical fertilizer + vermi-compost@ 15t/ha) recorded maximum gross returns (368700) followed by T₄ (50% of the recommended dose of fertilizer + FYM 20t/ha) and T₅ (25% of the recommended dose of chemical fertilizers + FYM 25t/ha). Maximum Benefit-cost ratio was revealed in treatment with maximum (4.5) in T₄ (50% of the recommended dose of chemical fertilizer + FYM25t/ha) and T₅ (25% of the recommended dose of chemical fertilizer +FYM25t/ha). Minimum benefit-cost ratio (0.9) was observed in T₁₁ (25% of the recommended

dose of chemical fertilizer + EM Bokashi@3q/ha) followed by T₃ (75% of the recommended dose of chemical fertilizer + FYM@ 20t/ha) and T₁ (Absolute control). These results are also in conformity with finding of Patle *et al.* 2018.

Conclusion

It may be concluded that with the application of T₇ (50% of the recommended dose of chemical fertilizer + vermi-compost@ 15t/ha) the highest gross return was observed due to maximum yield per plant, yield per plot, yield per ha. However, with the application of 50% of the recommended dose of chemical fertilizers + FYM @ 25t/ha and 25% of the recommended dose chemical fertilizer + FYM @ 25t/ha has been found the highest net returns and Benefit: cost was observed. This was due to the lower cost of cultivation with the application of FYM.

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Table 1: Effect of organic manures and chemical fertilizers on growth, yield and quality of Summer squash (*Cucurbita pepo* L.)

Treatments	Plant Height (cm)	Days to first male flower appearance	Days to first female flower appearance	Sex ratio	Days to first fruit set	Days to first fruit harvest	Harvest Duration	Number of picking	Number of fruit per plant	Fruit yield per plant(kg)	Fruit yield per plot(kg)	Fruit yield/ha(q)	TSS	Ascorbic acid
T1	69.85	74.33	83.00	0.23	84.00	87.00	48.67	15.67	3.97	0.39	4.86	75.13	1.23	15.67
T2	101.18	71.00	75.67	0.34	76.67	79.00	53.00	23.00	5.67	0.65	17.07	263.51	1.73	38.33
T3	91.97	68.67	75.67	0.29	77.00	79.00	53.67	24.33	8.60	0.50	6.13	94.86	2.40	41.67
T4	90.65	71.33	75.33	0.29	76.67	79.00	53.67	17.67	9.33	1.87	22.48	346.98	0.73	36.67
T5	122.85	71.00	76.00	0.25	77.00	79.67	53.00	24.67	6.97	1.82	21.97	339.15	0.93	31.67
T6	100.87	70.33	77.33	0.33	78.33	81.00	52.33	22.67	8.23	1.49	17.88	276.05	1.93	25.00
T7	72.45	71.00	75.67	0.38	76.67	79.00	49.00	11.00	9.22	2.20	26.26	405.57	1.80	28.33
T8	114.13	67.33	74.67	0.19	76.33	78.33	53.00	25.67	5.75	1.62	19.47	298.29	2.23	52.50
T9	109.43	65.00	76.00	0.34	78.00	80.00	54.33	24.33	5.13	1.45	17.38	268.40	1.70	36.23
T10	71.00	67.33	75.00	0.38	76.33	78.67	54.33	26.00	9.85	0.90	10.71	163.39	1.73	26.23
T11	101.45	72.67	77.00	0.30	78.33	80.00	51.33	25.00	5.06	1.67	20.08	310.00	2.20	40.83
SEm±	11.2	2.34	1.34	0.05	1.05	0.77	1.86	1.88	1.05	0.07	0.94	14.45	0.271	6.78
CD 5%	23.52	4.91	2.83	0.04	0.74	1.09	N/A	3.96	2.20	0.16	1.98	30.37	0.569	14.25

Table 2: Economics of Summer squash cultivation as influenced by various nutrient combinations

Treatments	Total cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net return (Rs/ha)	B:C ratio
T1	53335	68300	14965	1.2
T2	62335	239560	177225	3.8
T3	70835	86240	15405	1.2
T4	69845	315440	245595	4.5
T5	68325	308320	239995	4.5
T6	130835	250960	120125	1.9
T7	164345	368700	204355	2.2
T8	162825	273180	110355	1.6
T9	150835	244000	93165	1.6
T10	167345	148540	-18805	0.8
T11	165825	281820	115995	1.6