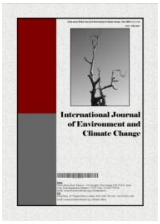

International Journal of Environment and Climate Change

11(4): 142-152, 2021; Article no.IJECC.69806
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Organic Manures and Chemical Fertilizers on the Growth, Yield and Quality Traits of Summer Squash (*Cucurbita pepo* L.)" cv. Punjab ChappanKaddu

Amandeep Kaur[1] and Puja Rattan[1*]

[1]Faculty of Agricultural Sciences, DAV University, Jalandhar, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2021/v11i430402
Editor(s):
(1) Prof. Anthony R. Lupo, University of Missouri, USA.
Reviewers:
(1) Yufita Dwi Chinta, Hokkaido University, Japan.
(2) Maryam Mohammadzadeh Alghou, University of Maragheh, Iran.
(3) P. Sampathkumar, SASTRA University, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/69806

Original Research Article

Received 20 April 2021
Accepted 24 June 2021
Published 30 June 2021

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 (T_8) 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 (T_5). 75% of the recommended dose of chemical fertilizer + EM (Effective Micro-organism) Bokashi 2.5q/ha (T_9) 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 (T_{10}). 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 (T_{10}). 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

**Corresponding author: E-mail: rattanpooja16@gmail.com;*

application of 50% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha (T_7). 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 (T_3) while, the ascorbic acid was maximum (52.50 mg/100g) when 25% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha (T_8) were applied. The highest net returns and benefit: cost (4.5) were obtained when 50% of recommended dose of chemical fertilizer + FYM 25t/ha (T_4) was applied.

Keywords: Summer squash; FYM; vermi-compost; EM Bokashi.

1. 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 [1]. The total global area under pumpkin, squash and gourd is 204.29 Million Hectares and global production is 2764.39 Metric Ton [2]. India produces about 556.98 Metric Ton of pumpkin, squash and gourd from an area of 58.02 Million Hectares [2]. In Punjab, Cucurbits occupy 5th rank in the area (17.01 thousand ha) and production (270.45 thousand ton) among different vegetable crops [3]. 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 [4]. It also helps in preventing cancer, heart disease and asthma [5].

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 [6]. 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.).

2. 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, T_1 (Absolute control), T_2 (100% of the recommended dose of fertilizer (NPK100:50:40kg/ha), T_3 (75% of the recommended dose of chemical fertilizer + FYM 20t/ha), T_4 (50% of the recommended dose of chemical fertilizer + FYM 25t/ha), T_5 (25% of the recommended dose of chemical fertilizer +FYM 25t/ha), T_6 (75% of the recommended dose of chemical fertilizer + vermi-compost10t/ha), T_7 (50% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha), T_8 (25% of the recommended dose of chemical fertilizer + vermi-compost 15t/ha), T_9 (75% of the recommended dose of chemical fertilizer + EM Bokashi 2.5q/ha), T_{10} (50% of the recommended dose of chemical fertilizer + EM Bokashi 3q/ha), T_{11} (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 [7].

3. 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.

3.1 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 T_5 which was statistically at par with T_8 (114.13cm), T_9 (109.43cm), T_{11} (101.45cm), T_2 (101.18cm) and T_6 (100.87cm). Minimum plant height (69.85 cm) was recorded in T_1 which was significantly at par with T_{10} (71.00cm), T_7 (72.45cm), T_4 (90.65cm) and T_3 (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 [8]. These findings corroborate the finding of Vishwakarma et al. [9], Mahmoud et al. (2009) and Das et al. [10]. The finding are also in line with the finding of earlier researchers *viz.,* Martinetti and Paganini [11], Pradhu et al. (2006), Mulani et al. [12], Azarmi et al. [13], Eifediyi and Remison (2010), Thriveni et al., [14], Singh et al. [15], Geethu et al. [16], Dash et al. [17] and Baghel et al. [8] who also reported increased plant height with the use of Integrated Nutrient Management in other cucurbits.

3.2 Days to First Male Flower Appearance

The data revealed that T_9 showed minimum days to first male flower i.e 65.00. It was statistically at par with T_8 in which male flower appeared after 67.33 days and T_3 which resulted in first male flower production after 68.67 days. Maximum days to first male flower appearance (74.33) was observed in T_1 which was statistically at par with all the treatments except T_7 (71.00), T_3 (68.67) and T_8 (67.33).

T_9 (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 T_1. 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 [18]. The results are in line with the findings of Martinetti and Paganini [11], Ezzo et al. [19], Thriveni et al. [14], Vishwakarma et al. [9], Anjanappa et al. [20] and Singh et al. [21] who observed earliness with Integrated Nutrient Management.

3.3 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 T_8 which was significantly at par with all other treatments except T_1 which produce the first female flower after 83 days. Maximum number of days to the first female flower was observed in T_1 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 [22]. The results are in line with the findings of Martinetti and Paganini [11], Ezzo et al. [19], Kumar et al. [23], Thriveni et al. [14], Vishwakarma et al. [9], Anjanappa et al. [20] and Singh et al. [21].

3.4 Sex Ratio

It was observed that treatments showed significant difference for sex ratio. Highest sex ratio (0.38) was recorded in T_{10} and T_7 which was statistically at par with T_9 and T_2 showing 0.34 sex ratio. Lowest sex ratio (0.19) was observed in T_8 which was statistically at par with T_1 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 [24]. 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. [20], Gill et al. [25] and Singh et al. [21] who also reported higher sex ratio in integrated nutrient management.

3.5 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 T_8 and T_{10} which were statistically at par with all other treatments except T_9 producing first fruit after 78 days, T_{11} producing fruits after 78.33 days. T_1 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. [26]. 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. [27] and Moharana et al. [28]. 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 [11], Ezzon et al. (2012), Kumar et al. [23], Thriveni et al. [14], Vishwakarma et al. [9], Anjanappa et al. [20] and Singh et al. [21].

3.6 Days to First Fruit Harvest

The results revealed that the minimum days to first fruit harvest (78.33) were recorded with treatment T_8. This was statistically at par with T_{10} which resulted first fruit harvest after 78.67 days, T2, T3, T_7 and T_4 which resulted first fruit harvest after 79 days. Maximum days to first fruit harvest 87.00 were observed in T_1 which was significantly highest among all.

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

Least number of days to fruiting in most of the treatment combinations except T_1 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., [9] in spine gourd, Mohan et al. [29] and Singh et al. [24] in cucumber.

4. 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 T_5 (25% of the recommended dose of chemical fertilizer +FYM25t/ha) and T_8 (25% of the recommended dose of chemical fertilizer +Vermi-compost15t/ha) while it was minimum (47.67 days) in T_1 (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.

4.1 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 T_{10} showed maximum (26) number of picking. This was statistically at par with all the treatments except T_4 showing 17.67 pickings, T1 resulting 15.67 pickings. Minimum (11.00) number of picking was observed in T_3 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., [7] in spine gourd, Mohan et al., [29] and Singh et al., [24] in cucumber who also reported early harvesting with integrated nutrient management.

4.2 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 T_{10}. It was statistically at par with T_4 producing 9.33 fruits per plant per picking, T_7 (9.22), T_6 (8.23) and T_3 (8.60). The minimum number of fruits per plant per picking (3.97) was observed in T1 which was statistically at par with T_8 (5.75), T_2 (5.67) and T_9 (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 (T_2) were supplied and when no fertilizers were supplied (T_1). 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 [11], Multani et al. (2007), Azarmi et al. [13], Eifediyi and Remison [30], Mohan et al. [29] and Mohrana et al. (2017).

4.3 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 T_7 which was statistically at par with T_4 producing 1.87 kg fruit yield per plant. Minimum fruit yield per plant (0.39 kg) was observed in T_1 which was statistically at par with T_3 resulting in 0.50 kg fruits per plant.

Aggrandized yield in T_7 (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 T_7, could be the reason of the maximum fruit yield per plant. The results are in close conformity with the findings of

Kameswari et al., [26]. Similar findings were quoted from the experimental trial conducted by Shreeniwas et al., (2000) in ridge gourd, Prabhu et al., [31] and Narayanamma et al., [32] in cucumber. Likewise, the possible reason behind the higher number of fruits resulting in the highest fruit yield in T_7 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 T_7. These findings are in congruence with the findings of Anjanappa et al., [20] in cucumber, Thriveni et al., (2017) in bitter gourd and Singh et al., [24] in cucumber.

4.4 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 T_7 which was significantly higher than all other treatments except T_4 which resulted in 22.48 kg fruit yield per plot. Minimum fruit yield per plot (4.86 kg) was found in treatment T_1 which was significantly lowest among all the treatments except T_3 producing 6.13 kg per plot yield. The higher yield due to integrated nutrient management was reported earlier in pumpkin by Ghayal et al. [33] in cucumber, Bindiya et al. [34], in sponge gourd and ridge gourd by Nair and Nair [35], in bitter gourd by Mulani et al. [12] and Sood and VidyaSagar [5]. The results are in confirmatory with the finding of earlier researchers *viz.,*Sreeniwas et al. (2008), Prabhu et al. [31], Azarmi et al. [13], Sunaryo [36], Narayanamma et al. [32], Bindiya (2014), Das et al. [10], Threveni et al. (2015), Mohan et al. [29], Nayak et al. [37], Nager et al. [38], Kumar et al. [39] and [40] who observed increased yield with the application of vermi-compost as an organic source of fertilizers.

4.5 Fruit Yield Per Hectare (q/ha)

Treatments revealed significant difference for fruit yield per hectare. The highest fruit yield (405.57q) was observed in T_7 which was statistically at par with T_4 resulting 346.98 q/ha yield. Minimum fruit yield per hectare (75.13 q) was observed in Treatment T_1 which was significantly at par with T_3 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. [31], Azarmi et al. [13], Sunaryo [36], Narayanamma et al. [32], Kumar et al. (2012), Bindiya (2014), Tavali et al. (2014), Das et al. (2015), Threveni et al. (2015), Mohan et al. [23], Kanaiyia and Daniel (2016), Fawaz et al. (2016) Nayak et al. [37], Nager et al. [38], Kumar et al. [39] and [40] who observed increased yield with the application of vermi-compost as an organic source of fertilizers.

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

4.6 TSS

Treatments revealed significant difference for Total Soluble Solids. It was noticed that TSS was maximum (2.40) in T_3 which was statistically at par with T_8 and T_{11} which resulted in TSS to the tune of 2.23 and 2.20, respectively. Minimum TSS (0.73) was found in T_4 which was statistically at par with T_1 and T_5 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. [14], Singh et al. [21] and Shree et al. [41]. Positive influences of substitution of inorganic fertilizer with different organic manures on TSS content have been reported by Vishwakarma et al. [9]. 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. [13], 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.

4.7 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 T_8 which was statistically at par with T_3 (41.67 mg/100g), T_{11} (40.83mg/100g) and T_2 (38.33mg/100g). The minimum ascorbic acid (15.67) was observed in treatment T_1 which was statistically at par with T_7 (28.33mg/100g) and T_{10} (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. [10] in bottle gourd and Kameswari and Narayanamma (2011) in ridge gourd.

4.8 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 T_7 (50% of the recommended dose of chemical fertilizer + vermi-compost@ 15t/ha) recorded maximum gross returns (368700) followed by T_4 (50% of the recommended dose of fertilizer + FYM 20t/ha) and T_5 (25% of the recommended dose of chemical fertilizers + FYM 25t/ha). Maximum Benefit-cost ratio was revealed in treatment with maximum (4.5) in T_4 (50% of the recommended dose of chemical fertilizer + FYM25t/ha) and T_5 (25% of the recommended dose of chemical fertilizer +FYM25t/ha). Minimum benefit-cost ratio (0.9) was observed in T_{11} (25% of the recommended dose of chemical fertilizer + EM Bokashi@3q/ha) followed by T_3 (75% of the recommended dose of chemical fertilizer +FYM@ 20t/ha) and T_1 (Absolute control). These results are also in conformity with finding of Patle et al. 2018.

5. CONCLUSION

It may be concluded that with the application of T_7 (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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Majeed SH, Mahmoud MJ. Iraqi Herbs and plants in Popular Medical and Scientific

Research. First publication. Drug and Drug Education Department. Biological Research Centre. Scientific Research Council. Iraq; 1988.
2. Anonymous 2018. FAO Stat. 2018.
3. Anonymous. Package of practices of vegetable crops. Punjab Agricultural University Ludhiana. 2019;1.
4. Dhaliwal MS. 2018. Hand book of Vegetable.
5. Sood R and Vidyasagar. Nitrogen economy through the use of biofertilizers on yield of summer squash (*Cucurbitapepo* L.). Crop Research. 2008;36(1, 2 &3):201-207.
6. Kumar, Mukesh. Effect of integrated nutrient management on growth, flowering and yield attributes of cucumber (Cucumis sativus L.). 2018;6:567-572.
7. Gomez AK, Gomez AA. Statistical procedure for Agriculture Research. John Willey and sons Pnc, New York; 1996.
8. Baghel SS, Bose US and Singh SS. Impact of Different Organic and Inorganic Fertilizers on Sustainable Production of Bottle Gourd [*Lagenaria siceraria* L.]. Int. J Pure App. Biosci. 2018;5(2):1089-1094.
9. Vishwakarma SK, Gautam DS, Yadav NS and Gautam SS. Effect of different levels of nitrogen and phosphorus on growth, yield and quality of spine gourd (*Momordica dioica* Roxb.). Technoframe-A Journal of Multidisciplinary Advance Research 2007;119-23.
10. Das R, Mandal AR, Priya A, Das SP and Kabiraj J. Evaluation of integrated nutrient management on the performance of bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. Journal of Applied and Natural Science, 2015;7(1):18-25.
11. Martinetti L and Paganini F. Effect of organic and mineral fertilisation on yield and quality of zucchini. In International Symposium Towards Ecologically Sound Fertilisation Strategies for Field Vegetable Production, 2006;700:125-128. DOI:10.17660/ActaHortic.2006.700.18
12. Mulani TG, Musmade AM, Kadu PP and Mangave KK. Effect of organic manures and biofertilizers on growth, yield and quality of bitter gourd (*Momordica charantia* L.) cv. Phule Green Gold. Journal of Soils and Crops. 2007; 17(2):258-261.
13. Azarmi R, Giglou MT and Hajieghrari B. The effect of sheep manure vermi-compost on quantitative and qualitative properties of cucumber (*Cucumis sativus* L.) grown in the greenhouse. African Journal of Biotechnology. 2009;8(19):4953-4957.
14. Thriveni V, Mishra HN, Pattanayak SK, Sahoo GS and ThomsonT. Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd (*Momordica charantia* L.). International Journal of Farm Sciences. 2015;5(1):24-29.
15. Moharana DP, Mohan L, Singh BK, Singh AK, Kumar H and Mahapatra AS. Effect of integrated nutrirnt management on growth and yield attribites of cucumber (*Cucumber sativus* L.) cv. SwarnaAgeti under polyhouse conditions. The Bioscane, 2017; 12(1):305-308.
16. Geethu BL, Saravanan S, Prasad VM, Gokul P and Baby R. Effect of organic and inorganic fertlizers on the plant growth and fruit yield of bittergourd (*Momordica charantia*) variety: Preethi. The Pharma Innovation Journal, 2018;7(7):75-78
17. Dash SK, Sahu GS, Das S, Sarkar S, Tripathy L, Pradhan S.R and Patnaik A. Yield improvement in cucumber through integrated nutrient management practices in Coastal Plain zone of Odisha, India. International Journal of Current Microbiology and Applied Science. 2018;7(2): 2480-2488.
18. Kumura A, Pandey G, Mishra PP and Kumar R. Effect of Integrated Nutrient Management on Growth and Flowering of African Marigold (*Tagetes erecta*) cv. Pusa Narangi Gainda. Int. J. Curr. Microbiol. App. Sci 2019;8(11):1271-1278.
19. Ezzo MI, Glala AA, Saleh SA and Omar NM. Improving squash plant growth and yieldling ability under organic fertilization condition. Australian Journal of Basic and Applied Sciences, 2012;6:572-578.
20. Anjanappa M, Venkatesh J, and Kumara BS. Influence of organic, inorganic and bio fertilizers on flowering, yield and yield attributes of cucumber (cv. Hassan Local) in open field condition. Karnataka Journal of Agricultural Sciences. 2012;25(4):493-497.
21. Singh V, Prasad VM, Kasera S, Singh BP and Mishra S. Influence of different organic and inorganic fertilizer combinations on growth, yield and quality of cucumber (*Cucumis sativus* L.) under protected

cultivation. Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1079-1082.
22. Amrithalingam S,Balakrishnan R. Studies on the effect of Azospirillum, nitrogen and NAA on the growth and yield of chilli. South Indian J. Hort. 1988;36:218.
23. Kumar V, Singh VK, Rani T. Effect of integrated nutrient management on economics in bottle gourd (*Lagenaria siceraria*). Environment & Ecology, 2012;30(4A):1410-1412.
24. Singh J, Singh MK, Kumar M, Kumar V, Singh KP and Omid AQ. Effect of integrated nutrient management on growth, flowering and yield attributes of cucumber (*Cucumis sativus* L.). Intl. J. Chem. Studies 2018;6(4):567-572.
25. Gill J, Dhillon WS, Gill PPS and Singh N. Fruit set and quality improvement studies on bitter gourd. Indian journal of Horticulture, 2012;69(1):39-44.
26. Kameswari PL, Narayanamma M, AhmedSR and Chaturvedi A. Influence of integrated nutrient management in ridge gourd (*Luffaacutangula* (Roxb.) L.). Vegetable Science. 2010;37(2):203-204.
27. Arshad I, Ali W and Khan ZA. Effect of different levels of NPK fertilizers on the growth and yield of greenhouse cucumber (*Cucumis sativus* L.) by using drip irrigation technology. International Journal of Research. 2014;1(8): 650-60.
28. Mohan L, Singh BK, Singh AK, Moharana DR and Kumar H. Effect of integrated nutrient managrment on growth and yield attributes of cucumber (*Cucumis sativus* L.) cv. SwarnaAgeti under polyhouse conditions. The Bioscan. 2016;12(1): 305-308.
29. Eifediyi EK and Remison SU. Growth and yield of cucumber (*Cucumis sativus* L.) as influenced by farmyard manure and inorganic fertilizer. Journal of Plant Breeding and Crop Science, 2010;*2*(7): 216-220.
30. Prabhu M, Natarajan S, Srinivasan K, and Pugalendhi L. Integrated nutrient management in cucumber. Indian Journal of Agricultural Research, 2006;40(2):123-126.
31. Narayanamma M, Chiranjeevis CH, Ahmed R and Chaturvedi A. Influence of integrated nutrient management on the yield, nutrient status and quality of cucumber (*Cucumis sativus* L.). Vegetable Science. 2010;37(1):61-63.
32. Ghayal RG, Vaidya KP and Dademal AA. Effect of different organic and inorganic fertilizers on growth and yield of cucumber (*Cucumis sativus* L.) in lateritic soil of Konkan (MS). International Journal Chemical Studies 2018;6(2):3452-3454.
33. Bindiya Y, Reddy IP, SrihariD, Reddy RS and Marayanamma M. Effect of different sources of nutrition on soil health, bacterial population and yield of cucumber. Journal of Research A.N.G.R.A.U. 2006;34:12-20.
34. Nair AK and Nair SA. Influence of FYM and nutrient on ridge and sponge gourd yield intercropped with coconut palm in South Andaman. International Journal of on Agriculturl Science2006;2:284-285.
35. Sunaryo Y. Effect of vermi-compost and bokashi on nutrient content of mustard green and lettuce. In International Seminar on Horticulture to Support Food Security. 2010;22-23.
36. Nayak DA, Pradhan M, Mohanty S, Parida AK and Mahapatra P. Effect of integrated nutrient management on productivity and profitability of pointed gourd (*Trichosanthes dioica* Roxb.). Journal of Crop and Weed 2016;12(1): 25-31.
37. Nager M, Soni AK and Sarolia DK. Effect of organic manures and different levels of NPK on growth and yield of bottle gourd (*Lagenariasiceraria (*Mol.) standl.). International Journal of Current Microbiology and Applied Science. 2017;6(5):1776-1780.
38. Kumar KM, Somasundaram E, Marimuthu S and Meenambigai, C. Growth, Yield and Quality of Snake Gourd (*Trichosanthes anguina* L.) as Influenced by Organic Nutrient Management Practices. Int. J. Curr. Microbiol. App. Sci. 2017;6(11):918-924.
39. Kharga S, Sarma P, Warade SD, Debnath P, Wangchu L, Singh AK and Simray AG. Effect of Integrated Nutrient Management on Growth and Yield Attributing Parameters of Cucumber (*Cucumis sativus* L.) under Protected Condition. Int. J. Curr. Microbiol. App. Sci. 2019;8(8):1862-1871.
40. Shree S, Regar CL, Ahmad F, Singh VK, Kumari R and Kumari A. Effect of organic and inorganic fertilizers on growth, yield and quality attributes of hybrid bitter gourd (*Momordica charanita* L.). International Journal of Current Microbiology and Applied Sciences. 2018;7(4):2256-2266.

41. Ayuso MS, Pascal JA, Garcia C and Hernandez T. Evaluation of urban wastes for urban agricultural use. Soil Science Plant Nutr., 1996;42:105-111.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/69806