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Influence of different organic and inorganic fertilizer combinations on growth, yield and quality of cucumber (*Cucumis sativus L.*) under protected cultivation

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Abstract

Cucumber is thought to be one of the oldest vegetable crops. A field experiment was conducted at Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, (U.P) India, during the rabi season of 2016-17, to study the effect of different organic and inorganic fertilizers on cucumber yield under protected cultivation. The experiment was laid out in randomized block design with three replications consisted of nine treatment combinations viz. T₀ (Control), T₁ [FYM (75%) + NPK (25%)], T₂ [FYM (50%) + NPK (50%)], T₃ [Vermi Compost (75%) + NPK (25%)], T₄ [Vermi Compost (50%) + NPK (50%)], T₅ [Poultry manure (75%) + NPK (25%)], T₆ [Poultry manure (50%) + NPK (50%)], T₇ [FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)] and T₈ [FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)] were allocated randomly in each plot. The results showed that the treatment T₈ (FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)) significantly found best among the all treatments at all successive growth stages in term of maximum plant height (370.00cm), Number of leaves (119.84) and Number of Branches per plant (3.51) as growth parameters whereas maximum length of fruit (15.03cm), fruit diameter (14.07cm), average fruit weight (198.93g), fruit yield per plot (11.87kg) and fruit yield per hectare (824.30q/ha) as yield related traits and also recorded maximum with TSS (4.10°Brix) and vitamin C (8.39mg/100g of fruit pulp) with lowest acidity (0.90 per cent) as quality parameters while lowest response in term of growth, yield and quality of cucumber was recorded with T₀ (control) which received only recommended dose of NPK (120:60:120 kg per hectare).

Keywords: *Cucumis sativus*. L, yield, vermicompost, poultry manure, FYM and NPK.

Introduction

Cucumber (*Cucumis sativus* L.) is a member of the gourd family cucurbitaceae, which comprises of 117 genera and 825 species in warmer parts of the world (Gopalakrishnan, 2007) [6]. It is cultivated throughout the country in the areas extending from high altitude to the plains and along riverbeds (Munshi *et al*, 2008) [7]. The crop is the fourth most important vegetable after tomato, cabbage and onion in Asia (Tatlioglu, 1997) [12]. The fruit of cucumber is said to have cooling effect, prevent constipation and check jaundice and indigestion. It is a low energy and high water content salad crop. It is a primary source of vitamins and mineral of man (AVRDC, 1999) [2]. It is one of the most important crop grown under green house. Parthenocarpic cucumber cultivation in greenhouse can be a profitable venture for the vegetable growers. They produce earlier and more fruits per plant compared to tomatoes and capsicum.

Greenhouse production technology of cucumber emphasizes the need for proper density in order to boost up the production per unit area by utilizing the available space and nutrients applied. Cucumber requires large quantities of both macro and micro nutrients for required of economic yields of cucumber. Nitrogen, phosphate and potash nutrients are important and play a key role in the production of both quantity and quality level in cucumber. These nutrients are specific in function and must be supplied to the plant at the right time and in the right quantity. Indiscriminate use of inorganic fertilizers has resulted in decreased nutrient uptake, poor quality of vegetables and deterioration of soil health (Agrawal, 2003) [1]. The indiscriminate uses of chemical fertilizers alter the soil fertility and increase the cost of production as well. However, considering the recent concept of eco-friendly and increase in cost of inorganic and organic fertilizers, the use of cost effective and eco-friendly organic manures with suitable integration of inorganic fertilizers restores the soil health while keeping the soil productive and sustainable.

Among the organic sources, the old age concept of nutrient application is the utilization of farm yard manure, vermicompost is easily prepared and much effective manure and Fresh poultry manure represents about 5% of live bird weight. These manures being good source of essential plant nutrients especially NPK and give good crop stand by virtue of improvement in physical, chemical and biological characteristics of the soil.

Materials and Methods

The present investigation entitled "Effects of Different Organic and Inorganic Fertilizers on Cucumber (*Cucumis sativus* L.) Yield Under protected cultivation" was conducted from September 2016 to December 2016. The experiment was laid out in a Randomised Block Design with 9 treatments and 3 replications and each replicated thrice under Allahabad agro climatic conditions at the experimental field of the Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad.

Treatment Details

Notation	Treatment Combination
T ₀	Control (Recommended dose of NPK 150:120:120 kg/ha)
T ₁	FYM (75%) + NPK (25%)
T ₂	FYM (50%) + NPK (50%)
T ₃	Vermi Compost (75%) + NPK (25%)
T ₄	Vermi Compost (50%) + NPK (50%)
T ₅	Poultry manure (75%) + NPK (25%)
T ₆	Poultry manure (50%) + NPK (50%)
T ₇	FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)
T ₈	FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)

A basal dose of 15 tonnes/hectare well rotten farm yard manure, 5t/ha vermicompost and 5t/ha poultry manure was applied in relevant treatment combination plots before sowing of seeds. Nitrogen was applied in the farm of urea in two split dose out of which half dose applied at the time of planting and rest was applied during flowering stage. Phosphorus and potassium were applied in the form of di-ammonium phosphate and murate of potash respectively at the time of sowing. The fertilizer as per treatments was thoroughly mixed in the soil with the help of weeding hoe.

Results and Discussion

Growth parameters

The findings of the present investigation revealed that the combination of different organic manures and inorganic fertilizers significantly affected growth parameter like plant height, number of branches and number of leaves at all successive stages of growth in cucumber as shown in (Table 1).

Among the treatments, the highest plant height (370.00cm) was recorded with treatment T₈ [FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)] with more number of branches per plant (3.51) which significantly resulted in increased number of leaves per plant (119.84) at 90 DAP in treatment T₈ [FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)] followed by treatment T₆ [Poultry manure (50%) + NPK (50%)]. However the lowest mean values in term of vegetative growth traits was observed in T₀ (control). The organic manure applied in the

form of FYM, Poultry Manure and Vermicompost might have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which might have promoted the maximum vegetative growth while the minimum plant growth was due to non-availability of nutrients. The results reported with Sharma *et al.* (2009)^[11], Umamaheswarappa *et al.* (2005)^[13-14] and Okoli and Nweke (2015)^[8] are in close conformity with these findings. Similar results have also been reported by Prabhu *et al.* (2006)^[9] in cucumber.

Flowering Parameters

The time taken to the first flower appearance is an important pre-requisite which decides the early fruit yield. The data relevant to flowering traits is presented in (table 1). At the minimum days to first flowering 31.24 days with minimum days taken to 50% flowering (43.33) was recorded in T₈ [FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)] which resulted in earliness for first harvest (56 days) in treatment T₈ followed by T₇ [FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)], while the maximum days to first flowering was recorded in T₀ (control), which was 34 days. The earliness to flowering in treatment T₈ might be due to the better translocation of nutrients to the aerial parts. Similar findings were reported by Bindiya *et al.* (2006)^[3] in cucumber and Prativa and Bhattacharai (2011)^[10] in tomato.

Yield Parameters

The effect of different combination of Organic and Inorganic Fertilizers showed the significant result on yield and related traits. Where the treatment T₈ [FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)] contributed as a better treatment combination than other treatments and resulted in more number of fruits per plant (62.67), widest fruit (14.80cm), maximum fruit length (15.03 cm) and maximum average fruit weight (198.93gm) in term of yield related traits which leads significant positive effect for increasing the yield. The highest fruit yield per plot (11.87kg) and fruit yield per hectare (824.30q ha⁻¹) was recorded in T₈ [FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)] followed by T₇ [FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)] which was (8.62kg plot⁻¹) and (598.95q ha⁻¹) respectively, whereas lowest fruit yield was recorded in T₀ (control), which was (3.12kg plot⁻¹) and (216.66q ha⁻¹) respectively.

The highest yield per plant was corresponding to more number of fruits per plant and average fruit weight with application of adequate amount of organic manure in combination with NPK. These results have been reported by Bindiya *et al.* (2006)^[3] and Ghasem *et al.* (2014)^[5] in cucumber.

Quality Parameters

The statistical analysis of findings revealed that the combination of different organic manures and inorganic fertilizers significantly affected the quality of cucumber fruits like TSS, vitamin C and acidity. Among all the treatments, the maximum total soluble solid (4.10°Brix) and Vitamin 'C' (8.39mg/100g) with minimum acidity of fruit (0.90%) was recorded with treatment T₈ [FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)] followed by T₇ [FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)] and T₄ Vermi Compost (50%) + NPK (50%) as depicted in (table 3).

As compare to other treatments in present investigation, fruits of cucumber in treatment T₀ (control) attained lowest quality in term of TSS, vitamin C and acidity, which shows that inadequate supply of nutrients in the form of organic and inorganic fertilizers, deteriorates the quality of fruit, lower the

amount of TSS and increase the acidity and bitterness in the cucumber fruit. Similar findings were reported by Eifedi and Remison (2010)^[4] in cucumber and Okoli and Nweke (2015)^[8].

Table 1: Effects of Different Organic and Inorganic Fertilizers on Growth and Flowering of Cucumber (*Cucumis sativus L.*) under Protected Cultivation.

Treatments No.	Treatments Combination	Plant height (cm)	No. of Branches	Number of Leaf	Days to First Flowering	Days to 50% Flowering	Days to First Harvest
T ₀	Control (Recommended dose of NPK 150:120:120)	314.87	2.80	104.73	34.00	47.59	62.67
T ₁	FYM (75%) + NPK (25%)	332.80	3.00	108.60	33.63	47.10	61.67
T ₂	FYM (50%) + NPK (50%)	337.07	3.23	108.07	33.00	47.33	62.00
T ₃	Vermi Compost (75%) + NPK (25%)	343.67	2.83	110.07	33.33	47.00	61.33
T ₄	Vermi Compost (50%) + NPK (50%)	344.47	3.38	114.93	32.33	45.00	60.00
T ₅	Poultry manure (75%) + NPK (25%)	330.07	3.43	115.13	33.33	45.53	57.66
T ₆	Poultry manure (50%) + NPK (50%)	345.20	3.48	115.80	31.43	44.76	58.00
T ₇	FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)	353.13	3.20	114.80	31.33	44.43	57.00
T ₈	FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)	370.00	3.51	119.84	31.24	43.33	56.00
	F-test	S	S	S	S	S	S
	C.D. at 0.5%	3.99	0.30	3.00	1.74	2.29	2.90
	S.Ed	1.88	0.14	1.41	0.82	1.08	1.37

Table 2: Effects of Different Organic and Inorganic Fertilizers on Yield and Yield Related Traits in Cucumber (*Cucumis sativus L.*) under Protected Cultivation.

Treatments No.	Treatments Combination	Diameter of Fruit (cm)	Length of Fruit (cm)	Average Fruit Weight (gm)	Total Number of Fruit	Fruit Yield Per Plot (Kg)	Fruit Yield (q/ha)
T ₀	Control (Recommended dose of NPK 150:120:120)	12.10	13.27	139.13	23.66	3.12	216.66
T ₁	FYM (75%) + NPK (25%)	13.10	13.53	162.13	28.01	4.25	295.13
T ₂	FYM (50%) + NPK (50%)	13.22	13.67	168.53	31.33	5.08	352.77
T ₃	Vermi Compost (75%) + NPK (25%)	13.18	13.55	140.33	29.50	3.60	250.00
T ₄	Vermi Compost (50%) + NPK (50%)	13.68	13.80	153.27	38.10	5.57	386.80
T ₅	Poultry manure (75%) + NPK (25%)	13.53	14.13	168.40	33.30	5.42	376.38
T ₆	Poultry manure (50%) + NPK (50%)	14.80	14.43	172.40	41.85	7.04	488.88
T ₇	FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)	13.57	14.80	175.3	51.20	8.625	598.95
T ₈	FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)	14.07	15.03	198.93	62.67	11.870	824.30
	F-test	S	S	S	S	S	S
	C.D. at 0.5%	0.95	0.58	4.61	5.42	0.88	7.07
	S.Ed	0.45	0.27	2.17	2.56	0.42	3.34

Table 3: Effects of Different Organic and Inorganic Fertilizers on Fruit Quality of Cucumber (*Cucumis sativus L.*) under Protected Cultivation.

Treatments No.	Treatments Combination	TSS (°Brix)	Vitamin C	Acidity
T ₀	Control (Recommended dose of NPK 150:120:120)	3.25	5.16	1.45
T ₁	FYM (75%) + NPK (25%)	3.31	5.67	1.39
T ₂	FYM (50%) + NPK (50%)	3.48	6.21	0.33
T ₃	Vermi Compost (75%) + NPK (25%)	3.60	6.93	1.17
T ₄	Vermi Compost (50%) + NPK (50%)	3.81	7.66	0.98
T ₅	Poultry manure (75%) + NPK (25%)	3.40	6.50	1.26
T ₆	Poultry manure (50%) + NPK (50%)	3.53	7.01	1.03
T ₇	FYM (50%) + Poultry manure (25%) + Vermi Compost (25%)	3.90	7.85	0.93
T ₈	FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)	4.10	8.39	0.90
	F-test	S	S	S
	C.D. at 0.5%	0.49	0.95	0.17
	S.Ed	0.23	0.45	0.08

Conclusion

On the basis of above findings it is concluded that the treatment T₈ (FYM (25%) + Poultry manure (25%) + Vermi Compost (25%) + NPK (25%)) was recorded the best among all the treatment combinations of organic and inorganic fertilizer in term of growth and yield attributes and also increases the T.S.S. and vit. C as well as treatment T₈ was also recorded best in terms of cost benefit ratio (8.52).

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