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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND YIELD ATTRIBUTES OF CUCUMBER (*CUCUMIS SATIVUS* L.) CV. SWARNA AGETI UNDER POLYHOUSE CONDITIONS

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ABSTRACT
The present investigation was carried out in order to study the effects of integrated nutrient management on cucumber cv. Swarna Ageti under polyhouse conditions conducted during the *Kharif* season of 2015 at Vegetable Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.). From the results it is concluded that the application of various combinations of organic, inorganic and bio-fertilizer sources of nutrients at optimum level evidenced to be effective in promoting germination per cent, growth, flowering and yield of the cucumber. The most effective among all the combinations of organic, inorganic and bio-fertilizer sources of nutrients for minimum number of days to 50 per cent flowering (44.33), fruit length (15.11 cm), fruit weight (176.22 g), number of edible fruits per vine (9) and maximum edible fruit yield per hectare (58.73 t/ha) is found to be 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB. From the results it can be concluded that the application of different combinations of organic, inorganic and bio-fertilizer source of nutrients at optimum level proved to be effective in promoting germination per cent, growth, flowering and yield of cucumber.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a warm season vegetable, grown throughout the world under tropical and subtropical conditions. It is said to be the native of northern India.Cucumber is a highly cross pollinated crop and usually monoecious in nature preferring warm weather and bright light for its better growth and development. However, it can be grown in both summer and rainy seasons, but it can't tolerate cold injury (Rastogi, 1998).It is one of the most important salad crops grown extensively throughout India as well as the world. In India the total cucumber production in 2014-15 was 0.685 million tons from 0.044 million hectare area (NHB database, 2015). The immature fruits of cucumber are used both for salad as well as for pickling purpose. The cucumber pickle ranks first in the world. The fruits of cucumber possess various medicinal properties *e.g.* cooling effect, prevents constipation, checks jaundice and indigestion. There is well response from cucumber towards manuring and fertilization. Average farmers cannot afford the extensive use of expensive commercial fertilizers as per the recommendations. In order to achieve an improved production, application of high cost inputs like inorganic fertilizers, herbicides, pesticides, *etc.* can be advocated but on the other hand we also have to look at the soil health and environment sustainability.Integrated Nutrient Management (INM) system refers to the balanced use of chemical fertilizers in combination with organic manures, crop residues, bio-fertilizers and other biological sources (Thriveni *et al.,* 2015). INM maintains soil as storehouses of plant nutrients that are essential for vegetative growth. The goal of INM is to integrate the use of all natural and man-made sources of plant nutrients, so that crop productivity increases in an efficient and environmentally benign manner, without sacrificing soil productivity of future generations (Maruthi *et al*., 2014). Higher dose of fertilizers, although inexpensive for some farmers in developed countries, induces neither substantially greater crop nutrient uptake nor significantly higher yields (Smaling and Braun, 1996).The protected vegetable cultivation technology can be utilized for the year round production of high value quality vegetable crops. Increasing photosynthetic efficiency and reduction in transpiratory loss are major advantages of protected cultivation. Both of these are of vital importance for healthy and luxuriant growth of crop plants. This technology is highly suitable for farmers in peri-urban areas of the country, especially in northern plains of India. But, protected cultivation requires careful planning and attention including selection of varieties, suitable production technology like spacing, time of planting, water and nutrient management and plant protection to produce economic yield of good quality. However, no precise information is available on the influence of integrated nutrient management on growth and yield attributes of cucumber under protected condition. Therefore, the objective of the research was to find out the

influence of various organic, inorganic and bio-fertilizer source of nutrients at optimum level on growth and yield parameters of cucumber under polyhouse conditions.

MATERIALS AND METHODS

The present investigation was carried out in the polyhouse of the Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during *kharif* season of 2015.The seeds of cucumber cultivar Swarna Ageti having high yield potential with 90 days duration were planted at the spacing of 100 cm for row to row and 60 cm for plant to plant. The seeds were obtained from ICAR-Indian Institute of Vegetable Research, Varanasi. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were twelve treatment combinations of different organic, inorganic and bio-fertilizer source of nutrients. Inorganic fertilizers were applied in both basal and split doses while; bio-fertilizers were applied with vermicompost as the basal dose. The treatment combinations are T_1- Control (without nutrient), T_2- 100% RDF (72:60:96 kg NPK/ha), T_3- 100% RDF + 100% Vermicompost (1.5 t/ha), T_4- 90% RDF + 90% Vermicompost (1.5 t/ha) + *Azotobacter* (5 kg/ha) + PSB, T_5 - 90% RDF + 90% Vermicompost + *Azotobacter*+ *Trichoderma*, T_6- 90% RDF + 90% Vermicompost + *Azotobacter* + PSB (5 kg/ha) + *Trichoderma*, T_7- 60% RDF + 60% Vermicompost + *Azotobacter*+ PSB, T_8- 60% RDF + 60% Vermicompost + *Azotobacter*+ *Trichoderma* (5 kg/ha), T_9- 60% RDF + 60% Vermicompost+ *Azotobacter*+ PSB + *Trichoderma*, T_{10}- 30%RDF + 30% Vermicompost + *Azotobacter*+ PSB, T_{11}- 30% RDF + 30% Vermicompost + *Azotobacter*+ *Trichoderma*, T_{12}- 30% RDF + 30% Vermicompost + *Azotobacter*+ PSB + *Trichoderma*.The vegetative parameters included in the study are germination percentage, days to first flowering, node number offirst staminate flower appearance, node number of first female flower appearance, days to 50 per cent flowering, total number of leaves per vine, vine length (cm), total number of branches per vine. The yield and quality parameters are days to first fruit initiation, length of edible fruit (cm), diameter of edible fruit (cm), weight of edible fruit (g), TSS (ºBrix),number of fruits per vine, edible fruit yield (t/ha). The results obtained from the observation were analyzed statistically as per Panse and Sukhatme (1985) for Randomized Block Design. The significance was tested by referring to 'F' tables as suggested by Fisher and Yates (1963).

RESULTS AND DISCUSSION

The growth parameters in cucumber were influenced by the

Table 1: Effect of different treatment combinations of organic, inorganic and bio-fertilizer sources of nutrients on vegetative parameters of cucumber

Treatment	Germination percentage	Days to first flowering	Days to 50 per cent flowering	Node number of first staminate flower appearance	Node number of first pistillate flower appearance	Total number of leaves per vine	Number of branches per vine	Vine length (cm)
T_1	66.66	59.67	69.67	17	21.27	81.87	3.87	224.2
T_2	73.33	57.33	65.67	16.27	19.47	103.53	4.8	319.4
T_3	70	55.67	67.33	14.6	16.73	91.87	5.27	292
T_4	73.33	40	51.33	14.53	18.07	101.27	5.33	347.53
T_5	63.33	52.33	62.33	14.73	18.93	108.07	5	381.27
T_6	83.33	51.67	64.33	14.6	17.2	101.2	5.67	306.93
T_7	86.66	42.33	53.67	12.47	16.93	105	5.93	318.73
T_8	76.66	41	56.67	13.53	18.67	128.47	6.8	426
T_9	86.66	36.67	44.33	13.6	18	124.53	4.4	380.13
T_{10}	86.66	44.33	57	14.13	18.27	80	4.87	310.6
T_{11}	86.66	47.33	64	14.8	18.73	100.13	4.67	260.93
T_{12}	63.33	44	52	13.33	18.13	109.67	5.07	417.87
Mean	3.61	1.12	1.15	0.6	0.71	2.28	0.25	25.41
CD	10.66	3.27	3.39	1.77	2.11	6.73	0.74	75

Table 2: Effect of different treatment combinations of organic, inorganic and bio-fertilizer sources of nutrients on yield and quality parameters of cucumber

Treatment	Days to first fruit initiation	Length of edible fruit (cm)	Diameter of edible fruit (cm)	Weight of edible fruit (g)	TSS of edible fruit (ºBrix)	Number of fruits per vine	Edible fruit yield (t/ha)
T_1	67.67	13.33	4.24	117.94	1.55	7.13	31.15
T_2	64.06	14.91	4.32	125.36	1.75	7.4	34.35
T_3	64.2	14.48	3.9	124.54	1.75	7.6	35.05
T_4	48.6	13.9	4.28	153.54	1.85	7.8	44.35
T_5	60.93	14.47	4.57	176.02	1.92	7.4	48.24
T_6	58.73	14.37	4.62	170.62	2.16	7.8	49.29
T_7	49.47	14.35	4.36	168.66	1.95	8.2	51.23
T_8	48.13	14.04	4.41	172.39	1.8	8.07	51.52
T_9	44.73	15.11	4.38	176.22	2.08	9	58.74
T_{10}	52.07	14.45	4.36	154.44	1.92	7.8	44.61
T_{11}	55.8	14.49	4.5	160.52	2.08	7.8	46.35
T_{12}	52.8	14.19	4.65	174.06	1.95	6.87	44.26
Mean	1.13	0.24	0.1	0.72	0.05	0.13	0.83
CD	3.33	0.72	0.29	2.11	0.16	0.38	2.45

combined application of organic, inorganic and bio-fertilizers sources of nutrients. Perhaps it has been the consequence as a result of higher nutrient availability and increased nitrogen from organic products along with inorganic source of nutrients which had profound influence in mobilizing the nutrients from the unavailable form of nutrients mainly due to improved physical, chemical and biological properties of the soil.

The maximum germination per cent (86.67) of cucumber was found by the application of medium concentration of organic and inorganic source of nutrients along with *Azotobacter*, *Trichoderma* and PSB. Similar results were also obtained in the treatment T_7, T_{10} and T_{11}. This may be due to the application of *Azotobacter* and PSB which were effective in nitrogen fixation, synthesis of plant growth promoting hormones and enzyme activation.

There was significant decrease in days to first flowering by application of medium concentration of organic and inorganic sources of nutrient along with *Azotobacter*, *Trichoderma* and PSB. Promotion of early flowering might be due to enhancement in reproductive phase due to the treatment of relevant combination of organic and inorganic sources of nutrient along with *Azotobacter*, *Trichoderma*, and PSB. 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB promoted early flowering and the results were in close conformity with Vishwakarma *et al*. (2007), Anjanappa *et al*. (2012) and Parmar *et al*. (2011).

The effect of different combinations of organic, inorganic and bio-fertilizers source of nutrients on node number at which first male flower appeared was found to be significant. The minimum node number at which first male flower appeared was recorded with application of 60 per cent each of RDF and vermicompost along with *Azotobacter* and PSB, while, least was recorded in control. This is in accordance with the earlier report of Prasad *et al*. (2015). The minimum node number at which first female flower appeared was recorded with application of 100 per cent each of RDF and Vermicompost, while, least was recorded in control. This is in accordance with Das *et al*. (2015).

There was significant decrease in number of days to 50 per cent flowering by application of medium concentration of organic and inorganic sources of nutrients. Treatment of 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB showed early 50 per cent flowering whereas; control recorded maximum number of days to 50 per cent flowering. These results are in accordance with Kameswari *et al*. (2011).

The maximum number of leaves per vine was recorded with treatment of 60 per cent each of RDF and Vermicompost along with *Azotobacter* and *Trichoderma* whereas; the minimum number of leaves per vine was recorded in treatment of 30 per cent each of RDF and Vermicompost along with *Azotobacter* and PSB. There was a significant increase in vine length, number of branches with different combinations of organic, inorganic and bio-fertilizers source of nutrients. Treatment of 60 per cent each of RDF and vermicompost along with *Azotobacter* and *Trichoderma* recorded highest vine length and maximum number of branches whereas, control recorded the minimum. This may be attributed to the prevailing favorable microclimate inside the greenhouse which helped the plants in better utilization of solar radiation, nutrients and water for the synthesis of photosynthates and also the prevailing higher temperature inside the greenhouse might have helped in faster multiplication of cells and cellular elongation resulting in better growth of roots and shoots, which helped better vegetative growth including vine length, number of leaves and number of branches. The results obtained were in agreement with Narayanamma *et al*. (2010).

The days to first fruit initiation was observed with different treatment combinations of organic, inorganic and bio-fertilizers source of nutrients. Among the treatments, treatment of 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB recorded minimum days to first fruit initiation whereas, control recorded maximum days to first fruit initiation. The integrated approach of nutrient application has improved earliness as compared to no fertilizer application. These findings are in line with Arshad *et al*. (2014).

There was significant increase in fruit length with different treatments. Among the treatments, treatment 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB gave longer length of fruits. The increase in fruit length might be due to incresed diversion of photosynthates to reproductive organs. Similar findings were also recorded by Eifediyi and Remison (2010). The diameter of fruits also increased considerably by different combinations of organic, inorganic and bio-fertilizers source of nutrients. The maximum fruit diameter was recorded with the treatment of 30 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB. There was significant increase in weight of fruit with different combination of organic, inorganic and bio-fertilizers source of nutrients. Due to increase in length and diameter there was significant increase in weight of fruit. Treatment 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB showed maximum weight of fruit whereas, control recorded minimum fruit weight. This may be due to the effect of *Azotobacter*, *Trichoderma* and PSB which provides protection against the nonparasitic pathogens produces biologically active substances like auxins and gibberellins and transforms unavailable mineral and organic compounds into available forms to the plants. The maximum number of fruits per vine was obtained with 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB, while, minimum was observed in the treatment 30 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB. This is because of more length and axillaries branches which maximized the fruiting buds on a vine and ultimately number of fruits per vine was increased. These findings are in conformity with the findings of Arun and Kumar (2014) and Prabhu *et al*. (2006)

Plants supplied with 90 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB recorded maximum TSS content of edible fruit (°Brix) whereas, control recorded minimum TSS content of edible fruit (°Brix). TSS content of fruit in these treatments could be attributed to combined application of organic, inorganic fertilizers along with the bio-fertilizers (*Azotobacter* and PSB) which helped in better uptake of NPK nutrients including micronutrients, which in turn influenced the quality traits in cucumber.

Highest yield were achieved from the treatment with 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB while, least was obtained from control. The beneficial effect of organic manures on yield and other characters could be attributed to the fact that the decomposition and mineralization of organic manures made the nutrients readily available to the plant and also had solubilizing effect on fixed form of nutrients in the soil.

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