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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF TOMATO CV. PUSA EARLY DWARF

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ABSTRACT

In order to determine the response of tomato cv. Pusa Early Dwarf to organic and inorganic sources of plant nutrients and their combinations, the present investigation was carried out at the Agriculture Farm, Doon (PG) College of Agriculture Sciences & Technology, Selaqui, Dehradun (Uttarakhand). The layout of experimental field was completely randomized block design with three replications. The field experiment included treatments *viz.*, sole applications of recommended dose of fertilizers (RDF), farm yard manure (FYM) and Vermicompost (full doses); and combined applications of organic and inorganic sources of plant nutrients (half doses) along with control (without manures and fertilizers), forming seven different treatments, which were distributed randomly in each block. The experimental findings indicated that treatment T_6 (50% RDF + 50% vermicompost) gave maximum plant height (37.44, 62.75 and 71.55 cm, respectively), number of branches (5.93, 8.00 and 12.33, respectively) and number of compound leaves (28.42, 40.18 and 49.50, respectively) at 30 and 60 days after transplanting, and at harvesting; number of fruits per plant, fruit length, fruit breadth, average fruit weight, yield per plant, yield per plot and yield per hectare (25.16, 5.90 cm, 4.20 cm, 61.83 g, 1.56 kg, 46.73 kg and 39.33 t, respectively).

***Keywords*:** Farmyard Manure, Integrated Nutrient Management, Tomato, Vermicompost, Yield.

Introduction

Tomato (*Solanum lycopersicon* L.) is one of the most important fruit vegetables grown in India as well as world due to its wider adaptability to various agroclimatic conditions *i.e.* tropical and subtropical regions of country and being cultivated in kitchen gardens, at commercial level under protected conditions, soil less cultivation *i.e.*, hydroponic systems and market garden for table and processing purposes. Tomato is cultivated under 852-thousand-hectare area with 21.03 million tons production (NHB, 2021). Tomato is also considered as a "Protective Food" because it is a good source of vitamin A, B and C, minerals and antioxidants like lycopene and anthocyanin which are essential for human health (Parmar *et al.*, 2019).

Vegetables are an integral part of human diet. As per Indian Council for Medical Research (ICMR), 310 g of vegetable consumption is recommended per capita per day whereas, only 257.7 g of vegetables are actually supplied per capita per day (Motkuri, 2020). Demand of vegetables is rising more and it is becoming more difficult to be supplied because of continuous increase in human population and industrialization, although cultivated land area decreases. Poor soil health also plays a significant role in the gap between food supply and demand. The overuse of chemical fertilizers by farmers is having a negative impact on the health of the soil. Improved soil health for sustainable food production or reducing the gap between demand and supply requires environment friendly approaches like integrated nutrient management *i.e.*, the combined application of organic and inorganic sources of nutrients to balance the ecology (Paramesh *et al.*, 2023). Pure organic farming is not possible for Indian population because the demand of food is more than supply, as well as organic farming has some limitations like shortage of biomass, requires more care, labour intensive, lack of special infrastructure, *etc.* (Kumar *et al.*, 2022). Improving soil fertility as well as crop yields are two main benefits of integrated nutrient management. Therefore, integrated nutrient management is the most effective means to fulfill the demand of vegetable crops among the Indian population. Keeping in view, a field experiment was carried out to find the effect of integrated nutrient management on growth and yield of tomato cv. Pusa Early Dwarf.

Materials and Methods

The present study entitled "Effect of integrated nutrient management on growth and yield of tomato cv. Pusa Early Dwarf" was carried out at the Agriculture Farm, Doon (PG) College of Agriculture Science and Technology, Dehradun (Uttarakhand) during the *Kharif* season. Pusa Early Dwarf is a short-duration variety of tomato that matures in 75-80 days after transplanting. The plant habit is determinate type; fruit shape is flattish round, and it is suitable for table as well as processing purposes. There were a total of seven treatment combinations *viz*., T_1 (100% RDF), T_2 (100% FYM), T_3 (100% Vermicompost), T_4 (50% FYM + 50% Vermicompost), T_5 (50% RDF + 50% FYM), T_6 (50% RDF + Vermicompost) and T_7 (Without manures and fertilizers). All treatments of the field experiment were allocated in the field in a completely randomized block design manner with three replications. The recommended dose of RDF @ 120:80:60 kg NPK per hectare, FYM @ 20 t/ha and vermicompost @ 30 q/ha were applied as per treatment combinations as basal dose at the time of transplanting except nitrogen, which was applied in 2 splits *i.e.*, half as basal at transplanting and half as top dress at 30 days after transplanting. One month old seedlings were transplanted in a well-prepared field with plant-to-plant and row-to-row spacing of 60 cm x 45 cm. Transplanting was done during the evening to avoid transplanting shock, then light irrigation was done for better establishment of seedlings in the main field. Gap filling was done within 2-3 days after transplanting to maintain uniformity in the experimental field. Other agronomic practices like irrigation, weeding, staking, and plant protection measures were adopted as per the recommendation provided for tomato cultivation.

Five plants from each plot were selected randomly for the observations on growth and yield parameters of the tomato plant. Growth parameters *viz.*, plant height, number of branches and number of compound leaves were observed at 30 and 60 days after transplanting, and at harvesting. Plant height measured by scale while number of branches and compound leaves counted manually. Yield parameters *viz.*, number of fruits per plant, fruit length, fruit breadth, average fruit weight, yield per plot and yield per hectare were recorded at the time of harvest. Number of fruits were counted manually. Length and breadth of randomly selected tomato fruits were measured with the help of vernier calipers and weighed on electronic balance for yield measurements. Yield per plant, per plot and per hectare were calculated on the basis of average fruit weight, yield per plant and yield per plot, respectively. The data thus obtained was subjected to analysis of variance (ANOVA) using the method given by Panse and Sukhatme (1989) and means were compared with Fisher's least significant difference test (LSD) at 5% level of significance.

Results and Discussion

Growth Parameters

Plant height

The maximum plant height (37.44, 62.75 and 71.55 cm, respectively) at 30 and 60 days after transplanting, and at harvest was recorded under treatment T_6 (50% RDF + 50% Vermicompost) which was statistically *at par* with treatment T_1 (100% RDF) during all stages of plant growth whereas, minimum plant height at 30 and 60 days after transplanting, and at harvest (23.39, 37.15 and 44.46 cm, respectively) was recorded under treatment T_7 (Without manures and fertilizers). It is evident from the data (Table 1) that plant height of tomato plant was increased with combined application of 50% RDF and 50% vermicompost. It is mainly due to the continuous supply of nutrients especially nitrogen throughout the growth period of tomato crop. During initial stage of plant growth, nitrogen was available through inorganic fertilizers while during later stage of plant growth it was available through vermicompost. Hence, no or very less problem of leaching and may be maximum availability of nitrogen to the tomato plant (Kumari and Ushakumari, 2002). On other hands, vermicompost is a good sourse of variable amount of available plant nutrients as well as plant growth promoters like auxin, gibberelins and cytokinin which also increased height of tomato plant (Tomati *et al.*, 1990). These results were confirmed by the findings of Saini *et al.* (2023).

Number of branches

The maximum number of branches (5.93, 8.00 and 12.33, respectively) at 30 and 60 days after transplanting, and at harvest was recorded under treatment T_6 (50% RDF + 50% Vermicompost) which was statistically *at par* with treatment T_1 (100% RDF) at 60 days after transplanting whereas, minimum number of branches at 30 and 60 days after transplanting, and at harvest (3.21, 4.68 and 5.84, respectively) was recorded under treatment T_7 (Without manures and fertilizers). It is evident from the data (Table 1) that number of branches of tomato plant was increased with combined application of 50% RDF and 50% vermicompost because its combination provides essential nutrients as well as plant growth promoters. Combined effect of plant nutrients and plant growth promoters increases plant height, which is directly correlated with number of branches (Singh and Tripathy, 1995). Similar finding was also reported by Saini *et al.* (2023) and Joshi and Vig (2010).

Number of compound leaves

The maximum number of compound leaves (28.42, 40.18 and 49.50, respectively) at 30 and 60 days after transplanting and at harvest was recorded under treatment T_6 (50% RDF + 50% Vermicompost) which was statistically *at par* with treatment T_1 (100% RDF) during all stages of plant growth whereas, the minimum number of compound leaves at 30 and 60 days after transplanting, and at harvest (15.84, 23.33, 28.25, respectively) was recorded under treatment T_7 (Without manures and fertilizers). A critical observation of the data (table 1) revealed that the number of compound leaves in tomato plants increased with the combined application of half dose of NPK and vermicompost because it is positively correlated with plant height and number of branches (Singh and Tripathy, 1995). These findings are in partial agreement with the results of Saini *et al.* (2023).

Yield Parameters

Number of fruits per plant

The maximum number of fruits per plant (25.16) was recorded under treatment T_6 (50% RDF + 50% Vermicompost) which was statistically *at par* with treatment T_1 (100% RDF) at harvest whereas, minimum number of fruits per plant (14.89) was recorded under treatment T_7 (Without manures and fertilizers). A critical observation of the data (Table 2) revealed that number of fruits per plant were positively influenced by the application of manures and fertilizers because it improves growth and yield parameters like plant height, number of branches, number of compound leaves, number of truss and fruit setting, which are directly related with the number of fruits. On other hand, vermicompost is a good source of plant available forms of macro (NPK) and micro (Fe, Cu, Zn, etc.) nutrients, beneficial soil microbes like nitrogen fixing bacteria and phosphate solubilizing bacteria, actinomycetes, as well as plant growth promoters, which improve fruit setting (Chaulagain *et al.*, 2017). These findings are also supported by the results obtained by Saini *et al.* (2023), Parmar *et al.* (2019) and Singh and Singh (2011).

Fruit length and breadth

The maximum fruit length and breadth (5.90 and 4.20 cm) were recorded under treatment T_6 (50% RDF + 50% Vermicompost) which was statistically *at par* with treatment T_1 (100% RDF), T_3 (100% Vermicompost) and T_5 (50% FYM + 50% NPK) at harvest. The minimum fruit length and breadth (5.30 and 3.60 cm) were recorded under treatment T_7 (Without manures and fertilizers). It is evident from the data presented in table 2 that fruit length and breadth were improved with the application of manures and fertilizers. It was mainly due to the fact that size of tomato fruit is directly correlated with higher uptake of nutrients and more photosynthesis by tomato plant when treated with manures and fertilizers (Mohankumar and Narasegowda, 2010). On other hand, vermicompost provides plant nutrients and growth promoting substances like auxins, gibberelins and cytokinins which are responsible for the cell elongation by increasing the permeability of cell wall to water and osmotic solutes (Singh *et al.*, 2021). Similar findings were reported by Saini *et al.* (2023).

Fruit weight

The maximum fruit weight (61.83 g) was recorded under treatment T_6 (50% RDF + 50% Vermicompost) which was statistically *at par* with treatment T_1 (100% RDF) at harvest. The minimum fruit length (42.11 g) was recorded under treatment T_7 (Without manures and fertilizers). It is evident from the data presented in table 2 that the average fruit weight of tomato is increased with the application of manures and fertilizers probably because of its positive correlation with length and breadth of fruit (Singh and Tripathy, 1995). Similar findings were also reported by Saini *et al.* (2023) and Parmar *et al.* (2019).

Fruit yield

Yield per plant, per plot and per hectare were maximum (1.56 kg, 46.73 kg and 39.33 t, respectively) under treatment T_6 (50% RDF + 50% Vermicompost) which was statistically *at par* with treatment T_1 (100% RDF), whereas minimum yield per plant, per plot and per hectare (0.63 kg, 18.78 kg and 15.81 t, respectively) were recorded under treatment T_7 (Without manures and fertilizers). It is evident from the data presented in table 2 that average yield of tomato is increased with the application of manures and fertilizers because it is positively correlated with the number of fruits as well as average weight of fruits (Singh and Tripathy, 1995). Similar findings were also reported by Saini *et al.* (2023), Parmar *et al.* (2019) and Alidadi *et al*. (2014).

Conclusion

From the present investigation, it could be concluded that integrated nutrient management through treatment T_6 (50% RDF and 50% Vermicompost) was best source of plant nutrients for growth and yield parameters *viz.,* plant height, number of branches, number of compound leaves, number of fruits per plant, fruit length, fruit breadth, average fruit weight, yield per plant, yield per plot and yield per hectare.

Table 1 : Effect of integrated nutrient management on growth of tomato cv. Pusa Early Dwarf.

Treatment	Plant height (cm)			No. of branches			No. of compound leaves		
	30 DAT	60 DAT	At Harvest	30 DAT	60 DAT	At Harvest	30 DAT	60 DAT	At Harvest
T_1 (100% NPK)	35.00	58.13	68.85	5.23	7.30	10.28	26.50	38.80	46.61
T_2 (100 % FYM)	25.22	45.00	53.70	3.40	5.22	7.07	19.08	28.97	33.44
T_3 (100 % VC)	29.28	49.67	62.83	4.05	6.09	8.07	22.10	33.37	40.52
T_4 (50% FYM + 50% VC)	27.47	42.65	57.85	3.81	5.64	7.81	20.59	31.18	37.43
T_5 (50% NPK + 50 % FYM)	32.81	53.80	65.00	4.86	6.57	9.82	23.55	36.23	43.17
T_6 (50% NPK + VC)	37.44	62.75	71.55	5.93	8.00	12.33	28.42	40.18	49.50
T_7 (without manure and fertilizers)	23.39	37.15	44.46	3.21	4.68	5.84	15.84	23.33	28.25
SEm±	1.22	1.74	1.71	0.10	0.26	0.42	1.12	1.55	1.40
C.D. (0.05)	3.76	5.34	5.26	0.31	0.81	1.30	3.47	4.78	4.32

Table 2 : Effect of integrated nutrient management on yield of tomato cv. Pusa Early Dwarf.

Treatment	No. of fruits per plant	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Yield per plant (kg)	Yield per plot (Kg)	Fruit yield per ha (t)
T_1 (100% NPK)	23.34	5.70	4.00	59.56	1.40	41.88	35.25
T_2 (100 % FYM)	17.43	5.50	3.70	48.11	0.83	24.96	21.01
T_3 (100 % VC)	21.65	5.60	3.90	53.78	1.16	34.89	29.37
T_4 (50% FYM + 50% VC)	19.66	5.50	3.80	50.89	1.00	29.91	25.18
T_5 (50% NPK + 50 % FYM)	22.43	5.60	3.90	56.22	1.26	37.81	31.83
T_6 (50% NPK + VC)	25.16	5.90	4.20	61.83	1.56	46.73	39.33
T_7 (without manure and fertilizers)	14.89	5.30	3.60	42.11	0.63	18.78	15.81
SEm±	1.14	0.12	0.11	2.31	0.07	2.12	1.79
C.D. (0.05)	3.50	0.36	0.32	7.11	0.22	6.54	5.51

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