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Research Note

ROLE OF INTEGRATED NUTRIENTS MANAGEMENT ON GROWTH, YIELD AND QUALITY OF TOMATO UNDER GARHWAL HILLS

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ABSTRACT : A field experiment was conducted at Horticulture Research Centre, Chauras Campus, HNB, University, Garhwal, Uttarakhand during Rabi season to find out the effect of integrated nutrients on growth, yield and quality of tomato (*Lycopersion esculantum* Mill.) Cv. Punjab Chhuhara. The experiment was laid out in randomized block design with three replications. The experiment consist of twelve treatments *viz.,* NPK 100% (T_1), NPK 50% (T_2), F.Y.M (T_3), Vermicompost (T_4), *Azotobactor* (T_5), NPK 100% + F.Y.M (T_6), NPK 100% + Vermicompost (T_7), NPK 100% + *Azotobactor* (T_8), NPK 50% + F.Y.M (T_9), NPK 50% + Vermicompost (T_{10}), NPK50% + *Azotobactor* (T_{11}) with Control (T_{12}). Results were found to be significant for all the growth, yield and quality characters under combined use of organic, inorganic and biofertilizer. Plant height (83.12 cm), leaf area (219.12 cm^2), branch/plant (8.23), leaf/branch (18.59), cluster/plant (13.83), fruit/cluster (4.36), T.S.S (5.82 °Brix) and ascorbic acid (28.16 mg/100g) were maximum in T_8 (NPK 100% + *Azotobactor*), while minimum in T_{12} (Control). Whereas, fruit size (6.38 cm), fruit weight (119.32 g), fruit yield/plant (1.83 kg), yield/ha (285 q) were highest in T_7 (NPK 100% + Vermicompost), while minimum in T_{12} (Control). The results clearly indicated that T_7 (NPK 100% + Vermicompost) and T_8 (NPK 100% + *Azotobactor*) is most effective to improve the growth, yield and quality of tomato compression to other treatments.

Keywords : *Tomato, integrated nutrient management, growth, yield, quality.*

Tomato (*Solanum lycopersicum* Mill.) is the most popular vegetable crop of the world due to its wider adaptability and multifarious uses. It consists of vitamins, minerals and antioxidants, which are essential for human health (Kallo, 5). Tomato is grown in all type of soil on a small scale for family use and on a commercial scale as a cash crop by the vegetable growers. As far as global vegetable production is concerned tomato is the most popular and consumed vegetable in the world. However, tomato yield in India quite low (18 t/ha) as compared to the average yield in Asia (24.30 t/ha) and world (26.74 t/ha). The area under tomato cultivation in India is about 6.10 lakh ha and total production of 11.00 million tonne (FAO, 3). The majority of tomato growers do not produce good quality fruit and also high yield due to lack of knowledge regarding improved production technologies including proper use of inorganic and organic fertilizer (FAO, 4). Tomato, being a heavy feeder and exhaustive crop, requires large quantities of nutrient inputs from soil. The excessive or indiscriminate use of nitrogenous fertilizer is not judicial for soil health and crop production. Farmers use imbalance inorganic fertilizers and pesticides injudiciously in order to harvest to good yield. The continuous use of chemical fertilizers increases the concentration of heavy metal in the soil (Arya and Roy, 2), disturb soil health and quality which cannot support plant growth in long term basis. Integrated nutrient management comprises organic, inorganic and biofertilizer that is highly beneficial for sustainable crop production. Hence, application of organic manure and biofertilizer in judicious combination to chemical fertilizers facilitates profitable and sustainable crop production along with maintenance of soil fertility (Singh and Sinsinwar, 11). Therefore, the present research work was undertaken to assess the response of integrated nutrient management on growth, yield and quality of tomato under Garhwal Himalayan region.

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The experiment was carried out at Horticultural Research Centre, Chauras Campus, H.N.B Garhwal University, Srinagar (Garhwal), Uttarakhand during rabi season, 2014-2015. Srinagar (Garhwal) is located in the Alaknanda valley (78° 47' 30" E longitude and 30° 13' 0" N latitude and at an elevation of 540 m above MSL), a semi-arid, subtropical climate with dry summer and rigorous winters with occasional dense fog in the morning hours from mid December to mid February. The experiment consist of inorganic, organic manures and biofertilizer *viz.,* NPK 100% (T_1), NPK 50% (T_2), F.Y.M (T_3), Vermicompost (T_4), *Azotobacter* (T_5) with their combination *i.e.,* NPK 100% + F.Y.M (T_6), NPK 100% + Vermicompost (T_7), NPK 100% + *Azotobactoer* (T_8), NPK 50% + F.Y.M (T_9), NPK 50% + Vermicompost (T_{10}), NPK50% + *Azotobacter* (T_{11}) and Control (T_{12}). The experiment was laid out in Randomized Block

Design which was replicate thrice. The entire experimental field was divided into three blocks of equal size and each block possessed twelve plots. Five weeks old seedlings of tomato cv. Punjab Chhuhara were uprooted and then their root were dipped in *Azotobacter* solution and transplanted into well prepared field. The full doses of inorganic fertilizers were applied before transplanting, whereas, full quantity of F.Y.M and vermicompost was applied at the time of last ploughing. The nursery was raised on flat beds and five week old seedlings were transplanted during mid November. Each plot measured 3.0 × 2.7 m^2 area with 60 cm × 45 cm spacing. All the intercultural operations and plant protection measures recommended for the successful crop growth were followed and irrigation was given to maintain the proper moisture in the field for better growth and development of the plants. Randomly five plants from each plot were selected to record the data on the following observations *viz.,* plant height (cm), branch/plant, leaf/branch, leaf area (cm^2), cluster/plant, fruit/cluster, fruit/plant, fruit size (cm), fruit weight (g), yield (q/ha), T.S.S (°Brix) and ascorbic acid (mg/100g) The obtained data were analyzed by using analysis of variance (ANOVA) under RBD following the procedure as stated by Panse and Sukhatme (9).

Integrated use of inorganic, organic and bio-fertilizer had a significant and positive influence on maximum growth, yield and quality parameters. The result of present investigation revealed that all the growth, yield and quality attributes were highly influence by the full dose of NPK with combination of either vermicompost or *Azotobacter* as shown in Table 1. Maximum plant height (83.12 cm) was observed in T_8 (NPK 100% + *Azotobacter*) followed by (81.36 cm) T10 (NPK 50%+ Vermicompost). While, minimum (59.86 cm) plant height were recorded in T_{12} (control). Maximum number of branches/plant (8.23) was recorded under treatment T_8 (NPK 100% + *Azotobacter*) followed by (8.15 cm) T_{10} (NPK 50% + Vermicompost), whereas minimum of branches/plant (4.65) was recorded under treatment T_{12} (control). Leaf per branches (18.59) were found maximum under treatment T_8 (NPK 100% + *Azotobacter*) followed by (17.58) T_{11} (NPK 50% + *Azotobacter*), while minimum (9.65) was found under treatment T_{12} (control). Highest leaf area (219.12 cm^2) were found under treatment T_8 (NPK 100% + *Azotobacter*) followed by (216.87 cm^2) T_{12} (NPK 50% + *Azotobacter*), while lowest leaf area (149.36 cm^2) was found under treatment T_{12} (control). The highest values of all growth parameters were recorded in treatment combination of NPK 100% and *Azotobacter*, these might be due to continuous nutrient availability from combined nutrient sources which ultimately improved growth parameters and photosynthetic activity of plants (Padloe *et al.,* 7).

The yield attributes of tomato were highly influenced by the application of fertility level and their combination with vermicompost. It is well known fact that nitrogen and phosphorous both are essential constituents of proteins and chlorophyll along with their involvement in many other compounds of physiological importance in plant metabolism. Highest cluster/plant (13.83) were recorded under treatment T_8 (NPK 100% + *Azotobacter*) followed by (12.89) T_1 (NPK 100%), whereas lowest cluster/plant (4.96) was recorded under treatment T_{12} (control). Maximum fruit/cluster (4.36) were observed under treatment T_8 (NPK 100% + *Azotobacter*) followed by (4.20) T_{11} (NPK 50%+ *Azotobacter*), while minimum fruit/cluster (2.99) was observed under treatment T_{12} (control). Maximum fruit size (6.38 cm) were observed under treatment T_7 (NPK 100% + vermicompost) followed by (6.30cm) T_{11} (NPK 50%+ *Azotobacter*), while minimum fruit size (4.89cm) was observed under treatment T_{12} (control). Highest fruit weight (119.30g) were recorded in treatment T_7 (NPK 100% + vermicompost) followed by (109.63g) T_{10} (NPK 50% + vermicompost), while lowest fruit weight (86.25g) was recorded in T_{12} (control). Maximum fruit yield/plant (1.83g) were recorded in treatment T_7 (NPK 100% + vermicompost) followed by (1.68g) T_{10} (NPK 50% + vermicompost), while minimum fruit yield/plant (0.629g) was recorded in T_{12} (control). Maximum fruit yield/ha (285q) were recorded in treatment T_7 (NPK 100% + vermicompost) followed by (256.12q) T_{10} (NPK 50% + vermicompost), while minimum fruit yield/ha (152.3q) was recorded in T_{12} (control). The yield attributes of tomato were highly influenced by the application of fertility level and their combination with vermicompost. It is well known fact that nitrogen and phosphorous both are essential constituents of proteins and chlorophyll along with their involvement in many other compounds of physiological importance in plant metabolism. Hence, increase in yield due to the application of organic manure, fertilizer and biofertilizer together was might be responsible for synthesis of plant growth hormone, development of root system and therefore high nutrients utilization by the crop plants (Pandey and Kumar, 8; Kumarswamy and Madalageri, 6). Hence, with the increment in supply of essential nutrients to tomato, their availability, acquisition, mobilization and influx into the plant tissues increased and thus improved growth and yield components could be achieved (Shukla *et al.,* 10).

Application of NPK with biofertilizer may have exhibited regulatory role on absorption and translocation of various metabolites, in which most important carbohydrates affect the quality of fruits. Maximum TSS (5.82°Brix) were recorded under treatment T_8 (NPK 100% + *Azotobacter*) followed by (5.59 °Brix) T_{10} (NPK 50% + vermicompost), while minimum TSS (4.79 °Brix) was recorded in T_{12} (control). Maximum vitamin-C (28.16mg/100g) were

Table 1 : Effect of integrated nutrients on growth, yield and quality of tomato.

Treatments	Plant height (cm)	Branch/plant	Leaf/branch	Leaf area (cm^2)	Cluster/plant	Fruit/cluster	Fruit size (cm)	Fruit weight (g)	Fruit yield/plant (kg)	Yield/ha (q)	T.S.S (^{0}Brix)	Vit.C (mg/100g)
T_1 : NPK 100%	78.63	7.12	15.89	205.69	12.89	4.01	5.84	104.69	1.14	220.54	5.10	22.30
T_2 : NPK 50%	70.15	6.58	14.52	200.14	12.01	3.98	5.50	100.54	1.05	200.14	5.05	21.74
T_3 : FYM	60.19	6.10	12.36	198.36	10.69	3.15	4.98	98.36	0.759	171.32	4.85	20.18
T_4 : Vermicompost	68.12	6.25	14.01	202.56	10.89	3.29	5.14	100.89	0.896	185.36	4.90	23.59
T_5 : *Azotobacter*	66.23	6.03	13.25	199.63	11.25	3.50	5.20	101.47	0.850	180.69	4.98	24.74
T_6 : NPK100% + FYM	79.31	7.69	15.98	208.35	12.62	3.89	5.69	105.40	1.10	210.74	5.20	25.64
T_7 : NPK100% + Vermi-compost	78.89	7.89	16.36	212.45	12.36	4.18	6.38	119.30	1.83	285	5.36	25.98
T_8 : NPK 100% + Azotobacter	83.12	8.23	18.59	219.12	13.83	4.36	6.10	108.32	1.25	236.47	5.82	28.16
T_9 : NPK 50% + FYM	80.06	8.01	16.25	206.51	11.58	4.15	6.05	107.14	1.36	240.56	5.41	25.36
T_{10} : NPK50% + Vermi compost	81.36	8.15	16.32	215.87	12.69	4.18	6.25	109.63	1.68	256.12	5.59	26.14
T_{11} : NPK 50% + *Azotob acter*	79.29	7.89	17.58	216.87	12.81	4.20	6.30	104.89	1.54	245.36	5.48	27.14
T_{12}: Control	59.86	4.65	9.65	149.36	4.96	2.99	4.89	86.25	0.629	152.36	4.79	19.01
CD (P=0.05)	2.973	0.523	2.195	7.529	2.105	0.249	0.198	9.716	40.136	45.588	0.076	2.121

recorded under treatment T_8 (NPK 100% + *Azotobacter*) followed by (27.14mg/100g) T_{11} (NPK 50% + *Azotobacter*), while minimum vitamin-C (19.01mg/100g) was recorded in T_{12} (control). Similar observation has also been reported by Ahlawat *et al.* (1). Terry *et al.* (12) have reported that translocation of assimilates from leaves to the developing fruit increased during ripening stage. Biofertilizers are also known to favour the synthesis of different growth regulators like IAA, GA and cytokinins.

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