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Effect of integrated nutrients management on growth, yield and quality of tomato (*Solanum Lycopersicum* L.) under Chhattisgarh plains

Sumant Kumar and PC Chaurasiya

Abstract
The current study titled **"**Integrated nutrient management in tomato under Chhattisgarh Plains.**''** was carried out in Horticulture research farm College of Agriculture and Research Station, Mahasamund, (C.G.) during *Rabi* 2020-21.To estimate the influence of INM practices on growth, production and economics of tomato. The trial was conducted in RBD with three replication and nine treatments using variety Kashi Adarsh, to find out the mixture of organic and inorganic fertilizers on growth and yield of tomato. On the basis of results, application of 75% RDF +50% vermicompost found to be most effective were it recorded maximum plant height 67.12 cm, 75.70 cm, 96.35 cm, and 98.30 cm (30, 50, 70 DAT and at harvest respectively.), maximum number of internodes per plant 8.79, 15.72, 21.67 and 21.74 (30, 50, 70 DAT and at harvest respectively), maximum number of branches per plant 7.37, 9.51, 12.98 and 12.98 (30, 50, 70 DAT and at harvest respectively), lowest day to 50% flowering (29.99 days). Maximum number of fruit per plant (42.02), maximum number of diameter (69.22 mm), maximum fruit weight (74.49 g), the maximum fruit yield per plot (22.45 kg).Maximum number of locules per fruit (4.00 per fruit). Maximum (TSS 4.59%), maximum titrable acidity (0.91%), highest content of ascorbic acid (32.06mg 100 g^{-1}), maximum fruit pH (4.21).

Keywords: Tomato, INM, TSS, growth, yield, bio-fertilizer

Introduction
Tomato (*Lycopersicum esculentum* Mill.) is one of the most popular vegetable crops grown all over the world due to its wider adaptability to various agro-climatic conditions. Its fruits are very popular among people of all social strata and consumed in variety of ways. It is equally liked by both poor and rich and is quite high in nutritive value. Apart from this, it also embodies certain Ayurvedic medicinal properties. It contains higher quantity of total sugar (2.5- 4.5%), starch (0.6-1.2%) and minerals like potassium, calcium, sodium, magnesium, phosphorus, boron, manganese, zinc, copper, iron, etc. Apart from these, it also contains organic acids such as citric, malic and acetic acids which are known as health acids in fresh tomato fruit.

The continuous use of chemical fertilizers increase the concentration of heavy metals in the soil, disturb soil health and quality which can't support plant growth in long term basis. Organic manures in proper blend with chemical fertilizers will predictably support crop growth (Kumar *et al.* 2009) [3].

The integrated use of inorganic fertilizers, farm yard manure and vermicompost and other organics hold large agree in secure maximum level of crop productivity and also protect soil health from deterioration and toxic waste hazard. To maintain higher amount of soil fertility and crop output, a balanced use of chemical fertilizers, organic manure, and vermi-compost must be used. The vegetable constraint of our country through biological processes that have been shown to increase production of many vegetables. (Purkayastha *et al.*, 1998) [4].

Material and Methods
The experiment was conducted at the Horticultural Research Farm College of Agriculture and Research Station, Mahasamund (Chhattisgarh) during Rabi season 2020-21. In this chapter the details of trial during the course of study, current weather conditions, material used and techniques adopt are in brief presented. The trial was laid out in RBD with 3 replications. The experimental material included nine treatment combinations *viz.* T_1 100% RDF, T_2 75% RDF+ 25% FYM, T_3 50% RDF + 50% FYM, T_4 75% RDF + 25% vermicompost, T_5 75% RDF +

50% vermicompost, T_6 100% RDF + Azotobacter + PSB, T_7 75% RDF + Azotobacter + PSB, T_8 50% RDF + Azotobacter + PSB, T_9 control.

The seedlings were raised in the nursery for transplanting. The raised beds of 2.4 m x 1.2 m x 0.15 m size were prepared and 10 kg of farm yard manure to each bed were combining thoroughly in the soil. The tomato seeds were sown on the raised beds by line sowing and irrigation was applied by surface method. Thirty days old, stocky and healthy seedlings of 15 cm height with 3 to 4 leaves, free from any insect pest and disease and true to type were selected and transplanted in the experimental field after dipping their roots in Imidachloprid solution for 15 minutes during both the years of winter seasons at 60 cm x 60 cm apart in the late afternoon. Full dose of FYM (10t/h), vermicompost (5t/ha), Phosphorus, Potassium and half dose of Nitrogen as per treatment were applied in the plot as basal dose of recommended dose of NPK 100:80:80. Remaining half dose of nitrogen was applied in 40 day after transplanting. N, P and K were applied, through urea, SSS and MOP respectively. The observations were recorded on 13 characters under growth, yield, and quality attributing traits in tomato *i.e.* Plant height (cm), Number of internodes per plant, Number of branches per plant, Days to 50% flowering, Number of fruits per plant, fruit diameter (mm), Average fruit weight (g), Fruit yield per plot (kg), Number of locules per fruits, Total soluble solids (%), Titrable acidity (%), Ascorbic acid Vitamin C (mg 100 g^{-1}), Fruit pH

Result and Discussion

The maximum plant height was recorded in treatment T_5 which received 75% RDF + 50% vermi-compost at 30, 50, 70 DAT and at harvest (67.12 cm, 75.70 cm, 96.35 cm, and 98.30 cm respectively), followed by treatment T_6 (100% RDF + Azotobacter + PSB) (65.11 cm, 73.10 cm, 95.16 cm and 97.14 respectively). Whereas, the maximum plant height was recorded in T_9 (control plot) at all the stage of observation (56.61 cm, 61.29 cm 72.47 cm and 74.27 cm) at 30, 50, 70 DAT and at harvest respectively.

The maximum number of internodes was recorded in Treatment T_5 (75% RDF + 50% vermi-compost) at 30, 50, 70 DAT and at harvest (8.79, 15.72, 21.67 and 21.74 respectively show the maximum number of internodes per plant followed by treatment T_6 (100% RDF + Azotobacter + PSB) (8.11, 14.33, 20.84 respectively). while, the maximum number of internodes $plant^{-1}$ was observed in treatment T_9 (control plot) at all the stages of observation (5.25, 8.47, 15.13 and 15.13) at 30, 50, 70 DAT and at harvest respectively.

The number of branches $plant^{-1}$ was significantly maximum in treatment T_5 (75% RDF + 50% vermi-compost) at 30, 50, 70 DAT and at harvest (7.37, 9.51, 12.98 and 12.98 respectively), followed by treatment T_6 (100% RDF + Azotobacter + PSB) (6.24, 7.72, 11.33 and 11.33 respectively). Whereas, the treatment T_9 (control plot) recorded lowest number of branches per plant (3.49, 4.08, 7.15 and 7.15) at all the stage of observation at 30, 50, 70 DAT and at harvest respectively.

Treatment T_5 (75% RDF + 50% vermi-compost) observed the lowest day taken for the first flowering (29.99 days) followed by T_6 (100% RDF + Azotobacter + PSB) (30.44 days) whereas, the treatment T_9 (control plot) recorded the maximum days (35.50 days) taken for the first flowering after transplanting. The maximum number of fruits $plant^{-1}$ (42.02) was obtained in the treatment T_5 (75% RDF + 50% vermi-compost) followed by T_6 (100% RDF + Azotobacter + PSB) (39.50). The minimum number (20.41) per plant was observed under the treatment T_9 (control plot). The treatment T_5 (75% RDF + 50% vermi-compost) T_5 (75% RDF + 50% vermi-compost) recorded highest fruit diameter (69.22 mm) followed by T_6 (100% RDF + Azotobacter + PSB) (66.45 mm). Followed by treatment T1 (100% RDF) (65.74) However the treatment T9 (control plot) noted the minimum fruit diameter (39.58 mm).

The maximum average fruit weight (74.49 g) was recorded in treatment T_5 (75% RDF + 50% vermi-compost) followed by T_6 (100% RDF + Azotobacter + PSB) (71.41 g) followed by treatment T_1 (100% RDF) (69.68). The minimum fruit weight (54.40) was observed in treatment T_9 (control plot), the result of this character shows significant influence.

The maximum fruit yield (22.45 kg) per plot was recorded in the treatment fertilized with T_5 (75% RDF + 50% vermi-compost) followed by treatment T_6 (100% RDF + Azotobacter + PSB) (21.03 kg). The lowest yield (14.60 kg) per plot was reported in treatment T_9 (control plot).

The highest number of locules 4.00 per fruits was observed in the treatment T_5 (75% RDF + 50% vermi-compost) followed by treatment T_6 (100% RDF + Azotobacter + PSB) (3.95) the minimum number of locules per fruits (3.14) was reported in treatment T_9 (control plot).

The treatment T5 (75% RDF + 50% vermicompost) maximum fruit TSS (4.59%), followed by treatment T6 (100% RDF + Azotobacter + PSB). **(**4.43) the lowest TSS was recorded in treatment T_9 (control plot).

The maximum titrable acidity (0.91%) was recorded in treatment T_5 (75% RDF + 50% vermi-compost) Followed by treatment T_6 (100% Recommended dose of fertilizers + Azotobacter + PSB) (0.90%) the lowest titrable acidity was recorded in treatment T_9 (0.82%) control plot.

The maximum content of ascorbic acid (32.06mg 100 g^{-1}) was registered in the treatment T_5 (75% RDF + 50% vermi-compost) followed by treatment T_6 (100% RDF + Azotobacter + PSB) (31.39 mg 100 g^{-1}) the lowest ascorbic acid was observe in treatment T_9 (27.91 mg 100 g^{-1}) control plot.

The maximum pH content in treatment T_5 (75% RDF + 50% vermi-compost) (4.21) followed by treatment T6 (100% Recommended dose of fertilizers + Azotobacter + PSB) (4.14) the minimum pH was observe in treatment T_9 (4.03) control plot.

Table 1: Effect of integrated nutrient management on growth parameters

Treatment details	Plant height			No. of internodes per plant			No. of branches per plant			Days to 50% flowering
	30 DAT	50 DAT	70 DAT	30 DAT	50 DAT	70 DAT	30 DAT	50 DAT	70 DAT	
100% RDF	62.22	72.42	93.10	8.05	11.66	20.35	4.85	5.85	9.96	31.35
75% RDF+25% FYM	64.56	71.40	91.82	7.20	13.60	18.21	5.26	7.39	10.94	32.67
50% RDF + 50% FYM	63.25	69.79	93.04	6.40	12.25	20.35	5.23	6.85	10.68	33.82
75% RDF + 25% Vermicompost	61.93	72.78	94.26	7.01	13.34	19.77	4.14	7.49	10.48	31.75
75% RDF + 50% Vermicompost	67.12	75.70	96.35	8.79	15.72	21.67	7.37	9.51	12.98	29.99
100% RDF + Azotobacter + PSB	65.11	73.10	95.16	8.11	14.33	20.84	6.24	7.72	11.33	30.44
75% RDF + Azotobacter + PSB	62.13	71.82	91.47	6.60	12.58	18.71	5.58	7.15	8.55	33.75
50% RDF + Azotobacter + PSB	61.89	72.35	91.83	6.13	13.10	20.42	4.55	6.66	9.37	34.42
Control	56.61	61.29	72.47	5.25	8.47	15.13	3.49	4.08	7.15	35.50
SEm±	1.01	1.06	0.85	0.37	0.93	0.74	0.63	0.50	0.52	0.52
CD (0.05)	2.97	3.12	2.52	1.09	2.73	2.19	1.85	1.49	1.52	1.54

Table 2: Effect of integrated nutrient management on yield attributes

Treatment details	No. of fruits plant^{-1}	Fruit diameter	Fruit weight	Fruit yield per plot	No. of locules per fruits
100% RDF	38.95	65.74	69.68	19.65	3.88
75% RDF+25% FYM	39.39	64.35	68.36	20.48	3.84
50% RDF + 50% FYM	37.32	62.28	65.83	18.69	3.85
75% RDF + 25% Vermicompost	36.97	65.35	70.08	20.76	3.88
75% RDF + 50% Vermicompost	42.02	69.22	74.49	22.45	4.00
100% RDF + Azotobacter + PSB	39.50	66.45	71.41	21.03	3.95
75% RDF + Azotobacter + PSB	34.60	59.43	66.30	19.03	3.74
50% RDF + Azotobacter + PSB	32.60	55.06	60.74	19.94	3.83
Control	20.41	39.58	54.40	14.60	3.14
SEm±	1.54	1.65	0.92	0.93	0.12
CD (0.05)	4.54	4.83	2.72	2.75	0.37

Table 3: Effect of integrated nutrient management on Quality parameters

Treatment details	TSS (%)	Titrable Acidity (%)	Ascorbic acid Vitamin C	Fruit pH
100% RDF	3.69	0.85	30.25	4.12
75% RDF+25% FYM	3.43	0.82	28.16	4.10
50% RDF + 50% FYM	3.47	0.85	28.31	4.08
75% RDF + 25% Vermicompost	3.70	0.84	31.12	4.04
75% RDF + 50% Vermicompost	4.59	0.91	32.06	4.21
100% RDF + Azotobacter + PSB	4.43	0.90	31.39	4.14
75% RDF + Azotobacter + PSB	3.63	0.86	29.67	4.09
50% RDF + Azotobacter + PSB	4.12	0.84	30.48	4.11
Control	3.12	0.82	27.91	4.03
SEm±	0.10	0.02	0.24	0.13
CD (0.05)	0.31	0.06	0.70	0.39

Conclusion

The highest gross returns (Rs.249440 Rs./ha) and net return (182550) Rs/ha) was recorded under treatment T_5 (75% RDF + 50% vermicompost) followed by T_6 (100% RDF + Azotobacter + PSB) which were approximately similar trend in gross and net return, The minimum gross return (Rs. 162216 Rs/ha) and lowest net return (Rs. 102006 Rs/ha) was recorded under treatment T_9 (control plot), In respect of benefit cost ratio, treatment T_5 (75% RDF + 50% vermicompost) shows highest value (2.7) followed by T_6 (100% RDF + Azotobacter + PSB) *i.e.* (2.6) and the treatment T_9 (control plot), on the basis of above findings, treatment T_5 (75% RDF + 50% vermicompost) stand first in position and T_6 (100% RDF + Azotobacter + PSB) stand in second order of preference. Therefore it may be concluded that treatment T_5 (75% RDF + 50% vermicompost) may be prefer for integrated nutrient management in tomato.

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