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ORGANIC NUTRIENT MANAGEMENT IN TOMATO

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ABSTRACT
A field experiment was conducted during Rabi 2014-15 and 2015-16 with an objective to find out the effective organic nutrient management practice in tomato. This field trial was comprised of 9 treatments and replicated three times in randomized block design. The treatments T_1 and T_2 were applied with FYM @ 10 t/ha and 20 t/ha, T_3 and T_4 were applied with vermicompost @ 5 t/ha and 2.5 t/ ha, T_5 and T_6 were applied with one year old well rotten poultry manure @ 5 t/ha and 2.5 t/ ha, T_7 and T_8 were applied with neem cake @ 2 t/ha and 1 t/ha respectively and T_9 was applied with recommended dose of fertilizer @ 125: 50: 100 kg N: P_2O_5: K_2O per hectare as control. Application of Recommended dose inorganic fertilizer produced the highest fruit yield (265.81 q/ha) and Benefit-Cost ratio (2.61) which was at par with FYM @ 20 t/ha (245.39 q/ha) and poultry manure @ 5 t/ha (234.98 q/ha) but significantly superior to other treatments. Thus, it was inferred that application of FYM @ 20 t/ha as basal or poultry manure @ 5t/ha as was found to be the best and cost effective organic nutrient management practices for better fruit yield and quality of tomato as well as maintaining the soil health.

KEY WORDS: Growth, Organics, Recommended Dose, Tomato, Yield.

INTRODUCTION

Tomato (*Lycopersicon esculentum Mill.)* is one of the most common, leading, widely consumed, popular, staple, day neutral, self-pollinated, annual and economically important solanaceous fruit vegetable crop (Tekale *et al.*, 2017). It is third most consumed vegetable in the world next to potato and sweet potato (Sadaf *et al.*, 2012). India is the second largest producer of vegetable after China in the world and producing 18.23 MT tomato from 0.879 m ha area having the productivity of 20.74t/ha (Anon, 2014). Tomato occupies a prime position in the list of protective foods since, it consists of vitamins, minerals and antioxidants which are essential for human health (Kallo, 1993). In the recent decades, the consumption of tomato has been associated with prevention of several diseases (Willcox *et al.*, 2003 and Sharoni and Levi, 2006) mainly due to the content of antioxidants including carotenes, (Lycopene as well as β-carotene), ascorbic acid, and phenolic compounds (Periago *et al.*, 2009). Farmers generally use imbalanced inorganic fertilizers and pesticides injudiciously in order to harvest good yield. Almost all farmers are relying on commercial fertilizers for profitable yields, thus less or no build-up of organic matter occurs in our soil (Khan *et al.*, 2017). Mineral fertilizers when applied continuously over the years, affects the physical properties of the soil and may not have the ability to produce more yields (Zia *et al.*, 2000). Continuous use of chemical fertilizers increases the concentration of heavy metal in the soil (Arya and Roy, 2011), disturbs soil health and quality which can't support plant growth in long-term basis. The present agriculture production system for last several decades has depleted the soil properties and eroded environmental quality resulting in extinction of several beneficial insects, birds and micro-organisms *etc*. (Pandey and Chandra, 2013) On the other hand, judicious use of organic manures facilitates good quality fruits along with maintaining the soil fertility (Singh and Sinsinwar, 2006). Most studies on the use of animal wastes dealt with cow dung, poultry manure and and confirmed their fertility improving value for many crops (Akanbi, 2002). Saidu *et al.*, 2011, reported that organic agriculture was an ecologically sound production management system that promoted and enhanced biodiversity and biological activities in the soil. The primary goal of organic agriculture was to optimize the soil health and productivity of plants (Saidu *et al.*, 2011). Soil organic carbon is a crucial factor for realizing higher yield of vegetables, addition of organic manures like FYM, compost, vermicompost etc can play a vital role in the sustenance of soil fertility and crop production (*Singh et al.*, 2013.)

Generally, Solanaceous vegetables require large quantity of major nutrients in addition to secondary nutrients such as Calcium and Sulphur for better growth, fruit and seed yield. Adequate supply of nutrients increases fruit quality, fruit size, keeping quality, colour and taste and acidity (Maji and Ghosh, 2006, 2007a and b) FYM refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. Neemcake is used for controlling nematodes and other soil born organism. It is very useful organic manure and it is directly or indirectly helpful in increasing the production of crops. Vermicompost provides excellent soil structure, porosity, aeration, drainage, water retention capacity and prevent soil degradation (Pal *et al.*, 2015). Organic manures such as

cow dung; poultry manure and crop residues and vermicompost were used as alternatives for the inorganic fertilizers but no conclusive results were obtained to ascertain which among these organic sources of nutrition gave a higher yield of tomato (Ali *et al*., 2014).

The information on the conjoint use of organic fertilizers in tomato under the Indian conditions in general and north central plateau zone of Odisha in particular is very limited. Therefore, keeping the above-mentioned facts in view, the present study was undertaken with objectives to study the response of tomato to different organic sources to its growth, yield and quality of tomato and to find out the effective organic nutrient management practice in tomato for North Central Plateau Zone of Odisha.

MATERIALS AND METHODS

The field experiment on organic nutrient management was conducted during rabi 2014-15 at Regional Research and Technology Transfer Station (OUAT), Keonjhar, Odisha, which is located at 21^0.25' North latitude and 85^0.37' East longitude. The average precipitation during study period was 1716.7 mm per year, while maximum temperature was 40^0 C in May and June and minimum temperature was 6^0C in December and January. Soil of experimental plot was loamy in texture and slightly acidic with pH 6.5 and EC 0.309 ds/m, organic carbon 0.42%, available N–106 kg/ha, P_2O_5–21.0 kg/ha and K_2O 225.0 Kg/ha. Nine treatments (T_1- FYM 10 t/ha as basal and T_2- FYM 20 t/ha as basal, T_3-vermicompost 5t/ha as basal, T_4-vermicompost 2.5 t/ha as basal,T_5- one year old well rotten poultry manure 5 t/ha as basal, T_6 -one year old well rotten poultry manure 2.5 t/ha as basal, T_7 - neem cake 2 t/ha, T_8 -neem cake 1 t/ha and T_9 was applied with recommended dose of fertilizer 125:50: 100 kg N:P_2O_5 : K_2O per hectare which was consider as control) were imposed with three replications in randomized block design. Seeds of tomato variety BT-10 were treated with Captan @ 2g per Kg of seeds and then sown in raised bed in lines 5cm apart during October in both the year in nursery. The seeds were watered as and when necessary after sowing. After 3 weeks the seedlings of tomato were planted in rows at distance of 60 x 45cm. Cultural activities and irrigations were done whenever required. Plant height (cm), number of leaves per plant and number of branches per plant were determined *in situ* at maturity. Picking was done as per maturity of fruits from each plant and data was recorded from five randomly sampled and tagged plants per treatments. Matured fruits were harvested at weekly interval or assessment of number of fruits per plant, average fruit weight. Fruit yield per hectare was obtained through conversion of plot yield. The observations were taken for its vegetative growth; fruiting and yield were determined by following the standard procedures (AOAC 2000). Total soluble solids (TSS) were determined with the help of hand refractometer and expressed in ^{0} Brix (Ranganna, 1997). The economic parameters such as cost of production, net return and benefit-cost ratio were calculated by considering all inputs and outputs. The recorded data was analyzed statistically in Randomized Block Design (RBD) as per the procedure described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

All the growth attributes like plant height, number of branches, number of leaves were significantly influenced by application of organic fertilizers (Table-1). It revealed that growth parameters of tomato were highly influenced by application of organic fertilizer in different treatments. The treatment T2 (FYM @20t/ha) gave the highest plant height (38.78 cm) and number of leaves per plant (42.2). However, the maximum number of branches per plant was found in treatment applied with recommended dose of fertilizer (7.6) which was at par with the treatments applied with FYM @ 20t/ha (6.53) and Vermicompost @ 5t/ha. Better vegetative growth might be due to fact that vermicompost and farm yard manure supplying additional amount of nutrients and also improve the physico-chemical and microbial environment of the rhizosphere leading to better expression of response (Kumaran *et al.,* 1998, Pal *et al.,* 2015). The increasing levels of FYM significantly increased the vegetative growth of plants. The improvement in plant might be due to better moisture holding capacity, supply of micronutrients and availability of major nutrients due to favourable soil conditions. FYM improved physical condition of soil like structure, moisture holding capacity, aeration etc, These results are in close conformity with the finding of Manohar *et al.* (2013), Samawat *et al*. (2001), Rao and Sankar (2001) and Hashemimajd *et al.* (2004).

Increased doses of organic fertilizers considerably increased the number of fruits per plant, total fruit weight per plant and yield of fruit per hectare. It is well known fact that nitrogen and phosphorus both are essential constituents of proteins and chlorophyll. Application of RDF resulted an increase in number of fruits per plant (16.07) and total fruit weight (762.50g) followed by the treatment applied with FYM @ 20t/ha as basal. Though RDF shows the highest value but it was found to be comparable with non- significant differences with the treatments @ 20t/ha as basal (T2) and vermicompost 5t/ha (T3) and well rotten one-year old poultry manure @ 5t/ha as basal (T5). This might have helped in producing higher amount of carbohydrates which might have translocated from source (leaf) to reproductive parts (sink) resulting in more number of fruits and fruit weight (Tekale *et al.,* 2017). The yield and yield attributing characters were better due to plants which were supplied nutrients from chemical fertilizers or organic manures that were readily available to plants in sufficient amount throughout the growth period (Islam *et al.,* 2013 and Singh *et al.,* 2013).

Total soluble solid (T.S.S.) of the fruit was found to be significantly affected by higher level of organic nutrients. However highest T.S.S. was found under the treatment applied with RDF (5.36) which was at par with T5 (5.3), T2(5.24) and T3 (5.08). Improvement in TSS content of tomato fruits with the application of various organic sources of nutrient might be due to increased photosynthetic activity and exhibited regulatory role on absorption and translocation of various metabolites, resulted improved level of carbohydrates and other quality parameter of the fruit through the way of enzymatic activity that stimulated by plant growth substances produced by application of organic manure and other nutrients. Similar observation has also been reported by

Ahlawat *et al.,* 2009, Pal *et al.* 2015 and Singh *et al.,* 2017 in tomato.

TABLE 1 Effect of different organic nutrient management practices on growth and yield attributes of tomato (pooled data of 2014-15 and 2015-16)

Treatments	Plant height (cm)	No. of Leaves per plant	No. of Branches per plant	No. of fruits/ plant	Total fruit weight/ plant (g)	T.S.S.
T1: FYM @ 10 t/ha as basal	35.23	37.40	6.47	12.93	612.50	4.68
T2: FYM @ 20 t/ha as basal	38.78	42.20	6.53	13.80	730.01	5.24
T3: Vermicompost @ 5 t/ha as basal	36.49	40.67	6.53	13.33	647.51	5.08
T4:Vermicompost @ 2.5 t/ha as basal	33.33	38.40	6.40	11.47	490.01	4.92
T5: Poultry manure (well rotten) 5 t/ha as basal	37.16	36.93	6.47	13.73	675.00	5.3
T6: Poultry manure one year old (well rotten) 2.5 t/ha as basal	34.17	36.47	6.27	11.53	547.50	4.44
T7: Neem Cake @ 2 t/ha	33.10	35.40	6.27	11.53	525.00	4.96
T8: Neem Cake @ 1 t/ha	32.92	29.13	5.67	10.73	480.0	4.41
T9: RDF (125:50:100 kgN:P_2O_5:K_2O/ha) (control)	37.41	40.00	7.60	16.07	762.50	5.36
CD (0.05)	1.88	3.03	2.13	2.59	113.72	0.62

Yield is the ultimate and most important objective for which crops are grown. Table-2 shows the data recorded on fruit yield as affected by organic fertilizers and inorganic fertilizers. Application of Recommended dose inorganic fertilizer (125:50:100 kg N: P_2O_5: K_2O/ha) produced more numbers of fruits per plant with higher fruit weight per plant resulting the highest fruit yield (265.81 q/ha) which was at par with FYM @ 20t/ha (245.39 q/ha) and poultry manure @ 5 t/ha (234.98 q/ha) but significantly superior to other treatments. This might be due to the availability of higher amount of nutrients to plant from soil and there by higher uptake of the essential nutrients by plant as also scribed by Adekiya and Agbede, 2009 and Pandey and Chandra, 2013, Khan and pariari, 2012, Khan *et al.,* 2017. Good vegetative growth led to better photosynthetic activity which was reflected on yield and quality of tomato (Singh *et al.,* 2013, and Pal *et al.,* 2015, Rajya Laxmi *et al.,* 2015. As regards to B: C ratio among organic treatments poultry manure @ 5 t/ha was found more profitable (2.22) than FYM @ 20 t/ha (2.04) indicating the best practice with respect to profitability. The increase in the tomato yield may also be attributed to the higher absorption of N, P and K which might have favourably affected the chlorophyll content of leaves resulting increased synthesis of carbohydrates and build up of new cells (Jagadeesha, 2008) Similar findings were also reported by Murmu *et al.,* 2013 and Damse *et al.,* 2014. As regards to B: C ratio among organic treatments poultry manure @ 5t/ha was found more profitable (2.22) than FYM @ 20 t/ha (2.04) indicating the best practice with respect to profitability.

CONCLUSION

From the results of present study, it is concluded that, applications of organics at higher doses increase the yield and produce quality as well as maintain soil health. Thus, it was inferred that application of FYM @ 20 t/ha or vermicompost@5 t/ha as basal or poultry manure @ 5t/ha considerably increase the vegetative growth, yield and soil health. However, poultry manure@ 5t/ha was found to be the best and cost effective organic nutrient management practices for better fruit yield and quality of tomato in the north central plateau zone of Odisha.

REFERENCES

Adekiya, A.O. and Agbede, T.M. (2009) Growth and Yield of tomato as influenced by poultry manure and NPK fertilizer. *Emir. J. Food Agri.* 21: 10-20.

Ahlawat, O.P., Dev Raj, Indurani, C., Sagar, M.P., Gupta, P. and Vijay B. (2009) Effect of spent mushroom substrate recomposted by different methods and of different age of vegetative growth, yield and quality of tomato. *Indian Journal of Horticulture*. 66(2):208-214.

Akanbi, W.B. (2002) Growth, Nutrient uptake and yield of maize and okra as influenced by compost and Nitrogen fertilizer under different cropping systems. PhD Thesis, University of Ibadan, Nigeria. 222 p.

Ali, M.B., Lakun, H.I., Abubakar, W. and Mohammed, Y.S. (2014) Performance of tomato as influenced by organic manure and sowing date in Samaru, Zaria, *International Journal of Agronomy and Agricultural Research.* 5 (5):104-110.

Anonnymus (2014) National Horticulture Board Database.

AOAC (2000) Official Methods of Analysis of Association of Official Analytical Chemists, 16th ed. Association of Official Analytical Chemists, Arlington, VA.

Arya, S.K. and Roy, B.K. (2009) Manganese induced changes in growth, chlorophyll content and antioxidants activity in seedlings of broad bean (*Vicia faba* L.). *Journal of Environ. Biology.* 32: 707-711.

Damse, D.N., Bhalekar, M.N. and Pawar, P.K. (2014) Effect of integrated nutrient management on growth and yield of garlic. *The Bioscan.* 9(4): 1557-1560.

Gomez, K.A. and Gomez, A.A. (1984) Statistical procedure for agricultural research with emphasis on rice. International Rice Research Institute. Los Bancos, Phillipines. p.294.

Hashemimajd, K., Kalbari, M., Golchin, A. and Shariatmadari, H. (2004) Comparison of vermicompost and composts as potting media for growth of tomatoes. *J. Plant Nutrition.* 27 (6): 1107-1123.

Islam, M.R., Chaudhary, M.A.H., Saha, B.K. and Hasan, M.M. (2013) Integrated nutrient management on soil fertility, growth and yield of tomato. *J. Bangladesh Agril. Univ.*, 11(1): 33–40.

Jagadeesha, V. (2008) Effect of organic manures and bio-fertilizers on growth, seed yield and quality in tomato (Lycopersicon esculentum Mill.) cv. „Megha", Thesis M.Sc. University of Agricultural Sciences, Dharwad.

Kallo, G. (1993) Tomato: In: genetic improvement of vegetable crops. Oxford England. Pergamen Press. p. 6.

Khan, A.A., Bibi, H., Ali, Z., Sharif, M., Shah, S.A., Ibadullah, H., Khan, K., Azeem, I. and Ali, S. (2017) Effect of compost and inorganic fertilizers on yield and quality of tomato. *Academia Journal of Agricultural Research.* 5(10): 287-293.

Khan, S. and Pariari, A. (2012) Effect of n-fixing biofertilizers on growth, yield and quality of chilli (*Capsicum annuum* L.). *The Bioscan*, 7(3): 481-482.

Kumaran, S.S., Natrajan and Thamburaj, S. (1998) Effect of organic and inorganic fertilizer on growth and quality of tomato. *South Indian Horticulture*. 46(3-6): 203-205.

Maji, S. and Ghosh, S.N. (2006) Effect of different levels of nitrogen on some growth parameters of pummelo [*Citrus grandis* (L.), *C. maxima* (Merill)]. *The Horticulture J*. 19(3): 185-86.

Maji, S. and Ghosh, S.N. (2007a) Different nitrogen levels on flowering and fruiting behavior of pummel *Citrus grandis* (L.). *Environment and Ecology*. 25(4): 1212-1213.

Maji, S. and Ghosh, S.N. (2007b) Effect of nitrogen levels on physicchemical characteristics of fruits of pummel [*Citrus grandis* (L.), *C. maxima* (Merill)]. *Environment and Ecology*. 25(4): 1214-1215.

Manohar, S.V.S., Paliwal, R., Matwa, J. and Leua, H.N. (2013) Integrated nutrient management in tomato (*Lycopersicon esculentum* Mill) cv. ROCKY. *The Asian Journal of Horticulture*. 8 (2) :414-417.

Murmu K., Ghos B.C. and Swain, D.K. (2013) Yield and quality of tomato under organic and conventional nutrient management. *Archives of Agronomy and Soil Science.* 59(10): 1311-1321.

Pal, A., Majhi, S., Govind, Kumawat, R., Kumar, S. and Meena, D. (2015) Efficacy of various sources of nutrients on growth, flowering, yield and quality of tomato (*Solanum lycopersicum*) cv. Azad T-6. *The Bioscan.* 10(1): 473-477.

Pandey, S.K. and Chandra, K.K. (2013) Impact of integrated nutrient management on tomato yield under farmers field conditions. *Journal of Environmental Biology.* 34(11): 1047-1051.

Periago, M.J., Garcıa-Alonso, J. and Jacob, K. (2009) Bioactive compounds, folates and antioxidant properties of tomatoes (*Lycopersicum esculentum*) during vine ripening *International Journal of Food Sciences and Nutrition*, 60(8): 694–708.

Rajya Laxmi, P., Saravanan, S. and Lakshman Naik, M. (2015) Effect of organic manures and inorganic fertilizers on plant growth, yield, fruit quality and shelf life of Tomato (*Solanum lycopersicon* L.) c.v. PKM-1. *International Journal of Agricultural Science and Research*. 5(2): 7-12.

Ranganna, S. (1997) Handbook of Analysis and Quality Control for Fruit and Vegetable Products, 2nd edn., Tata McGrraw Hill Pub. Co. Ltd., New Delhi.

Rao, T.S.S.S. and Sankar, C.R. (2001) Effect of organic manures on growth and yield of brinjal. *South Indian J. Hort.*, 49: 288-291.

Sadaf, J.Q., Khan, M., Habib, U.R., Imam, B. (2012) Response of Tomato Yield and Post Harvest Life to Potash Levels. *Sarhad J. Agric*. 28(2):227-235 .

Saidu, A., Bello, L.Y., Tsado, E.K. and Ibrahim, F.K. (2011) Effect of cow dung on the performance of tomato. *International Journal of Applied Biological Research.*17: 169-176.

Samawat, S., Lakzian, A. and Zamirpour, A. (2001) The effect of vermicompost on growth characteristics of tomato. *Agric. Sci. & Technical*. 15 (2): 83-89.

Sharoni, Y. and Levi, Y. (2006) Cancer prevention by dietary tomato lycopene and its molecular mechanisms. Tomatoes, Lycopene & Human Health, A.V. Rao, Ed., pp. 111–125, Caledonian Science Press Ltd, Barcelona, Spain.

Singh, R.K., Dixit, P.S. and Singh, M.K. (2017) Effect of bio fertilizers and organic manures on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.) Cv. Arka Vikas. *Journal of Pharmacognosy and Phytochemistry*, 6 (5):1793-1795.

Singh, A., Gulati, I.J. and Chopra, R. (2013) Effect of Various Fertigation Schedules and Organic Manures on Tomato (*Lycopersicon esculentum* Mill.) Yield under Arid Condition. *The Bioscan.* 8(4): 1261-1264.

Singh, R. and Sinsinwar, B.S. (2006) Effect of integrated nutrient management on growth, yield, oil content and nutrient uptake of Indian mustard (*Brassica juncea*). *Indian Journal of Agricultural sciences.* 76(5):322-24.

Tekale, G.S., Saravaiya, S.N., Jadhav, P.B., Tekale, C.D. and Patel, R.P. (2017) Integrated Nutrient Management (INM) on Nutrient Availability, Uptake and Yield of Tomato (*Lycopersicon esculentum* Mill.) cv. "Gujrat Tomato-2". International Journal of Current *Microbiology and Applied Sciences.* 6(5): 864-874.

Willcox, J.K, Catignani, G.L. and Lazarus, S. 2003. Tomatoes and cardiovascular health, *Critical Reviews in Food Science and Nutrition*, 43(1): 1–18.

Zia, M.S., Mann, R.A., Aslam, M., Khan, M.A. and Hussain, F. (2000) The role of green manuring in sustaining rice-wheat production. In: Proc. Symp. "Integrated Plant Nutrition Management", NFDC, Islamabad. 130-149.

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TABLE 2: Yield and economics of Tomato

Treatments	Cost of cultivation (without treatment)	Cost of Treatment (Rs./ha)	Gross cost of cultivation (Rs./ha)	Yield (q/ha)			Net Return (Rs./ha)			B:C ratio		
				2014-15	2015-16	mean	2014-15	2015-16	mean	2014-15	2015-16	mean
T1	64062	10000	74062	207.02	184.9	195.96	70852	55368	63110	1.96	1.75	1.85
T2	64062	20000	84062	242.18	248.6	245.39	85464	89958	87711	2.02	2.07	2.04
T3	64062	25000	89062	232.86	231.1	231.98	73940	72708	73324	1.83	1.82	1.82
T4	64062	12500	76562	157.38	143.9	150.64	33604	24168	28886	1.44	1.32	1.38
T5	64062	10000	74062	233.36	236.6	234.98	89290	91558	90424	2.21	2.24	2.22
T6	64062	5000	69062	198.08	167.7	182.89	69594	48328	58961	2.01	1.70	1.85
T7	64062	30000	94062	182.04	183.4	182.72	33366	34318	33842	1.35	1.36	1.36
T8	64062	15000	79062	144.72	131.1	137.91	22242	12708	17475	1.28	1.16	1.22
T9	64062	7304	71366	267.72	263.9	265.81	116038	113364	114701	2.63	2.59	2.61
CD	-	-	-	64.72	37.2	-		-			-	