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EFFICACY OF VARIOUS SOURCES OF NUTRIENTS ON GROWTH, FLOWERING, YIELD AND QUALITY OF TOMATO (*SOLANUM LYCOPERSICUM*) CV. AZAD T-6

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ABSTRACT
An investigation was carried out to assess the efficacy of various sources of nutrients on growth, fruiting, yield and quality of tomato cv. Azad T-6 at Babasaheb Bhimrao Ambedkar University, Lucknow during the year 2013-2014 under subtropical climate of Lucknow having high soil pH (8.2). Nine treatments comprising FYM, Vermicompost, Neemcake, PSB, Azotobacter and urea were applied following randomized block design with 3 replications. The study revealed that plant height (32.86 cm) and number of branches (8.83 per plant) at 90 days after transplanting (DAT) were maximum by the application of FYM 50% + Vermicompost 50% (T_6). The treatment T_6 also induced earliness in flowering as well as produced more flowers (36.42 per plant at full bloom) causing higher yield (84.33 total fruits per plant or 288.73 q per ha).The treatment T_6 produced fruits with higher size (4.18 cm and 4.66 cm length and diameter, respectively) and pulp thickness, TSS: Acid ratio, vitamin C and sugars content. Thus, the study concluded that among the various sources of nutrients the application of FYM 50% + Vermicompost 50% (T_6) was the best for improving growth, fruiting, fruit yield and quality of tomato cv. Azad T-6 grown in Lucknow.

INTRODUCTION

Tomato (*Solanum lycopersicum* Syn. *Lycopersicum esculentum* Mill.) belongs to family Solanaceae (2n=24) is one of the most popular fruit vegetables grown all over the world. The cultivated tomato originated in the Peru-Ecuador-Bolivia area of the Andes in South America and was introduced in India by the Portuguese (Meena *et al.*, 2014; Kumar *et al.*, 2013).India is the second largest producer of vegetable after China in the world producing 18.23 mt tomato from 0.879 mha area having the productivity of 20.74 t/ha (Anon., 2014). Tomato contains protein, fat, carbohydrate, major and minor minerals, antioxidant (Aykroyd, 1963). Tomato is used directly as raw vegetables in various dishes and several processed products. Tomato juice is sold as a drink and is used in the cocktails known as "Bloody Marry", acts as a blood purifier and works as intestinal antiseptic.Tomato is universally treated as a "protective food" and is also a very good source of income to small and marginal farmers.

High productive ability of tomato puts tremendous pressure on soil for removal of nutrient. This can be managed through integrated nutrient management, which involve a combined use of fertilizers and organics to sustain crop production and maintenance of soil health (Nanjappa *et al.*, 2001) and organic manures also supply the micronutrients which are not supplied by chemical fertilizers (Kachat *et al.*, 2001). However, biofertilizer an alternative to chemical inputs, which have ability to mobilize the nutritionally important elements from non-usable to usable form through biological process and are known to increase yield in several vegetables (Kumar, 2014 and Kumar *et al.*, 2001) and fruits (Maji and Das, 2008).To maintain sustainability in production and quality, proper use of techniques, which will help to maintain the fertility of the soil, is required (Palaniappan and Annadurai, 2000, Govind *et al.*, 2014).One such alternative is organic farming that avoids depletion of soil organic matter and plant nutrients, besides suppression of some insect-pests and diseases (Gaur *et al.*, 2001; Maji, 2013). Major component of organic farming are organic manures, bio-fertilizers and bio-pesticides (Asokan *et al.*,2000), they not only balance the nutrient supply but also improve the physical and chemical properties of soil (Maji and Das, 2008) as well as reduces health hazards and good practice for sustainable development (Maji and Kumar, 2014; Govind *et al.*, 2014). 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 nitrogen increases fruit quality, fruit size, keeping quality, colour and taste and acidity (Sharma and Thakur, 2001, Maji and Ghosh, 2006, 2007a and b) as nitrogen is an integral constituent of amino acid, protein enzyme, vitamins and plant hormones. 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.The same nutrient may be applied through various sources and their effect on crop is also different. They may supply other beneficial matters besides the major element. Integrated approach of fertilizer scheduling and organic manures was also found as beneficial in tomato under arid condition (Singh *et al.*, 2013). In view of this, present investigation has been planned to assess the effect of various sources of nutrients on vegetative growth and yield of tomato.

MATERIALS AND METHODS

The experiment was laid out during the rabi season from November, 2013 to April 2014 at Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow, U.P. which falls under sub-tropical climate in the gangetic plains of eastern Uttar Pradesh, subjected to the extreme of weather conditions (above 45°C in summer and 3.5°C in winter) and is situated at an elevation of 111 meter above Mean Sea Level at 26°56′North latitude and 80°52′East longitude having soil pH 8.2. The experiment was laid out in a randomized block design with 3 replications. There were 9 treatments *i.e.*T_1 - Control, T_2-FYM 100%,T_3-FYM 75% + Urea 25%, T_4 -FYM 75% +Vermicompost25%, T_5-FYM 75% + Neemcake25%,T_6-FYM 50% + Vermicompost 50%, T_7-FYM 50% + Neemcake 50%, T_8 -Urea 50% +PSB 1kg/ha,T_9-Urea 50% + Azotobacter1kg/ha. Farm Yard Manure (FYM), Vermicompost and Neemcake doses as mentioned in the above treatment combination were applied after preparation and before transplanting and rests of the inorganic fertilizers were also applied as per principles. Seedlings of the tomato cv. Azad T-6 were collected from the Department of Vegetable Science (Vegetable Research Station, Kalyanpur), Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.). After preparation of fields, tomato seedlings were transplanted during afternoon at a spacing of 60 x 30 cm. The observations were taken for its vegetative growth, flowering fruiting, yield and quality parameters and were determined by following the standard procedures (AOAC 2000). The recorded data was analyzed statistically following the analysis of variance table as suggested by Panse and Sukhatme (1985) at 5% level of significance.

RESULTS AND DISCUSSION

The result (Table 1) showed that use of various sources of nutrients with organic manures significantly improved the vegetative growth of tomato in comparison to chemical fertilizers and control. Application of FYM 50% + Vermicompost 50% (T_6) resulted the maximum plant height (17.18, 29.38 and 32.86 cm) at 30, 60 and 90 days after transplanting (DAT), respectively. Similarly, the number of branches per plant (8.83 at 90 DAT) was also increased by the treatment T_6 in comparison to the other treatments. The integrated use of nutrients actually resulted in improvement of vegetative growth of the plant in terms of plant height and

Table 1: Effect of various sources of nutrients on vegetative growth of tomato

Treatments	Plant height (cm)			Number of branches per plant			Days to first flowering	Flowers per plant	No. of flower cluster /plant	Number of fruits /plant	Fruit weight (g)	Fruit yield per plant (Kg)	Fruit yield per plot (Kg)	Yield per ha (q)
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90DAT								
T_1	12.04	18.58	22.77	3.75	4.92	6.42	36.58	21.08	5.42	56.67	33.25	2.98	47.71	165.64
T_2	13.05	24.22	26.22	4.42	6.17	7.25	34.75	29.33	7.25	72.00	49.50	4.15	66.44	230.70
T_3	15.83	28.12	31.72	5.25	7.17	8.08	34.42	28.17	6.42	77.67	52.58	4.22	67.58	234.64
T_4	13.46	27.85	28.18	4.92	5.92	8.67	33.33	31.25	7.17	82.00	51.42	4.78	76.50	265.64
T_5	15.13	26.90	25.71	5.58	6.58	8.33	35.17	24.58	6.83	72.00	50.75	4.23	67.67	234.98
T_6	17.18	29.38	32.86	5.75	6.75	8.83	31.58	36.42	9.17	84.33	58.33	5.20	83.15	288.73
T_7	14.43	24.75	26.33	4.83	5.92	8.50	32.75	25.17	6.33	74.33	54.58	4.62	73.96	256.80
T_8	14.52	24.25	27.25	5.25	5.58	8.50	33.50	33.17	7.33	75.33	56.25	4.19	67.04	232.79
T_9	13.36	23.12	27.36	4.92	6.08	8.75	34.83	30.25	7.25	74.00	48.33	4.23	67.66	234.94
SEm (±)	0.834	2.516	2.205	0.327	0.416	0.526	2.156	1.341	0.527	1.530	6.115	3.670	3.670	12.74
CD (P=0.05)	1.77	5.33	4.67	0.69	0.88	1.11	N.S	2.84	1.12	3.24	12.96	7.78	7.78	27.01

Table 2: Effect of various sources of nutrients on tomato

Treatment	Fruit diameter (cm)	Fruit length (cm)	Fruit pulp thickness (cm)	Number of locule/ fruit	T.S.S. (°Brix)	Titratable acidity (%)	Vitamin C (mg/ 100g)	Total sugars (%)	Reducing sugar (%)	Non reducing sugar (%)
T_1	3.80	3.68	0.33	3.80	3.63	0.58	22.58	3.42	2.07	1.06
T_2	4.34	3.81	0.41	4.46	4.51	0.52	25.43	3.62	2.18	1.14
T_3	3.94	4.02	0.39	4.40	4.34	0.54	23.72	3.83	2.56	1.01
T_4	4.19	3.93	0.40	4.47	4.25	0.48	24.47	3.60	2.32	0.92
T_5	4.43	3.86	0.37	4.00	4.52	0.49	25.20	3.82	2.38	0.86
T_6	4.66	4.18	0.46	4.87	5.12	0.51	26.50	3.87	2.66	1.14
T_7	4.24	3.84	0.37	4.00	4.58	0.49	24.17	3.76	2.18	0.86
T_8	4.43	3.88	0.39	4.27	4.72	0.48	23.43	3.49	2.56	0.90
T_9	4.53	3.78	0.37	4.33	4.46	0.49	24.47	3.82	2.18	0.87
SEm(±)	0.157	0.157	0.053	0.42	0.125	0.013	0.586	0.074	0.058	0.099
CD (P=0.05)	0.33	0.33	0.11	0.92	0.27	0.03	1.24	0.16	0.12	0.21

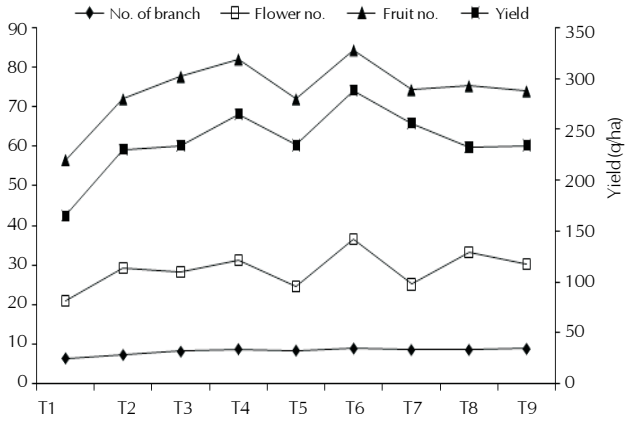

Figure 1: Graphical comparison among the treatments for some parameters

number of branches per plant.The above results were in close agreement with the finding of Kumaran *et al.* (1998) who tested different organic sources *i.e.* FYM, Neemcake, Vermicompost, Azotobacter and PSB in different combinations in tomato and recorded more plant height and number of branches per plant with the application of organic manure and inorganic fertilizers. Similar kind of results were also observed by Kumar and Srivastava (2006); Chaudhary *et al.* (2005) and Krishna and Alloli (2005); Singh *et al.* (2014); Kumar *et al.* (2013) in tomato; Kashyap *et al.* (2014) in brinjal; Kumar *et al.* (2014) in radish, Dushyant *et al.* (2014) in stevia.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, Sharma and Thakur, 2001)

Although, there was a non-significant effect in respect of days to first flowering, the plants under T_6 (FYM 50% + Vermicompost 50%) showed early flowering (31.58 DAT) followed by T_7 and late flowering (36.58 DAT) was observed under control followed by T_5. The maximum flower per plant recorded in the plants treated with FYM 50% + Vermicompost 50% (T_6). The similar trend was also observed in case of flower cluster per plant producing maximum under T_6 and minimum under control. Raut *et al.* (2003) also recorded the maximum number of flowers per cluster with the application 100:50:50kg NPK/ha + 20 t/ha Farm Yard Manure. Renuka and Sankar (2001) investigated on effect of organic sources and suggested that early flowering of tomato could be obtained with the application of FYM + biogas slurry which confirmed theresult of present finding which was also found in the investigation of Damse *et al.* (2014) in the integrated nutrient management of tomato.

Table1 showed that the maximum (84.33) number of fruits per plant was recorded under treatment T_6 (FYM 50% + Vermicompost 50%) followed by T_4 (FYM 75% + Vermicompost 25%) which was better than control (56.67 fruits per plant). Similarly, T_6 also improved fruit weight significantly and recorded maximum fruit weight of 58.33 g followed by T_8 (56.25 g). This improvement in fruit number and fruit weight ultimately increased the fruit yield (maximum yield 5.20 kg/plant, 83.15 kg/plot and 288.73 q/ha.) which was recorded highest under T_6 followed by T_4 much higher than control. Significant improvement was recorded with application of various sources of nutrients in an integrated manner that might be possible due to balanced supply and availability of nutrients, through chemical fertilizers and macro and micro nutrients from farm yard manure, neemcake and vermicompost. Good vegetative growth led to better photosynthetic activity which was reflected on yield and quality of tomato. Patil *et al.* (2004) also studied the response of different nutrient sources FYM, neemcake, vermicompost and urea and recorded highest yield by the application of recommended dose of fertilizer NPK@ 100:75:100 Kg/ha + vermicompost @ 2 t/ha. Similar findings were also reported by Sharma and Thakur (2001); Rao *et al.* (2010); Naidu *et al.* (2002); Harikrishna *et al.* (2002), Kumar *et al.* (2001); Kumar and Srivastava (2006) and Dass *et al.* (2008), Kumar *et al.*, 2014, Meena *et al.*, 2014, Maji, 2010. Fig. 1 showed that though flower number increased at T_8 from T_7 but, the yield was decreased. Likewise, at T_9 the yield was not decreased although fruit number and flower number was decreased from T_8.

The nutritive quality of tomato fruit was judged by determining the total soluble solids (%), titratable acidity (%), ascorbic acid (mg/100 g) total sugars (%), reducing sugars (%) and non-reducing sugar (%). It was observed that with the application of various sources of nutrients all the quality attributes mentioned above were significantly improved during

investigation.The maximum total soluble solids, ascorbic acid, total sugars, reducing sugar, non-reducing sugar with the application of (T_6) FYM 50% +Vermicompost 50% fallowed by T_8 (Urea 50 % + PSB 1 kg/ha) and minimum was recorded under control. Improvement in TSS content of tomato fruits with the application of various organic sources of nutrient specially vermicompost might be due to increased photosynthetic activity and other minerals supplied by the integrated nutrient sources 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 nutrient. Similar findings were alsoreported by Raut *et al.* (2003, 2004), Yadav *et al.* (2004), Kannan *et al.* (2006), Raut*et al.* (2006), Meena *et al.* (2014). It is concluded that among the various sources of nutrients integrated use of organic manure *i.e.* FYM 50% +Vermicompost 50% (T_6) may be suggested for tomato cultivation under the high pH soil of Lucknow subtropical condition of Utter Pradesh for improving growth, fruit yield and fruit quality of tomato cv. Azad T_6.

REFERENCES

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.

Asokan, R., Mohandas, S. and Anand, L. 2000. Biofertlizers and biopesticides for horticulture crops. *Indian Horticulture*. **45(1):** 44-47.

Chaudhary, M. R., Talukdar, N. C. and Saikia, A. 2005. Changes in organic carbon, available N, P_2O_5 and K_2O under integrated use of organic manure, biofertilizer and inorganic fertilizer on sustaining productivity of tomato and fertility of soil. *Research on Crop*. **6(3):** 547-550.

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.

Dass, A., Lenka, N. K., Sudhishri, S. and Patnaik, U. S. 2008. Influence of integrated nutrient management on production, economics and soil properties in tomato (*Lycopersicon esculentum*) under on-farm conditions in Eastern Ghats of Orissa. *Indian J. Agricultural Sciences*. **78(1):** 40-43.

Dushyant, Maji, S., Kumar, S., Maurya, A. K. and Meena, K. R. 2014. Efficacy of organic manures on growth, yield and biomolecules of stevia (*Stevia rebaudiana* Bertoni). *J. Crop and Weed*. **10(1):** 107-110.

Gaur, A. C. 2001. Organic Manure: a basic input in organic farming. *Indian Farming*. **26(1):** 3-7.

Govind, Maji S., Kumawat, R. and Meena, D. C. 2014. Liquid manuring: an approach for sustainable production using natural resources. *International conference on Environmental Technology and Sustainable Development: Challenges and Remedies* held during 21-23 February, 2014 at BBAU, Lucknow. p. 27.

Harikrishna, B. L.,Channal, H. T., Hebsur, N. S., Daharmatti, P. R. and Saranga Nath, P. A. 2002. Integrated nutrient management (INM) on availability of nutrients, uptake and yield of tomato. *Karnataka J. Agricultural Sciences*.**15(2):** 275-278.

Kachat, N. A., Malvia, D. D., Solanki, R. M. and Sagarka, B. K. 2001. Integrated nutrient management in rainy season groundnut. *Indian J. Agronomy*. **46(3):** 516-522.

Kannan, P., Saravanan, and Balaraji, T. 2006. Organic farming of tomato yield and quality. *Crop Research Hissar*. **32(2):** 196-200.

Kashyap, S., Kumar, S., Maji, S. and Kumar, D. 2014. Effect of organic manures and inorganic fertilizers o growth, yield and quality of Brinjal (*Solanum melongena* L.) cv. Pant Rituraj. *International J. Agricultural Sciences*. **10(1):** 305-308.

Krishna, B. E. and Allolli, T. B. 2005. Morphological features and yield of tomato as influenced by incorporation of loppings and different sources of nutrients in leucaena based alley cropping system. *Karnataka, J. Agricultural Science*. **18(1):** 91-95.

Kumar, A., Singh, R., Chchillar, R. K. and, Pal, M. 2001. Influence of fertility levels and support management of tomato *(Lycopersicon esculentum* Mill.*)* under different planting methods. *Crop Research Hisar*. **22(3):** 437-441.

Kumar, M., Meena, M. L., Kumar, S., Maji, S. and Kumar, D. 2013. Effect of nitrogen, phosphorus and potassium fertilizers on growth, yield and quality of tomato var. Azad T-6. *The Asian J. Horticulture*. **8(2):** 616-619.

Kumar, R. and Srivastava, B. K. 2006. Residual effect of integrated nutrient management on growth, yield and yield attributes of tomato. *Indian J. Horticulture*. **63(1):** 98-100.

Kumar, S., Maji, S., Kumar, S. and Singh, H. D. 2014. Efficiency of organic manures on growth and yield of radish (*Raphanus sativus*) cv. Japanese White. *International J. Plant Sciences*. **9(1):** 57-60.

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. 2010. *Ph.D Thesis* submitted to Bidhan Chandra Krishi Viswavidyalaya

Maji, S. 2013. Different farming options to reduce pesticide load in crop and environment. In: *Green Chemistry and Sustainable Agriculture Practices: a Step towards a Better Future*, Eds.- T. Chattopadhyay and B. Bhowmik. *Council for MS Academic Pub*. pp. 45-65.

Maji, S. and Das, B. C. 2008. Quality improvement of guava: an organic approach. *J. Asian Horticulture*. **4(3):** 191-195.

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 pummelo*Citrus grandis* (L.). *Environment and Ecology*. **25S(4):** 1212-1213.

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

Maji, S. and Kumar, S. 2014. Green technology: a tool for reducing hazards in agriculture. *International conference on Environmental Technology and Sustainable Development: Challenges and Remedies* held during 21-23 February, 2014 at BBAU, Lucknow. p. 21.

Meena, R. K., Kumar, S., Maji, S., Kumar, D. and Kumar, M. 2014. Effect of organic manures and biofertilizers on growth, yield and quality of tomato cv. PusaSheetal. *International Journal of Agricultural Sciences*. **10(1):** 329-332.

Naidu, A. K., Kushwah, S. S., Mehta, A. K. and Jain, P. K. 2002. Study of organic and inorganic and biofertilizer in relation to growth and yield of tomato. *JNKV Research J.* **35(1/2):** 36-37.

Nanjappa, I. I. P., Ramachandrappa, B. K. and Mallikarjuna, B. O. 2001. Effect of integrated nutrient management on yield and nutrient balance in maize. *Indian J. Agronomy*. **46(4):** 668-701.

Palaniappan, S. P. and Annadurai, K. 2000. In: *Organic Farming: Theory and Practice*. Science Publication. (India).

Panse, U. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers.

Patil, M. B., Mohammed, R. G. and Ghadge, P. M. 2004. Effect on organic and inorganic fertilizers on growth and quality of tomato. *J. Maharashtra Agriculture University*. **29(2):** 124-127.

Rao, K. R., Musan , L. C., Mulani, A. C., Khatavkar, R. S., Parlekar, G. Y. Shah, N. V. 2010. Effect of vermicompost on growth and yield of onion (*Allium cepa*). *Karnataka J. Agriculture Science*. **23(2):** 361-363.

Raut, R. L., Naidu, A. K., Jain, P. K. and Rajwade, V. B. 2003. Influence if organic and chemical sources of nutrients on the yield fruit quality and storage of tomato in Madhya Pradesh. *JNKVV Research J.* **37(1):** 30-33.

Raut, R. L., Rawar, A. K. and Baghel, S. S. 2006. Soil microbial population and tomato yield as influenced by plant nutrient sources. *International J. Agricultural Science*. **2(1):** 42-43.

Renuka, B. and Sankar, C. R. 2001. Effect of organic manures on growth and yeild of tomato. *South Indian Horticulture*. **49:** 216-219.

Sharma, S. K. and Thakur, K. S. 2001. Effect of Azotobacter and nitrogen on plant growth and fruit yield of tomato. *Vegetable Science*. **28(2):** 146-148.

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, A., Maji, S. and Kumar, S. 2014. Effect of biofertilizers on yield and biomolecules of anti-cancerous vegetable broccoli. *International J. Bio-resource and Stress Management*. **5(2):** 262-268.

Yadav, B. D., Balraj, S. and Sharma, Y. K. 2004. Production of tomato under the organic conditions. *Haryana J. Horticulture Science*. **33(3-4):** 306-307.