

Full Length Research Paper

Comparative Analysis of Vermicompost and Conventional Fertilizers on Tomato Plant Growth

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Field trials were conducted using different fertilizers having equal concentration of nutrients to determine their impact on different growth parameters of tomato plants. Six types of experimental plots were prepared where T_1 was kept as control and five others were treated by different category of fertilizers (T_2 -Chemical fertilizers, T_3 -Farm Yard Manure (FYM), T_4 -Vermicompost, T_5 and T_6 - FYM supplemented with chemical fertilizers and vermicompost supplemented with chemical fertilizer respectively). The treatment plots (T_6) showed 73% better yield of fruits than control, Besides, vermicompost supplemented with N.P.K treated plots (T_5) displayed better results with regard to fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant from other fertilizers treated plants.

Key words: Tomato plants, vermicompost, chemical fertilizers.

INTRODUCTION

The green revolution in India promoted the indiscriminate use of chemical fertilizer and pesticides to obtain a better crop yield. In course of time, the tropical soil after receiving such chemicals turned unproductive due to lack of proper amendments of organic matters (Kale, 1995). The best alternative of the present day's environmental degradation is to make proper use of the available unutilized organic biodegradable wastes in order to convert them into compost within a short period. Vermi-compost could be used as an excellent soil amendment for main fields and nursery beds and has been reported to be useful in raising nursery species plants. In nature, some time plants follow altered growth patterns such as negative geotropism of roots, stem elongation and dwarfing, shortening of vegetative phase, enhancement of leaf area, photosynthetic rate, flowering and fruiting by matured plants. Edwards (1988) reported that vermicompost could promote early and vigorous growth of seedlings. Vermicompost has found to effectively enhance the root formation, elongation of stem and production of biomass, vegetables, ornamental plants etc.

(Grappelli et al., 1985; Kale and Bano, 1986; Kale et al., 1987; Kale, 1998; Bano et al., 1993; Atiyeh et al., 1999). Ghosh et al. (1999) observed that integration of vermicompost with inorganic fertilizers tended to increase the yield of crops viz- potato, rape seed, mulberry and marigold over other traditional composts. The application of vermicompost rendered better performance in respect of all round growth of mulberry plants in the lateritic soil of South West Bengal (Chakraborty et al., 2008). The nutrient level, especially the (macro or micro-nutrients) were found to be always higher than the compost derived from other methods (Kale, 1998). One of the unique features of vermicompost is that during the process of conversion of various organic wastes by earthworms, many of the nutrients are changed to their available forms in order to make them easily utilizable by plants.

Therefore, vermicomposts have higher level of available nutrients like nitrate or ammonium nitrogen, ex-changeable phosphorous and soluble potassium, calcium and magnesium derived from the wastes (Buchanan et al., 1988). The paper has attempted to evaluate comparative efficacies of vermicompost developed by indigenous method on tomato plants.

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MATERIALS AND METHODS

The effect of vermicompost in comparison to other organic and

Table 1. Nutrients status of different fertilizers and soil characteristics of tomato planted study sites.

Parameters	Nutrient status of vermicompost	Nutrient status of farm yard manure	Physico-chemical properties of study site soil
pH	7.2	7.2	6.4
Organic carbon (%)	15.4	39.4	0.87
Total kjeldahl nitrogen (%)	1.65	1.1	0.045
Total potassium (%)	1.2	2	0.0041
Total phosphorous (%)	0.92	0.42	0.0026
C/N ratio (%)	11.24	35.82	19.33

Table 2. Standardization of dose of different fertilizers based on nutrient status.

Treatments	1st Dose (After 1 month)	2nd Dose (Flowering time)	Received amount of fertilizers /ha
T ₁	-	-	-
T ₂	110 kg, 40 kg, 75 kg	110 kg, 40 kg, 75 kg	220 kg, 80 kg, 150 kg
T ₃	10 tonne	10 tonne	20 tonne
T ₄	6.67 tonne	6.67 tonne	13.34 tonne
T ₅	5 tonne + (55 kg, 20 kg, 37.5 kg)	5 tonne + (55 kg, 20 kg, 37.5 kg)	10 tonne + (110 kg, 40 kg, 75 kg)
T ₆	3.34 tonne + (55 kg, 20 kg, 37.5 kg)	3.34 tonne + (55 kg, 20 kg, 37.5 kg)	6.68 tonne + (110 kg, 40 kg, 75 kg)

T₁ = (Control) ; T₂ = (Chemical that is -N.P.K); T₃ = (Farm yard manure) ; T₄ = (Vermicompost) ; T₅ = (50% farm yard manure + 50 % Chemical fertilizers that is NPK) and T₆ = (5 0% Vermicompost + 50% Chemical fertilizers that is NPK).

chemical fertilizers was tested on gotya variety tomato plants (*Lycopersicon esculentum* Mill) through randomized block design method (Panse and Sukhatmo, 1967). All total 96 seedlings having 21 days time were sown in the field prepared following standard method of agronomy. The field trial experiments were undertaken in the university study site during November, 2000 - March, 2001. The air temperature during the experiment period varied from 18°C (December, 2005) to 26°C (March, 2006). Prior to this experimental study, nutrient status of different fertilizers and soil characteristics of study site were estimated (Table 1).

Before introduction of vermicompost as fertilizer, only nitrogen content of different fertilizers Farm Yard Manure (F. Y. M) and chemical was estimated. Amount of nitrogen present in vermicompost was considered as standard and on the basis of that, the dose of other fertilizers (F. Y. M and chemical fertilisers –urea, single super phosphate, murated potash) were determined and applied to tomato plants in the same ratio (Table 2). Effects of these fertilizers on the average yield of the tomato fruits were recorded. All total six treatments were made (T₁- Control; T₂- Chemical fertilizers; T₃- F. Y. M; T₄ – Vermicompost; T₅ - F. Y. M supplemented with chemical fertilizers and T₆ - Vermicompost supplemented with chemical fertilizers) and each treatment was with four replicates.

RESULTS

The effect of these different fertilizers showed significant increase of the fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches, number of fruits and yields in terms of fruit production in all the treatments in comparison to controlled one (Table 3). The yield of vermicompost treated plants was found to be 28,665 Kg/hectare, which was 47% more than the plants in control plots and was very nearer to inorganic fertilizer

treated plants (Kg/hectare). This result was statistically significant at 1% level. It was also observed that the plants treated with vermicompost supplemented with chemical fertilizers displayed (T₆) better results than the plants treated separately with vermicompost (T₄), chemical fertilizers (T₂), F.Y.M (T₃) and F.Y.M. supplemented with chemical fertilizers (T₅) treated plants (Table 3). In this field trial experiment, it was observed that the plants treated with vermicompost supplemented with chemical fertilizers (T₆) displayed better results than the plants treated separately with vermicompost (T₄), chemical fertilizer (T₂), F.Y.M (T₃) and F.Y.M supplemented with chemical fertilizers (T₅) treated plants.

DISCUSSION

Plant's response to vermicompost showed much better results than any other commercial potting or rooting media. Vermicompost can also influence a number of physical, biological and chemical processes of soil which have their bearings on plant's growth. In the present research, it was found that only organic fertilizer treated tomato plants (T₃ and T₄) showed more branching than chemical fertilizer treated plants (T₂), but overall stem lengths were higher in chemically treated plants (T₂). An interesting result was that organic fertilizer supplemented with chemical fertilizer treated plants (T₅ and T₆) exhibited better results than the plants treated separately with different fertilizers treated plants (T₂-inorganic, T₃-F.Y.M and T₄-vermicompost) (Table 3). It has been

Table 3. Effect of different fertilizers on different vegetative parameters and yield of tomato crop.

Treatments	Fresh wt. of leaves	Dry Wt.of leaves	Dry wt. of fruits	No. of Branches	No. of Fruits/ plant	Wt. of fruits (g)	Yield (Q/hect)
T ₁	3.15 (100)	0.41 (100)	1.9 (100)	4.3 (100)	12.4 (100)	39.38 (100)	195.77 (100)
T ₂	6.08 (193)	1.41 (158)	2.32 (122)	4.7 (109)	18.83 (152)	41.81 (106)	311.7 (161)
T ₃	10.03 (318)	2.23 (191)	2.46 (129)	5.4 (126)	16.35 (132)	41.21 (105)	269.66 (139)
T ₄	12.05 (383)	2.63 (191)	2.81 (148)	6.2 (144)	17.25 (140)	41.6 (106)	286.65 (147)
T ₅	12.38 (393)	2.65 (209)	2.74 (144)	6 (140)	19.4 (156)	41.99 (107)	325.7 (166)
T ₆	14.47 (459)	2.84 (216)	2.87 (151)	7.3 (170)	19.95 (161)	42.34 (108)	338.7(173)
C.D (P = .01)	* 652.31	* 177.28	* 9.27	* 10.99	1.82	* 46.63	* 39.11

T₁ = (Control); T₂ = (Chemical that is N.P.K); T₃ = (farm yard manure); T₄ = (Vermicompost); T₅ = (50% farm yard manure + 50 % Chemical fertilizers that is NPK) and T₆ = (5 0% Vermicompost + 50 % Chemical fertilizers that is NPK).

reported that N. P. K of organic manure require more time for their utilization by plants because of slow releasing of N.P.K. Many hybrid varieties have very high demand for the nutrients. These high demands for che-mical fertilizer meets nutrients whereas organic manure initially form conducive environment with regard to physical parameters of soil which promote better root growth and other vegetative growth. It is assured that other factors, such as the presence of beneficial micro-organisms or biologically active plant growth influencing substances such as phytohormone are released by beneficial microorganisms present in the vermicompost rich soil (Tomati and Galli, 1995; Edwards, 1998). Root initiation, increased root biomass, enhanced plant growth and development and sometimes, altera-tions in plant morphology are among the most frequently claimed effects of vermicompost treatment (Tomati et al., 1988). Stem elongation, dwarfing and early flowering have been found to be because of the hormone effect in a wide variety of plants and in a number of physiological situations, stem elongation is promoted (or inhibited) by endogenous phytohormones, a class of growth-regulating substances which inhibited stem elongation without affecting leaf or flower development (dwarfing agents) (Wirwille and Mitchil, 1950).

Plant and crop physiologists, microbiologists and agronomists agree that plant growth and development are strictly dependent on biological fertility factors. Earthworms stimulate microbial activities and metabolism and also influence microbial populations. As a consequence more available nutrients and microbial metabolites are released into the soil (Tomati et al., 1988).

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REFERENCES

- Allen SE, Grinshed HM, Parkinson JA, Quarnty C (1974). Chemical analysis of ecological materials, New York: Published by John Wiley and Sons, pp. 138.
- Atiyeh RM, Subler S, Edwards CA, Metzger J (1999). Growth of tomato plants in horticulture potting media amended with vermicompost. *Pedobiologia*, 43: 724-728.
- Bano K, Kale RD, Satyavathi GP (1993). Vermicompost as fertilizer for ornamental plants. In: Rajagopal, D., Kale, R. D. and Bano, K. (Ed.) *Proc. IV National Symposium Soil, Biology. Ecology. ISSBE. UAS, Bangalore.* pp. 165-168.
- Buchanan MA, Russelli E, Block SD (1988). Chemical characterisation and nitrogen mineralization potentials of vermicomposts derived from differing oraganic wastes, in *Earthworms in Environmental and waste Management*, (eds C. A. Edwards and E. F. Neuhauser), SPB Acad, Publ., The Netherlands, pp. 231-9.
- Chakraborty B, Chandra AK, Chakraborty SK (2008) Effect of intregated nutrient supply and growth, leaf yield and field performance of mulberry (*Morus alba*) under semi irrigated lateritic soil condition of west midnapore district, West Bengal. *J. Environ. Sociobiol.*, 5(2): 221-226.
- Edwards CA (1998). Use of earthworms in breadown and management of organicwastes. In: Edwards. C.A. (Ed.) *Earthworm ecology*. CRC Press LLC, Boca Raton, Florida, pp. 327-354.
- Ghosh M, Chottopadhyya GN, Baral K, Munsu PS (1999). Possibility of using vermicompost in Agriculture for reconciling sustainability with productivity. *Proceeding of the Seminar on Agrotechnology and Environment.* pp. 64-68.
- Grappelli A, Tomati U, Galli E (1985). Earthworm casting in plant propagation. *Hortic. Sci.*, 20(5): 874-876.
- Jackson ML (1967). *Soil chemical analysis*, Prentice Hall of India Private Limited.
- John MK (1970). Spectrometric determination of phosphorous in soil and plant materials with ascorbic acid, *Soil Sci.*, 109: 214-220.
- Kale RD (1998). *Earthworm: Cinderella of Organic Farming*. Prism Books. Bangalore.
- Kale RD, Bano K (1986). Field trials with vermicompost (vee comp. E.83 UAS) an organic fertilizer. In Dash, M. C., Senapati, B. K. and Mishra, P. C. (Ed.) *Proceeding National Seminer Org. Waste Utiliz Vermicomp Part B: verms and vermicomposting*. Five Star Printing Press. Burla, Orissa. pp. 151-156.
- Kale RD, Bano K, Sreenivasa MN, Bagyaraj DJ. (1987). Influence of worm cast (vee comp. E.83 UAS) on the growth and mycorrhizal colonization of two ornamental plants. *South Indian Hortic.*, 35: 433-437.
- Panse VG, Sukhatma PV (1967). *Statistical methods for agricultural workers*. ICAR, New Delhi.

Tomati U, Galli E (1995). Earthworms, Soil fertility and plant productivity. *Acta Zoologica Fennica*, 196: 11-94.

Tomati U, Grappelli A, Galli E (1988). The hormone like effect of earthworm casts on plant growth. *Biol. Fertil. Soils*. 5: 288-294.

Walky A, Black TA (1934). An estimation method for determining soil organic matter and proposed modification of the chromic acid titration method. *Soil Science*. 37: 250-260.