Studies On The Influence Of Organic Manures And Effective Microorganisms On Growth Characters Of Okra

[1]S. Kamalakannan, [2]S. Ganesan, [3]R. Sudhagar, [4]S. Kumar and [5]S. Venkatesan

[1, 3]Associate professors, [4, 5]Assistant professors, [2]Research scholar,
Department of Horticulture,
Faculty of Agriculture, Annamalai university, Annamalainagar-608002, Tamil Nadu, India.

Abstract : A field study was carried out in the vegetable field unit, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu to find out the influence of organic manures and effective microorganisms on growth characters of okra. The treatments comprises of applying organic inputs like FYM @ 25 t ha^{-1}, vermicompost @ 5 t ha^{-1} and EM @ 1:1000 dilution as foliar spray and as soil application in comparison with recommended dose of NPK (40:50:30 kg ha^{-1}) along with bio-fertilizers (*Azospirillum* and phosphobacteria each at 2 kg ha^{-1}). The results of present investigation showed that, the plant height (73.04, 93.46 and 114.33 cm at 30, 60 and 90 days respectively), number of branches (2.55, 3.75 and 4.73 at 30, 60 and 90 days respectively), number of leaves (11.95, 17.45 and 21.49 at 30 60 and 90 days respectively) and leaf area (112.27, 160.67, and 205.43 cm^2 at 30, 60 and 90 days respectively) were recorded best in the treatment T_8 which received the application of vermicompost, @ 5 t ha^{-1} plus EM @ 1: 1000 dilution (soil+ foliar application).

IndexTerms **- Bhendi, vermicompost, effective microorganisms, FYM, growth.**

I. INTRODUCTION

Bhendi (or) Okra (*Abelmoschus esculentus* (L.) Moench.) is one of the most popular vegetable crop widely grown under varying climatic condition and in almost all parts of India, throughout the year. It requires heavy manuring for its potential production (Naik and Srinivas, 1992). However increased expenditure on fertilizers has been a major constraint of recurrent nature to the farmers. Moreover, the ill effects caused by continued and over use of chemical fertilizers to soil, water and environment cannot be under-estimated. Hence there is a need to develop sustainable practices which requires higher use of organic inputs in cultivation. Organic cultivation is very much native to India and it is our contribution to the world. Organic cultivation promises a balanced environment and quality food to people, organic vegetable production is now a commercial venture, on a small scale in several developed countries. With an increasing demand for organic products, especially in Europe, U.S and Japan, many countries are making an onset in the development of organic products. India, backed by the legacy of organic farming has a potential to make a mark in the international market.

Under the present circumstances of awareness on organic farming, this study brings light on the effect utilization of some of the organic inputs viz., FYM, vermicompost, EM and biofertilizers to replace the use of chemical fertilizers. Use of organic manures not only increases the moisture holding capacity of the soil, but also plays an important role in soil and water conservation by binding and aggregation properties. They also help in balancing the availability of all essential plant nutrients to the growing plant, not only to maintain high yield, but also the quality of produce (Kanwar, 1984). In view of the above facts, an investigation was undertaken to study the influence of organic fertilization along with effective microorganisms on growth and yield of bhendi.

II. MATERIALS AND METHODS

An investigation was carried out in the vegetable field unit, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu, to study the influence of organic fertilization along with effective microorganisms on yield and yield attributes of Bhendi (*Abelmoschus esculentus* (L.) Moench.), during two seasons (March – May) and (August – October) under irrigated condition. The experiment was laid out in a randomized block design with 12 treatments in three replications. Seeds of bhendi variety Arka Anamika were used for this study. The treatments comprises of applying organic inputs like FYM @ 25 t ha^{-1}, vermicompost @ 5 t ha^{-1} and EM @ 1:1000 dilution as foliar spray and as soil application in comparison with recommended dose of NPK (40:50:30 kg ha^{-1}) along with bio-fertilizers (*Azospirillum* and phosphobacteria each at 2 kg ha^{-1}). The treatment details are as follows. T_1 - FYM alone (25 t ha^{-1}), T_2 - Vermicompost alone (5 t ha^{-1}), T_3 - FYM (25 t ha^{-1}) + EM (1:1000 Dilution) (Soil Application), T_4 - Vermicompost (5 t ha^{-1}) + EM (1:1000 Dilution) (Soil Application), T_5 - FYM (25 t ha^{-1}) + EM (1:1000 Dilution) (Foliar Spray), T_6 - Vermicompost (5 t ha^{-1}) + EM (1:1000 Dilution) (Foliar Spray), T_7 - FYM (25 t ha^{-1}) + EM (1:1000 Dilution) (Soil Application + Foliar Spray), T_8 - Vermicompost (5 t ha^{-1}) + EM (1:1000 Dilution) (Soil Application + Foliar Spray), T_9 - FYM (25 t ha^{-1}) + Azospirillum (2 kg ha^{-1}) + Phosphobacteria (2 kg ha^{-1}), T_{10} - Vermicompost (5 t ha^{-1}) + Azospirillum (2 kg ha^{-1}) + Phosphobacteria (2 kg ha^{-1}), T_{11} - Inorganic fertilizer alone (40:50:30 kg NPK ha^{-1}), T_{12} - Inorganic fertilizer (40:50:30 kg NPK ha^{-1}) + Bio-fertilizer (Azospirillum + Phosphobacteria (2 kg ha^{-1}). Observations on growth attributes were recorded. The data of two seasons were pooled and statistically analysed as per the procedure given by Panse and Sukhatme (1978).

III. RESULTS AND DISCUSSION

The results of the present investigation showed that application of organic manures along with EM markedly influenced the growth characters of bhendi viz., plant height, number of branches, number of leaves and leaf area. Plant growth characters showed a progressive increase with applied nutrients in general.

The plant height is considered to be an important factor to judge the vigour in bhendi. In the present investigation, application of vermicompost @ 5 t ha^{-1} plus EM (1:1000 dilution) in both soil and foliar application recorded greater plant height, more number of branches and leaves, leaf area which was on par with the treatment which received the recommended dose of inorganic fertilizers plus bio-fertilizers viz., *Azospirillum* and Phosphobacteria each @ 2 kg ha^{-1}. This was followed by the treatment which received FYM @ 25 t ha^{-1} plus EM (1:1000 dilution) in both soil and foliar application.

The results of the present study are in agreement with findings of Leopold (1974) who stated that organic manures improve the soil physical conditions and promote microbial and soil organic matter, which in turn produce organic acids, which inhibits enzymes, particularly IAA oxidase, resulting in enhancing the effect of auxin-IAA which has direct effect on plant growth.

The increase in growth parameters due to application of vermicompost may be due to the presence of growth substances (Gavirilov, 1962), nitrogen fixers (Loquet *et al*., 1977), other essential nutrients (Bano *et al*., 1987) and also due to higher fertilization by a symbiotic mycorrhizal association as reported by Kale *et al*. (1987). Incorporation of vermicompost promotes the lush growth of plants which may be due to the presence of plant growth promoters like auxins and cytokinins, which are responsible for the cell division and cell elongation. Furthermore, Chaudhary *et al*. (2004) also reported that vermicompost contains biologically active substances such as plant growth regulators which enhances sufficient quantity of nutrient flow in the plant system, thereby, stimulating the axillary buds and leading to increase in plant height and number of branches.

Hayworth *et al*. (1996) opined that FYM, being a bulky organic material releases the soil compaction and improves the aeration in addition to the supply of essential plant nutrients and organic matter, thereby increasing the soil biological activities. FYM also provides room for better microbial establishment along with accumulation of excess humus content and also the phytohormones extracted from FYM helps the plant to grow more luxuriantly even with reduced doses of chemical fertilizers as suggested by Gupta *et al*. (1983). More number of branches and leaves due to application of organic manures may be attributed to the fact that FYM possesses optimum C:N ratio, which on decomposition readily releases nitrogen in the easily available form of nutrient ions such as ammonium and nitrate. The increase in the nitrogen levels of soil might have resulted in the production of more number of branches and leaves plant^{-1}, since nitrogen is the chief constituent of amino acid and co-enzymes of biological importance. This is in accordance with findings of Maheswarappa *et al*. (2001).

The increase in the growth characters was attributed to the ability of EM to decompose organic materials in the soil, thereby releasing additional available nutrients for plant growth. The ability of EM to change the conditions of the rhizosphere to a zymogenic state and thereby providing a more favourable environment for plant growth (Higa, 1988). The results of the present study confirmed the earlier findings of Sangakkara (1991) who reported increased leaf area in sweet potato and Lee and Sung (1999) who reported improved plant height in tomato due to application of EM along with organic manures.

Table 1. Effect of organic fertilization along with EM on plant height in bhendi cv. Arka Anamika.

Treatments	**Plant height (cm)**		
	30 Days	**60 Days**	**90Days**
T_1 - FYM alone (25 t ha^{-1})	45.16	62.75	79.42
T_2 - Vermicompost alone (5 t ha^{-1})	49.39	66.14	85.90
T_3 - FYM (25 t ha^{-1}) + EM (S)	58.48	75.27	97.10
T_4 - Vermicompost (5 t ha^{-1}) + EM (S)	61.23	78.07	100.21
T_5 - FYM (25 t ha^{-1}) + EM (F)	63.71	80.97	103.37
T_6 - Vermicompost (5 t ha^{-1}) + EM (F)	66.71	86.33	106.85
T_7 - FYM (25 t ha^{-1}) + EM (S + F)	69.23	89.18	109.98
T_8 - Vermicompost (5 t ha^{-1}) + EM (S + F)	73.04	93.46	114.33
T_9 - FYM (25 t ha^{-1}) + A + P	51.88	69.48	90.84
T_{10} - Vermicompost (5 t ha^{-1}) + A + P	54.94	72.32	93.98
T_{11} - NPK 40:50:30 kg ha^{-1}	66.33	85.44	106.50
T_{12} - NPK 40:50:30 kg ha^{-1} + A + P	72.04	92.10	113.06
S.Ed.	0.75	0.74	0.97
CD (p=0.05)	1.51	1.50	1.94

S – Soil application, F – Foliar spray, A – *Azospirillum*, P - Phosphobacteria

Table 2. Effect of organic fertilization along with EM on number of branches in bhendi cv. Arka Anamika.

Treatments	**Number of branches per plant**		
	30 Days	**60 Days**	**90 Days**
T_1 - FYM alone (25 t ha^{-1})	1.21	1.81	1.97
T_2 - Vermicompost alone (5 t ha^{-1})	1.34	2.16	2.23
T_3 - FYM (25 t ha^{-1}) + EM (S)	1.77	2.76	3.05
T_4 - Vermicompost (5 t ha^{-1}) + EM (S)	1.94	2.98	3.37
T_5 - FYM (25 t ha^{-1}) + EM (F)	2.08	3.16	3.67
T_6 - Vermicompost (5 t ha^{-1}) + EM (F)	2.24	3.36	4.05
T_7 - FYM (25 t ha^{-1}) + EM (S + F)	2.39	3.53	4.37
T_8 - Vermicompost (5 t ha^{-1}) + EM (S + F)	2.55	3.75	4.73
T_9 - FYM (25 t ha^{-1}) + A + P	1.48	2.36	2.41
T_{10} - Vermicompost (5 t ha^{-1}) + A + P	1.62	2.57	2.68
T_{11} - NPK 40:50:30 kg ha^{-1}	2.20	3.32	4.00
T_{12} - NPK 40:50:30 kg ha^{-1} + A + P	2.50	3.69	4.67
S.Ed.	0.02	0.03	0.03
CD (p=0.05)	0.04	0.06	0.07

S – Soil application, F – Foliar spray, A – *Azospirillum*, P - Phosphobacteria

Table 3. Effect of organic fertilization along with EM on number of leaves in bhendi cv. Arka Anamika,

Treatments	Number of leaves plant^{-1}		
	30 Days	60 Days	90 Days
T_1 - FYM alone (25 t ha^{-1})	6.01	8.69	10.74
T_2 - Vermicompost alone (5 t ha^{-1})	7.02	10.20	13.12
T_3 - FYM (25 t ha^{-1}) + EM (S)	8.83	13.02	16.18
T_4 - Vermicompost (5 t ha^{-1}) + EM (S)	9.43	13.92	17.23
T_5 - FYM (25 t ha^{-1}) + EM (F)	9.97	14.75	18.26
T_6 - Vermicompost (5 t ha^{-1}) + EM (F)	10.67	15.72	19.38
T_7 - FYM (25 t ha^{-1}) + EM (S + F)	11.20	16.54	20.35
T_8 - Vermicompost (5 t ha^{-1}) + EM (S + F)	11.95	17.45	21.49
T_9 - FYM (25 t ha^{-1}) + A + P	7.61	11.05	14.15
T_{10} - Vermicompost (5 t ha^{-1}) + A + P	8.25	11.92	15.13
T_{11} - NPK 40:50:30 kg ha^{-1}	10.50	15.60	19.21
T_{12} - NPK 40:50:30 kg ha^{-1} + A + P	11.73	17.35	21.33
S.Ed.	0.18	0.19	0.11
CD (p=0.05)	0.37	0.39	0.22

S – Soil application, F – Foliar spray, A – *Azospirillum*, P - Phosphobacteria

Table 4. Effect of organic fertilization along with EM on leaf area in bhendi cv. Arka Anamika.

Treatments	Leaf area (cm^2)		
	30 Days	60 Days	90 Days
T_1 - FYM alone (25 t ha^{-1})	95.27	127.05	170.70
T_2 - Vermicompost alone (5 t ha^{-1})	99.85	130.45	176.20
T_3 - FYM (25 t ha^{-1}) + EM (S)	104.22	141.03	187.61
T_4 - Vermicompost (5 t ha^{-1}) + EM (S)	105.61	144.25	190.66
T_5 - FYM (25 t ha^{-1}) + EM (F)	107.05	147.57	193.75
T_6 - Vermicompost (5 t ha^{-1}) + EM (F)	109.12	152.94	198.01
T_7 - FYM (25 t ha^{-1}) + EM (S + F)	110.52	156.17	201.05
T_8 - Vermicompost (5 t ha^{-1}) + EM (S + F)	112.27	160.67	205.43
T_9 - FYM (25 t ha^{-1}) + A + P	101.36	134.21	181.41
T_{10} - Vermicompost (5 t ha^{-1}) + A + P	102.82	137.71	184.53
T_{11} - NPK 40:50:30 kg ha^{-1}	108.47	151.96	196.83
T_{12} - NPK 40:50:30 kg ha^{-1} + A + P	111.90	159.23	204.06
S.Ed.	0.52	1.09	1.14
CD (p=0.05)	1.04	2.18	2.30

S – Soil application, F – Foliar spray, A – *Azospirillum*, P - Phosphobacteria

REFERENCES

[1] Bano, K., Kale, R.P. and Gajanan, G.N. 1987. Culturing of earthworms *Eudrillus eugeniae* for cast production and assessment of worm cast as biofertilizer. J. Soil. Biol. Ecol., 7: 98-105.

[2] Chaudhary, D. R.,. Bhandari, S.C and Shukla, L.M.2004. Role of vermicompost in sustainable agriculture. Agric. Rev., (1): 29-39.

[3] Gavirilov, K. 1962. Role of earth worms in the enrichment of soil by biologically active substances. Veprosy Ekologil Vysshauya shkola Moscow, 7:34.

[4] Gupta, J.P., Agarwal, R.K., Gupta, G.N. and Kaul, P.1983. Effect of continuous application of FYM and urea on soil properties in West Rajasthan. Indian J. Agri. Sci., 53 (1): 53-56.

[5] Hayworth, F., Cleawer, T.J. and Bran, J.M. 1996. The effects of different manurial treatments on the yield and mineral composition of early potato. J. Hort. Sci., 41 (3): 225- 241.

[6] Higa, T. 1988. Studies on the application of microorganism in nature farming. II. Practical application of effective microorganisms. Paper presented at the 7th IFOAM conference. Ouagadougou, Burkina Faso-PP.5.

[7] Kale, R.D.., Bano, Sreenivasa, M.N.and Bagyaraj, D.J.1987. Influence of worm cast (ver.comp.E.UAS, 93) on growth of mycorrhizal colonization of two ornamental plants. South Indian Hort., 35: 433-437.

[8] Kanwar, J.S. 1984. Contribution of soil science in agriculture. Soil Sci. India Bull., 14: 79-95.

[9] Lee, K.H and Sung, J.M. 1999. Improvement of tomato cultivation by effective microorganisms. Proceedings of sixth international conference on Kyusei Nature farming in Pretoria, South Africa. P: 75-79.

[10] Leopold, A.C. 1974. Plant growth and development. Tata Mc Graw Hill Publishing Company Ltd., New Delhi. pp. 169-181.

[11] Loquat, M., Bhatnagar, T., Bouche, M.S.and Roulle, J. 1977. Estimation of the ecological influence of earth worms on microorganisms. Pedobiologia, 17: 400-417.

[12] Maheshwarappa, H.P., Nanjappa, H.V.and Hedge, H.R. 2001. Effect of planting material, plant population and organic manures on growth components and yield of galangal (*Kaempferia galangal* L.) when growth as intercrop in coconut gardens. Indian J. Agri. Sci. 71 (3): 183-186.

[13] Naik, L.B. and Srinivas. 1992. Influence of nitrogen and phosphorus fertilization on seed crop of okra (*Hibiscus esculentus*). Indian J. Agron., 37(4): 769-771.

[14] Panse, V.G. and Sukhatme, P.V. 1978. In: Statistical method for agricultural workers. Indian Council of Agriculture Research, New Delhi.

[15] Sangakkara, U.R. 1991. Effect of EM on the growth and yield of sweet potato in wet and dry seasons. In: Proceedings of second international conference on Kyuesei Nature Farming, Brazil. p103-110.