J. Sci. Trans. Environ. Technov. 2009, 3(3): 130-133

Evaluation of the effect of microbial consortia on vegetable crops

P. Marimuthu* and R. Parimala devi

Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamilnadu, India.

Abstract

Foliar spraying of microbial consortia at 1.5 ml concentration recorded 14.0 and 15.4 per cent increased plant height and plant dry weight of tomato, respectively, over the control. In case of yield parameters, the 1.5 ml/lit concentration of microbial consortia increased the number of fruits and fruit weight by 14.2 and 11.1 per cent, respectively, than the control about 9.9 per cent increase over control in fruit yield of tomato was recorded in microbial consortia treated plants. In case of brinjal, microbial consortia when applied as foliar spray increased the plant height, dry weight of plants and dry weight of roots by 15.6, 15.8 and 12.2 per cent, respectively, when compared to the control. The yield parameters of brinjal *viz*., number of fruits, fruit weight and fruit yield were increased by 14.6, 12.2 and 12.7 per cent in microbial consortia treated plants than the control.

INTRODUCTION

Beneficial Microorganisms (BM) specifically refers to a cocktail of beneficial bacteria that is used as a soil remediation and health measure in many organic farms in Japan. BM was discovered and developed by the Japanese horticulturalist and agriculturalist Dr Higa, Professor at the University of Okinawa. BM contains over 80 microorganisms including populations of lactic acid bacteria and yeasts and smaller numbers of photosynthetic bacteria, actinomycetes and other types of organisms like *Phosphobacteria, Azospirillum*, etc., that are mutually compatible and can coexist in balance in liquid culture. Beneficial Microorganisms (BM)/ Microbial consortia are reported to assert a powerful regenerative effect on soil (Higa, 1994) helping to re-establish balanced soil ecology and to combat oxidative corrosion in plants and humans. The essential basic technology of the BM microbial culture is a consortium of five or more species of microorganisms, across at least three classes of organisms, in a synergistic culture (called a consortium) which produces lactic acid under anaerobic fermentation and which also produces an environment (in the liquid or plant matter under fermentation, etc.) which is highly anti-oxidative and regenerative, or syntropic (anti-entropic) and which contains numerous powerful antioxidants, largely produced by phototrophic anaerobic bacteria known as purple non-sulfur bacteria. BM is not a substitute for other management practices. It is, however, an added dimension for optimizing our best soil and crop management practices such as crop rotations, use of organic amendments, conservation tillage, crop residue recycling, and biocontrol of pests. If used properly, BM can significantly enhance the beneficial effects of these practices (Higa and Wididana, 1991).

BM can be used in agriculture *via* a number of methods. EM is innoculated into the rhizosphere with the intention to regenerate soil, raise yields, and improve the nutrient content of foods. BM can be drip fed or sprayed in dilution onto crops and soil (Higa, 1994). Research on papaya in Brazil (Chagas *et al*, 2001), herbage grasses in Holland and Austria (Bruggenwert, 2001, Hader, 2001), vegetables in New Zealand and Sri Lanka (Daly and Stewart, 1999, Sangakkara and Higa, 2000) and apples in Japan (Fujita, 2000) all demonstrate that the correct use of EM and Bokashi increase yields of traditional organic systems over a period of time.

In the present study different concentrations of microbial consortia were applied for the vegetable crops like tomato and brinjal under various agro climatic conditions to study the effect of microbial consortia on yield of tomato and brinjal. Foliar spraying of the microbial consortia was given at three critical stages of the crop growth (pre flowering, flowering and fruit development stages).

MATERIALS AND METHODS

Method of application

Two hundred ml of liquid inoculant was mixed with 10 litres of 10% jaggery solution and kept overnight for revival of the cells. Then 90 liters of water was added and was applied as foliar spray for one acre of field crop.

Frequency of spraying

For each crop three rounds of foliar spray (pre flowering, flowering and fruit development stages) were given at equal intervals.

Treatment details

*Corresponding Author
email: *profmarimuthu1@yahoo.com*

Table 1. Effect of microbial consortia on plant height, dry weight of plant and dry weight of roots of Tomato (see "Methods" for treatment details)

Treatments	Plant height (cm)	% Increase over control	Dry weight of plants (g)	% Increase over control	Dry weight of roots (g)	% Increase over control
T_1	60.88	11.6	131.45	10.1	3.91	8.6
T_2	61.16	12.1	135.16	13.2	3.93	9.2
T_3	62.19	14.0	137.78	15.4	4.00	11.2
T_4	54.56	-	119.4	-	3.60	-
SEd	0.40	-	0.14	-	0.07	-
CD (0.05)	0.90	-	0.31	-	0.16	-

Farmer's name: Chinnapan
Place: Palacode, Dharmapuri District
Var US618 Season : Dec '07- Mar '08

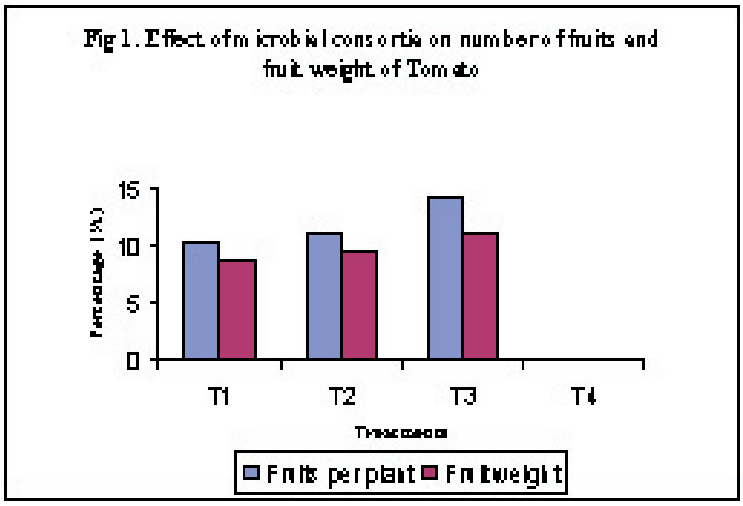
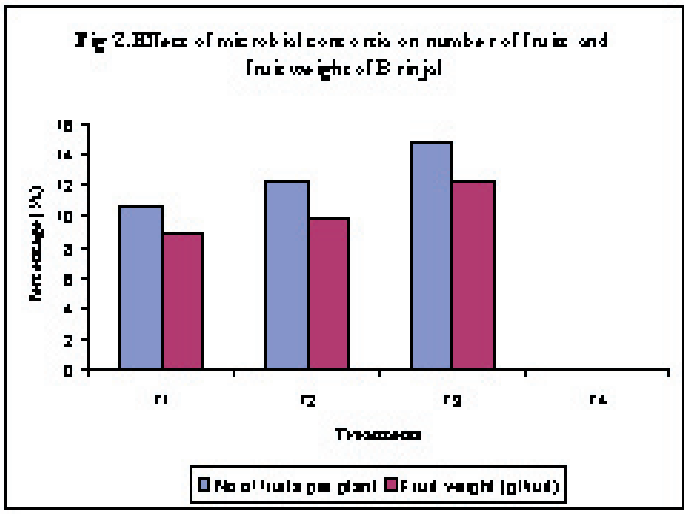


Table 2. Effect of microbial consortia on fruit yield of Tomato (see "Methods" for treatment details)

Treatments	Fruit yield (kg/plant)	Fruit yield (t/ha)	% Increase over control
T_1	1.06	29.4	8.2
T_2	1.07	29.6	8.7
T_3	1.08	29.9	9.9
T_4	0.98	27.2	-
SEd	0.005	0.096	-
CD (0.05)	0.012	0.217	-

Table 3. Effect of microbial consortia on plant height, dry weight of plant and dry weight of roots of Brinjal (see "Methods" for treatment details)

Treatments	Plant height (cm)	% Increase over control	Dry weight of plants (g)	% Increase over control	Dry weight of roots (g)	% Increase over control
T_1	53.9	11.9	99.6	11.2	4.5	9.1
T_2	54.6	13.2	102.1	13.9	4.5	10.3
T_3	55.7	15.6	103.8	15.8	4.6	12.2
T_4	48.2	-	89.6	-	4.1	-
SEd	0.21	-	0.18	-	0.09	-
CD (0.05)	0.47	-	0.40	-	0.21	-



T_1- 1 ml/lit of microbial consortia + recommended dose of fertilizers

T_2 1.5 ml/lit of microbial consortia + recommended dose of fertilizers

T_3 2.0 ml/lit of microbial consortia + recommended dose of fertilizers

T_4 Control (Recommended dose of fertilizers alone)

Crop details

Tomato (Var US618)

Place: Palacode, Dharmapuri District, Tamilnadu, South India

Season: December 2007- March 2008

Brinjal (Var NEBH 11)

Place: Thippampatti, Dharmapuri District, Tamilnadu, South India

Season: October 2007 February 2008

RESULTS AND DISCUSSION

Foliar spraying of microbial consortia at 1.5 ml concentration recorded 14.0 and 15.4 per cent increased plant height and plant dry weight of tomato, respectively, over the control. In case of yield parameters the 1.5 ml/lit concentration of microbial consortia increased the number of fruits and fruit weight by 14.2 and 11.1 per cent, respectively, than the control about 9.9 per cent increase over control in fruit yield of tomato was recorded in microbial consortia treated plants. The increase in crop yield might be due to the plants receiving most of their nutrients from the interactions of soil microorganisms. When beneficial microorganisms are present in the rhizosphere, plants can acquire nutrients much easier *via* soil microorganisms than through direct uptake from soil (Higa, 1993). (Fig 2 & Table 4).

In case of brinjal, microbial consortia when applied as foliar spray increased the plant height, dry weight of plants and dry weight of roots by 15.6, 15.8 and 12.2 per cent, respectively, when compared to the control. The yield parameters of brinjal *viz*., number of fruits, fruit weight and fruit yield were increased by 14.6, 12.2 and 12.7 per cent in microbial consortia treated plants than the control

According to Higa and Parr (1994) beneficial microorganisms present in the microbial consortia are capable of generating minerals such as tocopherol, lycopene, ubiquinone, saponin, and powerful anti-oxidant flavonoids, such as quercetin, quercetin-3-O-glucopyranoside, and quercetin-3-O-rhamnopyranoside and as such a yield is expected to increase by 20% to 30% with the general use of BM and even by 50% to 100% when a high level of BM is maintained in the soil.

The use of beneficial microorganisms as soil and plant inoculants to shift the microbiological equilibrium has been regarded as a way that enhances soil quality and the yield and quality of crops (Higa and Wididana, 1991; Higa, 1991 & 1994). Further more, BM treated products taste better, with higher content of vitamins C and E, show longer storage life and characteristics of general health products when consumed. Secondary products processed from these crops such as wine, juice, etc., also show better quality. Higa and Parr (1994) also reported that a significant difference existed between BM treated and the chemically fertilized flood irrigated plots with BM treated plots producing significantly higher yields.

To reduce the pollution of our environment and to

Table 4. Effect of microbial consortia on fruit yield of Brinjal (see "Methods" for treatment details)

Treatments	Fruit yield (kg/plant)	Fruit yield (t/ha)	% Increase over control
T_1	1.1	28.0	8.5
T_2	1.1	28.1	9.1
T_3	1.1	29.1	12.7
T_4	1.0	25.8	-
SEd	0.032	0.442	-
CD (0.05)	0.072	0.999	-

improve the quality of our agricultural produce we have to adopt new strategies like microbial consortia. A combination of microorganisms applied to the soil has a much higher chance of establishing itself than the inoculation of a single strain. Since, microbial consortia are a combination of microbes and each of the microbes is capable of promoting the crop growth in a unique way, the quality and quantity of the crop yield will be improved. Further more, the product is a liquid formulation and hence the application process is simple and easy.

Monitoring the population of microbes in rhizosphere region of the crops will enable us to maintain required population to enhance the crop growth and yield. Application of the above liquid formulation in three critical stages of the crop growth (split application) will meet out the crop need in an effective way and will improve the crop growth. Application of microbial consortia reduces the rate of use of chemical fertilizer which is to be applied to the vegetable crops and hence reduces the cost of production and also the negative impact of chemical fertilizer on the environment. Further more, it is an ecofriendly approach, which leads to the production of high quality vegetables with high consumer preference.

REFERENCES

Bruggenwert, M. G. M. 2001. EM research in the Netherlands. *In: Proceedings of the 6th International Conference on Kyusei Nature Farming*. Senanayake, Y.D.A. and Sangakkara, U.R. (Eds), South Africa.

Chagas, P.R.R., Tokeshi, H. and Alves, M.C. 2001. Effect of calcium on yield of papaya fruits on conventional and organic (Bokashi EM) systems. *In: Proceedings of the 6th International Conference on Kyusei Nature Farming*. Senanayake, Y.D.A. and Sangakkara, U.R. (Ed), South Africa.

Daly, M.J. and Stewart, D.P.C. 1999. Influence of Effective Microorganisms (EM) on vegetable production and carbon mineralization - A preliminary investigation. *J. Sustai. Agric.*, 14: 15 25.

Fujita, M. 2000. Nature farming practices for apple production in Japan. *In:* Nature farming and microbial applications. Xu, H.L. *et al* (Eds.) *J. Crop Production*, 3: 119-126.

Hader, U. 2001. Influence of EM on the quality of grass/hay for milk production. *In: Proceedings of the 6th International Conference on Kyusei Nature Farming*, Senanayake, Y.D.A. and Sangakkara U R (Ed), South Africa.

Higa, T. 1991. Effective microorganisms: A biotechnology for mankind. p.8-14. *In:* J.F. Parr, S.B. Hornick, and C.E. Whitman (Ed.) *Proceedings of the First International Conference on Kyusei Nature Farming*. U.S. Department of Agriculture, Washington, D.C., USA.

Higa, T. 1993. An earth saving revolution. Sumartk Publishing Inc, Japan.

Higa, T. 1994. An earth saving revolution II. Sumartk Publishing Inc, Japan.

Higa, T. 1994. Effective Microorganisms: A New Dimension for Nature Farming. *In:* J.F. Parr, S.B. Hornick, and M.E. Simpson (Ed.) *Proceedings of the Second International Conference on Kyusei Nature Farming*. U.S. Department of Agriculture, Washington, D.C, USA. p. 20-22.

Higa, T. and G.N. Wididana 199lb. Changes In the soil microflora Induced by effective microorganisms. J.F. Parr, S.B. Hornick, and C.E. Whitman (ed.) *In: Proceedings of the First International Conference on Kyusei Nature Farming*. U.S. Department of Agriculture, Washington, D.C., USA. p. 153-162.

Higa, T. and J. Parr. 1994. Beneficial and Effective Microorganisms for a Sustainable Agriculture and Environment. International Nature Farming Research Center Atami, Japan. 16 p.

Sangakkara, U. R. and T. Higa. 2000. Kyusei Nature Farming and EM for enhanced smallholder production in organic systems. *In: Proceedings of the 13th International Scientific Conference of IFOAM*. Alfoeldi, T *et al.* (Ed). FiBL, Basel, Switzerland: 268.