Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 2575-2581

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-7 pp. 2575-2581**
Journal homepage: http://www.ijcmas.com

Original Research Article

Influence of Effective Microorganism on Growth, Physiological and Yield Contributing Characters of Sponge Gourd (Luffa cylindrica Roem)

Pushpendra Singh[1], Raj Bhawan Verma[1]*, Rajnarayan[2] and Vijay Kumar Singh[1]

[1]Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour (Bhagalpur)-813210
[2]Central Institute for Tropical Horticulture, ICAR regional station, Mukteshwar, Nainital-263138, India
**Corresponding author*

Keywords

Sponge gourd, Chlorophyll content, Effective microorganisms, Growth, Yield, Plant nutrition

A B S T R A C T

Effective microorganisms (EM) consist of mixed cultures of beneficial and naturally occurring microorganisms that can be applied as inoculants to increase the microbial diversity of soil and plant. Spraying of crops with effective microorganisms can improve vegetable crop yields and there by improve food security. The sponge gourd is one of the important cucurbitaceous vegetable grown in India because of its high nutritive value, high productivity and easy package of practices. Since, the literatures related to the EM on sponge gourd are meagre. Therefore a study was designed to explore the possibilities of spray of effective microorganism on growth and yield of sponge gourd. The experiment was conducted at Bihar Agricultural College, Sabour Bhagalpur in summer season 2012 with four levels, replicated thrice in a randomized block design. There were significant differences ($P \geq 0.05$) in length of main vine (cm), number of branches per vine, number of nodes per plant, internodal length (cm), days to first female flower emergence, node to first female flower emergence, days to first fruit picking, total biomass (g), leaf area (cm^2), number of leaves per plant, chlorophyll a, b, and total chlorophyll (mg/g), number of fruits per plant, weight of fruits per plant (kg), length of fruit (cm), fruit girth (cm), average fruit weight (g) and yield (q/ha). The results demonstrated that the spray of plants with effective microorganisms was found to be effective for the improvement of growth, physiology and yield and yield attributing characters of sponge gourd.

Introduction

Vegetable crops, the important components of horticulture and effective supplements of nutrition, assume great significance in providing food and nutritional security along with to generate employment in the country. The demand for fresh vegetable has increasing trend owing to growth of health conscious population and enhanced income. The challenges ahead are to have sustainability and competitiveness and to achieve the targeted production to meet the availability of 300g/caput/day. Challenges are to produce more vegetables from shrinking land and declining water in the scenario of climate change. Microorganisms are important attributes in agriculture to promote the circulation of plant nutrients and reduce the need for chemical fertilizers. Effective microorganism are organic products containing living cells of different

types of microorganisms that have emerged as important component of the integrated nutrient supply system and hold a great promise to improve crop yields through environmentally better nutrient supplies. These non infecting plant growth promoting bacteria (PGPB) might affect mineral nutrition of plants through their influence on: i) growth, morphology and physiology of roots; ii) the physiology and development of plants and iii) the availability of nutrients and its uptake processes. A lot of microorganisms, for example species of *Bacillus* and *Pseudomonas* have a direct effect on the plant growth (Kloepper *et al*., 1986).

The concept of effective microorganism, (EM) was developed by Professor Teruo Higa University of the Ryukyu, Okinawa, Japan (Higa, 1991). EM consists of mixed cultures of beneficial and naturally occurring microorganisms that can be applied as inoculants to increase the microbial diversity of soil and the growth, yield and quality of the crops (Kengo and Hui-lian, 2000). The sponge gourd (*Luffa cylindrica* L.) ; an important vegetable of family cucurbitaceae is very sensitive to frost and prefers warm and dry climate. Its unripe tender fruits are popular and well-known culinary vegetable in India with good nutritive value and high yield potentials. It is a good source of Carbohydrate, Vitamin A, Vitamin C and minerals and also posses many healing and medicinal properties. Besides, it is quite useful in asthma, skin diseases, splenic enlargement, and jaundice. Effective microorganisms can contribute significantly to the production of vegetables such as sponge gourd.

Understanding the limited use of effective microorganisms in the production of sponge gourd in India and the hypothesis that the spraying of effective microorganisms to sponge gourd will lead a positive response, the study was under taken to investigate the influence of effective microorganisms on growth, physiology and yield of sponge gourd.

Materials and Methods

Preparation of spray solution

One litre of EM stock solution and 1 litre of organically grown Jaggery (or molasses) mixed properly in a food-grade clean and not contaminated with chemicals, plastic container having airtight lid. (Glass or metal containers are not appropriate as the development of gas may cause the container to break or explode.). Little air was left inside the container (between the liquid and the lid) to release the air pressure developed during fermentation and used to open the lid everyday for a second to release the gas pressure. The process was continued till the appearance of a white layer on the top of the solution accompanied with a sweetish, sour rather pleasant smell. Analyse the pH of product using litmus indicator paper as the dropping pH below 4.0 is the indicator of readiness of the product and such an extended EM was used for the spray of the crop.

Experimental site and materials

The experiment was conducted at Bihar Agricultural College, Sabour Bhagalpur, which is situated between 25^0 50' N latitude and 87^0 19' E longitudes at an altitude of 46 meter above mean sea level in the heart of Indo - Gangetic plains of North India. The experiment was laid out in randomized block design with four different concentrations of effective microorganism *viz*. 0.0 (control), 0.5, 1.0 and 1.5 percent with full recommended dose of fertilizers (100: 60: 60 kg/ha N: P: K, respectively).

The treatments were replicated three times. The treatments involving different concentrations of effective microorganism were imposed by two foliar sprays at two and four true leaf stages of the crop. The seeds were sown at 250 x 50 cm row to row and plant to plant spacing on March 7, 2012 in the plots having size of 5 m x 3 m. Half of N and full of phosphorus and potassium were applied at the time of sowing, while remaining N was applied in two split doses at 20 and 40 days after sowing. All other cultural and plant protection measures were done as per recommended package of practices of crop.

Measurement of growth parameters

Five plants in each and every treatment in each replication were randomly selected and tagged properly for recording various observations. The observations recorded for the five plants were workout to give mean in respect of all the parameters, which were utilized in statistical analysis. Length of main vine was measured using a meter scale. Number of branches per plant and Number of nodes per plant was counted at the time of final harvest, Number of days taken from sowing of seed to the opening of first female flower was noted and the average was calculated, length between two nodes on the main shoot was recorded with help of meter scale.

The node number bearing first female flower and number of days taken from fruit set to fruit picking was noted and the average was calculated. The fresh and dry weight of plant after harvesting was measured with the help of electronic balance.

Measurement of physiological parameters

Leaf area was measured by using graph paper; number of leaves per plant was counted at the time of final harvest. Chlorophyll concentration was determined in 80% acetone extract with the help of spectrophotometer. Absorbency was measured against an 80% acetone blank at 647 nm and 664 nm. The values of chlorophyll a and chlorophyll b were determined according to Yadegari *et al.* (2007) using the following formula:

Chlorophyll a = 13.19 A664-2.57 A647 (mg per g fresh weight).

Chlorophyll b = 22.10 A647-5.26 A664 (mg per g fresh weight).

Where,

A664 was absorbance at 664nm and A647 was absorbance at 647nm, respectively.

Measurement of yield attributing traits and yield

Number of fruits of each picking of each tagged plant was counted and total number of fruits per plant was calculated by adding the fruits of all pickings, Altogether five randomly selected fruits of different harvesting times from the tagged plants were measured for their length at the maximum marketable maturity stage with the help of a meter scale, Girths of five randomly selected fruits (For measuring the fruit length) were measured with the help of slide callipers, The fruits harvested from each picking weighed separately and total weight of fruits was calculated by adding the fruits of all pickings, weight of five representative fruits was also recorded and the average fruit weight was calculated by dividing the total fruit weight by five, the product of the yield per plant and the plant population per hectare was taken as an indicator of yield in quintal per hectare in the present investigation.

Results and Discussion

Growth attributing characters

It is obvious from the data presented in Table 1 that each increasing concentration of effective microorganism (0-1.5%) showed significant influence on all the growth parameters and recoded maximum length of main vine (535.17cm), number of branches per plant (13.98 cm), number of nodes per plant (97.86), inter nodal length (11.09cm), fresh weight of vine(1479.56 g) and dry weight of vine after harvest (117.87g), However, the application of EM @ 1.5 percent significantly reduced the days to first female flower emergence, node number to first female flower emergence and days to first fruit picking and took minimum of 57.37, 10.78 and 65.90 days respectively. Maximum days for all the three parameters (61.39, 12.75 and 71.05 days respectively) were recorded under control treatment. The gradual increase in the parameters due to the increasing concentration of effective microorganism might be due to the fact that the effective microorganism does contain an array of beneficial microorganism *i. e.* Phosphate solubilizing bacteria, lactobacillus species, yeast, fungi, cellulolytic bacteria and streptomyces that might have increased the availability of nutrients and thereby improved the photosynthetic efficiency, which ultimately enhanced the growth attributes of plant. However, higher concentration of EM reduced the days to first female flower emergence, node number to first female flower emergence and days to first fruit picking. It may be due to the fact that the plant receiving EM might have completed their vegetative growth at fast rate by utilising adequate nutrients, which expected to regulate physiological response favourably that forced to enter in to the reproductive phase and resulted in early flowering and matured the fruits in shorter periods of time. The findings of present investigation are quite agreement with those already reported by the Pati and Chandra (1981), Higa (2002), Singh *et al.*, (2003) and Singh and Yadav (1989), Sharma *et al*. (1995).

Physiological characters

The physiological parameters significantly (P = 0.05) influenced by the spray of effective microorganism (Table 2). Maximum values of leaf area (193.84 cm^2), number of leaves per vine (178.23), chlorophyll `a` content (1.47mg /g), Chlorophyll `b` content (0.55mg /g) and Total chlorophyll `a+b` content (2.02mg /g) were observed when the crop was sprayed with EM @ 1.5 percent. Minimum values of all the mentioned physiological parameters were noticed under control treatment, where effective microorganism was not sprayed. The progressive increase in the leaf area and number of leaves per vine may be due to the more allocation of nutrients into shoot rather than roots under proper nutrition, which might have accelerated the photosynthesis and also the increase in chlorophyll a, b and total content, may contribute to increased photosynthetic activities, which ultimately increased the said physiological parameters. The increase in chlorophyll a, b and total content in plants may be due to the increase in photosynthesis efficiency and nutrient uptake by the plant during early stages of leaf growth. Synthesis of chlorophyll and protein, a structural compound is high during early stage and resulting in high catabolic rates to support energy supplied by effective microorganism. The findings are in quite in agreement with the findings of Primavesi and Kinjo (1997); Higa and Parr (1994); Beadle, (1993); Hendry *et al*. (1987).

Table.1 Growth characters as influenced by spraying of effective microorganism

Treatment	LMV (cm)	NBP	NNP	LI (cm)	DFFFE	NFFFE	DFFP	FWP (g)	DWP (g)
EM 0.0%	451.73	11.59	88.50	10.25	61.39	12.75	71.05	1036.66	83.33
EM 0.5%	493.84	12.73	92.11	11.00	59.78	12.17	67.94	1179.61	95.32
EM 1.0%	524.09	13.56	96.90	11.08	58.25	11.42	66.67	1296.92	105.81
EM 1.5%	535.17	13.98	97.86	11.09	57.37	10.78	65.90	1479.56	117.87
CD(P=0.05)	6.13	0.17	1.14	0.14	0.75	0.16	0.83	15.18	1.45
CV (%)	5.08	5.60	5.06	5.43	5.24	5.77	5.10	5.05	5.98

LMV= Length of main vine, NBP= No. of branches per plant, NNP= No.of nodes per plant, IL= length of Internodes, DFFFE= Days to first female flower emergence, NFFFE= Nodes to first female flower emergence, DFFP= Days to first fruit picking, FWP= Fresh weight of plant, DWP= Dry weight of plant

Table.2 Physiological characters as influenced by spraying of effective microorganism

Treatment	Leaf area (cm^2)	Number of Leaves per plant	Chlorophyll 'a' (mg/g)	Chlorophyll 'b' (mg/g)	Total chlorophyll (a + b) (mg/g)
EM 0.0%	176.75	146.00	1.25	0.51	1.76
EM 0.5%	185.06	160.48	1.37	0.53	1.90
EM 1.0%	191.48	175.95	1.44	0.54	1.99
EM 1.5%	193.84	178.23	1.47	0.55	2.02
CD(P=0.05)	2.25	2.38	0.02	0.01	0.02
CV (%)	5.01	6.0	6.29	6.35	5.27

Table.3 Yield and yield contributing traits as influenced by spraying of effective microorganism

Treatment	Number of Fruits/plant	Weight of Fruits/plant (kg)	Fruit Length (cm)	Fruit girth (cm)	Average fruit weight (g)	Yield (q/ha)
EM 0.0%	18.53	3.54	17.69	3.45	179.61	169.36
EM 0.5%	18.83	3.85	18.39	3.72	189.58	184.02
EM 1.0%	19.69	3.96	19.92	3.96	197.64	192.49
EM 1.5%	19.92	4.07	20.36	4.14	200.25	198.54
CD at 5%	0.25	0.06	0.26	0.06	2.15	2.90
CV (%)	5.49	6.83	5.60	6.63	5.31	6.47

Yield contributing traits and yield

All the yield attributing traits and yield influenced significantly due to application of various concentration of effective microorganism (Table 3). The highest concentration of effective microorganism @ 1.5 percent recorded maximum number of fruits per vine (19.92), fruit length (20.36 cm), fruit girth (4.14 cm), fruit weight per plant (4.07 kg), average fruit weight (200.25 g) and yield of fruits (198.54 q/ha). The minimum values of all the yield contributing parameters and yield were noticed under control treatment (without receiving effective microorganism). The progressive

increase in yield attributes and yield through the spray of EM was mainly due to the increase in morphological and physiological traits that might have increased the available nutrients to the roots, which helped in the absorption of nutrients and improved the photosynthesis and its translocation to the sink and ultimately improved the yield and its attributes of sponge gourd. Higher leaf area and number of leaves per plant might have remitted in high rate of net carbon assimilation and ultimately favoured the growth and reproduction. During early stage of leaf growth, synthesis of chlorophyll, protein and structural compounds is high resulting in high catabolic rates of support of energy needs by the plant. Accumulation of dry matter and its distribution it to different plant components is an important consideration in achieving desirable economic yield. All these may be attributed the increased nutrient uptake, fertilizer use efficiency, improved photosynthetic efficiency due to the application of EM spray solution. The findings are close conformity with the findings of Singh *et al*. (2003), Singh and Yadav (1989), Pati and Chandra (1981), Yadav (2000), Higa (2002), Sharma *et al*.(1995).

In conclusions, the results show that spraying of sponge gourd *(Luffa cylindrica* Roem*)* with effective microorganisms can improve their growth, physiological characters and yields. To prevent the environmental pollution from extensive application of fertilizers, the effective microorganisms could be recommended to farmers to ensure the public health and a sustainable agriculture. The data collected proves that the use of effective microorganisms can lead to higher yield of sponge gourd *(Luffa cylindrica* Roem*)*. Further research should be done to quantify the numerous effects of EM on growth and yield of other cucurbits crop.

References

Beadle, C. L. 1993. Growth analysis. In: Hall DO, Scurlock JMO, Bolhàr-Nordenkampf HR, Lee good RC, Log SP (eds), Photosynthesis and production in a changing environment- A field and laboratory manual. 36 - 46. Chapman and Hall, London.

Grant, C. A. and Bailey, L. D. 1993. Fertility management in canola production. *Journal of plant Science.* 73: 651-670.

Hendry, G. A. F., Houghton, J. D. and Brown S. B. 1987. Tansley review No 11: The degradation of chlorophyll-A Biological enigma. *New Phytologist*. 107: 255-302.

Higa, T. 1991. Effective microorganisms: A biotechnology for mankind. 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. 2002. E M Technology application in agriculture and environment protection. Proceedings of the 38th International Microbiological Symposium on Effective Microorganism in sustainable agriculture and Environment Protection. *SGGW Rogow Klodzi Poland*, 17 - 18

Higa, T. and Parr, J. F. 1994. Beneficial and effective microorganisms for a sustainable agriculture and environment. *International Nature Farming Research Centre.* 16.

Kengo, Y. and Hui-lian, X. 2000. Properties and applications of an organic fertilizer inoculated with effective microorganisms. *Journal of Crop production*. 3(1): 255-268.

Kloeppe,r J. W., Lifshitz, R. and Schroth, M. N. 1986. Pseudomonas inoculants to benefit plant production. *Anim. Plant Sci*. 60-64.

Pati, B. R. and Chandra, A. K. 1981. Effect of spraying of nitrogen fixing phyllosphere bacterial isolates on wheat plant. *Plant and Soil*. 61: 419 – 427

Primaveshi, A. and Kinjo, S. 1997. Comparision of the effect of EM and other bacterial and mineral products on bean yield. Brazil

Sharma, D. C., Chatterjee, C. and Sharma, C. P. 1995. Chromium accumulation and its effects on wheat (*Triticum aestivum* CV.HD 2204). *Metabolism Plant Science*. 111: 145-151.

Sigh, A. and Yadav, D. S. 1989. Effect of sowing date and plant density on dwarf field peas. *Indian J. Agron*. 34: 92-95.

Singh, D. S., Chand, S., Anvar, M. and Patra 2003. Effect of organic and inorganic amendments on growth and nutrients accumulation by Isabgol (*Plantago avata*) in sodic soil under green house conditions. *Journal of Medicinal and Aromatic Plant Science*. 25: 414 – 419

Yadav, S. P. 2000. Performance of effective microorganism (EM) on growth and yield of selected vegetables. Paper presented in conference of EM technology and Nature Farming from 20th to 22nd September in Pyengyong, DPR Korea.

Yadegari, L. Z., Heidari, R. and Carapetian, J. 2007. The influence of cold acclimation on proline, malondialdehyde (MDA), total protein and pigments contents in soybean (*Glycine max*) seedling. *Journal of Biological Sciences*. 7(8): 1436-1441.