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Combined effect of effective microorganisms (EM) and biofertilizer on the growth parameters of *Lycopersicon esculentum* Linn.

N. Anusuya, J. Victoria* and N. Uma Maheswari

PG and Research Department of Microbiology and a Division of Biotechnology, Sengamala Thayaar Educational Trust Women's College, Mannargudi-614001,Thiruvarur District, Tamilnadu, India.

Abstract

The Effective Microorganisms (EM) solution was prepared by using natural substrates such as banana, papaya, pumpkin, egg and jaggery. It was allowed to ferment for 45 days. The fermented EM was extended and activated before being used. The extendend EM was verified on the basis of pH 3.2 and by sweet sour smell. The seedlings of *Lycopersicon esculentum* were transplanted in 4 pots, T1 pot were treated with EM plus *Azospirillum* , T2 pot with EM alone, T3 pot with *Azospirillum*. The uninoculated pot was denoted as control. The pots were provided with water facilities. EM solution and *Azospirillum* was sprayed on plants at 15 days intervals. Then morphological parameters such as leaf number, plant height, shoot length, root length, root number were observed and chlorophyll content (7^{th},14^{th},21^{st} and 28^{th} days) and carbohydrate, protein content (28^{th} day) were determined. Maximum leaf number, height, shoot length, root length and number of roots were observed, and maximum chlorophyll, carbohydrate and protein content were observed in the plants treated with EM plus *Azospirillum* (T1).

Keywords : Effective microorganisms (EM), *Azospirillum*, *Lycopersicon esculentum* Linn., Plant growth promoting substances.

INTRODUCTION

Effective Microorganisms (EM) are non-harmful, non-pathogenic, not genetically engineered or modified, and not chemically synthesized. The technology of EM was developed during the 1970's at the University of Ryukyus, Okinawa, Japan (Sangakkara, 2002). It is a mixed culture of *Streptomyces* and *Lactobacillus* sp., yeast and small number of photosynthetic bacteria which improve crop yield by increasing photosynthesis, nitrogen fixation, controlling soil disease and accelerating decomposition of lignin material in the soil (Hussain *et al*., 1993). Effective Microorganisms solution is prepared from natural substrates and it can be used as an herbal insecticide to control insects and pathogenic microorganisms and can also be used as plant growth inducers. These microbes have the ability to breakdown the organic matter and thus by releasing beneficial soluble substances such as amino acids, sugars, alcohol, hormones and similar organic compounds.These are absorbed by plants and in turn growth is enhanced. *Azospirillum* is a very common root and soil inhabiting nitrogen fixing bacterium present in the rhizosphere. It is a Gram negative, symbiotic, vibrioid soil bacterium. It occurs in large numbers in association with roots of cereals, grasses, tuber crops and increases the vegetative growth and crop yield in many plants. This paper deals with the combined effect of EM and *Azospirillum* on the morphological and biochemical characteristics of *L. esculentum.*

MATERIALS AND METHODS

Effective Microorganisms (EM) Preparation:

250gm of banana, papaya and pumpkin were collected and chopped into small pieces and transferred into air tight container and mixed with one liter of bore well water, subsequently 250gm of jaggery and one egg was added. The barrel was closed tightly and incubated for 45 days. After 45 days, the white layer was formed on the surface. The fermented EM solution was collected by filtration. It is termed as EM stock solution (Ahmed John *et al*., 2007).

Extension (EMe) and activation (EMa) of EM stock solution (APNAN, 1995).

One liter of EM stock solution and 1 kg of jaggery were mixed with 20 liters of water. The water should be clean and free from chlorine. The container should be of good-grade plastic. Extended EM will be ready after 5-10 days. It was verified by a pH of 3.5 or lower and a pleasant sweet sour smell. For the period of activation, the container was placed in shade at ambient temperature (20-40°C) without exposure to strong temperature fluctuations.

Pot cultivation:

The seedlings of *Lycopersicon esculentum* were transplanted in four pots of equal size, 30cm in height and 6cm in diameter. Garden soil was used as the

*Corresponding author :
email: victii_23@yahoo.co.in

culture medium. The pots were provided with water facilities.

Treatment:

There were 4 treatments resulting from combination of

T1 - EM + Biofertilizer

T2 - EM

T3 - Biofertilizer

C - Control

There were four replications for each treatment. All the pots were arranged in a randomized design. The pots were maintained in the open shade at the temperature of 27° - 30°C (Parvathi *et al.,* 1985).

Morphological parameters:

After 7th, 14th, 21st, and 28th days of growth, 3 plants per pot were removed from all samples, and studied for the following morphological parameters. They were,

- Height of the plant (in cm)
- Number of leaves (per plant)
- Number of roots (per plant)
- Shoot length (in cm)
- Root length (in cm)

Chlorophyll Estimation:

The chlorophyll content of leaf sample from each treatments was estimated on 7th, 14th, 21st, and 28th day's intervals.(Arnon,1949).

Carbohydrate Estimation:

The carbohydrate content of leaf sample from each treatments was estimated (28th day) by Anthrone method (Hedge and Hofreiter, 1962).

Protein Estimation:

The protein content of leaf sample from each treatments (28th day) was estimated (Lowry *et al.,*1951).

Statistical Analysis:

Mean was calculated to facilitate the comparison of the data of various growth parameters in all samples (Salil Bose, 1982). The students't' test was carried out to find whether the differences between samples are significant or not.

RESULTS AND DISCUSSION

The effect of Effective Microorganisms(EM) and *Azospirillum* on the growth of *Lycopersicon esculentum* was reflected on the maximum number of leaves, shoot length, root length and number of roots of the plants.

TABLE –I

Combined Effect of EFFECTIVE MICROORGANISMS (EM) AND *Azospirillum* ON CHLOROPHYLL CONTENT OF *Lycopersicon esculentum* (28TH DAY) values are mean.

Treatments	Chlorophyll mg/g		
	A	B	Total
T1	0.173	0.119	0.293
T2	0.161	0.107	0.269
T3	0.155	0.101	0.257
Control	0.068	0.191	0.191

T1 = EM + *Azospirillum* A = Chlorophyll 'a'

T2 = EM B = Chlorophyll 'b'

T3 = *Azospirillum* Total Chlorophyll

TABLE – 2

COMBINED OF EFFECTIVE MICROORGANISMS (EM) AND *Azospirillum* ON TOTAL CARBOHYDRATE, PROTEIN MOLECULES IN THE LEAVES OF *Lycopersicon esculentum* (28th day)

Treatments	Carbohydrate (mg)	Protein (mg)
T1	10.725	60.73
T2	8.272	50.67
T3	6.636	47.64
Control	4.934	29.98

The effect was observed in plants inoculated with Effective Microorganisms(EM), *Azospirillum* and control.

Among four treatments (T1,T2,T3 and C), *L.esculentum* inoculated with Effective Microorganisms+ *Azospirillum* (T1) showed the maximum height of plant, leaf number, root number, root length and shoot length than other treatment used. T2 and T3 samples attained the second and third place respectively. Khan *et al.(*2006)have reported similar results of increasing height, leaf number and chlorophyll content by the application of Effective Microorganisms. During early stages of leaf growth, synthesis of chlorophyll, proteins and structural compounds is high, resulting in high catabolic rates to support energy needs of the plants. Inoculation of Effective Microorganisms increased the

available nutrients to plant roots and improved photosynthesis (Chrispaul Muthaura *et al.*, 2010).

Increase in chlorophyll a and b contents of the L. *esculentum* may contribute to increased photosynthetic activity. The synthesis and degradation of the photosynthetic pigments are normally associated with the photosynthetic efficiency of the plants and their growth adaptability to different environments (Beadle, 1993).

Chlorophyll a and b and total chlorophyll content were estimated on 7th, 14th, 21st and 28th day of intervals. Among them, T1 showed higher chlorophyll content than other treatments (Table – 1). Increase in chlorophyll a and b contents of the *L. esculentum* may contribute to increased photosynthetic activity.

Increase in leaf chlorophyll content could in turn lead to increased protein synthesis of the plants and this could have a direct consequence on the plant growth and photosynthesis (Henry *et al.*, 1987).

The total carbohydrate content of leaf sample from each treatment was estimated on 28th day of growth. Among them, T1 showed higher carbohydrate content (10.725mg). T2 and T3 samples attained the second and third place respectively. (8.272mg, 6.636mg) (Table–2).

The total protein content of leaf sample from each treatment was estimated on 28th day of growth. Among them, T1 showed highest protein content (60.73mg), than other treatments (T2-50.67mg, T3-47.64mg and control 29.98mg) (Table – 2).

The present results are in agreement with the findings of Xu (2000), Wang *et al.* (2000) and Mridha *et al.* (2002), who reported EM applied with organic fertilizers promote root growth and activity, and enhance photosynthetic efficiency and capacity. In general Effective Microorganisms in combination with *Azospirillum* seem to have direct impact on growth of *L. esculentum.*

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