International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 8(A); August 2018; Page No. 14599-14603
DOI: http://dx.doi.org/10.24327/ijcar.2018.14603.2653

Research Article

EFFECT OF DIFFERENT BIO-FERTILIZERS ON THE GROWTH PARAMETERS OF *Solanum lycopersicum* L.

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A R T I C L E I N F O

Article History:

Received 04th May, 2018
Received in revised form 16th June, 2018 Accepted 25th July, 2018
Published online 28th August, 2018

Key words:

Azospirillum, Bio-fertilizer, growth, Phosphobacteria, tomato, VAM fungi

A B S T R A C T

Bio-fertilizers are a suitable supplement to chemical fertilizers to meet the integrated nutrient demand of the crops. In the present study, the vegetable crop namely *Solanum lycopersicum* L. was taken and growth studies was carried out on the 30th, 45th and 60th day of growth. The growth parameters showed a higher growth rate on 30th day in terms of root length, shoot length, number of leaves, fresh weight and dry weight when the combination of bio-fertilizers were used. On the 45th day, the root length, shoot length, fresh weight and dry weight was higher in plants treated with the combination of fertilizers. The number of leaves was higher in VAM treated plants. On the 60th day, the fresh weight and dry weight was found to be higher in Phosphobacteria treated plants. There was significant increase in growth parameters when the plants were treated with bio-fertilizers rather than the control plant.

INTRODUCTION

Bio-fertilizers have shown great potential as supplementary, renewable and environmental friendly sources of plant nutrients and are an important component of Integrated Nutrient Management and Integrated Plant Nutrition System. The bio-fertilizer is based on renewable source of energy which does not pollute the environment. The current demand of sustainable agriculture has paved the way for bio-fertilizers usage and its advantage over chemical fertilizers has raised the awareness among the farmers. The bio-fertilizers play a major role in organic farming. In addition to nitrogen, bio-fertilizers provide certain growth promoting substances like hormones, vitamins, amino acids, etc. Application of bio-fertilizers results in increased mineral and water uptake, root development, vegetative growth and yield of the crop. They are eco-friendly, non-toxic, easy to use and cost effective that improves the soil fertility and crop productivity.Bio-fertilizers are one of the best modern tools for agriculture. They contain microorganisms which promote the adequate supply of nutrients to the host plants to ensure their proper development (Uma Maheswari and Elakkiya, 2014).

India is an agriculture based country. In order to feed the ever growing populations, India has to increase the per unit area productivity. Vegetables play an important role in human nutrition. Most are low in fat and calories but are bulky and filling (Fruits & Vegetables, 2015).

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Bio-fertilizers are one of the best modern tools for agriculture. It is a gift of our modern agriculture science. Bio-fertilizers are applied in the agriculture field as a replacement of our conventional fertilizers consisting of compost, household wastes and green manure. Those are not as effective as chemical fertilizers, so farmers often try to use chemical fertilizers in the agriculture field for crop development. Bio-fertilizers contain microorganisms which promote the adequate supply of nutrients to the host plants to ensure their proper development of growth and regulation in their physiology. Living microorganisms are used in the preparations of bio-fertilizers. Shelf life is the first and foremost problem of the carrier based bio-fertilizers which are up to three months and it does not retain throughout the crops cycle. Liquid bio-fertilizer is increasingly available in the market as one of the alternatives to chemical fertilizers and pesticide. One of the benefits from bio-fertilizers is a contribution from population of microorganism available.

The beneficial use of nitrogen fixing microorganism viz. *Azotobacter* and *Azospirillum*, as a supplementary source of N-nutrition to crops is well documented. *Azospirillum* synthesize considerable amount of biologically active substances like vitamins, nicotinic acid, indole acetic acids and gibberellins. All these hormones help the plant for better germination, early emergence and better root development.

Phosphobacteria means microbial inoculants capable of solubilizing phosphate. Commonly used Phosphobacteria is *Bacillus megaterium*. Around 95-99% of the total soil phosphorus is insoluble which is directly not available to plants. They multiply fast in the root zone. The P-solubilizers

containing bacteria or fungi may convert insoluble form of phosphate to soluble form by producing organic acids. About 15-25% of insoluble phosphate can be solubilized, saving chemical fertilizers significantly.Phosphobacteria can solubilize about 30 kg of insoluble source of phosphorus and make it available to plants. Application of phosphobacteria along with nitrogen fixing bacteria promotes growth and yield of the crops by 30% example maize, rice, tomato, bitter gourd etc.

Bio-fertilizers such as *Rhizobium, Azospirillum* and Phosphobacteria provide nitrogen and phosphorus nutrients to crop plants through nitrogen fixation and phosphorous solubilization processes. These Bio-fertilizers could be effectively utilized for rice, pulses, millets, cotton, sugarcane, ladies finger, tomato, vegetable and other horticulture crops. Bio-fertilizers is one of the prime input in organic farming that not only enhances the crop growth and yield but also improves the soil health and sustain soil fertility.

Mycorrhiza is the mutualistic association between plant roots and fungal mycelia. The mycorrhizal fungi mobilize phosphates and other micronutrients like zinc, boron and molybdenum from adjacent soil to the root system through hyphal network. Soil moisture plays a significant role on mycorrhizal development and colonization.

The tomato edible, often red, vegetable of the plant *Solanum lycopersicum* commonly known as a tomato plant belongs to the nightshade family, Solanaceae.Tomato plants are dicots, and grow as a series of branching stems, with a terminal bud at the tip that does the actual growing. When that tip eventually stops growing, whether because of pruning or flowering, lateral buds take over and grow into other, fully functional, vines. Tomato vines are typically pubescent, meaning covered with fine short hairs. These hairs facilitate the vining process, turning into roots wherever the plant is in contact with the ground and moisture, especially if the vine's connection to its original root has been damaged or severed.

The main objective of the present work is to study the efficiency of three different bio-fertilizers namely *Azospirillum,* Phosphobacteria and Vesicular Arbuscular Mycorrhizal fungi on the growth and yield of *Solanum lycopersicum* L. in pot culture study.

MATERIALS AND METHODS

The plant taken for the present study was *Solanum lyopersicum* L. belonging to the family Solanaceae. Growth studies was carried out under different treatments of bio-fertilizers namely *Azospirillum*, Phosphobacteria and Vesicular Arbuscular Mycorhiza during different stages of growth of the plant.

Collection of the seeds

Seeds of *Solanum lycopersicum* L. was obtained from Tamil Nadu Agricultural University, Coimbatore.

Collection of bio-fertilizers

The bio-fertilizers such as *Azospirillum*, VAM and Phosphobacteria were collected from TNAU, Coimbatore.

Bio-Fertilizers

Azospirillum

They are called as associative endosymbiont on roots of grasses and similar types of plants. They are known to fix atmospheric nitrogen and benefit host plants by supplying growth hormones and vitamins. *Azospirillum* is considered to be more efficient and it has been reported that *Azospirillum* inoculation increases the growth, nitrogen uptake and yield in number of crops (Mallikarjuna Rao *et al.,* 2014).

Vesicular Arbuscular Mycorrhiza (VAM)

Mycorrhiza is a mutualistic association between plant roots and fungal mycelia. Many graminaceous plants, legumes and horticultural crops are highly susceptible to VAM colonization. The transfer of nutrients mainly phosphorus from the soil to the cells of the root cortex is mediated by intracellular obligate fungal endosymbiont of the genera *Glomus, Gigaspora, Endosone*, etc. which possess vesicles for storage of nutrients and arbuscules for funneling these nutrients into the root system.

The mycorrhizal fungi mobilize phosphates and other micronutrients like zinc, boron and molybdenum from adjacent soil to the root system through hyphal network (Mallikarjuna Rao *et al.*, 2014)

Phosphobacteria

Microorganisms are also involved in the availability of phosphorus, the second most important nutrient required by crop plants. The phosphate solubilizing bacteria (PSB) solubilize the insoluble phosphates and make them available for crop plants in the rhizosphere region (Mallikarjura Rao *et al*., 2014)

METHODS

Pot Culture Experiment

The seeds obtained from TNAU, Coimbatore were soaked in different bio-fertilizers overnight. Later, the seeds were sown in pots (30cm×24cm×30cm sized pots) containing red soil and sandy soil in the ratio 1:1. The treated pots were maintained in triplicates. The effect of different bio-fertilizers on the growth of *Solanumlycopersicum* L. was assessed. Thulasi extract was sprayed at intervals to control the growth of insects. The different bio-fertilizer treatments given were:

T_0-Control
T_1-*Azospirillum*
T_2-Vesicular Arbuscular mycorrhiza
T_3-Phosphobacteria
T_4-*Azospirillum* + VAM + Phosphobacteria

Growth Parameters

Plant samples were uprooted carefully on 30^{th}day, 45^{th}day and 60^{th} day and the following growth parameters were measured and recorded for all the treatments.

1. Root length (cm)
2. Shoot length (cm)
3. Number of leaves
4. Fresh weight (gm)
5. Dry weight (gm)

Root Length

The plants were taken from control pot and other treatment pots and washed to get rid of adhering soil particles. Then, the length of the roots was measured with the help of a scale from

root collar point to root tip and expressed in centimeter. Ten seedlings were randomly selected from each treatment and their root length was measured using cm scale and recorded in cm/seedling.

Shoot Length

The shoot length of the plants was measured with the help of scale from the shoot collar point to shoot apex and expressed in centimeter. Ten seedlings were randomly selected from each treatment and their shoot length was measured using cm scale and recorded in cm/seedling. Three readings were taken for statistical analysis.

Number of leaves

The number of leaves present in the uprooted plants was calculated.

Fresh Weight

Fresh weight of the plants was measured with the help of an electronic digital balance and expressed in grams.

Dry weight

The collected plant materials were kept in hot air oven at 55°C for 24 hours. Then, the dry weight of the plants was measured using an electronic digital balance and expressed in grams.

Yield parameters

Number of fruits

The number of fruits obtained on 45th day and 60th day were calculated for *Solanum lycopersicum* L.

Statistical Analysis

The data obtained from various biochemical observations were subjected to statistical analysis as per the procedure of Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The study was conducted in *Solanum lycopersicum* L. using different bio-fertilizer treatments. Morphology of the plant ***Solanumlycopersicum* L.**

Systematic position

Order :Solanales
Family : Solanaceae
Genus : *Solanum*
Species :*S. lycopersicum* L.

Plate 1 Habit of *Solanum lycopersicum* L.

Description of the plant

- The tomato is native to South America, but, grows in temperate climates worldwide.
- Tomato is an easily grown vine plant that belongs to the night shade family
- The tomato (*Solanumlycopersicum*) is a short-lived perennial plant, grown as an annual plant, typically growing to 1-3 m tall, with a weekly woody stem that usually scrambles over other plants (Plate 1).
- The fruit is an edible, brightly colored (usually red, from the pigment lycopene) berry, 1-2 cm diameter in wild plants, commonly much larger in cultivated forms.
- The tomato begins its colorful and varied history upon the coastal highlands of Western South America, where it was being enjoyed by the native people for a long time.
- Tomatoes are consumed raw, or in salads, sauces and drinks. Tomatoes are rich in Vitamin A and are a kitchen- favourite throughout the world.
- Fruits can be harvested within 60-70 days' time.

Medicinal uses

- Tomato is good for liver health. Tomato has detoxification effect in the body.
- People eating tomatoes regularly have a reduced risk of cancer diseases such as lung, prostate, stomach, cervical, breast, oral, colorectal, esophageal, pancreatic and many other types of cancer.
- It reduces the risk of cardiovascular diseases because of lycopene in it.
- Maintain healthy blood pressureand reduce blood glucose in people with diabetes.
- Tomatoes contain key carotenoids such as lutein and lycopene. These can protect the eye against light-induced damage.

The result of the growth study carried out in tomato plant is as follows:

Growth parameters
Solanum lycopersicum L.

Growth parameters such as shoot length, root length, number of leaves, fresh weight and dry weight of *Solanum lycopersicum L.* was calculated on the 30th day, 45th day and 60th (Plate 2,3 and 4). The shoot length and root length on the 30th day was higher in T_4 i.e., the use of combination of bio-fertilizers such as *Azospirillum*, VAM and Phosphobacteria. The values were 29.9 ± 0.70 cm and 8.87 ±0.57 cm respectively (Table 1). The number of leaves on the 30th day was estimated to be 55.00 ± 9.54 (Table 1) in T_4.The fresh weight and the dry weight was also found to be higher in T_4 and the values were 15.20 ± 1.17 g and 1.36±0.52g respectively (Table 1). Improvement in growth and yield parameters in plants treated with bio-fertilizers were due to enhanced uptake of nutrients by the plants.

On the 45th day, similar to 30th day, the shoot length and root length showed its higher value in T_4 (combination of all three bio-fertilizers). The values obtained were 63.73±2.81cm and 21.67±3.01cm respectively (Table 2).The higher number of leaves present in the plant on the 45th day was 171.67±2.31 (Table 2) in plant treated with VAM (T_2).The fresh weight and dry weight was observed to be higher in plants treated with *Azospirillum*, VAM and Phosphobacteria. The readings obtained were 76.65±4.16g and 19.16±1.04g respectively. The

growth parameters on the 60th day were also estimated and tabulated (Table 3). The shoot length and root length was estimated to be higher in T_3 (74.20±5.5cm) and T_4 (27.47±1.27) respectively on the 60th day. The number of leaves in the plant was found to be higher in T_2 (201.67±3.21).

Plate 2 Growth of *Solanum lycopersicum* L. on 30th day

Table 1 Growth parameters of *Solanum lycopersicum* L. using different bio-fertilizers on 30th day

Treatments	Shoot length (cm)	Root length (cm)	No. of leaves	Fresh weight (gm)	Dry weight (gm)
T_0	23.37 ± 0.95	7.87 ± 0.95	20.33 ± 1.53	10.48 ± 0.30	1.70 ± 0.01
T_1	25.40 ± 3.50	7.43 ± 1.17	33.33 ± 1.53	4.96 ± 0.67	0.33 ± 0.30
T_2	26.73 ± 1.91	9.13 ± 1.14	37.00 ± 2.00	10.52 ± 0.82	0.67 ± 0.15
T_3	29.03 ± 0.99	8.37 ± 0.75	52.00 ± 11.53	13.69 ± 1.31	1.13 ± 0.23
T_4	29.90 ± 0.70	8.87 ± 0.57	55.00 ± 9.54	15.20 ± 1.17	1.36 ± 0.52
SEd	1.5608	0.7709	5.5698	0.7571	0.2393
Cd (p<0.05)	3.4776	1.7176	12.4103	1.6869	0.5332

Values are mean ± SD of three samples in each group

Plate 3 Growth of *Solanum lycopersicum* L. on 45th day

Table 2 Growth parameters of *Solanum lycopersicum* L. using different bio-fertilizers on 45th day

Treatments	Shoot length (cm)	Root length (cm)	No. of leaves	Fresh weight (gm)	Dry weight (gm)
T_0	55.53 ± 3.85	12.70 ± 0.75	97.00 ± 5.29	49.71 ± 13.86	12.85 ± 4.00
T_1	57.50 ± 2.13	16.37 ± 1.45	135.00 ± 18.36	47.06 ± 7.17	12.25 ± 1.37
T_2	55.57 ± 2.36	16.97 ± 0.83	171.67 ± 2.31	18.55 ± 3.42	4.64 ± 0.85
T_3	56.97 ± 1.12	18.60 ± 1.20	124.00 ± 10.44	41.42 ±16.37	10.35 ± 4.09
T_4	63.73 ± 2.81	21.67 ± 3.01	153.33 ± 26.63	76.65 ±4.16	19.16 ± 1.04
SEd	2.1330	1.0502	12.5892	8.4891	2.2038
Cd (p<0.05)	4.7527	2.6321	28.0507	18.9150	4.9103

Values are mean ± SD of three samples in each group

Bio-fertilizers such as *Azospirillum*, Phosphorus solubilizing bacteria and mycorrhiza are capable of improving the mineral nutrients of plants and enhance the soil fertility Phosphorus solubilizing bacteria are capable of solubilizing unavailable form of phosphorus into available form and make it available to plants (Veena *et al*; 2009; Shankarappa *et al*; 2012).

Earlier studies by Ghanti and Sharangi (2009) have revealed better growth, yield and quality of onion when *Azotobacter* was used in combination with *Azospirillum*.The fresh weight and dry weight of tomato on the 60th day of growth showed a high value in plants treated with Phosphobacteria (T_3). The values obtained were 148.11±42.87g and 49.37±14.29g respectively (Table 3).

Pongamia pinnata treated withVAM increased the plant height, root length and dry material (Venketech *et al*. 1998). Singh (2014) studied the yield parameters of coriander and found significant increase in plants treated with bio-fertilizers when compared to control. The result obtained in the present study on the uses of bio-fertilizers is in accordance with the studies carried out by Singh (2014).

Plate 4 Growth of *Solanum lycopersicum* L. on 60th day

Table 3 Growth parameters of *Solanumlycopersicum*L. Using differentbio-fertilizerson 60th day

Treatments	Shoot length (cm)	Root length (cm)	No. of leaves	Fresh weight (gm)	Dry weight (gm)
T_0	55.97 ± 3.38	14.10 ± 0.87	156.67 ± 7.09	91.89 ± 6.61	23.07 ± 1.36
T_1	67.47 ± 3.31	21.83 ± 3.17	193.33 ± 15.50	178 .40 ± 41.73	59.45 ± 13.88
T_2	65.07 ± 3.81	27.07 ± 5.15	201.67 ± 3.21	96.70 ± 2.96	33.11 ± 1.83
T_3	74.20 ± 5.55	27.03 ± 3.32	151.33 ± 15.04	148.11 ± 42.87	49.37 ± 14.29
T_4	72.53 ± 0.97	27.47 ± 1.27	174.67 ± 26.31	132.46 ± 21.01	44.15 ± 7.00
SEd	4.3214	1.3881	12.7523	23.3049	7.7544
Cd (p<0.05)	7.0068	2.2188	28.4141	51.9269	17.2780

Values are mean ± SD of three samples in each group

Yield parameters

Number of fruits

The number of fruits of tomato was calculated on 45th day and 60th day and tabulated (Table 4). On the 45th day, the number of fruits was higher in T_4, but on the 60thday, the number of fruits was found to be higher in T_3 (Phosphobacteria treated plants). This indicates that the phosphate solubilizing bacteria increase the yield of tomato at the later stage of its growth.

Application of higher dosage of inorganic fertilizers along with the bio-fertilizers influenced the growth and yield of onion significantly (Singh *et al*., 2017).

Table 4 Number of fruits of *Solanum lycopersicum* L. on the 45th day and 60th day

Treatments	Number of fruits 45thday	Number of fruits 60th day
T_0	1.00 ±0.17	7.00 ± 2.00
T_1	1.50 ± 0.17	8.33 ± 0.58
T_2	1.50 ± 0.17	6.33 ± 1.15
T_3	2.00 ± 1.41	11.00 ± 1.73
T_4	2.00 ± 0.00	10.33 ± 3.21

Values are mean ± SD of three samples in each group

In the study carried out by Sridevi and Ramakrishnan (2010) on the plant growth and yield of cotton, AM inoculation significantly increased the plant growth and yield of cotton at

all the levels of NPK. The statistical analysis of various growth and biochemical parameters showed significance at 5% level.

Studies on the effect of PSB, *Azospirillum* and *Azotobacter* by Choudhary *et al.* (2017) have indicated that the application of bio-fertilizers not only improves the quality of Knol-Khol, but also gives a maximum monitory benefit. They have concluded that the use of PSB, *Azospirillum* and *Azotobacter* could significantly increase the yield of Knol-Khol and also the net return of the crop. Bio-fertilizers are natural fertilizers containing microorganisms that enhance crop productivity through nitrogen fixation, solubilizing of plant nutrients and produce plant growth regulators. Work done by Kumar *et al*. (2002) has proved that the potato yield could be significantly increased by the application of bio-fertilizer. This study is in accordance with the present study of tomato that showed high yield by the treatment of bio-fertilizer.

References

Choudhary, M., Jat, RK., Chand, P. and Choudhary, R.(2017). Effect of bio-fertilizers on growth, yield and quality of knol-khol.*Journal of Pharmacognosy and Phytochemistry*. 6(6): 2234-2237.

Fruits and vegetables. Nutrition for everyone. *Centres for Disease Control and Prevention. 2015-03-30.*

Ghanti, S. and Sharangi, A.B. (2009). Effect of Bio-fertilizers on Growth, Yield and Quality of Onion cv. Sukhsagar. *Journal of Crop and Weed*. 5(1):120-123.

Kumar, K., Chaurasia, S.N.S. and Singh, G.(2002). Effect of biofertilizers and their methods of inoculation on Growth and Yield of Potato (*Solanumtuberosum* Linn.). *Tropical Agricultural Research*. 14: 368-371.

Mallikarjuna Rao, K. and Singh, P.K. Ryingkhun, H.B.K. and Maying, B. (2014). Use of Bio-Fertilizer in Vegetable Production. *Indian Horticulture Journal*. 4(1): 73-76.

Panse, V.G. and Sukhatme, P.V. (1978). Statistical methods for agricultural workers, 3rdEdn., ICAR, New Delhi, p. 347.

Shankarappa, T.H., Gurumurthy, S.B, Patil, S.V. and Lokesh, M.S. (2012). Influence of phosphorus enriched biogas spent slurry (BSS) on growth and yield of sunflower (*Helianthus annuus*). *Int. J. Pl Sci.*7(2):253-258.

Singh, S.P. (2014). Effect of bio-fertilizer *Azosprillum* on growth and yield parameters of coriander (*Coriandrumsativum L.*) cv. Pant Haritima. *International Journal Seed Spices*. 4(2): 73-76.

Singh, V.K., Amrita Kumari., Chaudhary, V.K. and Shree, S. (2017). Role of Bio-fertilizer and Chemical Fertilizer for Sustainable Onion (*Allium cepa* L.) Production. *International Journal of Current Microbiology and Applied Sciences.* 6(9): 2034-2040.

Sridevi, S. and Ramakrishnan, K. (2010). The Effect of NPK Fertilizer and AM Fungi on the Growth and Yield of Cotton (*Gossypiumhirsutum* L.) *var*. LRA 5166. *Recent Research in Science and* Technology. 2(10): 39-41.

Uma Maheswari, N and Elakkiya, T. (2014). Effect of liquid Biofertilizers on Growth and Yield of V*igna mungo* L. *Int. J. Pharm. Sci. Rev. Res*. 29(2): 42-45.

Veena, S.C, Alagawadi, A.R, Shankarappa, T.H. and Krishnaraj, P.U. (2009). Development of inoculums consortia for improved performance: II. Impact on growth and nutrient uptake of Sorghum (*Sorghum bicolor* L. Moench). *J. Soil Bio Ecol*. 29 (1&2): 52-59.

Venkatech, A., Malika, V., Vanangamudi, K., Ravichandran, V. and Rani., R.S.V. (1998). Impact of biofertilizers on morpho-physiological attributes in pungam (*Pongamiapinnata*) seedling. *Trop, Agric. Res. Extension*1: 7-11.

How to cite this article:

Gayathri V and Malathi R (2018) 'Effect of Different Bio-Fertilizers on the Growth Parameters of *Solanum lycopersicum* L.', *International Journal of Current Advanced Research,* 07(8), pp. 14599-14603.
DOI: http://dx.doi.org/10.24327/ijcar.2018.14603.2653

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