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# Effect of Biofertilizers and Biocontrol Agents on Growth and Yield in off Season Brinjal under Low Cost Polyhouse

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***Authors' contributions***

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## ABSTRACT

An experiment was conducted to determine the combined effect of biofertilizers and biocontrol agents on growth and yield of brinjal (*Solanum melongena* L.) under low cost polyhouse during off season in the experimental polyhouse of the College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Central Agricultural University (CAU), Ranipool, Sikkim, India. The experiment was planned with 3 treatments and six replications viz. $T_1$- Farm Yard Manure 5 kg/m$^2$, $T_2$- FYM 5 kg/m$^2$ + biofertilizer (a mixture of *Azotobactor* + PSB at the rate 10 g/kg FYM each), $T_3$- FYM 5 kg/m$^2$ + biofertilizer + biocontrol agent (a mixture of *Pseudomonas fluorescens* + *Trichoderma* at the rate 5 g/kg FYM each). There was a significant variation in vegetative growth and yield among all the treatments. The maximum plant height (45.62 cm), the number of branches/ plant (11.17) and the number of leaves/ plant (50.05),the number of fruits/ plant (38.9) and fruit yield/ plant (810 g) were observed with treatment $T_3$ which was at par with the treatment $T_2$ and were significantly higher than the treatment $T_1$ receiving FYM singly. Organic manure (FYM) inoculated with biofertilizers may therefore, be recommended for organic brinjal production for cultivation under

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low cost polyhouses in Sikkim (India) and application of biocontrol agents may be limited to areas having some history of occurrence of diseases because it involves an extra production cost in the application of biocontrol agents.

*Keywords: Brinjal; biofertilizers; biocontrol agents and low cost polyhouse.*

## 1. INTRODUCTION

Brinjal or eggplant (*Solanum melongena* L.) is an important solanaceous vegetable crop widely grown in the subtropical and tropical regions of the world. It is of much importance as a warm weather vegetable crop of far East being grown extensively in India, Bangladesh, Pakistan, China and the Philippines. In India, it is one of the most common, popular and principal vegetable crops grown throughout the country. Brinjal occupies 669 thousand ha of total area and produces 12400 thousand MT [1]. In the southern states with mild climatic conditions, its harvest period is prolonged whereas in the northern parts it is shortened. It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year in South India whereas in the hilly regions, it is cultivated only in the summer season.

On the other hand, biofertilizer is a substance which contains living microorganisms when applied to seed, plant root, or soil, colonizes the rhizosphere of the plant and promotes the growth by providing essential nutrients or makes available primary nutrients to the host plant [2]. The use of biofertilizers is beneficial in regenerating the soil health by enriching fertility and fulfilling plant nutrient requirements by supplying the organic nutrients through microorganism and their byproducts [3]. Microorganism in biofertilizer provides three primary nutrients N, P and K through atmospheric nitrogen fixation, phosphorous solubilization, and potash mobilization which have potential to reduce the use of chemical fertilizers to the tune of 50% and increase productivity up to 20% [4-8].

The major constraint in the production of brinjal is the bacterial wilt disease caused by *Ralstonia solanacearum* which constitutes a serious obstacle to the cultivation of the economically important brinjal among other crops, causing total damage of plantations before as well as after bearing fruits [9]. Biological control could have an important role in the management of bacterial wilt [10]. Effective management of bacterial wilt of brinjal by *Pseudomonas fluorescens* in field experiment signifies its potentiality and scope as a plant growth promoting rhizobacteria (PGPR) when formulated using effective substrate carrier and adhesive [9]. But reports on the use of a combination of biocontrol agents and biofertilizers in the quality and quantity production of brinjal are very scanty. *Trichoderma* and *P. fluorescens* are effective against damping off, collar rot and seedling blight diseases of vegetables [11-14].

Sikkim being an organic state, the demand for organic vegetables is very high. Therefore, there is a need to produce vegetables with high quality and yield through an organic mode of farming. Organic farming through the use of a combination of biofertilizers and biocontrol agents along with locally available farm manures (FYM, vermicompost, etc.), not only gives the quality organic produce but also sustains the soil health and environment friendly practices for brinjal cultivation in the terrace farm lands of Sikkim. Keeping above points in view, present investigation has been undertaken to investigate the effect of biofertilizers and biocontrol agents in enhancing growth and yield of brinjal under low cost polyhouse during the winter season.

## 2. METHODS AND MATERIALS

The experiment was conducted during October, 2012 to March, 2013 at the all India Coordinated Research Project on Plasticulture Engineering and Technologies (AICRP on PET) experimental field of College of Agricultural Engineering and Post-Harvest Technology, CAU, Ranipool, Sikkim of India to evaluate the effect of biofertilizers and biocontrol agents in enhancing growth and yield of brinjal as an off season crop under low cost polyhouse. Brinjal being a cross-pollinated crop, bee-hive with bee colony was installed in the polyhouse to enhance pollination. The soil of the experimental site was sandy loam (sand: 62%, silt: 23%, clay: 15%) with pH of 6.2. Organic equivalent dose of recommended NPK (125:100:50 kg/ha) for brinjal as suggested by [15] was considered and manuring doses were calculated based on recommended doses of nitrogen (125 kg/ha) for FYM. The recommended

NPK dosage was found to be equivalent to 5 kg FYM per $m^2$. The experiment was laid out in randomized block design (RBD) with 3 treatments and six replications viz. $T_1$: FYM 5 kg/$m^2$, $T_2$: FYM 5 kg/$m^2$ + biofertilizer (a mixture of *Azotobactor* + PSB @ 10 g/kg FYM each), $T_3$: FYM 5 kg/$m^2$ + biofertilizer (a mixture of *Azotobactor* + PSB @ 10 g/kg FYM each) + biocontrol agent (a mixture of *P. fluorescens* + *Trichoderma* @ 5 g/kg FYM each).

The biological resources [*Trichoderma* (Strain UBT-18), *P. fluorescens* (StrainVPF-1), *Azotobacter* (Strain UBAZ-1) and Phosphate solubilizing bacteria (Strain UBPS-9)] used in the experiment were provided from Department of Plant Pathology, Faculty of Agriculture, UBKV.

The seedlings of brinjal were transplanted on raised beds of 15 cm height with row spacing of 50 cm and seedling spacing of 45 cm in the low cost polyhouse on October 10, 2012. Irrigation was given at two-three days interval depending on weather condition through hand/surface irrigation method. The data were recorded on various growths and yield parameters viz. plant height, number of branches, number of leaves, number of fruits/plant and fruit yield/plant. The data collected for various parameters were subjected to statistical analysis using RBD One Factor SPSS-16 software.

## 3. RESULTS AND DISCUSSION

### 3.1 Effect of Biofertilizers and Biocontrol Agents on Vegetative Growth of Brinjal

At the early stages of plant growth, the variation in vegetative growth among the treatments was insignificant. During the later stages (60 and 90 DAT), the treatments inoculated with biofertilizers alone ($T_2$) and combination of biofertilizers + biocontrol agents ($T_3$) were observed to be varying significantly on vegetative growth of brinjal than the treatment ($T_1$) receiving only FYM equivalent dose of recommended NPK.

The maximum plant height (25.92 cm) and the number of leaves (18.67) were recorded in treatment $T_3$ at 60 DAT which showed performance at par with the treatment $T_2$ and were significantly higher than the treatment $T_1$ receiving FYM alone. At 90 DAT, the maximum plant height (45.62 cm), the number of branches (11.17) and number of leaves (50.05) was observed in treatment $T_3$ which showed performance at par with the treatment $T_2$ and were significantly higher than the treatment $T_1$ receiving FYM alone. Biofertilizers and biocontrol agents were found to be effective in increasing vegetative growth parameters for organic brinjal. Higher vegetative growth in plants treated with biofertilizers and biocontrol agents may be attributed to improvement in plant mineral concentration through better nitrogen fixation caused by biofertilizer application [16], increase in phosphorus uptake by plant caused by phosphate solubilising bacteria [17] and disease protection as well as plant growth-promoting rhizobacteria effects caused by biocontrol agents [18]. Increase in plant height, the number of branches/ plant and number of leaves/ plant due to the application of biofertilizers have also been reported by [19] in tomato, [20] in gherkin. The application of biocontrol agents may have protected the plant from disease incidence by colonizing the rhizosphere of the plant preceding to the occurrence of any harmful disease causing pathogens as beneficial plant growth-promoting rhizobacteria and so enhanced the growth (plant height, number of branches and number of leaves)[21].Similar findings were also reported by [22] and [15] for brinjal.

### 3.2 Effect of Biofertilizers and Bio-control Agents on Yield of Brinjal

The maximum number of fruits/ plant (38.90) and fruit yield/ plant (810 g) was recorded in the treatment $T_3$ which showed performance at par with the treatment $T_2$ and were significantly higher than the treatment $T_1$ receiving FYM alone. Azotobacter may have enhanced the available nitrogen in the soil [18] and the inoculation of phosphate solubilizing microorganisms may have increased plant N and P uptake [23], which led to increasing in yield of brinjal. Increase in thenumber of fruits/ plant and fruit yield/ plant due to the application of biofertilizers have also been reported by [18] in tomato, [24 ] in safflower, [19] in gherkin and [25] in brinjal. Application of biocontrol agents increases the number of fruits/ plant and fruit yield/ plant probably due to its major role as antagonistic endophytic bacteria as well as plant growth-promoting rhizobacteria. Similar findings were also reported by [21,15] for brinjal.

**Table 1. Effect of biofertilizers and biocontrol agents on the growth of brinjal**

| Treatments | 60 DAT* | | | 90 DAT* | | | No. of fruits/ plant | Fruit yield/ plant (g) |
|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | No. of branches/ plant | No. of leaves/ plant | Plant height (cm) | No. of branches/ plant | No. of leaves/ plant | | |
| $T_1$ | 15.96 | 6.00 | 10.26 | 32.76 | 8.74 | 28.94 | 30.80 | 709.20 |
| $T_2$ | 22.23 | 7.10 | 17.45 | 39.87 | 10.26 | 37.56 | 34.00 | 796.70 |
| $T_3$ | 25.92 | 7.73 | 18.67 | 45.62 | 11.17 | 50.05 | 38.90 | 810.00 |
| LSD at 5% | 3.74 | NS | 3.24 | 5.92 | 1.10 | 7.74 | 5.33 | 79.95 |

**DAT: Days after transplanting*

## 4. CONCLUSION

The findings revealed that plant growth and yield of brinjal (local var.) cultivated within the low-cost polyhouse in the mid-hill region of Sikkim have been affected significantly by combined inoculation of biofertilizers (*Azotobactor* + PSB) and bio-control agents (*P.fluorescens* + *Trichoderma*). Yield in plots with inoculated with biofertilizer alone (without bio control agent) was also found to be at par with the corresponding yield in plots with combined inoculation of biofertilizer and biocontrol agents. Thus, it may be concluded that for obtaining optimum plant growth and yield from brinjal, the treatment receiving organic manure (FYM) inoculated with biofertilizers may be recommended as there is no significant difference between the treatment of combined inoculation of biofertilizers + bio-control agents and that of biofertilizers singly. It may be economically viable as because biofertilizer is considered as safer and cheaper fertilizers which have potential to reduce the use of chemical fertilizers, increase productivity and also regenerate the soil health in the long run. Moreover, it may be considered as cost-effective treatment, where there is no chance for the occurrence of diseases as compared to combined treatments because it involves an extra cost in the application of biocontrol agents. However, in places with some history of bacterial wilt or related infestation, biocontrol agents may be suggested along with biofertilizers.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Horticultural statistics at a glance horticulture. Statistics Division Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India; 2017.
2. Weyens N, Van der Lelie D, Taghavi S, Newman L, Vangronsveld J. Exploiting Plant-Microbe Partnerships to Improve Biomass Production and Remediation. Trends in Biotechnology. 2009;27(10): 591-598.
3. Dotaniya ML, Mishra A, Dotaniya CK, Regar KL, Manju L. Role of Biofertilizers in Conservation Agriculture; 2016. 10.1007/978-981-10-2558-7_4.
4. Sabalpara AN, Panda JR, Mahatma L. Use of beneficial microbes in agriculture. National Seminar on Role of Organic Farming in Climate Resilient and Sustainable Agriculture. 2014;75.
5. Hridya AC, Byju G, Misra RS. Effect of biocontrol agents and biofertilizers on root rot, yield, harvest index and nutrient uptake of cassava (*Manihot esculanta* Crantz), Archives of Agronomy and Soil Science. 2013;59(9):1215-1227. DOI: 10.1080/03650340.2012.702896.
6. Biswas JC, Ladha JK, Dazzo FB. *Rhizobia* inoculation improves nutrient uptake and growth of lowland rice. Soil Science Society of America Journal. 2000; 64:1644–1650.
7. Farzana Y, Radizah O. Influence of rhizobacterial inoculation on growth of the sweet potato cultivar. Journal of Biological Science. 2005;1(3):176–179.
8. Mosa WFAE, SasPaszt L, Frąc M, Trzciński P, Przybył M, Treder W, Klamkowski K. The influence of biofertilization on the growth, yield and fruit quality of “Topaz” apple trees. Horticulture Science. (inpress); 2016. Available:http://www.agriculturejournals.cz/web/hortsci.htm?type=article&id=154_2015-HORTSCI, 2016.04.10.

9. Chakravarty G, Kalita MC. Comparative evaluation of organic formulations of *Pseudomonas fluorescens* based biopesticides and their application in the management of bacterial wilt of brinjal (*Solanum melongena* L.). African Journal of Biotechnology. 2011;10(37): 7174-7182.
10. Akiew E, Trevorrow PR, Tonells PE. Management of bacterial wilt of tobacco. In: Bacterial wilt. Hartman GL and Hayward AC (Eds.). ACIAR Proceedings. Australian Centre Int. Agricultural Res. Camera. 1993;45:270-275.
11. Prakasam V, Sharma P. Trichoderma harzianum (Th-3) A potential strain to manage the purpleblotch of onion (*Allium cepa* L.) caused by *Alternaria porriunder* North Indian plains. Journal of Agricultural Science. 2012;10:266-27.
12. Jadon KS. Eco-friendly management of brinjal collar rot caused by Sclerotium rolfsii Sacc. Indian Phytopath. 2009;62(3): 345-347.
13. Khalid EE. Biological control of bean damping-off caused by *Sclerotium rolfsii*. Research Gate. 2013; 9:1-11.
14. Singh R, Singh PP, Singh V. Integrated management of collar rot of *Amorphophallus paeoniifolius* blume caused by *Sclerotium rolfsii Saccardo*. Vegetable Science. 2006;33(1):45-49.
15. Harish DK, Agasimani AD, Imamsaheb SJ, Patil SS. Growth and yield parameters in brinjal as influenced by organic nutrient management and plant protection conditions. Research Journal of Agricultural Sciences. 2011;2(2): 221-225.
16. Samah YAE. Effect of biofertilizer on yield and berry qualities of grapevines. M. Sc. Thesis. Fac. Agric., Mansoura Univ., Egypt; 2002. (In print).
17. Singh C, Sharma, BB. Leaf nutrient composition of sweet orange as affected by combined use of bio and chemical fertilizers. South Indian Horticulture. 1993; 41:131-134.
18. Grover MI, Nain L, Saxena A. Comparison between Bacillus subtilis RP24 and its antibiotic-defective mutants. World Journal of Microbiology and Biotechnology. 2009; 25:1329-1335.
19. Ramakrishnan K, Selvakumar G. Effect of biofertilizers on enhancement of growth and yield on Tomato (*Lycopersicum esculentum* Mill.). International Journal of Research in Botany; 2012.
20. Bindiya Y, Srihari D, Babu JD. Effect of organic manures and biofertilizers on growth, yield and nutrient uptake in gherkin (*Cucumis anguria* L.). Journal Research Angrau. 2012;40(1):26-29.
21. Dashti NH, Ali NY, Cherian VM, Montasser MS. Application of plant growth-promoting rhizobacteria (PGPR) in combination with a mild strain of Cucumber mosaic virus (CMV) associated with viral satellite RNAs to enhance growth and protection against a virulent strain of CMV in tomato. Canadian Journal of Plant Pathology. 2012;34(2):177-186.
22. Ramesh R, Joshi AA, Ghanekar MP. Pseudomonads: Major antagonistic endophytic bacteria to suppress bacterial wilt pathogen, *Ralstonia solanacearum* in the eggplant (*Solanum melongena* L.). World Journal of Microbiology and Biotechnology. 2009; 25(1): 47-55.
23. Sharma SP, Brar JS. Nutritional Requirements of Brinjal (*Solanum melongena* L.) – A review. Regional Station, PAU, Bathinda-151001, India. Agricultural Review. 2008;29(2):79-88.
24. Mirzakhani M, Ardakani MR, Aeene BA, Rejali F, Shirani RAH. Response of spring safflower to co-inoculation with *Azotobacterchroococum* and Glomusintrar adices under different levels of nitrogen and phosphourus. American Journal of Agricultural and Biological Sciences. 2009; 4:255-261.
DOI: 10.3844/ajabssp.2009.255.261.
25. Nanthakumar S, Veeraraghavathatham D. Effect of integrated nutrient management on growth parameters and yield of brinjal (*Solanum melongena*L.) cv. PLR-1. South Indian Horticulture. 2000;48(1-6):31-35.




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