Original Research Article

EFFECT OF BIOFERTILIZERS AND BIOCONTROL AGENTS IN ENHANCING GROWTH AND YIELD OF BRINJAL UNDER LOW COST NATURALLY VENTILATED POLYHOUSE DURING OFF SEASON

ABSTRACT

An experiment was conducted to study the combined effect of biofertilizers and biocontrol agents on growth and yield of brinjal under naturally ventilated 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. The experiment was planned with 3 treatments and sixreplication 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 + biocontrol agent (a mixture of *Pseudomonas fluorescens* + *Trichoderma* @ 5 g/kg FYM each). There was significant variation in vegetative growth and yield among all the treatments. The maximum plant height (45.62 cm), number of branches/ plant (11.17) and number of leaves/ plant (50.05),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 cultivation for cultivation under naturally ventilated polyhouses in Sikkim (India) and application of biocontrol agents may be limited to areas having some history of occurrence of diseases.

Key words: *Brinjal, biofertilizers, biocontrol agents and naturally ventilated 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 MT2)[1]. In the southern states with mild climatic conditions its bearing 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 whereas in the hilly regions, it is cultivated only in summer season.

Biofertilizer is a substance which contains living microorganisms which, when applied to seed, plant root, or soil, colonizes the rhizosphere of the plant and promotes the growth by providing essential nutrients or make 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 the productivity upto 20% [4].

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 [5]. Biological control could have an important role in the management of bacterial wilt [6]. Effective management of bacterial wilt of brinjal by *P. fluorescens* in field experiment signifies its potentiality and scope as a plant growth promoting rhizobacteria (PGPR) when formulated using effective substrate carrier and adhesive [5]. 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 *Pseudomonas fluorescens* are effective against damping off, collar rot and seedling blight diseases of vegetables [7][8][9][10].

Sikkim being an organic state, the demand of organic vegetables is very high. Therefore, there is a need to produce qualitative and quantitative vegetables through 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 naturally ventilated polyhouse (NVP) during the winter season.

2. METHODS AND MATERIALS

An 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 PostHarvest Technology, CAU, Ranipool, Sikkim to evaluate the effect of biofertilizers and biocontrol agents in enhancing growth and yield of brinjal as an offseason crop under low cost naturally ventilated 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 [11]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 5kg/m^2, T_2:FYM 5kg/m^2 + biofertilizer (a mixture of *Azotobacter* + PSB @ 10g/kg FYM each), T_3:FYM 5kg/m^2 + biofertilizer (a mixture of *Azotobacter* + PSB @ 10g/kg FYM each) + biocontrol agent (a mixture of *Pseudomonas fluorescens* + *Trichoderma* @ 5g/kg FYM each).

The biological resources [*Trichoderma* (Strain UBT-18), *Pseudomonas fluorescens* (Strain VPF-1), *Azotobacter*(Strain UBAZ-1) *and* Phosphate solubilizing bacteria (Strain UBPS-9)] used in the experiment were collected 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 NVP on October 10, 2012. 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. Result and Discussion

3.1.Effect of Biofertilizers and Bio-control Agents on Vegetative Growth of Brinjal

At early stages of crop 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 + bio-control 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.

Table 1: Effect of biofertilizers and biocontrol agents on growth of brinjal

Treatment	60 DAT*			90 DAT*			No. of fruits/ plant	Fruit yield/ plant (g)
	Plant height (cm)	No. of branches	No. of leaves	Plant height (cm)	No. of branches	No. of leaves		
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

The maximum plant height (25.92 cm) and number of leaves (18.67) were recorded with treatment T_3 at 60 DAT which shows 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), number of branches (11.17) and number of leaves (50.05) was observed with treatment T_3 which show performance at par with the treatment T_2 and were significantly higher than the treatment T_1receiving FYM alone. Biofertilizers and bio control 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[12], increase in phosphorus uptake by plant caused by phosphate solubilising bacteria[13] and disease protection as well as plant growth-promoting rhizobacteria caused by biocontrol agents[14]. Increase in plant height, number of branches/ plant and number of leaves/ plant due to application of biofertilizers have also been reported by [15]in tomato, [16]in gherkin. The application of biocontrol agents may have protected the plant from disease incidence by colonizing the rhizosphere of the plant preceding to 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)[17].Similar findings were also reported by[18]and [11]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 with 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 [14] and the inoculation of phosphate solublizing microorganisms may have increased plant N and P uptake[19], which led to increase in yield of brinjal. Increase in number of fruits/ plant and fruit yield/ plant due to the application of biofertilizers have also been reported by [14] in tomato, [20] in safflower, [15] in gherkin and [21] 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 [17] [11]for brinjal.

4. CONCLUSION

The findings in this study revealed that plant growth and yield of brinjal (local var.) cultivated within the low cost NVP in the mid hill region of Sikkim have been affected significantly by combined inoculation of biofertilizers (*Azotobactor* + PSB) and bio-control agents (*Pseudomonas fluorescens* + *Trichoderma*). Yield in plots with inoculation of biofertiliser alone (without bio control agent) was also found to be at par with the corresponding yield in plots with combined inoculation of biofertilizer and bio control 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. Moreover, it may be considered as cost effective treatment, where there is no chance for occurrence of diseases as compared to combined treatments because it involves extra cost in application of biocontrol agents. However, in places with some history of bacterial wilt or related infestation, biocontrol agents may be used along with biofertilizers.

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