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Effect of a Consortium of Phosphate Solubilizing Bacteria and *Tricoderma* Spp. on Yield Contributing Traits of Bell pepper (*Capsicum annum* L.)

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Abstract

The effect of combination (consortium) of Phosphate solubilizing bacteria and *Tricoderma* spp. on yield contributing traits of Chili (*Capsicun annum* L.)were studied.This experiment was conducted in a polyhouse during the year 2019-20 at Krushi Vigyan Farm, Bhende.All agronomic practices were kept same for control and treated plants.The morphological parameters of chili plants was recorded. It was found that, all vegetative and reproductive parameters of chiliwas enhanced. The parameters were studied such as height (cm) 29.64%, number of branches 49.26% ,length of leaf (cm) 5%, length of petiole (cm) 13.38%,breadth of leaf (cm) 16.58%, number of fruits 35.98% and weight (g)of fruits 87.64% increased over control.

Key words: Consortium of *Tricoderma*;.Phosphate solubilizing Bacteria;Chili;

Introduction

Chilli (*Capsicum annum* L.) is an important spice cum vegetable crop(family Solanaceae)commonly known as Bell pepper,sweet pepper, hot pepper or paprikacapsicum, green pepper or Shimla-mirch has becomeone of the high value vegetable crops in India because of its delicacy and pleasant flavor coupled with rich content of ascorbic acid, vitamins and minerals (Sreedhara *et al*., 2013). Chilli cultivation has existed for several hundred years as a sustainable form of agriculture in India and in many other countries. It is an annual herbaceous vegetable and spice grown in both tropical and sub-tropical regions. In India, bell pepper is cultivated in an area of 30000 ha with a production of 171000 MT (NHB, 2015) [2]. In Himachal Pradesh, it is an important summer and rainy season crop which covers an area of 2070 ha and having production of 34130 MT (NHB, 2014) and has about 50% share in the country's area and

production. India accounts for 25% of the world's total production of chili (Ashwini and Srividya, 2014). In order to meet the demand of increasing human population, large amounts yields are expected.For this, large amount of synthetic fertilizers have been used but leading to detrimental environmental effects.

Trichoderma, a filamentous soil inhabiting myco-parasite, is used in a commercial preparation for biological control of many fungal plant pathogens (Jash, 2006).

Pathogens could be controlled through antibiosis, competition for nutrients or space, tolerance to stress through enhanced root and plant development, induced resistance, solubilization and sequestration of inorganic nutrients and inactivation of pathogen enzymes (Harman, 2000).

However, with the increasing interest in biological control, owing to environmental and economic concerns, and with the rapid development of biotechnology, several *Trichoderma* species were formulated in a commercial production for protection and growth enhancement of crops in several countries (McSpadden and Fravel, 2002).

The effect of *Trichoderma* isolates on plant growth and development is important, especially improvement of plant vigor to overcome biotic and/or abiotic stresses results in the production of stronger plants and increase in plant productivity and yields (Bull, 2002).

Trichoderma species are commonly used as biological control agents against phytopathogenic fungi and some isolates are able to improve plant growth (Kumar *et al*, 2019).

Trichoderma being a soil fungus, its growth, multiplication and eventually its biocontrol potentials is highly affected by various physical, chemical and biological soil properties. They are reported to be affected by factors like soil pH, soil temperature and moisture level, water potential and most importantly by the activities of the native antagonistic microflora which is present in the soil where they are applied as biocontrol agents.In addition, *Trichoderma* species are well-organized biocontrol agents that are used to prevent development of several soil pathogenic fungi.

Plant growth promoting *rhizobacteria* (PGPR) are naturally occurring soil bacteria that aggressively colonize plant roots and benefit plants by providing growth promotion and disease suppression. The PGPR have been demonstrated to increase growth and productivity of many commercial crops (Saharan and Nehra, 2011).

Different mechanisms have been suggested as being responsible for their biocontrol activity, which include competition for space and nutrients, secretion of chitinolytic enzymes, mycoparasitism and production of inhibitory compounds. The antagonistic fungus like *Trichoderma harzianum* has shown a promising biocontrol measure of fungal pathogen viz.*Rhizoctonia solani* in chili (Bunker and Mathur, 2001).

It is highly desirable to reduce the use of synthetic chemical fertilizers.They are not economical in the long run. Theyleave harmful residues causing environmental pollutionin the soil. Therefore, screening of *Trichoderma* isolates is beneficial in enhancing crop growth and development.

Hence, information on plant growth promotion activity of different isolates of *Trichoderma*, PSB, in the form of consortium *is* an important aspect of this research not only for coping up with diseases but also to reduce application of synthetic fertilizers and enhancing crop growth and yield in an eco-friendly manner.

Material and Methods

The *Trichoderma* spp. was isolated from sugarcane cuttingsfrom sugarcane field during winter by serial dilution method on PDA medium. Simultaneously the phosphate solubilizing bacteria (PSB) were also isolated from soil of sugarcane field,on Pikovasky's medium. The culture was further purified by plate streaking method.

The pure isolates of *Trichoderma*and PSB strain were inoculated on Pikovasky's liquid broth for 5 days on shaker at 120 rpm. The colony numbers were recorded by serial dilution method. $10x10^8$ cfu ofphosphate solubilizingbacteria and $18x10^8$ cfu of *Trichoderma*as consortium. This consortium was used for treatment.

The Capsicum plants were grown in a polyhouse. The drenching of consortia were done at 1%solution 50 ml per plant at the time of planting and during branching and 2 doses of foliar spray 7ml /lit with 30 days interval was given. All the Agronomic practices were kept same.Morphological parameters of the plants viz. height, number of branches, number of fruits weight offruit were measured after at 60 DAS. (ReferTable.1 and Plate 1.)

Table 1:Effect of Phosphate Solublizing Bacteria and *Tricoderma* Spp.: A Consortium on yield contributing traits of Bell pepper (*Capsicum annum* L.)

Sr. No	Parameters	Treatment	Control	P-value at 0.05%	CD at 0.05%
1	Height of plant (cm)	143.45 ±0.44 (29.64)	110.65 ±0.35	5.39E-22	0.48
2	No. of Branches	30.30 ±0.36 (49.26)	20.30 ±0.55	1.34E-11	0.58
3	Length of Leaf (cm)	23.53 ±0.21 (5.00)	22.41 ±0.054	7.57E-05	0.19
4	Length of Petiole (cm)	9.15 ±0.04 (13.38)	8.07 ±0.02	4.84E-15	0.04
5	Breadth of Leaf (cm)	8.51 ±0.03 (16.58)	7.30 ±0.03	2.62E-17	0.03
6	No. of Fruits	25.70 ±0.15 (35.98)	18.90 ±0.27	2.75E-14	0.27
7	Weight of Fruit (g)	39.63 ±0.12 (87.64)	21.12 ±0.01	3.15E-28	0.11

Data presented are means of ten readings. Data was analysed using Single factor ANOVA test Followed by CD & Tukey's test. [Figures in parentheses indicate % increase (+) over control; ±: standard error of mean; CD: critical difference; P-value: alpha value at 0.05%.

Graph 1: Effect of Phosphate Solublizing Bacteria and Tricoderma Spp

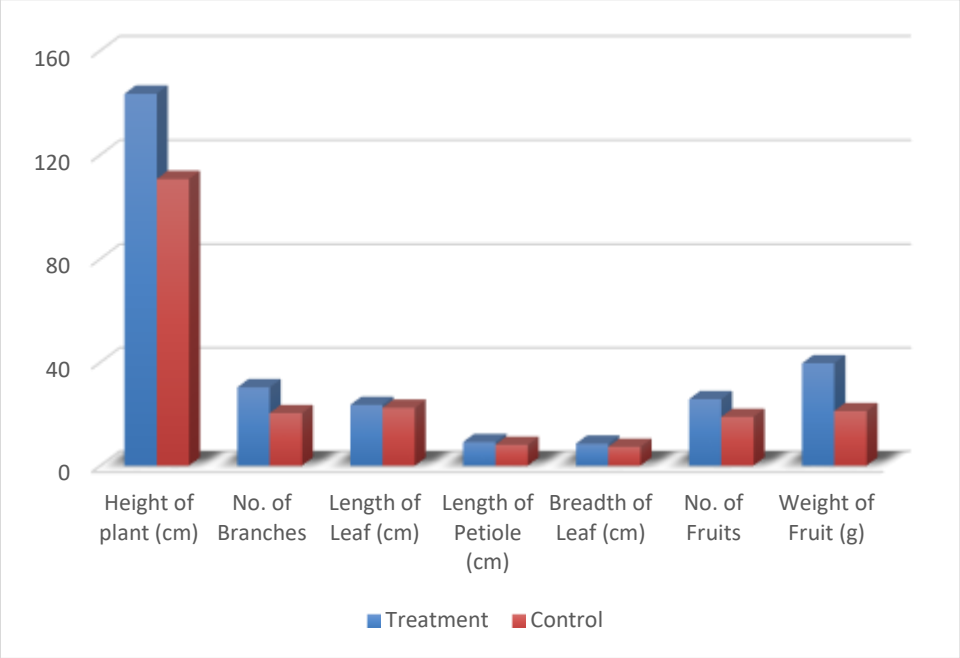

Plate I:Effect of Phosphate Solubilizing Bacteria and *Tricoderma* Spp.: A Consortium on yield contributing traits of Bell pepper (*Capsicum annum* L.)

Observations

It was recorded that, in polyhouse experiment the soil application (Drenching) of consortia of Phosphate Solubilizing Bacteria and *Tricoderma* increased yield contributing traits of Chilli.It was recordedthat, drenching and foliar spray of consortia increased the plant Height (29.64% over control), No. of Branches (49.26% over control), Length of Leaf (5.00% over control), Length of petiole (13.38 % over control), No. of Fruits(35.98% over control), Wt. of Fruit(87.64 over control) (refertable No1).

Summary andConclusion

The effect of combination (consortium) of Phosphate solubilizing bacteria and *Tricoderma* spp. on yield contributing traits of Chili (*Capsicun annum* L.)were studied. Consortium of Phosphate solubilizing Bacteria and *Tricoderma* Spp. increased morphological parameters (yield contributing traits)of Bell pepper (*Capsicum annum* L.).Height and number of branches were more affected in comparison to leaf and petiole length. Enhancement in the weight of fruits (yield) was recorded (87.64% increased over control). Combination (consortium) of PSB and *Trichoderma* species thus found useful in increasing yield of fruits of *Capsicum annum*L.

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