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BIO EFFICACY STUDIES OF TAEGRO (*BACILLUS SUBTILIS*) ON ROOT ROT INCIDENCE, GROWTH AND YIELD ATTRIBUTING CHARACTERS

Harit Kumar *et al.,*

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HARIT KUMAR*, ANAND KUMAR SINGH, B. V. RAJKUMAR, VAIBHAV SINGH AND BHAGAT SINGH
Department of Horticulture,
Institute of Agricultural Sciences, B.H.U-Varanasi
e-mail: harit_26june@live.com

ABSTRACT

A study was carried out to evaluate the efficiency of bio-control agents for controlling root-rot and wilting diseases of chilli. The results showed that Taegro (*Bacillus subtilis*) was found to be best for controlling *Rhizoctoniasolani, Sclerotiumrolfsii*and *Fusarium oxysporum* among bio agents used and it is significantly at par with chemical treatments. The seed dressing of chilli and soil drenching with bio-control agents gave the lowest records of disease severity of chilli, while, seed soaking only gave the highest records. Generally, it could be recommended that the application of bio-control agents for chilli at sowing was more efficient for controlling of fungal soil borne diseases fungi. Application of such inoculum minimizes the hazard effects of fungicides, protect the environment from pollution and maintenance of the human health.

*Corresponding author

INTRODUCTION

Chilli (*Capsicum annum*) is one of the most important vegetable and spice crop in India. It is well known that, several fungal diseases attack chilli plants during all stages of growth causing a considerable reduction in both yield quality and quantity. Damping-off, root rots and wilting are among the important diseases. Root rot pathogens such as *Rhizoctoniasolani* and *Sclerotiumrolfsii* attack the roots and stem base of chilli (AbdEl-Wahab, 2004 and Morsy, 2005).

Both *Rhizoctonia solani* and *Sclerotiumrolfsii* were causing high damage in chilli cultivations. Fusarium wilting was among the most deleterious diseases of chilli seedlings either in the nurseries or in fields after transplanting. It was widely spread in many parts of the world. Biological control had attracted the interest because of increasing regulation and restriction of pesticides or unsuccessful control attempts by other means. Biological control for soil-borne pathogens by antagonistic microorganisms is potential especially for soil-borne diseases because these pathogens are difficult to be controlled with specific fungicides (Moussa *et al.*, 2006 and 2007, Seetharamulu and Umamaheshwari, 2012). The excessive use of broad spectrum or persistent chemicals might results in soil contamination, fungicidal resistance or other harmful effects. Biological control was usually more enduring with no toxic residue in nature's food chains, safe for application and cheaper in cost. The present investigation was conducted to evaluate the effect of bio-control agents (fungi and bacteria) on controlling root- rot and wilting diseases of chilli.

MATERIALS AND METHODS

Field Experiment

The experiment was carried out in the Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) during the year 2013-2014. A very promising and having high yield variety of chilli PusaJwala was selected for the present experimentation. The plants received uniform cultural operations throughout the experimental period and the whole of the experiment field was kept clean. The following treatments were investigated.

Time of application

T_1: Seeds of chilli are treated prior to sowing.

T_2: The seedlings are treated with the Taegro @ 4g/l by dipping the plants into the solution for 15 minutes prior to transplanting.

T_3: The treatment T_3 consists of 3 application out of which first one is given before the nursery sowing as seed treatment the second application is given after 15 days of transplanting to main field and the 3 application is given at 30 days after transplanting to the plants through foliar spray of Taegro @ 250g/ha.

T_4: The treatment T_4 consists of 3 application out of which first one is given before the nursery sowing as seed treatment the second application is given after 15 days of transplanting to main field and the 3 application is given at 30 days after transplanting to the plants through foliar spray of Taegro @ 500g/ha.

T_5: The treatment T_5 consists of 3 application out of which first one is given at the time of transplanting the second application is given after 15 days of transplanting to main field and the 3 application is given at 30 days after transplanting to the plants through foliar spray of Taegro @ 250g/ha.

T_6: The treatment T_6 consists of 3 application out of which first one is given at the time of transplanting the second application is given after 15 days of transplanting to main field and the 3 application is given at 30 days after transplanting to the plants through foliar spray of Taegro @ 500g/ha.

T_7: The treatment T_7 consist of 3 application out of which first one is given at the time of transplanting the second application is given after 15 days of transplanting to main field and the 3 application is given at 30 days after transplanting to the plants through foliar spray of Dithane M-45@ 300g/ha.

T_8: The treatment T_8 consist of biological control in which the *Trichoderma* is applied to the soil @ 2.8kg/ha prior to transplanting of plants to the main field.

T_9: The treatment T_9 is under untreated control therefore no biological or chemical fungicide is applied to the plants.

Observations recorded

Disease Incidence and Disease severity

Soil borne diseases: Root rot.

The observations have to be taken by taking out the percentage of plants infected from the disease in each plot of each treatment under different replications. The disease severity percentage was then calculated as the summed value in each class and then taking out the mean value from the recorded data. The per cent disease incidence was calculated by using the following formula. The coefficient of infection

$$\text{Per cent Disease incidence} = \frac{\text{Number of plants affected}}{\text{Total number of plants observed}} \times 100$$

Plant growth characters

Plant height (cm)

No. of branches per plant

Yield and Yield parameters

Fruit length (mm) and Fruit width (mm)

Av. fruit weight (g)

Fruit yield (kg)

Statistical analysis

The observations recorded during course of investigation were subjected to statistical analysis by adopting appropriate Model "Analysis of variance". According to the procedure described by (Panse and Sukhatme, 1985). Critical difference (CD) with in the treatment was calculated in order to compare the treatment at 5% level of Significance only.

RESULTS AND DISCUSSION

Soil borne diseases

Among the different soil borne diseases listed for bio-efficacy studies, the occurrence of root rot have been seen and an attempt was made to manage root rot of chilli caused by *Sclerotiumrolfsii* by utilizing bio-fungicide Taegro, as earlier explained in the material and methods. There was no incidence found for *Fusarium* and *Rhizoctonia*. The results obtained have been presented in Table. The results from table revealed that there was significant wilting percentage in different treatment combinations tested. T_7 recorded the least per cent wilted plants (6.67%) and was found to be significantly superior over the rest of the treatments tested. This was followed by T_6 producing 7.78 per cent wilted plants. Next best treatments were T_5, $T_3$and T_4, recorded with 12.22, 14.44 and 15.56 per cent wilted plants respectively, whereas the highest per cent wilted plants were recorded in control T_9 (24.44%) which was at par with T_1 (23.33%). Good rhizosphere competence might had resulted in significantly lower disease incidence, increased seed germination and dry mass production (Muthukumar*et al.*, 2007; Sarkar and Chaudhuri, 2013; Rajan *et al.*, 2013).

Plant growth characters

Plant height (cm)

The highest plant height was found to be in treatment T_3 with 103.20cm height which is significantly superior over other treatments. The treatments T_4 and T_5 remains at par among themselves with 93.67 cm and 93.20 cm plant height. The lowest plant height was found was under T_8 having 87.60cm plant height. (Xiang-Zhen *et al.*, 2011)

No. of branches per plant

The number of branches remains non-significant among all the treatments. The highest number of branches seen under treatment T_7 and T_4 having 3.33 number of branches. The lowest number of branches was recorded under T_2, treatment T_5, T_6 and T_9 remains at par among themselves with 2.93 numbers of branches. (Sarkar and Chaudhuri, 2013; Xiang-Zhen *et al.*, 2011)

Yield and Yield parameters

Fruit length (mm) and Fruit width (mm)

The highest length and width of fruits have been achieved by employing T_7 treatment which gives out the fruit with an average value of 99.11 mm length and 9.98 mm of width, which is followed by T_6 having 95.38 mm length and 9.84 mm width. The lowest growth in length and width of fruits was seen in control having 72.65 mm length and 7.50 mm width. (Muthukumar *et al.*, 2007)

Av. fruit weight (g)

Significantly higher fruit weight (4.55 g) has been recorded with T_7 treatment followed by T_6 (4.35 g) and least being in control (2.94 g). (Muthukumar *et al.*, 2007; Sarkar and Chaudhuri, 2013)

Fruit yield (kg)

The maximum fruit yield (36511.40 g) has been achieved by employing T_7 which was found significantly superior over T_8 and T_1. The treatment T_6 found to have fruit yield of 32088.00 g. (Sarkar and Chaudhuri, 2013).

Inoculating bio agents might had effected soil microbial diversity to some degree and the soil microbial diversity resulting

Table 1: Bio efficacy studies of Taegro (*Bacillus subtilis*) on root rot incidence, growth and yield attributing characters

Treatments	Root rot (%)	Av.Plant height (cm)	No. of branches per plant	Av. Fruit width(mm)	Av. Fruit length(mm)	Av. Fruit weight(g)	Fruit yield (g/10.8m^2)
T_1 Seed treatment @ 4g/kg seed	23.33	90.33	2.67	7.68	77.25	3.41	21250.13
T_2 Seedling dip only@ 4g/lt. water (dip for 15 mins)	16.67	95.73	2.53	8.38	79.11	3.56	25050.80
T_3 Seed treatment@ 4g/kg seed + 2nd& 3rd application. @ 250g/ha each.	14.44	103.20	3.00	8.78	83.47	3.66	22609.63
T_4 Seed treatment@4g/lt. water + 2nd& 3rd application. @ 500g/ha each.	15.56	102.40	3.33	9.10	85.55	3.74	24309.40
T_5 Soil & foliar drench @ 250g/ha (3 applications)	12.22	93.67	2.93	9.36	86.91	3.94	26759.07
T_6 Soil & foliar drench @ 500g/ha (3 applications)	7.78	93.20	2.93	9.84	95.38	4.35	32088.00
T_7 Standard Chemical control (Diethane M 45)	6.67	90.73	3.33	9.98	99.11	4.55	36511.40
T_8 Biological Control (*Trichoderma*)	22.22	87.60	2.80	7.88	76.79	3.09	21984.60
T_9 Untreated (control)	24.44	91.33	2.93	7.50	72.65	2.94	23861.40
SE(d)	1.24	1.85	0.45	0.09	1.67	0.05	1545.25
CD at 5%	3.67	5.47	1.33	0.27	4.94	0.16	4573.76

in good growth parameters higher yields (Xiang-Zhen *et al.*, 2011, Yadav and Raghuraman, 2014).

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