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EFFICACY OF INDIGENOUS *Trichoderma* STRAIN ON FOOT ROT OF TOMATO SEEDLINGS INDUCED BY *Rhizoctonia solani* UNDER GREENHOUSE CONDITIONS

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ABSTRACT

Islam MM, Akter A, Hossain MD (2016) Efficacy of indigenous *Trichoderma* strain on foot rot of tomato seedlings induced by *Rhizoctonia solani* under greenhouse conditions. *Int. J. Sustain. Crop Prod.* 11(3), 8-11.

Tomato (*Solanum lycopersicum*) is one of the important crops among all the vegetables and very popular vegetable in Bangladesh. As the pathogen, *R. solani* is a soil borne pathogen and prefers damp, especially water logged conditions, the incidence of foot rot has been found more and causes a great economic loss every year in all tomato growing areas. We evaluated three *Trichoderma* isolates (*T. harzianum* TR05, *T. virens* TR06 and *T. asperellum* TR08) originating from Bangladesh as potential biological control agents against foot rot of tomato under greenhouse conditions. After seed treatment with TR05, there was a lower disease incidence (5.79%) of foot rot of tomato seedlings than for the other isolates, and the germination percentage of the tomato seedlings was also highest (89.7%). The other growth parameters were also promoted by inoculation with the *Trichoderma* isolates; particularly TR05 showed statistically higher root length (13.5 cm), shoot length (12.7 cm), dry weight (5.40 g) and seedling vigour index (2532.4). Thus, TR05 has potential as biological control agents against foot rot in tomato seedlings.

Key words: *trichoderma, rhizoctonia solani, tomato, foot rot, seed treatment*

INTRODUCTION

The pathogen, *Rhizoctonia solani* is occurs in tropical and sub-tropical zone of the world where high temperature prevails. The pathogen attacks economically important plants including vegetables, ornamental, cereals, field crops and weeds. Some of the common hosts include legumes, crucifers, tomato, pulse, peanuts and tobacco in which the pathogen causes foot rot or root rot (Anahosur 2001). The infected plant shows rot of tissue, dark sunken lesions and girdle the stems adjacent to soil level termed as collar region causing death by disrupting the translocation of food from top to root as well as by breaking at the point of infection. As a result, the pathogen causes a great economic loss in various crops. As the pathogen *R. solani*, is a ubiquitous, cosmopolitan saprophyte & being poly phages, it appears every year in all tomato growing regions of Bangladesh. Because of *R. solani* is chiefly a seed-bed disease; young and tender plants infected in the seed bed and carry the disease to the field. As a result, the plants may be attacked at any age. Under favorable conditions of the disease, it may outbreak in epiphytotic forms. As a result, it affects yield and quality or cause total failure of the crop incurring substantial losses to the economy of the country. Moreover, Tomato (*Solanum lycopersicum*) is one of the important crop among all the vegetables and very popular vegetable crop of Bangladesh. As the pathogen, *R. solani* is a soil borne pathogen and prefers damp, especially water logged conditions (Fakir 2000), the low laying areas during summer season of Bangladesh, the incidence of foot rot has been found more (Babar 1999). Therefore, control of this disease is very important. Various methods have been investigated for controlling *R. solani*, including chemical controls, cultural practices, resistant variety use, plant extracts, plant volatile compounds and biological control. Although chemical control is an important method for eradication of the pathogen in severe attack, it is not economical in the long term because it pollutes the atmosphere, damages the environment, leaves harmful residues and can lead to development of resistant strains among the target organisms with repeated use (Naseby *et al*. 2000). Biological control is an alternative to control the pathogen at low cost and to restore soil fertility without disturbing other components of the environment.

Among the hundreds of organisms identified as potential biocontrol agents, only a few have been commercially acceptable to control *R. solani* (Warrior *et al*. 2002). In our previous study, we obtained three *Trichoderma* isolates, *T. harzianum* TR05, *T. virens* TR06 and *T. asperellum* TR08, from different locations in Bangladesh, which have potential as effective biocontrol agents against *R. solani* according to *in vitro* investigations (Islam *et al*. 2016). Their abilities to produce extracellular hydrolytic enzymes, including chitinase, β-1,3-glucanase and proteinase were also confirmed. The present study aimed to evaluate the effectiveness of these native *Trichoderma* isolates against *R. solani* on tomato seedlings under greenhouse conditions after seed treatments.

MATERIALS AND METHODS

Fungal strains

Three strains (*T. harzianum* TR05, *T. virens* TR06 and *T. asperellum* TR08) isolated from various regions of Bangladesh during 2012–2013 (Islam *et al*. 2016) were used in this study. As a pathogen, *Rhizoctonia solani* MAFF241953 obtained from the National Institute of Agrobiological Sciences, Japan, was used after its pathogenicity was confirmed by artificial inoculations on tomato seedlings.

Seed treatment

The effectiveness of the three *Trichoderma* strains against *R. solani* MAFF241953 on tomato seedlings was examined in a greenhouse following seed treatments. Inoculation of the *Trichoderma* strains and *R. solani* MAFF241953 were conducted according to the following combinations: SE_0 = Control, SE_1 = TR05 + pathogen, SE_2 = TR06 + pathogen, SE_3 = TR08 + pathogen and SE_4 = only pathogen. There were three replications per treatment.

First, a 12-d-old PDA-grown culture of each isolate was blended with sterile deionized water and a 30-ml fungal suspension was prepared. Spore density in the suspension was 7×10^8 spore/ml, determined by a haemocytometer under a light microscope. Tomato seeds were sterilized in a 1% sodium hypochlorite solution for 3 min and rinsed thoroughly in sterile distilled water. Inoculation with the *Trichoderma* strain was then performed by dipping seeds in the fungal suspension for 30 min. Control seeds were soaked in an equal volume of deionized water. The treated and control seeds were directly sown into trays (12″× 8″× 3″) filled with autoclaved commercial culture soil (0.8 kg/tray) at the rate of 50 seeds per tray.

R. solani MAFF241953 established on corn meal in a conical flask was applied to the trays at the rate of 5 g/kg-soil at 7 d before seed sowing. Trays were placed on a bench in a greenhouse. For 2 weeks after sowing, seedling emergence was monitored to determine effectiveness of the *Trichoderma* treatments on germination.

The percent disease incidence was determined 4 weeks after sowing using the following formula: Disease incidence (%) = $\frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$. The tomato seedlings were then removed from each tray and the roots gently washed using tap water. The effects of *Trichoderma* isolates on the growth of tomato seedlings were evaluated and recorded as follows: shoot length, root length and dry weights measured after drying for 5 d at 45°C. Seedling vigour was calculated using the following formula: Vigour index $=(\text{Root length} + \text{Shoot length}) \times \text{Seed germination percentage}$.

Statistical analysis

Tukey’s test was performed to determine statistical differences in antifungal activities among *Trichoderma* isolates using the statistical software KyPlot version 2.0 beta 15.

RESULTS AND DISCUSSION

Figure 1 shows the effects of *Trichoderma* isolates on disease incidence of *R. solani* MAFF241953, growth of tomato seedlings and seedling vigour in the seed treatment. TR05 (SE_1) showed statistically lower disease incidence (5.79%) than TR06 (SE_2: 35.7%) and TR08 (SE_3: 21.6%) (Fig. 1A). In general, seed coats bearing *Trichoderma* sp. inoculum can give systemic protection against many seed-borne diseases (Linda 2000). *Trichoderma* is also well known to provide plants with useful molecules such as glucose oxidase and growth-stimulating compounds that can increase their vigour and as a result resistance to pathogens (Brunner *et al*. 2005). Additionally, *Trichoderma* can produce antibiotics such as gliotoxin, viridian, cell wall degrading enzymes and also biologically active and heat stable metabolites such as ethyl acetate. These substances are mainly known to be involved in suppression of disease incidence. Moreover, *T. viride* and *T. harzianum* were reported as the best antagonists against several soil and seed-borne plant pathogens (Poddar *et al*. 2004).

The highest germination percentage (97.3%) was for the control (SE_0) and the lowest (55.3%) was for SE_4 (only pathogen). TR05 (SE_1) showed statistically higher germination percentage (89.7%) than TR06 (SE_2: 81.3%) and TR08 (SE_3: 73.3%) (Fig. 1B). The highest root length (13.5 cm) was for SE_1 (TR05) and the lowest (2.9 cm) for SE_4 (only pathogen) which was statistically similar with control (SE_0: 6.70 cm) (Fig. 1C). TR05 (SE_1) had statistically greater shoot length (12.7 cm) than TR06 (SE_2: 8.27 cm), TR08 (SE_3: 5.73 cm) and control (SE_0: 6.67 cm), and the lowest (3.00 cm) was for SE_4 (only pathogen) (Fig. 1D). The highest dry weight (5.40 g) was for TR05 (SE_1) followed by TR06 (SE_2: 3.00g), and the lowest (0.41g) for SE_4 (only pathogen) was not statistically different from both the control (SE_0: 2.0 g) and TR08 (SE3: 0.99 g) (Fig. 1E). In these study, the inoculation with TR05, TR06 and TR08 not only suppressed collar rot disease but also enhanced germination percentage, root and shoot growth, dry weight and vigour of tomato seedlings compared to the infected control. Among the three *Trichoderma* isolates, TR05 exhibited significant enhancement of the above mentioned plant growth characteristics after the seed treatment (Fig. 1). Some researchers have reported that *Trichoderma* increased plant growth and productivity (Harman 2006; Manju and Mall, 2008). In this study, isolate TR05 gave the highest germination percentages. These studies have been confirmed in the case of *T. harzianum* and *T. virens* enhancing seed germination, root and shoot length (Dubey *et al*. 2007) as well as increasing the frequency of healthy plants. Lo and Lin (2002) also screened different *Trichoderma* strains for effects on plant growth and root growth of bitter gourd, luffa and cucumber and noted that they significantly increased seedling height, root exploration, leaf area and dry weight at 15 d after sowing.

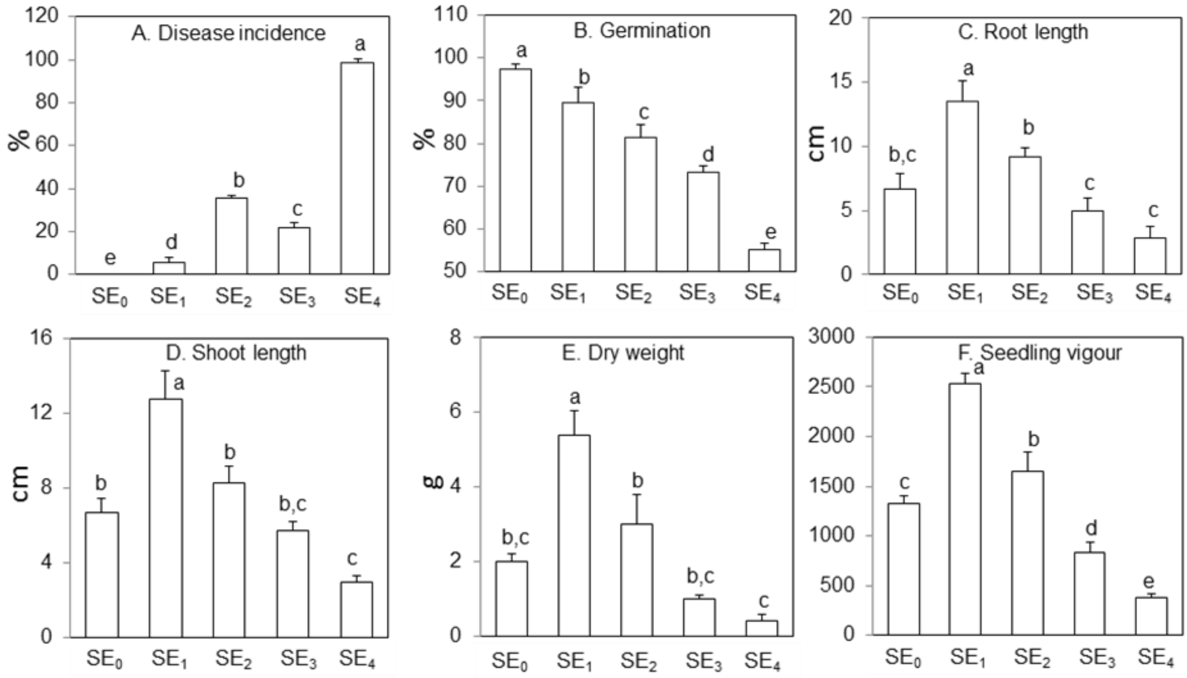

Fig. 1. Effects of the seed treatment with *Trichoderma* TR05, TR06 and TR08 on tomato seedlings infected by *R. solani* MAFF241953 (at four weeks): SE_0 = control, SE_1 = TR05 + pathogen, SE_2 = TR06 + pathogen, SE_3 = TR08 + pathogen and SE_4 = only pathogen. Bars indicate standard deviations (n=3). Different letters indicate significant differences according to Tukey's test (P<0.05).

TR05 (SE_1) had statistically higher seedling vigour index (2532.4) than TR06 (SE_2: 1647.5), TR08 (SE_3: 837.6) and control (SE_0: 1325.3), and the lowest of 376.6 was for SE_4 (only pathogen) (Fig. 1F). The vigour index showed similar trends to the germination percentages (Fig. 1). Mukhtar (2008) found that seed treatment with *T. harzianum* gave the highest germination index in okra and that *T. harzianum* could be useful to enhance the germination percentage as well as seedling vigour. Begum *et al*. (2010) observed that application of *T. harzianum* IMI 392432 significantly suppressed *Alternaria* fruit rot disease of chili and improved the seed germination percentage, vigour, growth and yield. Other investigators reported that seeds treated with *T. viride*, *T. harzianum* and *T. pseudokoningii* inoculant extracts showed increased seed germination rates and seedling vigour and reduced incidence of seed-borne fungal pathogens compared to controls (Zheng and Shetty, 2000; Bharath *et al*. 2006).

CONCLUSION

Results from the present investigation suggests that, applications of *T. harzianum* TR05 as a seed treatment has potential for controlling foot rot of tomato seedlings caused by *R. solani*. Further studies are underway to examine the effectiveness of these isolates as alternatives to chemicals to control this disease in different field conditions.

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