EFFICACY OF SEED TREATMENT AND SOIL DRENCHING WITH BOTANICAL AND FUNGICIDE TO CONTROL FOOT AND ROOT ROT (*FUSARIUM SOLANI* AND *SCLEROTIUM ROLFSII*) OF FENUGREEK (*TRIGONELLA FOENUM-GROECUM* L.)

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ABSTRACT

Khalequzzaman, K. M. 2019. Efficacy of seed treatment and soil drenching with botanical and fungicide to control foot and root rot (*Fusarium solani* and *Sclerotium rolfsii*) of fenugreek (*Trigonella foenum-groecum* L.). Bangladesh J. Plant Pathol. 35(1&2):27-32

A field experiment was conducted at Spices Research Centre, Bangladesh Agricultural Research Institute, Shibganj, Bogura, Bangladesh during Rabi season of 2017-2018 to evaluate efficacy of seed treatment and soil drenching with botanicals and fungicides to control foot and root rot (*Fusarium solani* and *Sclerotium rolfsii*) of Fenugreek (*Trigonella foenum-groecum* L.). Four botanicals namely garlic (*Allium sativum*), neem (*Azadirachta indica*), Henna (*Lawsonia inermis*) @ 1:5 and turmeric (*Curcuma domestica*) @ 0.050%, and three chemical fungicides namely Provax 200 WP (Carboxin + Thiram), Autostin 50 WDG (Carbendazim) @ 0.25% and Cabriotop (Pyraclostrobin 5% + Metiram 55% WG) @ 0.30% were tested with a control (plain water). A fenugreek variety, BARI Methi 2 was used in the experiment. The maximum of 34.11% foot and root rot incidence was observed under control. All treatments with botanicals and fungicides reduced the disease incidence by 9.89-69.48% over control. The maximum reduction in disease incidence and higher plant stand were achieved with Provax 200 WP, which was followed by Autostin 50 WDG, and Cabriotop. Plant height, number of pods per plant, number of seeds per plant, weight of seeds per plant and seed yield per hectare ranged 81.44-88.00 cm, 39.11-62.27, 489.99-928.88, 6.08-9.68 g and 1.75-2.52 t, respectively. The lowest values of all parameters were recorded under control. Every treatment increased each of the parameters significantly over control showing the highest values under Provax 200 WP, which was followed by Autostin 50 WDG and Seed treatment and soil drenching with Cabriotop, Plant survival, number of primary branches, secondary branches, pod length number of seeds per pod and weight of seeds per pod ranged 65.89%, 2.08-2.90cm, 6.55-8.83, 9.4-11.27 and 0.29-0.39 g, respective under different treatments including control. The lowest value of each parameter was observed under control. So, farmers and researchers may use Provax 200 WP (0.25%) or Autostin 50 WDG (0.25%) to control foot and root rot disease and to improve plant growth and seed yield of Fenugreek.

Keywords: Provax 200 WP, Autostin 50 WDG, foot and root rot, Fenugreek

INTRODUCTION

Fenugreek, in bengali 'Methi' (*Trigonella foenum-groecum* L.) is a minor annual legume field crop belonging to the family Fabaceae. It is native of South Eastern Europe and Africa. Presently it is commercially cultivated in several other countries including India and Bangladesh. Seeds of fenugreek have a characteristic odor and flavor and a pleasantly bitter taste. Although it is traditionally used as spice and vegetables for human consumption. The consumption of the seeds results in different medicinal effects such as hypocholesterolemic, antidiabetic, hepatoprotective, antibacterial, anthelmintic, anticancer and galactogogue. It has digestive, stomachic, carminative, stimulant, appetizer properties and is used in diseases like cholera, biliousness, dysentery, diarrhea, cough, cold, constipation and ailment of chest, lungs and kidney. The plant is also contains important vitamins, minerals, protein and amino acids, and fibers making it a nutritious fodder for livestock (Malhotra and Vashishtha 2008; Champawat and Singh 2008; Kumar *et al*. 2019). The crop is capable of fixing and utilizing atmospheric nitrogen through symbiotic relationship with *Rhizobium* in the root nodules.

In India, many diseases caused by fungi are the major constraints for the production of fenugreek

(Acharya *et al*. 2010). Among the diseases, foot and root rot caused by *Fusarium solani* and *Sclerotium rolfsii* is common and the most serious disease in Bangladesh. The pathogens cause seedling death at early stage resulting very poor plant stand which ultimately reduces yield. Foot and root rot disease of lentil may cause 100% seedling mortality in monoculture under conducive weather conditions for disease development (Begum 2003). The disease is one of the main constrains for the low production of chickpea (Godhani *et al.* 2010). The pathogenic fungi, *F. solani* and *S. rolfsii* are soil-borne. Hence, seed treatment with botanicals and chemicals may be beneficial in controlling the disease. Moreover, in seed treatment and soil drenching, very low quantities of materials are required compared to foliar application. Again, it reduces the risk of environmental pollution, health hazard and cost of application. Provax 200 (Carboxin + Thiram) was the most effective followed by Bavistin 50 WP (Carbendazim), Neem leaf extract and Garlic extract with respect to disease reduction and increase of seed yield (Rahman *et al*. 2012). Seed treated with Provax 200 showed least foot and root rot incidence of lentil (Anon. 2010). Integrated use of Vitavax 200 and biocontrol agents are effective in improving seedling emergence and yield as well as in reducing wilt incidence of chickpea (Gupta 2006). Vitavax 200 significantly decreased damping off disease and increased percentage of surviving plants of faba bean, lentil and chickpea (Zeid *et al*. 2003). Seed treatment and five times soil drenching with Bavistin DF @ 0.25% and Provax 200 WP @ 0.25% at an interval of 10 days from seedling to flowering stage decreased wilt incidence and increased seed yield of Cumin (Khalequzzaman *et al*. 2016).

Fenugreek is cultivated in very limited areas in Bangladesh and its yield is very low. The major causes of such low yield is diseases. However, comprehensive report on disease problems of the minor crop and their management are not available in the country. Our observations reveal that fenugreek is frequently attacked by foot and root rot disease caused by *F. solani* and *S. rolfsii*. causing considerable crop damage and yield loss.

Considering the above facts, the present piece of research was conducted to find out the effective control measures against foot and root rot of Fenugreek.

MATERIALS AND METHODS

A field experiment was conducted to evaluate the efficacy of four botanicals namely garlic (*Allium sativum*), neem (*Azadirachta indica*), Henna (*Lawsonia inermis*) and turmeric (*Curcuma domestica*); and three chemical fungicides namely Provax 200 WP (Carboxin + Thiram), Autostin 50 WDG (Carbendazim), Cabriotop (Pyraclostrobin 5% + Metiram 55% WG), as seed treating and soil drenching agents against foot and root rot disease of Fenugreek. All botanicals were used as 1:5 water except turmeric which was used at 0.50% powder. Provax 200 WP and Autostin 50 WDG were used at 0.25% and Cabriotop at 0.30%. Altogether there were eight treatments including a control where plain water was used for seed treatment and soil drenching. The doses of botanicals and chemicals were same for both seed treatment and soil drenching.

The experiment was conducted at Spices Research Centre, BARI, Shibganj, Bogura, Bangladesh during Rabi season of 2017-2018. The experimental plot was prepared with five ploughings and cross ploughings followed by laddering to break the clods as well as to level the soil. The weeds and stubbles of previous crops were removed from the field. Cowdung @ 5 t/ha, Urea @175 kg/ha, TSP @175 kg/ha and MOP @135 kg/ha were applied. The entire quantity of cowdung, TSP and MOP were applied during final land preparation. Urea was applied in two equal splits first at 20 days after germination and then at flowering stage just after irrigation (Anon. 2017). The experiment was carried out following randomized complete block design with three replications. Size of the unit plot was 2.5 m × 1.2 m and plant spacing was 30 cm × 10 cm. Variety, BARI Methi 2 was used in the experiment.

Seeds were treated before sowing and base at soil level was drenched with the materials by spraying five times at an interval of 7 days. Treated seeds were sown on 20 November, 2017. Weeding was done at 30, 45 and 60 days after emergence and three irrigations were also applied just after three days of each weeding. Other intercultural operations were done to maintain the normal hygienic condition of crop field. The plots were inspected regularly to take observations on foot and root rot disease from seedling to maturity stage of the crop. Dead plants were counted and removed from the field. Disease plant parts were collected in the laboratory for identifying foot and root rot causing pathogens.

The crop was harvested at 20 March, 2018. Data were recorded on foot and root rot incidence, plant survival, number of primary and secondary branches/plant, plant height at harvest, pod length, number of pods/plant, number of seeds/pod, weight of seeds/pod, number of seeds/plant, weight of seeds/plant and seed yield. The incidence of foot and root rot of fenugreek was recorded at every alternate day. The incidence of foot and root rot of fenugreek was calculated using the following formula:

$$\text{Incidence of foot and root rot (\%)} = \frac{\text{Number of infected plants}}{\text{Total number of plants checked}} \text{ X } 100$$

The recorded data were analyzed statistically to compute ANOVA and variations among treatments means were compared following Duncan's New Multiple Range Test (DMRT) according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of seed treatment and soil drenching with botanicals and fungicides on disease incidence, plant stand and plant growth

Disease incidence: Maximum of 34.11% disease incidence was recorded from control where no botanical or fungicide was applied. Seed treatments as well as soil drenching with all four botanicals and three fungicides significantly (P=0.05) reduced incidence of foot and root rot of fenugreek compared to control. The reduction under different treatments varied 9.49-69.48% and their differences were significant. The highest reduction of disease incidence was achieved with Provax 200 WP @ 0.25% followed by Autostin 50 WDG @ 0.30% and Cabriotop @ 0.25%. The lowest disease reduction was observed under neem leaf followed by garlic clove, henna leaf and turmeric powder (Table 1).

Plant stand: The minimum plant stand of 62.89% was recorded from control. It was increased to 69.13 to 89.59% due to seed treatment and soil drenching with botanicals and fungicides. However, efficacy of botanicals and fungicides to improve plant stand was not significant. The highest plant survival was achieved with Provax 200 WP followed by Autostin 50 WDG and Cabriotop. The minimum plant survival were observed under neem leaf followed by garlic clove, Henna leaf and turmeric powder (Table 1).

Plant growth: The minimum plant height of 81.44 cm was found under control. Due to seed treatment and soil drenching with botanicals and fungicides, the parameter was significantly increased within the range of 82.34-88.00 cm. The maximum improvement in plant height was achieved with Provax followed by Autostin, turmeric and neem. Efficacy of four materials was significantly different from each other. Plant height under neem, henna and Cabriotop was statistically similar but significantly compared to only garlic (Table 1).

Branching: Number of primary and secondary branches per plant under control were 2.08 and 6.55, respectively. Due to seed treatment and soil drenching with botanicals and fungicides, both the parameters were increased to 2.47-2.90 and 7.08-8.83, respectively. However, the increase was not significant compared to control (Table 1).

Table 1. Effect of seed treatment and soil drenching with four botanicals and three chemical fungicides on foot and root rot incidence, plant stand and plant growth of Fenugreek

Treatments (botanicals and fungicides with dose)	Disease incidence (%)	Reduction incidence over control (%)	Plant stand (%)	Plant height (cm)	Branch/plant	
					Primary	Secondary
Garlic clove extract (1:5)	25.95 c	23.92	74.05	82.34 e	2.73	7.10
Neem leaf extract (1:5)	30.87 b	9.49	69.13	83.66 d	2.64	7.08
Henna leaf extract (1:5)	20.11 d	41.04	79.89	83.50 d	2.53	7.60
Turmeric powder (0.50%)	17.50 e	48.69	82.50	85.55 c	2.73	7.91
Autostin 50 WDG (0.25%)	13.11 f	61.56	86.89	87.33 b	2.47	8.47
Cabriotop 0.30%)	15.41 e	54.82	84.59	83.50 d	2.67	8.40
Provax 200 WP (0.25%)	10.41 g	69.48	89.59	88.00 a	2.90	8.83
Control (Plain water)	34.11 a	-	65.89	81.44 f	2.08	6.55
CV (%)	7.12	-	-	7.38	-	-

Values within the same column having a common letter(s) do not differ significantly (P=0.05).

Effect of seed treatment and soil drenching with botanicals and chemicals on yield and yield contributing parameters

Number of pods per plant: The lowest number of 39.11 pods per plant was recorded from control. Seed treatment and soil drenching with botanicals and fungicides caused significant increase in pod number within the range of 42.61-62.27 per plant. Significantly the highest number of pods was obtained with Provax 200 WP (Carboxin + Thiram) @ 0.25%, which was statistically similar to only Autostin 50 WDG (Carbendazim) @ 0.25% and the lowest number was recorded under neem leaf (Table 2).

Length, seed number and seed weight per pod: Length, seed number and seed weight per pod under control were 9.40 cm, 15.07 and 0.29 g, respectively. Due to treatments, all three yield contributing parameters were increased to 10.07-11.27 cm, 16.13-17.00 and 0.31-0.39 g, respectively. The increase in those parameters was not significant compared to control.

Number and weight of seeds and seed yield: Number and weight of seeds and seed yield were 489.99/plant, 6.08 g/plant and 1.75 t/ha under control. All three parameter were significantly increased over control due to seed treatment or soil drenching with every botanical or fungicide. However, the efficacy of all treatments was not statistically similar. Provax 200 WP (Carboxin + Thiram) @ 0.25% yielded the highest seed number, 924.88/plant, seed weight, 9.68 g/plant and seed yield, 2.52 t/ha, which was followed by Autostin 50 WDG (Carbendazim) @ 0.25% and Cabriotop (0.3%). The lowest of those parameters were obtained with neem leaf followed by Garlic and henna leaf (Table 2)

Table 2. Effect of seed treatment and soil drenching with four botanicals and three chemical fungicides on yield and yield attributes of Fenugreek

Treatments (botanicals and fungicides with dose)	Pods number per plant	Pod length (cm)	Seeds per pod	Seeds wt. (g/pod)	Seed per plant	Seed wt. (g/plant)	Seed Yield (t/ha)
Garlic clove extract (1:5)	45.75 de	10.07 A	16.20 A	0.32 A	634.83 de	7.97 cd	1.95 d
Neem leaf extract (1:5)	42.61 e	10.46 A	16.43 A	0.31 A	587.77 e	7.50 d	1.90 d
Henna leaf extract (1:5)	48.89 cd	10.93 A	16.13 A	0.33 A	649.83 cd	8.02 cd	2.21 c
Turmeric powder (0.5)	50.72 c	10.80 A	16.23 A	0.34 A	701.67 c	8.56 bc	2.28 c
Autostin 50 WDG (0.25%)	60.27 a	11.10 A	16.94 A	0.36 A	835.33 b	9.33 ab	2.41 ab
Cabriotop (0.30%)	54.06 b	10.20 A	16.72 A	0.35 A	796.66 b	9.43 ab	2.33 bc
Provax 200 WP (0.25%)	62.27 a	11.27 A	17.00 A	0.39 A	924.88 a	9.68 a	2.52 a
Control (Plain water)	39.11 f	9.40 A	15.07 A	0.29 A	489.99 f	6.08 e	1.75 e
CV (%)	7.75	-	-	-	7.53	6.37	6.39

Values within the same column having a common letter(s) do not differ significantly (P=0.05).

Findings of the present piece of research reveal that considerable reduction was obtained in disease incidence and improvement of plant stand, plant growth and yield contributing parameters and/or chemical fungicides against foot and root rot disease of Fenugreek. In general, the efficacy of fungicides is appreciably higher than botanicals. The most effective seed treating and soil drenching material is Provax 200 WP (Carboxin + Thiram) @ 0.25%, which was followed by Autostin 50 WDG (Carbendazim) @ 0.25%, Cabriotop @ 0.3% and turmeric. The least effective treatment was seed treatment and soil drenching with neem leaf at 1:5 followed by garlic @ 1:5, henna leaf @ 1:5 and turmeric at 0.050%.

Control of foot and root rot of many other crops caused by *F. solani* and *S. rolfsii* have been reported by many other researchers. Khokhar *et al*. (2012) observed that seed treatment with Bavistin (Carbendazim) @ 1.5g / kg seed and Neem leaf extract @ 5 ml/ 10 g seed significantly enhanced seed germination, seedling vigour by preventing pre-and post-emergence mortality of Fenugreek over control. Khalequzzaman (2008) reported that the best treatment for controlling foot and root rot of lentil and chickpea was seeds dipping in 0.25% suspension of Vitavax 200 (Carboxin + Thiram) for 3 hours. Rahman *et al*. (2012) noted Provax 200 (Carboxin + Thiram) as the most effective fungicide followed by Bavistin 50 WP (Carbendazim) against foot and root rot disease reduction. He also found that Provax 200 (Carboxin + Thiram) was the most effective followed by Bavistin 50 WP (Carbendazim), Neem leaf extract and Garlic extract in respect of increase of seed yield.

Seed treated with Provax 200 (Carboxin + Thiram) showed least foot and root rot incidence of lentil (Anon. 2010). Khalequzzaman (2016) observed that the lowest foot and root rot (21.67%) was obtained

with seed treatment with Provax 200 (Carboxin + Thiram) (2.5 g/kg seed) in lentil. He found the highest number of pod/plant (45.26), number of seeds/plant (87.80) and weight of seeds/plant (2.44 g). The highest plant population and the lowest disease incidence per pot or plot exhibited with fungicides Provax (Carboxin + Thiram) and Bavistin (Carbendazim) application (Islam *et al.* 2018). Tanni *et al*. (2016) observed that the germination of chickpea was maximum by treating seeds with Bavistin 70 WP (Carbendazim) (81%). The lowest (4.00, 3.33 and 2.33%) seedling mortality rate were observed in plots where Bavistin 70 WP (Carbendazim) sprayed at 10, 20 and 30 days after sowing, respectively. Singh and Rao (2015) conducted field experiments for two years for the management of root rot of fenugreek and it was found that maximum reduction in disease incidence (14.52 and 11.4%, respectively) was observed in the treatment where seeds were treated with Carbendazim (2 g kg-1) + spray at 45, 60 and 75 days after sowing. Gupta (2006) observed that integrated used of Vitavax 200 (Carboxin + Thiram) and biocontrol agents were effective in improving seedling emergence and yield as well as in reducing wilt incidence of chickpea. Khalequzzaman *et al*. (2016) found that seed treatment and five times soil drenching with Bavistin DF (Carbendazim) @0.25% and Provax 200 WP (Carboxin + Thiram) @0.25% at an interval of 10 days from seedling to flowering stage decreased wilt incidence and increased seed yield of Cumin. Khalequzzaman *et al*. (2003) reported that seed treatment and soil drenching with Provax 200 WP (Carboxin + Thiram) @ 0.25% gave the highest plant survival and disease reduction over control, followed Autostin 50 WDG (Carbendazim) @ 0.25% and Cabriotop (0.3%). Zeid *et al*. (2003) observed that the lowest plant survival was found in untreated control. Vitavax 200 (Carboxin + Thiram) significantly decreased damping off disease and increased percentage of surviving plants of faba bean, lentil and chickpea.

Kaur and Gupta (2003) found that Vitavax 75 WP (Carboxin + Thiram) resulted the maximum increase in yield (86.14%) of lentil. It was observed that Provax (Carboxin + Thiram) for seed treatment performed highest yield (Siddique *et al*. 2013). Khalequzzaman (2016) observed that the highest yield (1845 kg/ha) was obtained from seed treatment with Provax 200 (Carboxin + Thiram) (2.5 g/kg seed) in lentil. Sharma and Sohi (1981) conducted experiment in field trials with 10 seed dressing fungicides against foot and root rot and found Bavistin (Carbendazim) and Vitavax (Carboxin + Thiram) resulted maximum yield. Tanni *et al.* (2016) found that the highest yield (1600 kg/ha) were obtained by spraying Bavistin 70 WP at 1 gram/liter with an increase of 52.38% grain yield in Chickpea.

Based on findings of the present study, it may be concluded that seed treatment and five times soil drenching at an interval of 7 days from seedling stage with Provax 200 WP (Carboxin + Thiram) @0.25% and Autostin 50 WDG (Carbendazim) @ 0.25% may be useful to reduce foot and root rot disease and to improve plant growth and yield of Fenugreek.

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