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Evaluation of Botanical and Chemical Fungicides to Control Foot and Root Rot of Chickpea

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Authors' contributions

This work was carried out in collaboration between all authors. Author TRT sets experiments, collect samples, data, analyses data and wrote first draft manuscript. Author JD collect data, test samples and wrote manuscript. Authors RH and AH guides and helps to wrote and analyses data. Author MH designed the study, supervises experimental procedure and revised final manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Effective disease management is essential for high quality and maximum production. The experiment was conducted on the experimental field of Sylhet Agricultural University, Sylhet to evaluate the effects of different chemical and botanical fungicides in controlling foot and root rot disease of chickpea. Total 15 samples of chickpea seeds of variety BARI Chola-9 were collected from different locations in chickpea growing area. Seven different treatments were sprayed as suspension into the experimental plot as per treatment. The Randomized Complete Block Design (RCBD) with three replications followed to complete the experiment. The germination of chickpea was found maximum by treating seeds with Bavistin 70 WP (81%). The lowest (4%, 3.33% and 2.33%) seedling mortality rate were observed in plots where Bavistin 70 WP sprayed at 10, 20 and 30 days after sowing respectively. Similarly, the minimum disease severity (33.37%) and the highest yield (1600 kg/ha) were obtained by spraying Bavistin 70 WP at 1gram/liter with an increase of 52.38% grain yield. The findings of our experiment suggested that, Bavistin 70 WP could be use as an efficient fungicide to control foot and root rot of chickpea.

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Keywords: Chemical; botanical; chickpea; fungicides; mortality; severity; germination.

1. INTRODUCTION

Chickpea is reported to be attacked by about 67 fungi, 3 bacteria, 22 viruses and mycoplasma and 80 nematodes [1]. Field fungi associated with seed causes deterioration of quality, affect viability and reduce germination of seeds. Beside these, most of the storage fungi are *Aspergillus spp., Penicillium* spp*., Rhizopus spp., Alternaria spp.* and *Fusarium spp.* affect roots, stems, leaves, flowers and pods. Among them *Fusarium oxysporum* is the destructive pathogen causing wilt disease [1]. Root rot caused by *Fusarium oxysporum, Fusarium solani* and *Sclerotium rolfsii* is considered as an important and destructive disease of pulse crops in Bangladesh and also in almost all legume growing countries of the world [2,3]. The disease is very difficult to control even by the use of chemical fungicide. Because the pathogens are soil and seed borne and can survive in the residual stubbles for more than three years [4]. Though, some effective fungicides are available in the market but their number is very few [5-8]. Recently Botanical extracts are used to control the disease which are biodegradable and their use in crop protection is a practical sustainable alternative [9]. There are also some plant extracts, which have micro-cidal qualities and antagonistic effect to pathogens [10,11]. Antifungal activities of garlic, neem, allamanda have also been reported by many researchers [12,13]. [14] stated the best treatment for controlling foot and root rot of lentil and chickpea was dipping seeds in 0.25% suspension of Vitavax 200 for 3 hours. Provax 200 was the most effective followed by Bavistin 50 WP, Neem leaf extract and Garlic extract with respect to disease reduction and increase of seed yield [11]. To find out the effective fungicide against the disease and considering the value of chickpea production, we decided to carry out this experiment. Hence, the current piece of research was undertaken to evaluate the efficacy of chemical and botanical fungicides against seed borne fungi.

2. MATERIALS AND METHODS

The experiment was conducted at the experimental field of Plant Pathology and Seed Science Department, Faculty of Agriculture, Sylhet Agricultural University (SAU), Sylhet during first week of December, 2014 to first week of April, 2015. The experiment was conducted in Randomized Complete Block Design (RCBD) having three replications. The individual plot size was 1 m x 2 m. The space between blocks and between plots was 1.0 m and 0.5 m respectively. Chickpea seeds of variety BARI Chola-9 were sown in the field about 2.0 cm depth in four lines per plot. A total of 15 seed samples were collected from the farmer's field of five different places following the International Rules for Seed Testing [15] at least 15 days before sowing. Chemicals viz. Bavistin 70 WP (2.5 g/kg), Iprozim 26 WP (2.5 g/kg), Qubee 50 WP (2.5 g/kg) were collected from market and botanical fungicides i.e. fresh leaves of Neem (*Azadirachta indica*), Biskatali (*Polygonum hydropiper*) and Marigold (*Tagetes patula*) were collected from surrounding area. Botanical fungicides (suspension) were a mixture of plant extracts and water (1:4). The extracts were prepared by crushing the plant parts in a blender with distilled water (100 g crushed plant materials in 100 ml water). Then the extracts were filtered through cheese cloth and obtained extracts kept in a refrigerator at 4±1℃ until use. Chemicals and botanical fungicides were sprayed as suspension into the experimental plot as per treatment. The whole surface of the plant was sprayed 3 times in 15 days interval by the solution of the chemicals 40 days after sowing. In case of control plot plain water was sprayed only. Every time the chemicals were freshly prepared prior to application and the spray tank was thoroughly cleaned before filling with the individual spray materials. The germination percentages, mortality rate, disease incidences and severity were recorded for three times. The counting was made in different days after sowing (DAS) maintaining intervals. Five infected plants were selected randomly from each replication plot to identify disease severity. Disease severity were assessed using a 0-8 scale of [16]. Disease incidence and Percent disease index (PDI) was calculated according to the following formula [16].

$$\%\text{Disease Incidence} = \frac{\text{Number of infected plants in each plot}}{\text{Total number of plants in each plot}} \times 100$$

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of total rating}}{\text{Total number of observation} \times \text{Highest grade in the scale}} \times 100$$

At harvest time, randomly ten plants of each plot were carefully uprooted allowing no loss of pods.

The pod yield of each plot was later converted into kilogram (kg) per hectare (ha). All the data were analyzed statistically and difference between the treatments means was evaluated using Duncan's Multiple Range Test (DMRT) following the procedure as described by [17].

3. RESULT AND DISCUSSION

3.1 Effect of Different Treatments on Germination of Chickpea Seeds

The effect of different fungicides on germination was evaluated at 5, 10 and 15 days after sowing (DAS). Significant variation in germination of chickpea seeds were found under different treatments. The highest germination (65%) was recorded at 5 days after sowing by treating seeds with Bavisin 70 WP while the lowest germination (48%) was recorded in the control plot. At 10 days after sowing the highest germination (70%) was observed in Bavistin 70 WP treated plot and lowest (55%) germination was found in control plot. In biskatali leaf extract and marigold leaf extract treated plot, the germination percentage was statistically similar. The germination of chickpea was found to be increased by treating seeds with Bavisitn 70WP (81%) where lowest germination (61%) was recorded in control plot at 15 days after sowing was also supported by previous study conducted by [18]. [18] reported that seed treated with bavistin at 0.2% increased germination of 39% over control. In an experiment carried out by [19], reported bavistin, benomyl and captan gave the highest chickpea seed germination (91.6%, 83.3% and 75.0%) over control. A study conducted by [8] showed that seed treatment with carbendazim increased seed germination (71.24%).

3.2 Effect of Different Treatments on Seedling Mortality

The mortality was observed at 10, 20 and 30 days after sowing (DAS) (Table 2). At 10 DAS maximum (15.67%) mortality was observed in control plot, which was statistically significant compared to other treatments. Minimum mortality (4%) was recorded in the plot where seeds were treated with Bavistin 70 WP. At 20 DAS maximum (17%) mortality was recorded in control plot where minimum mortality (3.33%) was found in the plot sprayed by Considering total mortality of chickpea due to seed and soil borne pathogen, Bavistin 70 WP seemed to be best treatment among the treatments applied. It has been observed that treating seeds with Bavistin 70 WP decreased mortality of chickpea up to 2.33% in the field experiment at 30 DAS. Fakir (1983b) recorded only 1.6% seedling mortality, during their treatment of foot and root rot diseases with Panoctin CG/450.

3.3 Effect of Different Treatments on Foot and Root Rot Disease Incidence of Chickpea

Data were recorded 20, 35 and 50 days after sowing (Fig. 1). The germination percentage of chickpea seeds at field condition showed a common trend for all the seedlings in all counting days. It was observed that disease incidence decreased by Bavistin 70 WP treated seed and it was the best treatment among other treatments. On the other hand, highest disease incidence (23.48%, 29.04%, 42.50%) was found in control plots. [20] reported that thiram gave the best control of seed borne fungi followed by captafol and mancozeb. A study conducted by [7] indicated that chemical seed treatment with thiram (0.15%) and carbendazim (0.1%) was proved to be the most effective against *Fusarium oxysporum* f. sp. *ciceri*. [21] recorded that carbendazim (Bavistin WP) was superior to carboxin for reducing wilt. Carbendazim applied as seed treatment reduced disease incidence significantly [8].

3.4 Yield Attributes and Yield

Plant height was statistically insignificant in all the treatments but still the highest plant height (42.67 cm) was observed in Bavistin 70 WP treated plot and the lowest (39.60 cm) was recorded in control plots (Table 3). Grain yield of chickpea (kg/m^2) per plot significantly varied from one treatment to another. The yield of chickpea (kg/m^2) ranged from 0.32 to 0.21. The highest (0.32 kg/m^2) grain yield was observed in plots where Bavistin 70 WP was sprayed and the lowest (0.21 kg/m^2) was recorded in control plot which was statistically significant. The highest grain yield (0.32 kg) was obtained in plots where chemical treatment (Bavistin 70 WP) was used and the lowest (0.21 kg) was recorded in control plot. Increase of yield over control was observed by using different management approaches. The maximum (52.38%) increase of yield per hectare over control was recorded from treatment Bavistin 70 WP and the minimum (21.90%) recorded from Qubee 50 WP and Marigold leaf extract treated plot. The maximum weight of 100 seed (21.37 g) was obtained in Bavistin 70 WP treated plots and the lowest (18.70 g) in control

plots. [22] reported that seed treatment of cowpea with 0.2% mancozeb against seed-borne diseases caused by *C. lindemuthianum* and *M. phaseolina* resulted in 14% yield increase and successfully controlled the diseases. A study findings by [23] stated that seed treatment with carbendazim and benomyl increased yield.

3.5 Relationship between the Incidence of Foot and Root Rot and Seed Yield of Chickpea

A negative correlation was observed between the incidence of foot and root rot of chickpea and seed yield, which indicated that higher incidence of foot and root rot conversely minimize the seed yield (Fig. 2). We observed that foot and root rot infection at early stage of crop growth maximize disease incidence which caused much higher reduction of seed yield. A linear regression line was fitted between the incidence of foot and root rot and seed yield recorded at 50 days after sowing. The correlation of coefficient (x) was negative (-0.966) and the contribution of regression (R^2= 0.9339) was 93%. This result supported by [24], as plant extracts are effective to control plant diseases. [25], observed that MYMV infection at early stage of crop growth maximize the disease incidence which caused much higher reduction of seed yield.

Table 1. Effect of different treatments on germination of chickpea seeds

Treatments	Germination (%)		
	5DAS	10DAS	15DAS
Bavistin 70 WP	65a	70a	81a
Iprozim 26 WP	62a	65b	78b
Qubee 50 WP	58b	62c	75c
Neem leaf extract (1:4)	55bc	65b	72d
Biskatali leaf extract (1:4)	53c	61c	74cd
Marigold leaf extract (1:4)	52c	60c	75c
Control	48d	55d	61e
LSD(0.05)	3.197	2.451	2.36
CV (%)	3.34	2.30	1.86

In the above column having common letter(s) do not differ significantly at 5% level of probability

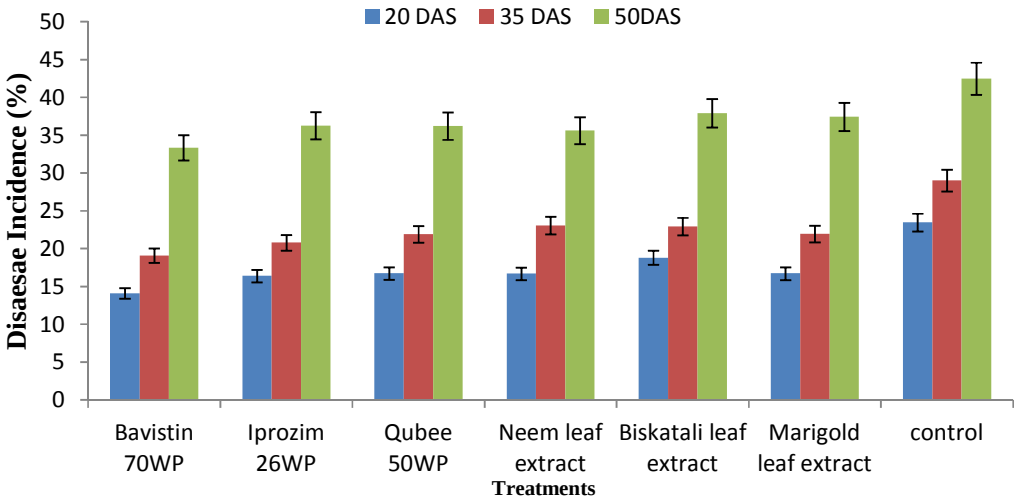

Fig. 1. Effect of different fungicides and botanicals on disease incidence of chickpea (error bars for the selected chart series with 5% value)

Table 2. Efficacy of different fungicides and botanicals against foot and root rot of chickpea seeds

Treatments	Seedling mortality (%)		
	10DAS	20DAS	30DAS
Bavistin 70 WP	4d	3.33d	2.33b
Iprozim 26 WP	6d	5.67cd	2.67b
Qubee 50 WP	5.67d	7.33bcd	2.67b
Neem leaf extract (1:4)	10c	8.33bcd	3.33b
Biskatali leaf extract (1:4)	11bc	10.33bc	2.67b
Marigold leaf extract (1:4)	12.67b	12.67ab	3.33b
Control	15.67a	17a	8a
LSD(0.05)	2.493	5.726	3.019
CV (%)	15.76	36.39	49.64

Figures (s) in the column having common letter(s) do not differ significantly at 5% level

Table 3. Yield attributes and yields of chickpea as influenced by different treatments

Treatments	Plant height(cm)	Plot yield (kg)	100 seed weight (g)	Yield increase over control (%)
Bavistin 70 WP	42.67a	0.32a	21.36a	52.38
Iprozim 26 WP	40.80a	0.28b	20.63ab	33.34
Qubee 50 WP	41.80a	0.26c	20.56ab	23.80
Neem leaf extract (1:4)	41.40a	0.28b	19.7ab	35.23
Biskatali leaf extract (1:4)	40.23a	0.26c	19.26ab	23.80
Marigold leaf extract (1:4)	40.33a	0.25d	20.2ab	21.90
Control	39.60a	0.21e	18.7b	
LSD(0.05)	3.79	0.0017	2.549	
CV (%)	5.44	3.19	7.46	

In the above column having common letter(s) do not differ significantly at 5% level of probability

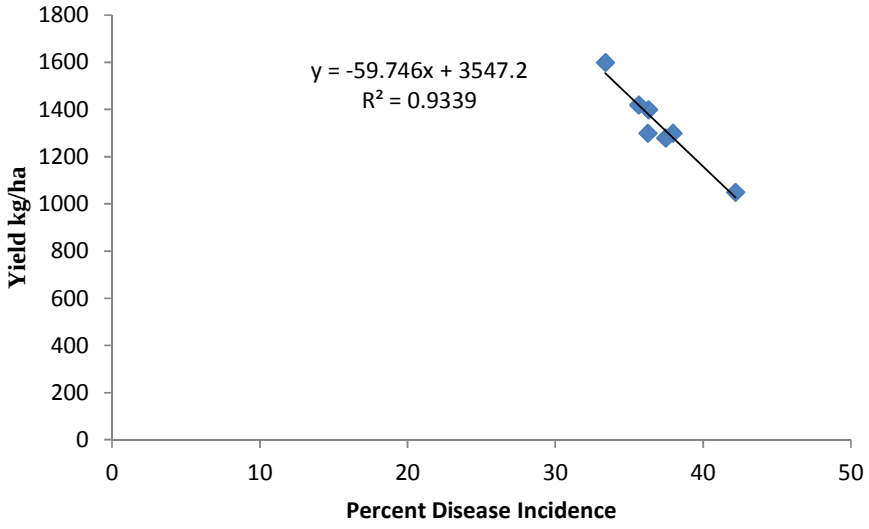

Fig. 2. Relationship between the incidence of foot and root rot and seed yield of chickpea obtained from seven different and chemical treatments

4. CONCLUSION

From the above study, it may be concluded that application of Bavistin 70 WP showed better performance in germination to mortality. This is also true that use of Bavistin 70 WP promoted plant height, reduced disease incidence and showed maximum (1600 kg/ha) grain yield of chickpea.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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