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Full Length Research Article

Management of Phomopsis Fruit Rot Disease of Brinjal (*Solanum melongena* L.) Caused by *Phomopsis vexans* under in Vivo Condition

Sabebaro Namo Das*[1]

[1] Department of Botany, B. P. Chaliha College, Nagarbera, Kamrup - 781 127, Assam, India

Abstract

Brinjal (*Solanum melongena* L.) is an important agricultural crop grown globally. Phomopsis fruit rot incited by *Phomopsis vexans* is a serious disease and can cause up to 15-62% yield losses. The disease is managed by application of fungicides which could lead to several environmental and health related problems. Thus, the present study was undertaken to find out the efficacy of fungicides, bio-agent and plant extracts against the disease of brinjal at CPCRI, Kahikuchi, Guwahati by following randomized complete block design (RCBD) with three replications under field condition during 2020-2021. Two fungicides (Bavistin 50 and Captan-50), a bio-agent *Trichoderma viride* and two botanicals (*Allium sativum* and *Allamanda cathertica*) were evaluated for their effectiveness against Phomopsis fruit rot. Result showed that seed treatment and foliar application with Bavistin @ 0.1% showed lowest disease incidence (8.3%) and highest yield contribution (303.55 q/ha) followed by Captan (13.3%) disease incidence @.2% and gave yield (255.55 q/ha) while the bio-agent *Trichoderma viride* 10^8 conidia/ml was observed (16.6%) disease incidence with (228.88 q/ha) yield. Among the two plants extracts @ 15 percent concentration *Allium sativum* and *Allamanda cathertica* found (21.6%) and (25%) disease incidence with 213.33q/ha and 200 q/ha yield respectively in comparison to untreated control.

***Key words*:** Bio-agent, *Solanum melongena*, *Phomopsis vexans*, Evaluate, Fruit rot, Fungicides, Plant extracts

Brinjal or eggplant is a popular vegetable crop grown in almost all districts of Assam. It is called king of vegetable due to its wide usage in every Indian food [1-2]. In India, Brinjal is cultivated in an area of 0.72 million ha with a production of 12.32 million tones and productivity of 16.95 t. ha^{-1} during the year 2016-17 [3]. It is grown round the year. This important crop is known to suffer from 12 diseases and amongst them fruit rot caused by *Phomopsis vexans* one of the major constraints of brinjal cultivation [4]. Mahadevakumar *et al*. [5] reported that yield losses 15 to 62% of eggplant due to Phomopsis fruit rot caused by *Phomopsis vexans*. It reduces yield and marketable value of the crop from 20-50% [6-9]. Due to Phomopsis fruit rot huge loss of yield, decreased fruit number (34.8%) and fruit weight up to 17% reported by [10]. The pathogen is generally dispersed by rain splashes and through rotten parts and insects [11]. Pale to light brown sunken spots develop on the infected fruits. Many workers have reported the varied efficacy of chemical fungicides to control the disease. Biological control could be successful alternative to chemical. Antifungal activities of Garlic, Neem, Alamanda, have been reported by many researchers [12-13]. Therefore, management of *P. vexans* is very important as it increasing the productivity and production of eggplant. Keeping in view the present study was under taken to find out the effective fungicides, bio-agent and plant extracts against the fruit rot disease of brinjal under natural condition.

MATERIALS AND METHODS

On the basis of good performance showed at *in vitro* tests two fungicides (Bavistin 50 @ 0.1%, Captan-50 @ 0.2%), one fungal antagonist (*T. viride*) and two botanical extracts (*Allium sativim*, *Allamanda cathertica* @ 15%) were selected for their efficacy in controlling the disease in fields condition.

Seed treatment with T. viride spore suspension

Brinjal seeds were soaked in the adhesive spore suspension for 30 sec. and then in the antagonistic spore suspension of 10^8 conidia/ml for half an hour. After soaking, the treated seeds were dried in shade [14].

Preparation of suspension of T. viride

Spore suspension of *T. viride* was prepared from 15 days old culture grown in PDA slants. The spores were suspended in sterile distilled water and the concentration was adjusted to 10^8 conidia/ml using haemocytometer. Carboxy methyl cellulose

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Correspondence to: Sabebaro Namo Das, Department of Botany, B. P. Chaliha College, Nagarbera, Kamrup - 781 127, Assam, India, Tel: +91 8876666517; E-mail: sabebaro.das@gmail.com

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(CMC) 0.2% was used as an adhesive for treating brinjal seeds with *T. viride* spore suspension.

Seed treatment with fungicides

Wet seeds treatments with fungicides were done separately with Bavistin (0.1%) and Captan with (0.2%). Untreated seeds served as control [15].

Seed treatment with plant extracts

Seeds were dipped in garlic and *Allamanda* extract at 15% concentration for half an hour and the untreated seeds served as control. The liquid was drained off and seeds were shade dried before sowing in pots as per methods of Islam and Meah [15].

Foliar spray

T. viride @ 10^8 conidia/ml, fungicides Bavistin (@ 0.1%) and Captan (@ 0.2%) and plant extracts Garlic and *Allamanda* @ 15% were sprayed into the plant with the help of atomizer till the wetting of leaves at four different intervals [16].

Details of the treatments

There were altogether seven treatments in the experiment and the combination as follows:

T_1: Control without pathogen.
T_2: Inoculated control only *P. vexans*
T_3: Seed treatment + spray with Bavistin @ 0.1% + *P. vexans*
T_4: Seed treatment + spray with Captan @ 0.2% + *P. vexans*
T_5: Seed treatment + spray with *T. viride* @ 10^8 conidia/ml + *P. vexans*
T_6: Seed treatment + spray with *A. sativum* @ 15% + *P. vexans*
T_7: Seed treatment + spray with *A. cathertica* @15%+ *P. vexans*

Percent of fruit rot infection was recorded for *Phomopsis vexans* with the following formula:

$$\text{Percent of fruit rot incidence} = \frac{\text{No. of fruits infected}}{\text{Total No. of fruits}} \times 100$$

Field experiment: The field experiment was done at CPCRI, Kahichuci, Guwahati during the year August, 2020 to February, 2021.

Preparation of the land

Experimental area was ploughed twice by tractor drawn disc plough up to a depth of about 20 cm. Then properly leveled and stubbles were removed by manual labours. All the recommended fertilizers dose such as FYM @ 10 t/ha, N 50 kg/ha., P_2O_5 50 kg/ha and K_2O 50 kg/ha were applied during the period of study. Seedlings raised from the surface sterilized certified seeds were transplanted into plots.

Design and layout of the experiment

Design	:	Randomized block design
Replication	:	3 (Three)
Number of treatments	:	7 (Seven)
Total number of plots	:	21
Individual plot size	:	3m × 1.5m
Plant per plot	:	12 (twelve)
Spacing	:	75 cm × 60 cm (Row to Row and Plant to Plant)

Preparation of inocula

Phomopsis vexans was first grown on PDA medium and incubated at 28±1°C for 7 days. One mycelial disc of each of the two fungus were inoculated separately in two 500 ml Erlenmeyer flasks contains 100 ml of Potato Dextrose Broth (PDB) medium to enhance more sporulation. Then the flasks were incubated at 25°C in a shaking incubator with a periodic shaking at 170 RPM and the spores were collected after 7 days. To remove the mycelial mat the culture was poured through cheese cloth and the final concentration was adjusted at $1x10^8$ conidia/ml for using sterile distilled water. By using haemocytometer the number of spore were counted.

Preparation of pot

Earthen pots (30 cm in diameter and 45 cm in height) were used for the experiments. The pots were washed with sterilized water followed by 70 percent alcohol. Garden soils were collected broken into powdery form and remove root bits and other foreign materials. Then the soil was mixed with decomposed cow dung and sand in a ratio of 2:1:1 and sieved through 4 mm sieve and then sterilized in an autoclaves at 15 lb/ $inch^2$ pressure for one hour for three successive days.

Inoculation

Healthy seedlings of brinjal were raised in the experimental field. Seven days old pure cultures of *P. vexans* inocula were prepared from PDA slants. The leaves were washed with sterile water before spraying and $1x10^8$ conidia/ml suspension was sprayed to 30 days old seedling, before flowering 60 days old and after flowering 90 days. The suspension was applied with the help of sprayer on abaxial and adaxial surfaces of leaves. The distilled water sprayed plants served as control.

RESULTS AND DISCUSSION

The data presented in the (Table 1, Fig 1) represented that all the treatments could reduce the incidence of fruit rot disease of brinjal, in compare to control; while the inoculated control showed 100 percent incidence. However, amongst the treatments applied Bavistin (T_3) was observed lowest (8.3%) incidence of fruit rot of brinjal. It was significantly most effective in comparison to the other treatments. Captan (T_4) was found to be the second best chemical in terms of lowest disease incidence which recorded(13.3%) followed by (T_5) treatment (*Trichoderma viride*) (16.6%). Among the two botanical treatments applied, *Allium sativum* extracts (T_6) was observed (21.6%) incidence whereas the extracts of *Allamanda cathertica* (T_7) recorded (25%) incidence of fruit rot disease which were found significantly better overall control (T_1) (33.3%). It was observed that ANOVA analyzed indicated that all the treatments were found statistically significant at 1% level against the development of fruit rot disease in brinjal as compared to control.

All the treatments used in the experiments reduced the incidence of fruit rot of brinjal. Among them Bavistin was noticed highest reduction of fruit rot (75%) followed by Captan (60%) and *Trichoderma viride* recorded (50.1%). The two botanical extracts applied, *Allium sativum* extract showed (35.1%) reduction while the *Allamanda cathertica* was found (24.9%) in terms of reducing the incidence over control.

Yield per plot

Data on fruit per plot were presented in (Table 2). There was significant difference among the treatments in this parameter. Perusal of data revealed that T_3 (Bavistin) recorded the maximum yield (13.66 kg) which was significantly higher than the other treatments. This was followed by T_4 (Captan) (11.5 kg), T_5 (*Trichoderma viride*) (10.3 kg), T_6 (*Allium sativum*) (9.6 kg), and T_7 (*Allamanda cathertica*) extract (9 kg).

The minimum yield per plot was observed in T_1 (control) treatment (7.5 kg). Statistically all the treatments were found significantly high effective (P≤0.05) against the increase in yield of brinjal as compared to control.

Table 1 Effect of different treatments on disease incidence against *Phomopsis* fruit rot of brinjal in field condition

Variety	Treatments	% Disease incidence	% Disease reduction over control
Bhola	T_1 (Control)	33.3 a	000
(Pusa Kranti)	T_2 (Inoculated control)	100 b	000
	T_3 (Bavistin)	8.3 c	75
	T_4 (Captan)	13.3 d	60
	T_5 (*T. viride*)	16.6 d	50.1
	T_6 (*Allium sativum*)	21.6 e	35.1
	T_7 (*Allamanda cathertica*)	25 e	24.9

Values within the same column having a common letter (s) do not differ significantly (P ≤ 0.05) by DMRT

Table 2 Effect of different treatments on yield per plot of brinjal

Variety	Treatments	Yield per plot (kg)	Yield per plot (q/ha.)	% Yield increase over control per plot
Bhola	T_1 (Control)	7.5 a	166.66	000
(Pusa Kranti)	T_2 (Inoculated control)	0 b	000	000
	T_3 (Bavistin)	13.66 c	303.55	82.13
	T_4 (Captan)	11.5 d	255.55	53.33
	T_5 (*T. viride*)	10.3 de	228.88	37.33
	T_6 (*Allium sativum*)	9.6 de	213.33	28
	T_7 (*Allamanda cathertica*)	9 e	200	20

Values within the same column having a common letter (s) do not differ significantly (P ≤ 0.05) by DMRT

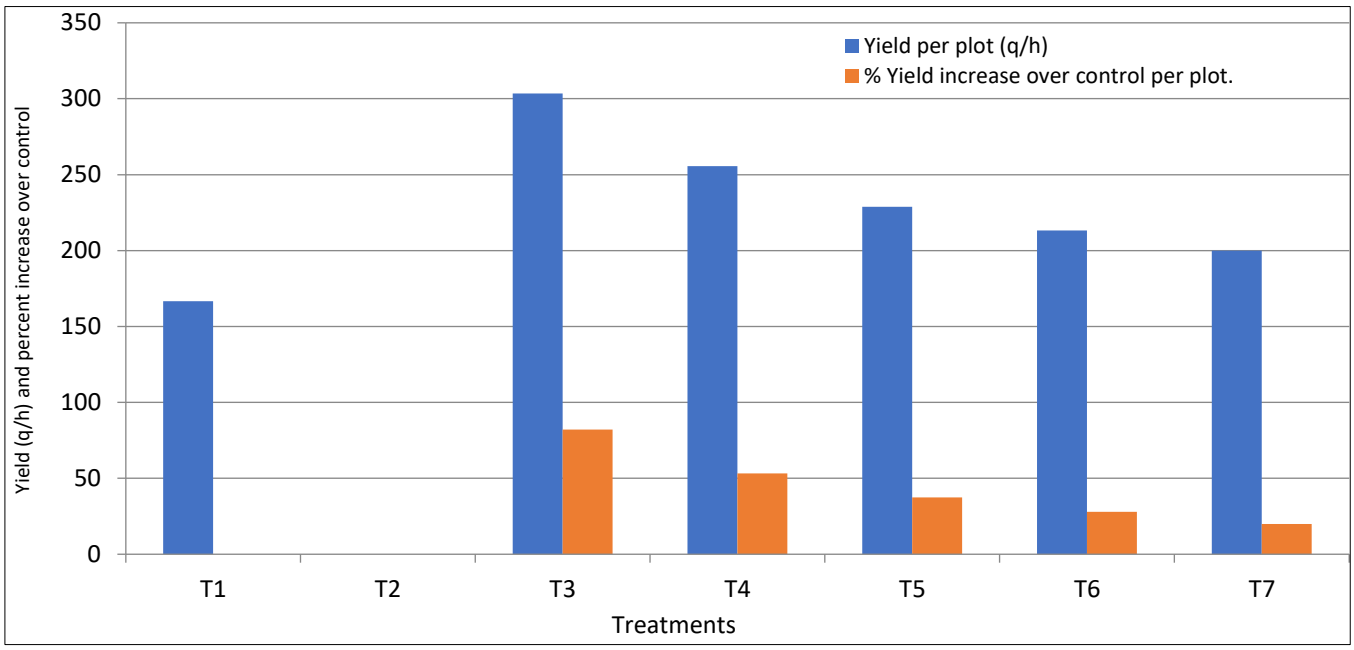

Fig 1 Effect of fungicides, *T. viride* and botanicals extracts against yield (q/h) per plot and yield increase in field condition

Yield increase in hectare per plot

The total yield of brinjal was highly influence due to application of different treatments (Table 2, Fig 1). The yield ranged from166.66 q/ha to 303.55 q/ha. Bavistin (T_3) was recorded the most effective which could significantly increase the yield to the extent of (V_1=303.55) q/ha against (82.13) percent increase over control. This was followed by Captan (T_4) resulting in (255.55) q/ha and (53.33) percent increase in yield. The next treatment (T_5) *T. viride* showed (228.88) q/ha and (37.33) percent increase in yield. However, among the two botanical extracts used *Allium sativum* extract (T_6) was found (213.33) q/ha against (28) percent increase in yield. Similarly, *Allamanda cathertica* (T_7) was recorded (200) q/ha and (20) percent yield increased over control. The lowest fruit yield was found inT_1 treatment (control) 166.66 q/ha. The effects of fungicides and the bio-agent were more potent when applied, rather than two botanical extracts. Among the treatments Bavistin when applied was found to be most effective in reducing the incidence of disease and increasing in yield over control. This may be due to inhibitory systematic protection imparted by Bavistin to the seeds of brinjal against the pathogen. Captan is the next best effective treatment, regarding the disease control and increased the yield. *T. viride* was found moderately effective treatment reducing the disease incidence as well as increased in yield. The reduction in the incidence of the disease with increase in yield may probably be attributed to the killing of the seed-borne pathogen including *Phomopsis vexans*. Among the two botanical extracts both *Allium sativum* and *Allamanda cathertica* were found to be effective in terms of reducing the disease incidence and increased the yield. The present finding is in agreement with the findings of Phansawan *et al*. [17] they reported that Carbendazim was proved the best control of *Phomopsis vexans* and increasing the yield of brinjal. Foliar spray of carbendazim (0.1%) twice thereafter at 15-day

interval which resulted in lowest disease incidence and highest fruit yield against *Phomopsis* fruit rot [18] also coincided the result of laboratory study wherein, carbendazim completely inhibited the mycelia growth of the pathogen [19]. The potentiality of *Trichoderma* spp. used as bio-pesticide for protection of several crop diseases found effective [20-22]. Garlic extract (5 and 10% w/v) inhibited the mycelial growth of *Phomopsis vexans* [23]. Seed treatment with botanicals like garlic (1:1w/v) or Allamanda (1:1 w/v) extract decreased the incidence of seedling blight. *Allium sativum* and *Allamanda cathertica* tablet controlled the seedling disease of eggplant [24]. The botanical extracts have a very good potentiality against seed borne pathogen of brinjal.

CONCLUSION

It is concluded that fruit rot disease of brinjal can be effectively managed by seed treatment and foliar application with fungicides, bio-agent and plant extracts. These were found to be most effective in terms of disease incidence and increasing the yield over control.

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