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**Original Research Article**

# Management of Fruit Rot of Brinjal Caused by *Phomopsis vexans* through Fungicides, Plant Extract and Host Plant Resistance

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**A B S T R A C T**

Experiments were conducted to assess the efficacy of different fungi toxicants and botanicals and to screen out suitable sources of resistance against phomopsis blight of brinjal caused by *Phomopsis vexans in -vitro* and *in vivo- condition.* Among fungicides, Saaf (Carbendazim 12% + Mancozeb 63% WP) @0.25% and Nativo (Tebuconazole 50% + Trifloxystorbin 25%) @ 0.2% and among botanicals, *Allamanda catheritica* @ 10 per cent concentrations completely inhibited the mycelial growth of pathogen *In Vitro*. Under field conditions, seed treatment with Saaf @ 2g/kg seed + 2 foliar spray with Contaf @ 0.1% recorded least disease intensity with highest fruit yield and registering 7.10 per cent increase in yield over control with cost benefit ratio 1: 5.40. Out of twenty varieties screened, none of the variety was found free from the disease only two test varieties Ramnagar Giant and Round Green Katedar showed moderately resistant reaction.

**Keywords**

Management, Fruit rot, *Phomopsis vexans*, Fungicides, Plants extracts, Resistance sources, Brinjal

## Introduction

Brinjal (*Solanum melongena* L.) is a common and popular vegetable crop grown in China, India, Bangladesh, Pakistan and Philippines. India is considered to be the centre of origin of cultivated brinjal from where it spread to other parts of the world. Brinjal is attacked by large no of biotic stress limiting its potential yield. In recent years, Phomopsis blight/ fruit rot of brinjal caused by *Phomopsis vexans* (Sacc. & Syd.) Harter has become one of the major constraint in its successful cultivation. The pathogen causes over 50 per cent loss in production and productivity in various parts of the world (Akhtar *et al*., 2008). The pathogen affect all the aerial parts of the plant and produced different disease symptoms such as damping off, leaf blight, stem blight and fruit rot on brinjal crop. Realizing the great economic importance of crop and disease, the study has been undertaken to evaluate fungicides, plant extract and host plant resistance for successful management of pathogen.

## Materials and Methods

The experiments were carried out in the research laboratory and the experimental field of Birsa Agricultural University, Kanke, Ranchi which is situated at 23 17' North latitude and 85 19' East longitude with an altitude of 625m above mean sea level during *Rabi*, 2016-2017 using brinjal variety "Pusa Purple Long in 3m x 4 m plot size at 50 cm x 60 cm row to row and plant to plant spacing each in completely randomized block design.To examine the inhibitory

effect of six fungi toxicants, Hexaconazole (0.1%), Tebuconazole 50% + Trifloxystrobin 25% (0.2%), Difenconazole (0.1%), Propiconazole (0.1%), Tebuconazole (0.05%), Carbendazim 12% + Mancozeb 63% (0.25%), and six botanicals viz., Garlic (*Allium sativum*) Tulsi (*Ocimum sanctum*), Ginger (*Gingiber officinale*), Pili kaner *(Allamanda catheritica*), Bael *(Aegle marmelos),* Sadabahar *(Carthemus roseus)* at 10% concentration were bio assayed against the pathogen by using poison food technique (Nene and Thapliyal,1993).

Extracts of botanicals were prepared by crushing their leaves /bulb/clove (100 g each) in 100 ml of sterilized distilled water. The extracts were then filtered through two layers of muslin cloth. Ten per cent of each extract were added to PDA and sterilized at 15 lbs/cm$^2$ pressure for 20 minutes. All the Petri plates were inoculated with 5 mm mycelial disc of pathogen in centre and incubated at room temperature (26 $\pm$ 1$^0$C) for seven days. The radial growth of the fungus was recorded for each replication individually. The growth inhibition in per cent was calculated by the formula given by Vincent (1927).

In order to find out a suitable control of the disease under artificial epiphytotic, "Pusa Purple Long variety of brinjal were raised in nursery beds, after treated with Saaf @ 0.2% (Carbendazim 12% + Mancozeb 63 %) and transplanted in 4x3 m plot size in Randomized Block Design with 3 replication. Sixty days old plants were artificially inoculated by spraying of mycelium cum spore suspension (2.4x 10$^4$ spore/ml) of the pathogen and the plots were irrigated from time to time, to maintain proper moisture. Good agronomic practices were followed to raise the crops. Four tested fungicides Tilt (0.1%), Nativo (0.2%), Saaf (0.25%), Contaf (0.2%) and two crude extract were tested as 2 sequential sprays at an interval of 15 days. The first spray was applied as soon as the first symptom of leaf blight was seen in the field. Fifteen plants were selected randomly in each plot and observation on severity of the fruit rot disease on the foliage was recorded by using 0-5 scale and per cent disease index (PDI) was worked out.

To find out host plant resistant against the pathogen, twenty genotypes of brinjal procured from HARP Palandu, Ranchi were screened under natural epiphytotic condition during *Rabi*, 2016-2017 at BAU, Ranchi, Jharkhand. Seedlings of all twenty cultivars were raised in nursery bed and 35 days after sowing transferred to the main field. A total of 40 seedlings were planted for each cultivar (5 rows and 8 plants / row). All the packages of practices were followed at the different stages of crop growth except disease management. Five plants per plot for each cultivar/variety, were inoculated with spore suspension of *P. vexans* at the vegetative stage, 5 plants at flowering stage and again 5 plants at the fruiting stage. The data on leaf blight and fruit rot were recorded at weekly interval till the completion of experiment starting with the first appearance of disease The disease intensity of leaf blight of brinjal was observed and the disease score of 1-9 point scale was followed the late blight score of potato adopted by James *et al*., (1971).

## Results and Discussion

Among fungicides, Saaf (Carbendazim 12% + Mancozeb 63% WP) and Nativo (Tebuconazole 75WP) completely inhibited the mycelial growth and sporulation of pathogen at 0.25 and 0.20 percent concentration, respectively (Table 1). Sharma and Razdan (2012) and Manna *et al*., (2004) also reported that Carbendazim

12%+ Mancozeb 63% @ 0.2% and Tebuconazole @ 0.05% completely inhibited the mycelial growth of *P. vexans*.

Among botanicals, crude leaf extract of *Allamanda catheritica* (Pilikaner) completely inhibited the mycelial growth and sporulation of pathogen at 10 per cent concentration (Table 2). Crude clove/ bulb extract of Garlic (*Allium sativum*) and Ginger (*Gingiber officinale*) were found to be the next best treatment to inhibit the growth of fungal mycelia by 87.45 and 82.14 per cent, respectively and were found at par with each other. However, the least per cent inhibition of 53.62 per cent was recorded in the crude extract of Sadababahar (*Carthemus roseus*). Islam (2004) also found 76 – 100 % inhibition of mycelial growth of *P. vexans* by Garlic clove and Allamanda leaf extracts. Inhibition of pathogenic fungi by garlic bulb extract might be due to the presence of antimicrobial compounds in the extract. Garlic contains an amino acid alliin which on crushing transferred into allicin by the action of allicinase enzymes and this allicin is toxic to the micro-organisms.

**Table.1** *In- vitro* evaluation of chemical fungi toxicants against mycelial growth of *P. vexans*

| **Chemical toxicants** | | **Dose (%)** | **radial growth** | **Percent inhibition** |
|---|---|---|---|---|
| **Chemical name** | **Trade** | | | |
| $T_1$- Hexaconazole 5% EC | Contaf | 0.1 | 3.00 | 96.61 |
| $T_2$-Carbendazim 12% + Mancozeb 63% WP | Saaf | 0.25 | 0.00 | 100.00 |
| $T_3$-Tebuconazole + Trifloxystorbin 75%WG | Nativo | 0.20 | 0.00 | 100.00 |
| $T_4$- Propiconazole 25% EC | Tilt | 0.1 | 3.00 | 96.61 |
| $T_5$- Tebuconazole 250 EC | Folicur | 0.05 | 26.00 | 70.67 |
| $T_6$- Difenconazole 25% EC | Score | 0.1 | 79.33 | 10.89 |
| $T_7$-Control | | | 89.5 | 00 |
| S.E(m) ±<br>CD at 5%<br>CV | | | 0.51<br>1.59<br>3.15 | |

**Table.2** *In vitro* evaluation of plant extracts against mycelial growth of *P. vexans*

| **Crude extract of botanicals** | **Plant part used** | **Dose (%)** | **Radial growth(mm)** | **Inhibition over control** |
|---|---|---|---|---|
| $T_1$- Pilikaner (*Allamanda catheritica*) | Leaf | 10 | 0.00 | 100 |
| $T_2$-Sadababahar(*Carthemus roseus*) | Leaf | 10 | 40.66 | 53.62 |
| $T_3$-Tulsi*(Ociumum sanctum*) | Leaf | 10 | 36.66 | 58.18 |
| $T_4$-Ginger (*Gingiber officinale*) | Rhizome | 10 | 15.66 | 82.14 |
| $T_5$- Garlic (*Allium sativum*) | Clove | 10 | 11.00 | 87.45 |
| T6- Bael (*Aegel mermelos*) | Leaf | 10 | 25.66 | 70.73 |
| S.Em ±<br>CD at 5%<br>CV | | | 0.81<br>2.47<br>4.5 | |

**Table.3** Effect of foliar spray of fungicides and botanicals against fruit rot disease and yield of brinjal

| Treatments | PDI | PDC | Yield (q/ha) | IYOC (q/ha) |
|---|---|---|---|---|
| **T1**-Seed treatment with Saaf @ 0.2% + 2 Foliar spray with crude extract of Allamanda @ 10% | 31.11 | 29.82 | 217.08 | 1.68 |
| **T2**-ST with Saaf @ 0.2% + 2 Foliar spray with Propiconazole (Tilt) @ 0.1% | 25.00 | 43.60 | 220.69 | 3.37 |
| **T3**- ST with Saaf@ 0.2% + 2 Foliar spray with Tebuconazole 50% + Trifloxystorbin 25% (Nativo) @ 0.2% | 22.78 | 48.61 | 224.36 | 5.09 |
| **T4**- ST with Saaf@ 0.2% + 2 Foliar spray with Carbendazim 12% + Mancozeb 63% (Saaf) @ 0.25% | 20.56 | 53.62 | 225.83 | 5.78 |
| **T5**- ST with Saaf@0.2%+ 2 Foliar spray with Garlic clove extract @ 10% | 36.11 | 18.54 | 215.83 | 1.10 |
| **T6**- ST with Saaf@ 0.2% + 2 Foliar spray with Hexaconazole (Contaf) @ 0.1% | 16.67 | 62.39 | 228.65 | 7.10 |
| T7-Control | 44.33 | | 213.48 | 00 |
| S.Em±<br>CD at 5 %<br>CV | 5.74<br>1.84<br>10.08 | | | |

**Table.4** Benefit-Cost Ratio

| Treatments | Yield (kg/ha) | Additional Yield (Yield-Control) | Value of additional Yield (Additional Yield x Procurement price) | Cost of application of fungici-des/ha | Net Return value of Additional yield-cost of application of fungicide | Net Return/ Cost of application of fungicides/h |
|---|---|---|---|---|---|---|
| **T1**-ST with Saaf@ 0.2% + 2 FS with crude extract of Allamanda @ 10% | 21708 | 360 | 4320 | 2100 | 2210 | 1:1.05 |
| **T2**-ST with Saaf@ 0.2% + 2 FS with Tilt @ 0.1% | 22069 | 721 | 10815 | 4250 | 6565 | 1:1.54 |
| **T3**- ST with Saaf@ 0.2% + 2 FS with Nativo) @ 0.2% | 22436 | 1088 | 16320 | 3670 | 12650 | 1:3.44 |
| **T4**- ST with Saaf@ 0.2% + 2 FS with (Saaf) @ 0.25% | 22583 | 1235 | 18525 | 2750 | 15775 | 1:7.01 |
| **T5**- ST with Saaf@0.2%+ 2 FS with Garlic clove extract @ 10% | 21583 | 235 | 3525 | 2250 | 1275 | 1:0.50 |
| **T6**- ST with Saaf@ 0.2% + 2 FS with Contaf @ 0.1% | 22865 | 1517 | 22755 | 3550 | 19205 | 1:5.40 |
| **Control** | 21348 | 00 | ---- | ---- | ---- | --- |

**Table.5** Screening of brinjal varieties/lines against Phomopsis blight pathogen

| S.N. | Varieties/Lines | PDI | | Yield q/h** | Disease Reaction |
|---|---|---|---|---|---|
| | | Leaf blight | Fruit rot | | |
| **1.** | Pusa Purple Long | 22.22(28.11) | 42.67 (40. 74) | 246.63 | S |
| **2.** | Brinjal Green Round | 17.28(24.50) | 32.22 (34. 57) | 254.23 | S |
| **3.** | Kusuma | 20.74(27.06) | 41.34 (39. 93) | 280.36 | S |
| **4.** | Hybrid Raj Kiran | 15.30(23.03) | 30.67 (33.58) | 272.20 | S |
| **5.** | Brinjal Green Long | 19.00(25.84) | 34.67 (36.03) | 280.36 | S |
| **6.** | Hybrid JK-8031 | 9.87(18.24) | 21.78 (27.76) | 340.66 | MS |
| **7.** | Hybrid KBRH-PK | 10.12(18.53) | 24.00 (29.33) | 334.45 | MS |
| **8.** | Hybrid Super Chhaya | 9.14(17.56) | 21.55 (27.63) | 352 | MS |
| **9.** | Hybrid PK 133 | 7.41(15.79) | 12.44 (20.62) | 457.28 | MS |
| **10.** | Hybrid KBRH-Blue Magic ($F_1$) | 8.64(17.05) | 15.56 (23.19) | 465.02 | MS |
| **11.** | Hybrid Utkal ($F_1$) | 13.33(21.39) | 27.78 (31.76) | 320.51 | S |
| **12.** | Pusa Kranti | 16.29(23.71) | 32.22 (34.57) | 303.8 | S |
| **13.** | KUR BR – 112 | 22.22(28.11) | 39.77 (39.06) | 318.76 | S |
| **14.** | Kusum ($F_1$) | 11.11(19.46) | 29.56 (32.90) | 320.75 | S |
| **15.** | Pratima ($F_1$) | 23.70(29.13) | 42.22 (40.51) | 263.66 | S |
| **16.** | Hybrid Mali ($F_1$) | 15.05(22.79) | 30.22 (33.34) | 297.16 | S |
| **17.** | Pusa Swarna Shyamli | 14.07(21.97) | 27.56(31.63) | 258.96 | S |
| **18.** | Ramnagar Giant | 7.41(15.79) | 9.78 (18.15) | 466.37 | MR |
| **19.** | Swarna Pratibha | 19.00(25.84) | 36.67(37.23) | 250.76 | S |
| **20.** | Round Green Katedar | 7.65(16.00) | 9.55 (17.95) | 360.95 | MR |
| | **SE(m)**<br>**CD at 5%**<br>**CV** | 1.45<br>4.19<br>11.51 | 1.65<br>4.75<br>9.04 | 49.43<br>17.20<br>9.24 | |

The results of field test with four fungicides and two botanicals seed treatment with Saaf @ 2g/kg seed + 2 foliar spray with Contaf @ 0.1% recorded least disease intensity (16.67 per cent) with highest fruit yield of 228.65 q/ha and registering 7.10 per cent increase in yield over control with cost benefit ratio 1: 5.40(Table 3 &4). Next best treatments was seed treatment with Saaf @ 2g/kg seed + 2 foliar spray with Saaf recorded 20.56 per cent disease intensity with 225.83 q/ha fruit yield and found to be superior among all treatment in respect to benefit cost ratio (1:7.01) which was closely

followed by ST with Saaf@ 0.2% + 2 Foliar spray with Tebuconazole @ 0.1%. Beura *et al*. (2008) recorded maximum per cent disease control and cost benefit ratio 1: 12.85 with four sprays of Carbendazim followed by Tebuconazole which recorded 62.67 per cent control of fruit rot and 59.52 per cent increase in fruit yield over the check plot with corresponding cost benefit ratio of 1: 9.45. Das (1998)) also reported control of Phomopsis blight of Brinjal by 3 sprayings of Bavistin and Indofil M-45 support the observation regarding foliar sprays.

Out of 20 cultivars screened to know the sources of resistance against phomopsis blight, the per cent disease intensity (PDI) for leaf blight ranged from 7.41 to 22.22 per cent and per cent disease intensity (PDI) for fruit rot ranged between 9.55 to 42.67 per cent during Rabi 2016-2017(Table 5). None of the test entries were found to be immune or resistance against the disease. However, only two test entries viz., Ramnagar Giant and Round Green Katedar showed moderately resistant reaction (9.78 and 9.55%) against fruit rot, respectively. Rest of the test entries showed moderately susceptible to susceptible reactions against the pathogen. Pandey *et al*., (2002) also evaluated forty-one brinjal entries consisting of promising varieties, lines, hybrids and local cultivars collected from different sources under natural epiphytotic conditions and observed that none of the entries was found resistant to fruit rot. Two varieties viz., Ramnagar Giant and KS-233 showed moderately resistant reaction against fruit rot.

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