

Original Research Article

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Integrated Disease Management of Stem and Root Rot of Brinjal caused by *Macrophomina phaseolina*

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ABSTRACT

During the present investigations on charcoal rot caused by *Macrophomina phaseolina* (Tassi) Goid of Brinjal (*Solanum melongena* L.), various experiments were conducted at the Department of Plant Pathology, College of Agriculture, Parbhani during 2014-2015 and 2015-16 to fulfill the objective to study the integrated management of stem and root rot disease (*M. phaseolina*) of brinjal (Pot culture). The experiment was conducted with CRD statistical design and all the treatments were replicated thrice. Overall 14 treatments were evaluated as against *M. phaseolina* (sick soil), sowing susceptible brinjal variety Rakesh in pot culture under screen house conditions. Study shows that all the treatments significantly improved the percentage of seed germination over untreated control (sick soil). On the other hand the percentage reduction in pre-emergence and post-emergence mortalities was ranged from 53.04 to 96.64 per cent and 51.95 to 94.06 per cent, respectively. However, Carbendazim 12% + Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica* and Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z.officinale* treatment were found most effective with significantly least pre-emergence seed rot and post emergence seedling mortality.

Keywords

Brinjal, *M. phaseolina*, Root rot, Stem rot etc.

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Introduction

Brinjal (*Solanum melongena* L.) is affected by several pathogens including fungi, bacteria, viruses, nematodes and phytoplasmas. The pathogen, *Macrophomina phaseolina* (Tassi.) Goid is one of the most destructive and wide spread diseases which may cause average losses of 25.60 - 48.62 % (Dinakaran *et al.*, 2005, Jaiman *et al.*, 2009) in many agronomical and horticultural crops. The pathogen being mostly soil borne and

polyphagous and hence very difficult to manage with chemicals alone. Therefore, for effective and economical management of the soil borne pathogens like *M. phaseolina*, integrated disease management is need to be explored along with fungicides and other options such as use of biocontrol agents, botanicals and organic amendments.

Therefore, present studies on stem and root rot (*M. phaseolina*) of brinjal will be undertaken with the objective of studying integrated

management of stem and root rot disease (*M. phaseolina*) of brinjal (Pot culture).

Materials and Methods

Based on the result obtained of the in vitro studies, the best and most effective fungicides, bioagents, botanicals and organic amendments (two each) will be selected and further evaluated (alone and in combination) using earthen pots (30cm dia.) for integrated management of stem/root rot disease (*M. phaseolina*) of brinjal. For the purpose *M. phaseolina* sick soil method will be employed and experiment will be conducted under controlled conditions of the screen house. Any local or improved cultivar of the brinjal most susceptible to *M. phaseolina* will be used. The experiment will be planned with CRD statistical design and all the treatments will be replicated thrice.

Results and Discussion

A total of 14 treatments were evaluated as against *M. phaseolina* (sick soil), sowing susceptible brinjal variety Rakesh in pot culture (Konde *et al.*, 2008) under screen house conditions. The results obtained on percentage seed germination, pre-emergence seed rot (PESR), post-emergence seedling mortality (PESM) and growth parameters are presented in the Table 1.

Seed germination

Result revealed that all the treatments significantly improved the percentage seed germination over untreated control (sick soil) and it was ranged from 66.67 to 98.52 per cent as against 28.89 per cent, in untreated control (sick soil). However Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica* treatment was found most effective with significantly highest seed germination (98.52 %). The second and third

best treatments found were Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z. officinale* (97.78 %) and Carbendazim 12% + Mancozeb 63% (94.08 %), both of which were at par. These were followed by the treatments *viz.*, Carbendazim 50 WP (90.37 %), Thiram 37.5% + Carboxin 37.5% (86.67 %), *Trichoderma viride* (84.45 %), *T. harzianum* (82.22 %), *T. hamatum* (80.00 %), Neem seed cake (77.78 %), Cotton seed cake (75.55 %), Groundnut cake and *A. indica* (73.33 %), *Z.officinale* (68.89 %) and *P. hystrophorus* (66.67 %).

Pre and post emergence mortalities

Results revealed that all the treatments significantly influenced both pre-emergence seed rot (PESR) and post emergence seedling mortality (PESM), caused by *M. phaseolina* in brinjal variety Rakesh.

The pre-emergence seed rot (PESR) recorded with all the treatments were ranged from 04.45 to 33.33 per cent, as against 71.11 per cent in untreated control (sick soil).

However, Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica* and Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z.officinale* treatments were found most effective with significantly least pre-emergence seed rot 4.45 and 6.67 per cent, respectively and both of which were at par.

These followed by the treatments *viz.*, Carbendazim 12% + Mancozeb 63% (8.89 %), Carbendazim 50 WP (11.11 %), Thiram 37.5% + Carboxin 37.5% (13.33 %), *Trichoderma viride I* (15.55 %), *T. harzianum* (17.78 %), *T. hamatum* (20.00 %), Neem seed cake (22.22 %), Cotton seed cake (24.45 %), Groundnut cake and *A. indica* (26.67 %), *Z.officinale* (31.11 %), and *P.hystrophorus* (33.33 %).

Table.1 Effect of fungicides, botanicals, bioagents and organic amendments on seed rot and seedling mortality in brinjal (Pot culture)

| Tr. No. | Treatments | Rate (g or ml/ kg seed or soil) | Av. Germination* (%) | Increase (%) over control | Rot / Mortality (%) | | Av. Mortality (%) | Reduction (%) over control | | Av. Reduction (%) | Final Plant Stand (%) |
|-----------------|---|---------------------------------|----------------------|---------------------------|---------------------|---------------|-------------------|----------------------------|---------------|-------------------|-----------------------|
| | | | | | PESR | PESM | | PESR | PESM | | |
| T ₁ | Carbendazim 12% + Mancozeb 63% (ST) | 2.0 g | 94.08 (77.12) | 69.29 | 08.89 (17.11) | 09.52 (17.73) | 08.56 (16.95) | 90.58 (74.84) | 87.26 (69.33) | 90.25 (72.07) | 82.22 |
| T ₂ | Carbendazim 50 WP (ST) | 1.0 g | 90.37 (72.84) | 68.03 | 11.11 (19.26) | 12.45 (20.46) | 11.41 (19.71) | 84.55 (67.00) | 83.79 (66.44) | 84.17 (66.59) | 77.78 |
| T ₃ | Thiram 37.5% + Carboxin 37.5% (ST) | 2.0 g | 86.67 (68.56) | 66.67 | 13.33 (21.41) | 15.38 (23.08) | 14.36 (22.26) | 81.22 (64.30) | 79.92 (63.36) | 80.57 (63.82) | 73.33 |
| T ₄ | <i>Trichodermaviride</i> (5 X 10 ⁶ cfu/g carrier) (ST) | 8.0 g | 84.45 (66.84) | 65.79 | 15.55 (23.12) | 18.38 (25.29) | 17.34 (24.58) | 78.19 (62.22) | 76.14 (60.79) | 77.16 (61.46) | 68.89 |
| T ₅ | <i>T. harzianum</i> (5 X 10 ⁶ cfu/g carrier) (ST) | 8.0 g | 82.22 (65.13) | 64.86 | 17.78 (24.84) | 21.58 (27.59) | 20.42 (26.84) | 74.85 (60.00) | 71.92 (58.04) | 73.39 (58.95) | 66.67 |
| T ₆ | <i>T. hamatum</i> (5 X 10 ⁶ cfu/g carrier) (ST) | 8.0 g | 80.00 (63.41) | 63.89 | 20.00 (26.55) | 25.00 (29.99) | 22.50 (28.31) | 71.82 (57.92) | 67.36 (55.14) | 69.59 (56.51) | 60.00 |
| T ₇ | Neem seed cake (SA) | 50 g | 77.78 (61.90) | 62.86 | 22.22 (28.06) | 22.73 (28.40) | 21.73 (27.77) | 68.79 (56.05) | 70.39 (57.06) | 69.59 (56.51) | 60.00 |
| T ₈ | Cotton seed cake (SA) | 50 g | 75.55 (60.39) | 61.76 | 24.45 (29.57) | 26.51 (30.97) | 25.11 (30.04) | 65.75 (54.18) | 65.34 (53.93) | 65.55 (54.06) | 55.56 |
| T ₉ | Groundnut cake (SA) | 50 g | 73.33 (58.88) | 60.60 | 26.67 (31.08) | 30.30 (33.34) | 28.49 (32.23) | 62.42 (52.18) | 60.61 (51.13) | 61.52 (51.65) | 51.11 |
| T ₁₀ | <i>A. indica</i> (SD) | 50 ml | 73.33 (58.88) | 60.60 | 26.67 (31.08) | 30.30 (33.34) | 28.49 (32.23) | 62.42 (52.18) | 60.36 (51.00) | 61.39 (51.58) | 51.11 |
| T ₁₁ | <i>Z.officinale</i> (SD) | 50 ml | 68.89 (56.11) | 58.06 | 31.11 (33.86) | 29.09 (32.62) | 30.84 (33.72) | 56.06 (48.49) | 62.51 (51.95) | 56.84 (48.93) | 48.89 |
| T ₁₂ | <i>P.hystrophorus</i> (SD) | 50 ml | 66.67 (54.72) | 56.67 | 33.33 (35.25) | 36.67 (37.21) | 35.00 (36.25) | 53.04 (46.72) | 51.95 (46.12) | 52.49 (46.41) | 42.22 |
| T ₁₃ | (Carbendazim 12%+ Mancozeb 63%) ST + <i>Trichodermaviride</i> (ST) +Neem seed cake (SA) + <i>A. indica</i> (SD) | 2.0g + 8.0g + 50g + 50ml | 98.52 (84.27) | 70.68 | 04.45 (09.97) | 04.60 (10.15) | 04.16 (11.45) | 96.64 (83.26) | 94.06 (78.41) | 95.35 (79.56) | 91.11 |
| T ₁₄ | Carbendazim 50 WP (ST) + <i>T. harzianum</i> (ST)+ Cotton seed cake (SA) + <i>Z.officinale</i> (SD) | 1.0g + 8.0g + 50g + 50ml | 97.78 (81.40) | 70.45 | 06.67 (14.96) | 07.14 (15.49) | 06.91 (15.23) | 96.61 (82.68) | 90.68 (72.20) | 93.65 (75.56) | 86.67 |
| T ₁₅ | Control | Untreated | 28.89 (32.47) | 00.00 | 71.11 (57.49) | 76.67 (61.12) | 73.52 (59.01) | 00.00 (00.00) | 00.00 (00.00) | 00.00 (00.00) | 06.67 |
| | S.E. ± | -- | 1.96 | -- | 1.72 | 2.12 | 1.92 | 2.73 | 2.74 | 1.93 | -- |
| | C.D. (P=0.05) | -- | 5.687 | -- | 5.00 | 6.16 | 5.58 | 7.91 | 7.96 | 5.60 | -- |

Similar trend in respect of the post- emergence seedling mortality (PESM) was also observed and it was ranged from 4.60 to 36.67 per cent, as against 76.67 per cent in untreated control (sick soil). Of the treatments, Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica* and Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z. officinale* were found most effective with significantly least post-emergence seedling mortality of 4.60 and 7.14 per cent respectively and both of which were at par.

These followed by the treatments viz., Carbendazim 12% + Mancozeb 63% (9.52 %), Carbendazim 50 WP (12.45 %), Thiram 37.5% + Carboxin 37.5% (15.38 %), *Trichoderma viride* (18.38 %), *T. harzianum* (21.58 %), Neem seed cake (22.73 %), *T. hamatum* (25.00 %), Cotton seed cake (26.51 %), *Z. officinale* (29.09 %), Groundnut cake and *A. indica* (30.30 %) and *P. hystrophorus* (36.67 %).

The average mortality recorded with all the treatments was ranged from 4.16 to 35.00 per cent, as against 73.52 per cent in untreated control (sick soil). However, significantly least average mortality was recorded with Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica* (4.16 %).

This was followed by the treatments viz., Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z.officinale* (6.91 %), Carbendazim 12% + Mancozeb 63% (8.56 %), Carbendazim 50 WP (11.41 %), Thiram 37.5% + Carboxin 37.5% (14.36 %), *Trichoderma viride* (17.34 %), *T. harzianum* (20.42 %), Neem seed cake (21.73 %), *T. hamatum* (22.50 %), Cotton seed cake (25.11 %), Groundnut cake and *A. indica* (28.49 %), *Z. officinale* (30.84 %), and *P. hystrophorus* (35.00 %).

Reduction in mortalities (PESR and PESM)

All the treatments were found to reduce / control both the mortalities (pre- and post-emergence) over untreated control (Table 1).

The percentage reduction in pre-emergence and post-emergence mortalities was ranged from 53.04 to 96.64 per cent and 51.95 to 94.06 per cent, respectively.

Of the treatments significantly highest reduction in PESR (96.64 %) and PESM (94.06 %) were recorded with Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica*.

The second and third best treatments found were The second and third best treatments found were Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z.officinale* and Carbendazim 12% + Mancozeb 63% with second and third highest reduction in PESR (96.61 and 90.68 %) and (90.58 and 87.26 %), respectively.

These were followed by the treatments viz., Carbendazim 50 WP (84.55 and 83.79 %), Thiram 37.5% + Carboxin 37.5% (81.22 and 79.92 %), *Trichoderma viride* (78.19 and 76.14 %), *T. harzianum* (74.85 and 71.92 %), *T. hamatum* (71.82 and 67.36 %), Neem seed cake (68.79 and 70.39 %), Cotton seed cake (65.75 and 65.34 %), Groundnut cake (62.42 and 60.61 %), *A. indica* (62.42 and 60.36 %), *Z. officinale* (56.06 and 62.51 %), and *P. hystrophorus* (53.04 and 51.95 %).

The average reduction in mortality (PESR and PESM) recorded with all the treatments were ranged 52.49 (*P.hystrophorus*) to 95.35 (Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica*) per cent over untreated control. However, significantly highest reduction in average mortality (95.35 %) was recorded with the treatment Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica*. This was followed by the treatments viz., Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z.officinale* (93.65 %), Carbendazim 12% + Mancozeb 63% (90.25 %), Carbendazim 50 WP (84.17 %), Thiram 37.5% + Carboxin 37.5% (80.57 %), *Trichoderma viride* (77.16 %), *T. harzianum* (73.39 %), *T.*

hamatum and Neem seed cake (69.59 %), Cotton seed cake (65.55 %), Groundnut cake (61.52 %), *A. indica* (61.39 %), *Z.officinale* (56.84 %), and *P. hystrophorus* (52.49 %).

Similar studies were carried out by Haque *et al.*, (2001) and Dandnaik *et al.*, (2006) they studied the integrated control of brinjal and groundnut against foot rot / collar rot / stem rot disease.

Final plant stand

It was also revealed that all the treatments imposed were found effective against *M. phaseolina*, causing stem / root rot of brinjal and encouraged better final plant standing the range of 42.22 to 91.11 per cent, as against 6.67 per cent in untreated control.

However, highest percentage of final plant stand was recorded with the treatment Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica* (91.11 %). This was followed by the treatments *viz.*, This was followed by the treatments *viz.*, Carbendazim 50 WP + *T. harzianum* + Cotton seed cake + *Z.officinale* (86.67 %), Carbendazim 12% + Mancozeb 63% (82.22 %), Carbendazim 50 WP (77.78 %), Thiram 37.5% + Carboxin 37.5% (73.33 %), *Trichoderma viride* (68.89 %), *T. harzianum* (66.67 %), *T. hamatum* and Neem seed cake (60.00 %), Cotton seed cake (55.56 %), Groundnut cake and *A. indica* (51.11 %), *Z.officinale* (48.89 %), and *P. hystrophorus* (42.22 %).

It is concluded that all the treatments significantly improved the percentage seed

germination over untreated control (sick soil). As well as all the treatments reduces or controls both mortalities i.e., pre- and post-emergence, over untreated control Treatment Carbendazim 12%+ Mancozeb 63% + *Trichoderma viride* + Neem seed cake + *A. indica* were found to be most significant with highest germination and reduction in PESR (96.64 %) and PESM (94.06 %).

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