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# Bioefficacy of antagonists against root-rot fungus *Macrophomina phaseolina* of safflower

**Vrijendra Singh, A. M. Ranaware** and **Nandini Nimbkar**
Nimbkar Agricultural Research Institute, Lonand Road, Phaltan 415523, Maharashtra, India.
nariphaltan@gmail.com

**Abstract**
Safflower (*Carthamus tinctorius* L.) is affected by a number of diseases. Though root-rot caused by *Rhizoctonia bataticola* is of minor importance, it is sporadic in some areas and as it forms a disease complex with wilt, is difficult to manage. The present investigation deals with the biological control of *Macrophomina phaseolina*-the pycnidial stage of this fungus.

A series of isolations were made from the soil of rhizosphere of healthy safflower plants. Among 13 isolates assayed for antagonism, all the seven fungi and six bacteria significantly inhibited colony growth of *M. phaseolina* in dual culture plates. In paper towel tests, four of the antagonists when used for seed treatment, did not show any detrimental effect on germination. On the contrary, the antagonist-coated seeds improved safflower germination and proved effective in protecting safflower from root-rot. Moreover, it also resulted in significant increase in root length and high vigour index. The four antagonists were later identified as *Trichoderma viride, T. harzianum, Bacillus subtilis* and *Pseudomonas fluorescens*.

**Keywords:** *Macrophomina phaseolina* – antagonists – *Trichoderma - Bacillus - Pseudomonas*

## Introduction

Safflower is affected by a number of diseases caused by fungi and a few caused by bacteria and viruses. In last few years the root-rot disease caused by the fungus *Macrophomina phaseolina* has become quite serious resulting in considerable yield losses in safflower. Seed treatment with fungicides does not protect the crop for very long. Chemical control measures like soil drenching with fungicides is uneconomical. Hence biological control method if found effective can be a promising approach for the management of root-rot caused by *M. phaseolina* in safflower.

## Materials and Methods

*R*hizosphere soil from root zone of healthy safflower plants was collected and a series of isolations were carried out on Potato Dextrose Agar (PDA) and Nutrient Agar (NA) media. Seven fungal and six bacterial isolates were obtained. Each isolate was assayed for antagonism to *Macrophomina phaseolina* individually using dual culture technique. The pathogen colony growth in dual culture plates and control plates was measured after seven days' incubation at $28^0$C. The inhibition percentage was calculated and is presented in Table 1.

On the basis of inhibition percentage all the isolates were identified to be antagonistic to *Macrophomina*. Out of them, four promising antagonists comprising of two fungi viz. *Trichoderma viride* (F-2) and *T. harzianum* (F-6) and two bacteria viz. *Bacillus subtilis* (B-4) and *Pseudomonas fluorescens* (B-6) were further tested by paper towel (blotter) method, to see their effect on germination of safflower seeds. Twenty seeds were first soaked in the suspension of *M. phaseolina* followed by coating with suspensions of the four promising antagonists separately, rolled in moist blotter and incubated at $28^0$C.

The seeds soaked only in *M. phaseolina* suspension served as control. Three replications were maintained. Ten days' later, the germination percentage, radicle and plumule lengths were measured. The vigour index was calculated by multiplying germination percentage with the sum of radicle and plumule lengths.

The reaction of seedlings raised from antagonist-coated seeds in root-rot sick soil was assayed to examine their effectiveness in controlling root-rot incidence. Fifteen seeds each coated with the four antagonists separately were planted in pots containing the sick soil and the experiment was carried out in triplicate. The pots containing sick soil with seeds not coated with any antagonist served as a control. Observations were recorded on germination percentage, radicle and plumule lengths ten days after planting.

**Results and Discussion**

Among the 13 isolates assayed all the seven fungi and six bacteria significantly inhibited colony growth. Two each of the fungal and bacterial isolates were found to be especially effective against the pathogen *Macrophomina phaseolina* (Table 1).

Table 1: Growth of pathogen and inhibition percentage in dual culture plates

| Sr. No. | Isolate no. | Radial growth of pathogen (cm) | Inhibition percentage |
|---|---|---|---|
| 1. | F-1 | 6.3 | 33.2 |
| 2. | F-2 | 2.1 | 61.4 |
| 3. | F-3 | 4.8 | 43.1 |
| 4. | F-4 | 6.0 | 35.2 |
| 5. | F-5 | 4.7 | 44.0 |
| 6. | F-6 | 2.3 | 59.6 |
| 7. | F-7 | 5.8 | 36.6 |
| 8. | B-1 | 6.7 | 30.5 |
| 9. | B-2 | 4.8 | 42.9 |
| 10. | B-3 | 4.7 | 43.5 |
| 11. | B-4 | 2.0 | 61.9 |
| 12. | B-5 | 4.6 | 44.2 |
| 13. | B-6 | 2.4 | 59.2 |
| 14. | Control | 9.0 | 0 |
| | General Mean | 4.73 | 42.52 |
| | CD (0.05) | 0.61 | 4.18 |
| | SEm $\pm$ | 0.21 | 1.4 |
| | C.V. (%) | 7.72 | 5.84 |

Treating with antagonists did not have any adverse effect on germination of safflower seeds. There was a significant increase in radicle length of seeds coated with the antagonists compared to the control. The plumule lengths of the antagonist-coated seeds and control were at par with each other. Seeds treated with the antagonists showed a significantly higher vigour index than that of control (Table 2).

Table 2: Response of antagonist-coated seeds against root-rot fungus *Macrophomina phaseolina* of safflower on blotter

| Sr. no. | Antagonists | Germination Percentage | Radicle length (cm) | Plumule length (cm) | Vigour index |
|---|---|---|---|---|---|
| 1. | *Trichoderma viride* (F-2) | 90.0 | 13.1 | 5.5 | 1676.7 |
| 2. | *T. harzianum* (F-6) | 90.0 | 10.0 | 4.9 | 1346.3 |
| 3. | *Bacillus subtilis* (B-4) | 81.7 | 10.5 | 6.9 | 1427.2 |
| 4. | *Pseudomonas fluorescens* (B-6) | 85.0 | 9.4 | 5.1 | 1233.0 |
| 5. | Control (*Macrophomina phaseolina)* | 73.3 | 7.3 | 5.5 | 941.8 |
| | General mean | 84 | 10.09 | 5.59 | 1325 |
| | CD (0.05) | N.S. | 1.13 | N.S. | 324.63 |
| | SEm ± | 5.82 | 0.35 | 0.26 | 99.37 |
| | C.V. (%) | 12.0 | 5.96 | 7.92 | 12.99 |

Antagonist-coated seeds in pots containing sick soil gave significantly better germination percentage compared to the control. Radicle and plumule lengths of the seedlings from the antagonist-coated seeds were also significantly better than those of control (Table 3). The efficacy of antagonists in the control of *M. phaseolina* has been reported earlier in soybean (Vyas, 1994) and sesamum (Sankar and Jeyarajan, 1996)

Table 3 : Response of antagonist-coated seeds against *Macrophomina phaseolina* of safflower in root-rot sick soil in pots

| Sr. no. | Antagonists | Germination Percentage | Radicle length (cm) | Plumule length (cm) |
|---|---|---|---|---|
| 1. | *Trichoderma viride* (F-2) | 91.1 | 18.3 | 5.2 |
| 2. | *T. harzianum* (F-6) | 86.7 | 16.4 | 5.1 |
| 3. | *Bacillus subtilis* (B-4) | 82.2 | 20.9 | 4.2 |
| 4. | *Pseudomonas fluorescens* (B-6) | 73.3 | 16.7 | 4.3 |
| 5. | Control | 37.8 | 11.2 | 3.1 |
| | General mean | 74.22 | 16.7 | 4.4 |
| | CD (0.05) | 13.37 | 1.99 | 0.84 |
| | SEm ± | 4.09 | 0.61 | 0.25 |
| | C.V. (%) | 9.55 | 6.35 | 10.2 |

It is concluded that seed treatment of *Trichoderma viride, T. harzianum, Bacillus subtilis* and *Pseudomonas fluorescens* as antagonists is effective for management of root-rot fungus *Macrophomina phaseolina* of safflower.

**References**

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