CERTAIN STUDIES ON THE MANAGEMENT OF *P. APHANIDERMATUM* CAUSING RHIZOME ROT OF TURMERIC BY USING FUNGICIDES AND BIO INOCULANTS

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Abstract

Turmeric is infected by many fungal, bacterial, viral, nematode diseases. Among all rhizome rot caused by *P. aphanidermatum* is most destructive and widespread disease causing very high crop loss under favorable conditions. Results revealed that all the fungicides tested @ 500, 1000 and 1500 ppm significantly inhibited the mycelial growth of *P. aphanidermatum*, over untreated control. Further, per cent mycelia inhibition was increased with increase in concentration of the fungicides tested. Of the antagonists tested, *T. viride* was found to be most effective with maximum mycelial inhibition of the test pathogen followed by *T. hamatum* and *T. harzianum*.

Keywords: Turmeric, *T. viride*, antagonists, fungicides, bio efficacy

Introduction

Turmeric (*Curcuma longa* L.) is one of the major spices cultivated for its underground rhizome. It is also called as hidden Lilly or golden spice or turmeric of commerce or Indian saffron. Turmeric is the third largest spice produced in the country and it accounts for about 14% of total spices produced in India. India is the world’s largest producer of turmeric and apparently accounts for more than 80 percent of the world’s production. The area, production and productivity of turmeric in India has been reported to be 175.73 and 185.58 thousand hectares, 959.35 and 943.33 thousand tones and 5459 and 5083 kg/ha, respectively, during year 2014-15 and 2015-16 (Anonymous, 2016). The total area in TN under turmeric was 11.0 thousand hectares, with production 11.0 thousand tonnes and productivity of 1000kg/ha, respectively (Anonymous, 2015). Turmeric is infected by many fungal, bacterial, viral, nematode diseases. Among all diseases rhizome rot caused by *P. aphanidermatum* is most destructive and widespread disease causes very high crop loss under favorable conditions (Rathaiah, 1982). The disease has been reported to causes more than 60 percent mortality of seedlings both in nursery and field condition and about 50-80 percent losses during storage (Nirmal, 1992). Experiments were done to find out the efficacy of certain fungicides and bio agents in inhibiting the growth and development of *P. aphanidermatum* under *in vitro* conditions.

Materials and Methods

**In vitro evaluation of fungicides**

Efficacy of five fungicides viz., Carbendazim 50 WP, Metalaxyl 50 WP, Hexaconazole 5 EC, Penconazole 10 EC and Fosetyl –AL 80 WP were evaluated *in vitro* at various concentrations against *P. aphanidermatum*, applying poisoned food technique (Nene and Thapliyal, 1993) and using potato dextrose agar (PDA) as basal culture medium. Based on active ingredient, requisite quantity of the test fungicides was calculated, mixed separately thoroughly with autoclaved and cooled (40 °C) PDA medium in conical flasks to obtain desired concentrations. This PDA medium amended separately with the test fungicides was then poured (20 ml/plate) aseptically in Petri plates (90 mm dia.) and allowed to solidify at room temperature. 3 replication were maintained. After solidification of the PDA medium, all the plates were inoculated aseptically by placing in the centre a 5mm culture disc obtained from actively growing 7 days old culture of *P. aphanidermatum* and incubated in an inverted position at 28± 2°C. Petri plates filled with plain PDA (without any fungicide) served ascontrol. Observations on radial mycelial growth / colony diameter were recorded at an interval of 24 hours and continued till any plate was fully covered with mycelial growth of the test pathogen. Percent inhibition was calculated by applying formula of Vincent, 1927.

Assessing the Efficacy of Bio Agents

Three fungal and two bacterial bioagents viz., *Trichoderma viride*, *Trichoderma harzianum*, *Trichoderma hamatum*, *Pseudomonas fluorescens*, *Bacillus subtilis* were evaluated *in vitro* against *P. aphanidermatum*, applying dual culture technique (Dennis and Webster, 1971). Seven days old cultures of the test bioagents and test pathogen (*P. aphanidermatum*) grown on PDA were used for the
study. Two 5mm culture discs, of each of the test pathogen and test bioagent were cut out with sterilized cork borer and placed at equidistance, exactly opposite to each other on autoclaved and solidified PDA medium in petriplates and incubated at 28±2°C. PDA plates inoculated with test pathogen alone served as control.

Observations on linear mycelial growth of the test pathogen and test bioagent were recorded at an interval of 24 hour still any plate was fully covered with mycelial growth of the test pathogen. Percent inhibition of the test pathogen with the test bioagent, over untreated control was calculated by applying formula (Arora and Upadhyay, 1978).

Results and Discussion

Evaluation of various fungicides against *P. aphanidermatum*

Results revealed that all the fungicides tested (500, 1000 and 1500 ppm) significantly inhibited mycelia growth of *P. aphanidermatum*, over untreated control. Further, per cent mycelia inhibition was increased with increase in concentration of the fungicides tested. Of all the fungicides, Metalaxyl gave per cent (100%) mycelial inhibition with all three concentrations. The next best fungicide was Carbendazim 50 WP which recorded percent mycelial inhibition at all three concentrations. Hexaconazole 5 EC and Fosetyl-AL showed lesser degree of success recording 77.9 & 76.34% inhibition.

Table 1: *In vitro* bioefficacy of fungicides against *P. aphanidermatum*

<table>
<thead>
<tr>
<th>Tr. No.</th>
<th>Treatments</th>
<th>Colony Dia. <em>(mm)</em></th>
<th>% Inhibition *at ppm</th>
<th>Av. inhibition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>500</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>T1</td>
<td>Carbendazim 50 WP</td>
<td>5.98b</td>
<td>0.00a</td>
<td>0.00a</td>
</tr>
<tr>
<td>T2</td>
<td>Metalaxyl 50 WP</td>
<td>0.00b</td>
<td>0.00b</td>
<td>0.00b</td>
</tr>
<tr>
<td>T3</td>
<td>Hexaconazole 5 EC</td>
<td>17.24b</td>
<td>11.08b</td>
<td>8.22b</td>
</tr>
<tr>
<td>T4</td>
<td>Penconazole 10 EC</td>
<td>22.72d</td>
<td>16.78b</td>
<td>10.92b</td>
</tr>
<tr>
<td>T5</td>
<td>Fosetyl—AL 80 WP</td>
<td>17.28c</td>
<td>12.18b</td>
<td>8.24b</td>
</tr>
<tr>
<td>T6</td>
<td>Control</td>
<td>90.00c</td>
<td>90.00c</td>
<td>90.00c</td>
</tr>
</tbody>
</table>

Table 2: *In vitro* bioefficacy of bioagents against *P. aphanidermatum*

<table>
<thead>
<tr>
<th>Tr. No.</th>
<th>Treatments</th>
<th>Colony dia. of test pathogen <em>(mm)</em></th>
<th>% inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td><em>Trichoderma viride</em></td>
<td>13.28b</td>
<td>85.24b</td>
</tr>
<tr>
<td>T2</td>
<td><em>Trichoderma hamatum</em></td>
<td>24.18b</td>
<td>73.18b</td>
</tr>
<tr>
<td>T3</td>
<td><em>Pseudomonas fluorescens</em></td>
<td>17.42b</td>
<td>80.64b</td>
</tr>
<tr>
<td>T4</td>
<td><em>Bacillus subtilis</em></td>
<td>48.92d</td>
<td>45.64d</td>
</tr>
<tr>
<td>T6</td>
<td>Control (untreated)</td>
<td>90.00c</td>
<td>0.00c</td>
</tr>
</tbody>
</table>

In *vitro* evaluation of bio agents against *Pythium aphanidermatum*

Results revealed that all the bioagents evaluated exhibited significant fungi static/antifungal activity against *Pythium aphanidermatum* and inhibited its growth, over untreated control. Of the antagonists tested, *T. viride* was found most effective with highest mycelial inhibition of the test pathogen. The second and third inhibitor antagonists were *T. hamatum* and *T. harzianum* with an inhibition of percentage of (85.24 & 80.64%), respectively. However, *Bacillus subtilis* and *P. fluorescens* were found least effective recording percent mycelial inhibition of (45.64 & 42.02%) respectively.

These results are in conformity with the earlier findings of workers who reported that fungicides are significantly superior in inhibiting the mycelial growth of *P. aphanidermatum* infecting turmeric (Rekha 2006).

The present results are in conformity with the earlier findings of those workers who reported that bioagents viz., *Trichoderma viride, Trichoderma hamatum, Trichoderma harzianum, Pseudomonas fluorescens* and *Bacillus subtilis* had significantly inhibited mycelial growth of *P. aphanidermatum* infecting turmeric (Sagar, 2006; Ushamalini et al., 2008; Anoop & Bhai, 2014), *P. aphanidermatum* *P. myriotylum* & *Pythium* spp. infecting ginger (Bhai et al., 2005; Sagar, 2006; Kadam, 2014; Dhroo et al., 2015).
Fig. 1 Endotrophic mycorrhiza (e-g) *Neottia*

Fig. 2 Bladderworts (e-g) *Utricularia* sp.

References


