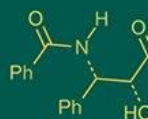


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In vitro evaluation of fungicides efficacy against *Rhizoctonia solani* causing root rot of chilli

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Abstract

Chilli (*Capsicum annum*. L.) is an important commercial crop of India, where *Rhizoctonia* spp. causes the most devastating root rot disease with severe loss in yield each year. An experiment was conducted in 2023-24 in which the efficacy of fungicides against *Rhizoctonia* spp. was evaluated. Among 11 fungicides tested, Tebuconazole 25.9% W/W, Mancozeb 75% WP, Carbendazim 50% WP, Thiophanate methyl 70% WP and Carbendazim 12% + Mancozeb 63% WP were found to be most effective with complete (100%) inhibition of mycelial growth of pathogen at all concentrations i.e., (0.1%, 0.2% and 0.3%), respectively. The minimum inhibitions were recorded by Tetraconazole 3.8% W/W (54.82%, 67.31% and 75.27%) followed by Azoxystrobin 23% SC (33.88%, 64.07% and 80.38%) at all concentration (0.1%, 0.2% and 0.3%), respectively.

Keywords: *Rhizoctonia* spp., devastating, fungicides, concentration

Introduction

Chilli (*Capsicum annum* L.) belonging to Capsicum genus and Solanaceae family is an important commercial crop grown in India. It is reported to be a native of South America. It is valued principally for its high pungency and colour. India is the world's biggest producer, consumer, and exporter of chilli. India's chilli production estimate was 20.60 lakh tonnes in 2022-2023 as against 18.36 lakh tonnes in 2021-22. The cultivation of chillies spans across almost all states in India. Major states contributing significantly to production shares include Andhra Pradesh (37.35%), Telangana (23.11%), Madhya Pradesh (15.83%), Karnataka (9.85%), Orissa (3.80%), Maharashtra (1.27%), Gujarat (1.19%) and Tamil Nadu (1.15%). Several fungal, viral, bacterial and nematode diseases affect chilli crop. Among these, root rot of chilli has attained the economic importance caused by *Rhizoctonia solani*. It is a soil-borne fungus and is one of the most destructive plant pathogens, affecting around 250 host plant species. It was identified based on morphological and colony characteristics includes septate hyphae, multinucleate young cells, brown mature hyphae, right-angled branching with constriction, dolipore septa and uniform-textured black sclerotia.

The major Symptoms include wilting and yellowing, starting with dark to light brown stem lesions, drooping of leaves and plants wilt gradually. Infected plants show reduced vigour and poor production, while mature plants dry suddenly. Seedlings die shortly after the germination.

Rhizoctonia sp., causes significant economic loss globally. It can cause up to 33.2 percent disease incidence of the seedling in greenhouse condition and in main field 40.2 percent. It is challenging to calculate yield losses on a single plant since many distinctive symptoms occur below the soil surface.

Keeping in mind the seriousness of disease, it was planned to elucidate the efficacy of fungicides, botanicals and bioagents against the pathogen *Rhizoctonia solani* and also to evolve suitable management strategies to prevent the losses incurred due to root rot of chilli.

Materials and Methods

Isolation, Identification and Pathogenicity

For the purpose of isolation of the pathogen, standard tissue isolation technique was used. Diseased root portions were cut into small bits, washed well in tap water, surface sterilized with 1:1000 sodium hypochlorite for 30 second, then washed thoroughly in sterilized

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distilled water three times to remove traces of sodium hypochlorite and then aseptically transferred to sterile Petri plates containing PDA medium. The plates were incubated at room temperature ($27 \pm 2^\circ \text{C}$). Based on the morphological and cultural characteristics the fungus was identified as *Rhizoctonia solani*.

The fungal culture was purified by hyphal tip method and culture obtained was maintained on Potato Dextrose Agar (PDA) medium slants by adopting subsequent sub-culturing at periodical, regular intervals for mass multiplication of the test pathogen. Sand: maize medium (90 gm sand + 10 gm crushed maize grains with 10 ml distilled water) was prepared, filled into the conical flasks (250 ml cap) and autoclaved at 15lbs pressure for 15 min. The flasks containing the sterilized sand: maize medium was inoculated with mycelial disc of test pathogen (5 mm dia.) and incubated at $27 \pm 2^\circ \text{C}$ for 15 days and used for soil inoculation.

Soil was sterilized with formalin for 15 days. The mass multiplied inoculum was added in 1:3 proportions to soil and thoroughly mixed to make the soil sick. The sick soil was filled in sodium hypochlorite sterilized pots. Chilli seeds per pot were sown and the initial root rot symptoms were recorded within 21 days after sowing.

The culture obtained after re-isolation was in resemblance with original one and hence pathogenicity was proved.

The fungicides were evaluated by poison food technique. Potato Dextrose Agar (PDA) medium was prepared, distributed equally measuring 100 ml in 250 ml flask and sterilized in autoclave. The desired quantity of fungicides was added to sterilize melted (45°C) PDA to obtain desired concentration. The flask containing poisoned medium was shaken well to have uniform distribution. About 10-15 ml melted poisoned PDA was poured in each sterilized petri plate and allowed it to solidify. Then these petri plates were inoculated by fungus separately. 5 mm disc of about one week old fungus culture was cut and transferred aseptically in the Centre of petri plates containing poisoned medium. Three replications were maintained for each fungicide of each concentration. The control petri plates were allowed to grow in same condition on PDA medium without fungicides. Treated plates were incubated at room temperature ($27 \pm 2^\circ \text{C}$) for seven days. Colony diameter was recorded in mm on 3rd, 5th, and 7th day and percent mycelial growth calculated as per Vincent's formula based on average colony diameter. The data was subjected to statistical analysis.

$$\text{Per cent inhibition} = \frac{C - T}{C} \times 100$$

Where,

C = Growth of the test fungus in untreated control plates.

T = Growth of the test fungus in treated plates.

Observations on days to initiation of disease symptoms from the date of inoculation, radial mycelia growth (mm), percent mycelial growth inhibition and percent disease incidence of pathogen were recorded.

'F' test of significance was used to know whether observed treatment effects were real or not from the data in which the treatment effects were significant. The standard error (SE) and critical difference (CD) at 1% level of probability were calculated.

Results and Discussion

The results of the fungicides treatments are presented in table below fungicides treatments reported that T₂ (Tebuconazole), T₅ (Mancozeb 75% WP), T₆ (Carbendazim 50% WP), T₇ (Thiophanate methyl 70% WP), T₁₀ (Carbendazim 12% + Mancozeb 63% WP), were completely (100%) inhibited the mycelial growth of *R. solani* and found most effective at all concentrations (0.1%, 0.2% and 0.3%), respectively. Followed by T₄ (Propiconazole 13.9% + Difenoconazole 13.9% EC) reported inhibition of 84.27%, 86.83 and 100%, T₁₁ (Benalaxyl-M 4% + Mancozeb 65% WP) 81.47%, 85.27% and 89.27%, T₉ (Metalaxyl 35% WS) 73.88%, 80.74% and 89.50%, T₈ (Propineb 70% WP) 60.93%, 73.80% and 85.13%. The minimum inhibitions were recorded by T₁ (tetraconazole 3.8% W/W) 54.82%, 67.31% and 75.27% followed by T₃ (Azoxystrobin 23% SC) 33.88%, 64.07% and 80.38% at (0.1%, 0.2% and 0.3%) respectively.

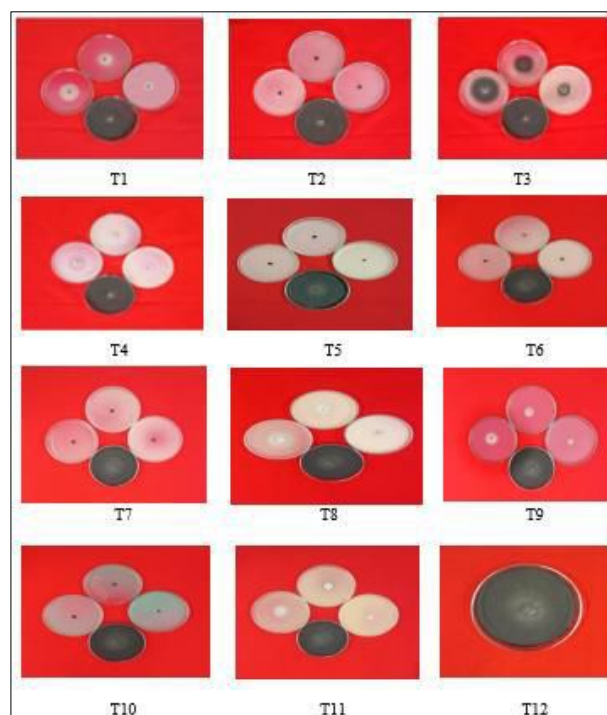


Fig 1: Efficacy of Different Fungicides on the Mycelial Growth Inhibition of *Rhizoctonia solani* at Various Concentrations

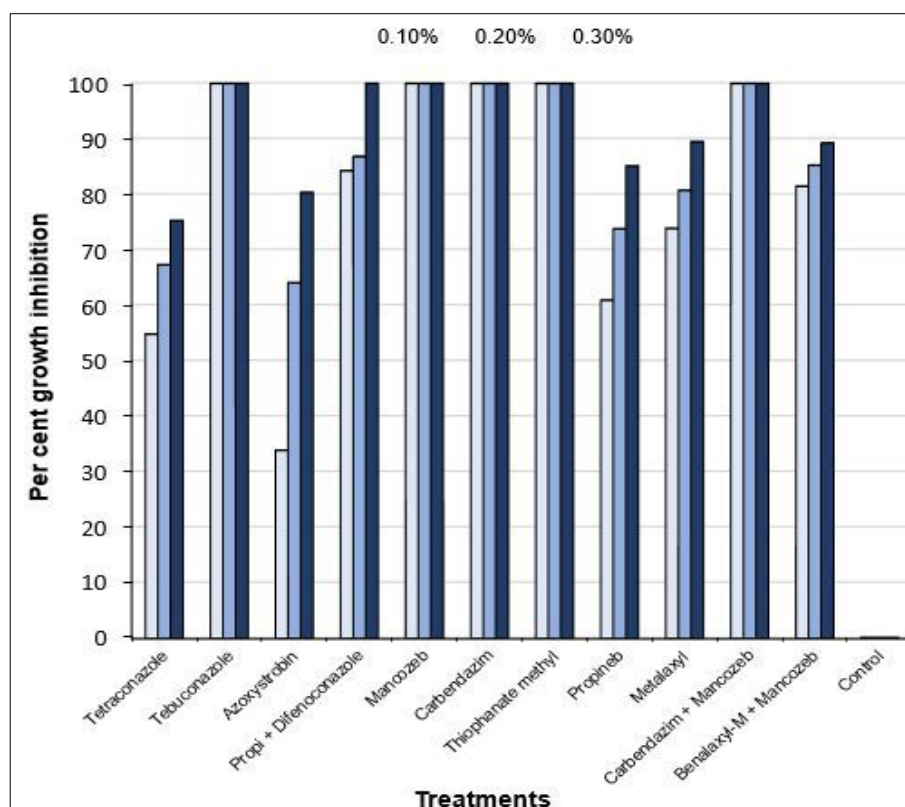


Fig 2: Percentage Inhibition of Mycelial Growth of *Rhizoctonia solani* by Different Fungicide Treatments at 0.1%, 0.2%, and 0.3% Concentrations

The results recorded for the fungicides treatments in Table were similar to Srinivas *et al.* (2014) [7] reported that Thiophanate methyl, Carbendazim + Mancozeb and Mancozeb showed 100% inhibition while Propineb showed 96.27% inhibition. Amrutha and Reshmi (2020) [1] and Sigdel *et al.* (2022) [6] reported that 100% inhibition of *Rhizoctonia solani* observed due to Carbendazim 50% WP, Carbendazim 12% + Mancozeb 63% (SAAF) at different concentrations. Punam *et al.* (2020) [9] reported Propiconazole 13% + Difenconazole 13.9% SC and Carbendazim 50% showed complete inhibition while Azoxystrobin 23% SC showed 21.11% inhibition at 0.1% concentration. Debbarma *et al.* (2021) [3] reported carbendazim 95.96% and tebuconazole 91.21% showed the maximum inhibition, while other fungicides like metalaxyl reported inhibition of 55.55% of inhibition, and Azoxystrobin at 0.28% reported 58.66% of mycelial growth inhibition. Babli *et al.* (2022) [2] reported Carbendazim and Tebuconazole completely inhibited test fungus. Poonacha *et al.* (2023) [5] reported that Propineb 70% WP showed mycelial growth of 9.26% at 2000 ppm and Difenconazole 25% EC, Carbendazim 50% WP, Propiconazole 25% EC, Tebuconazole 250 EC completely inhibited the test fungus at 500, 1000 and 1500 ppm concentration, respectively.

Conclusion

The research was made to evaluate the *in vitro* efficacy of 11 fungicides tested against *R. solani* by poisoned food technique. The results revealed that Tebuconazole 25.9% W/W, Mancozeb 75% WP, Carbendazim 50% WP, Thiophanate methyl 70% WP and Carbendazim 12% + Mancozeb 63% WP were found to be most effective with complete (100%) inhibition of mycelial growth of pathogen at all concentrations i.e., (0.1%, 0.2% and 0.3%), respectively.

The minimum inhibitions were recorded by Tetraconazole 3.8% W/W (54.82%, 67.31% and 75.27%) followed by Azoxystrobin 23% SC (33.88%, 64.07% and 80.38%) at (0.1%, 0.2% and 0.3%) respectively.

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