Original Research Article

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In vitro Evaluation of Fungicides and Bioagents against Alternaria raphani Inciting Alternaria Blight of Radish

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Abstract

The effect of fungicides and bioagents on Alternaria blight of radish caused by Alternaria raphani. Effect of six fungicides viz. Mancozeb, Carbendazim, Ridomil-MZ, Copper oxychloride, Propiconazole and Hexaconazole at (100, 250, 500, 750 and 1000 ppm) were evaluated to see their efficacy. The observations were recorded Hexaconazole (100%) maximum mycelium growth inhibition while Copper oxychloride found minimum mycelium growth inhibition i.e. (21.57, 28.88, 36.13, 45.55 and 60.17%) at all five concentrations. Among three bioagents T.harzianum was found (60.71%) maximum per cent mycelium inhibition while minimum was observed in B. cereus (14.69%).

Keywords
Radish, Alternaria blight, Alternaria raphani, Fungicides, Hexaconazole, Bioagents, Trichoderma harzianum

Introduction

Radish (Raphanus sativus L.) is a most important edible root vegetable of the family Brassicaceae, which grown throughout the year, being mostly eaten raw as a crunchy salad and leaves also used. In general, radish contains carbohydrates, vitamins, proteins and dietary fiber. While it also appears in continental cuisine. It grown as companion as well as catch crops in India. Alternaria leaf blight of oilseed brassicas is known to be incited by three species namely Alternaria brassicae (Berk.) Sacc., Alternaria brassicicola (Schw.) Wiltshire., Alternaria raphani Groves and Skolko (Jasalavichet al., 1995; Saharan and Mehta, 2002). Alternaria blight is the most devastating causing yield loss of 35-38% (Kolte et al., 1987). Meenu and Hundal (2004) reported that seed yield losses due to Alternaria blight in radish is about (46.48%) and varied from year to year.
The radish crop is severely affected by Alternaria blight caused by *Alternaria raphani* during both seed and root crop production. All foliage is full of small, circular spots and very destructive at siliqua formation stage where all floral part, pods peduncle and seeds become black (Mangala et al., 2006). Tu et al., (2015) they found against *A. brassicae* i.e. (60.84, 100, 100 and 100%) at different concentrations viz. (100, 250, 500 and 1000 ppm) in Hexaconazole. Khalse et al., (2017) found that against Alternaria leaf spot of cabbage caused by *Alternaria brassiace*. The bioagents that maximum inhibition of mycelial growth was recorded in T1- Trichoderma harzianum (65.21%) followed by T2- Pseudomonas fluorescens (62.41%). In present investigation applied fungicides and bio-control agents in a compatible manner for effective management of *Alternaria raphani*.

**Materials and Methods**

The present investigation was conducted in laboratory of the Department of Plant Pathology, College of Horticulture, VCSGUUHF, Bharsar (Pauri Garhwal) Uttarakhand. Alternaria specimen diseased portion along with healthy part of the specimen were cut into small pieces with the help of sterilized scissors and then surface sterilized by immersing in 0.1% mercuric chloride (HgCl2) or (70%) ethanol for about 30 seconds. After that, the specimens were washed thoroughly at least three changes of sterilized water and specimen were transferred into Petri plates containing PDA medium and incubated at 25±1ºC for 96 hours. Pathogenic isolates from respective host plant species were isolated from the moist chambers as well as on PDA Petri plates. All the isolates were cultured under sterilized conditions in a laminar air flow and incubated at 25±1ºC for 4 days till proper growth Shoaib et al., (2017). Culture was purified from single colony appearing on PDA after observed under microscope and maintained on PDA slants at 4ºC in a refrigerator for further use. The shape and size of conidia/spore arrangement was studied.

**In vitro efficacy of fungicides:** Six fungicides viz. Mancozeb, Carbendazim, Ridomil MZ, Copper oxy chloride(CoC), Propiconazole and Hexaconazole at five concentrations i.e.100, 250, 500, 750 and 1000 ppm were evaluated using the poisoned food technique (Nene and Thapliyal, 1993).Inoculated plates were incubated at 25±1º C for 96 hours. Average radial mycelia growth in (mm) was calculated, (r) is radius of diameter, per cent mycelium growth inhibition was calculated by formula and mentioned in below.

**In vitro efficacy of bioagents:** Three bio agents viz. Bacillus cereus, Trichoderma harzianum and Pseudomonas fluorescens were evaluated using dual culture technique (Faheem et al., 2010). The bioagents and the test fungus were inoculated both sides on a single Petri plates containing solidified PDA with five replications for each treatment. Control was also run along with the other treatments. Inoculated plates were incubated at 25±1º C for 96 hours. The radial growth of the colony of bioagents and the pathogen measured in two directions and average radial mycelial growth was recorded. Per cent mycelium growth inhibition was calculated by using the following formula given by Vincent (1947).

\[
\text{Per cent mycelium inhibition} = \frac{C - T}{C} \times 100
\]

Where,

C= radial growth in control
T= radial growth in treatment
The data obtained and analyzed by using standard statistical procedure in the simple completely randomized design (CRD) with the help of OPSTAT.

**Results and Discussion**

**Effect of fungicides**

The data recorded and presented in (Fig-1) among all the fungicides Hexaconazole was found most effective with maximum mycelium inhibition (100%) at all concentration which was followed by Propiconazole (75.86, 100, 100, 100 and 100%), Mancozeb *i.e.* (40.14, 52.86,58.13, 100 and 100%), Carbendazim and Ridomil-MZ. Copper oxychloride among all fungicides least effective at all concentrations *i.e.* (21.57, 28.88, 36.13, 45.55 and 60.17%).

Similar observations also found by Tu *et al.*, (2015) against *A. brassicaei.e.* (60.84, 100, 100 and 100%) at different concentrations viz.(100, 250, 500 and 1000 ppm)in Hexaconazole. Jakatimath *et al.*, (2017) evaluated fungicides against fruit rot of brinjal (*A.alternata*) and found that increased in all the fungicides when concentrations were increased. Difenoconazole and Tebuconazole were recorded 100.00% inhibition at all the concentration tested and hence recorded mean inhibition of 100.00 %. Propiconazole (91.25%) and Carbendazim (85.41%) were the next most effective fungicides when mean per cent inhibition was considered. Panwar *et al.*, (2013) tested seven fungicides *i.e.* mancozeb, tebuconazole, myclobutanil, tricyclazole, metalaxyl + mancozeb, carbendazim and hexaconazole at (0.05, 0.10 and 0.20%) concentrations, among these three fungicides *viz.*, tebuconazole, myclobutanil and hexaconazole completely inhibited growth of test pathogen at all concentrations.

**Fig.1** Effect of fungicides on per cent mycelium growth inhibition of (*A.raphani*) at different concentration

![Fig.1 Effect of fungicides on per cent mycelium growth inhibition of (*A.raphani*) at different concentration](image)

**Fig.2** Effect of bioagents on per cent mycelium growth inhibition of (*A. raphani*).
Effect of biocontrol agents

Effect of three bio-agents were observed and presented in (Fig. 2). *Trichoderma harzianum* was found (60.17%) maximum per cent mycelium growth inhibition followed by *Pseudomonas fluorescens* (49.07%) and least inhibition was recorded in *Bacillus cereus* (14.69%). Waghe et al., (2015) observed against Alternaria blight, *A. helianthi* (Hansf) of sunflower; fungal bioagents *T. harzianum* was found maximum per cent mycelium growth inhibition followed by *Pseudomonas fluorescens* (49.07%) and least inhibition was recorded in *Bacillus cereus* (14.69%).

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