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RESEARCH ARTICLE

Chemical management of anthracnose of chilli (*Capsicum annuum* L.)

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ABSTRACT

Anthracnose of chilli caused by *Colletotrichum capsici* is a serious disease affecting the yield and quality of fruits. *In vitro* and field experiments were conducted to evaluate the efficacy of Propiconazole (0.1%), Captan, (0.2%), Carbendazim (0.2%), Carboxin 37.5 per cent + Thiram 37.5 per cent (0.1%) and Thiram (0.2%) against anthracnose of chilli. The highest degree of mycelium inhibition was observed with Propiconazole, followed by Captan and Vitavax power. In field evaluation of fungicides, Propiconazole was found most effective at 0.1 per cent concentration showing least percentage disease index of 20.32 per cent as against 62.15 per cent in control, followed by Vitavax power and Captan. Propiconazole recorded highest yield (18.76 kg/plot) followed by Vitavax power.

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INTRODUCTION

Chilli (*Capsicum annuum* L.) is an important cash crop grown under both tropical and subtropical conditions. India is the largest grower, consumer and exporter of chilli, currently exporting dry chilli and chilli products to over 90 countries around the world (Singal, 1999). Various biotic and abiotic stresses cause immense losses to the chilli crop throughout the world. Among the biotic stresses, anthracnose and ripe fruit rot of chilli caused by the fungus [*Colletotrichum capsici* (Syd.) Butl. and Bisby], is the most serious disease and has national importance as it affects the crop during the early stage and continues till harvest and causes necrosis of the tender branches and rottening of the ripe fruits. The fungus is distributed throughout the tropics and very commonly occurs in chilli growing areas of India resulting in disease incidence levels ranging between 66 per cent and 84 per cent, and incurring yield loss up to 12–50 per cent (Thind and Jhooty, 1985, Sharma *et al.*, 2005). The symptoms of the disease appear mostly on unripe fruits. Bleaching symptoms and lesions in concentric rings can be seen on the fruit. The infected tissue forms a depression and the fruit shrinks. The spots on the tissue measure 20–40 mm in diameter (Fig. A). Goswami *et al.* (2013) and Gopinath *et al.* (2006) reported that Propiconazole was most effective fungicide for control of anthracnose of chilli. In the absence of resistant cultivars, chemical control offers the only viable solution for disease management. Under field conditions, only organo-sulphur and copperoxychloride compounds are extensively used.

MATERIAL AND METHODS

Systemic and non-systemic fungicides *viz.*, Propiconazole (Tilt 25 EC) Captan (Captaf 50WP), Carbendazim (Bovistin 50% WP), Carboxin 37.5 per cent + Thiram 37.5 per cent (Vitavax power) and Thiram (Thiram 50 WP) were

Fig. A : Infected fruit of chilli by *Colletotrichum capsici*

evaluated for their efficacy on the mycelial growth of *Colletotrichum capsici*, by food poisoning technique. Appropriate (20 ml) quantity of each fungicide was separately dispensed in molten sterilized Potato dextrose agar medium to make desired concentrations for each fungicide. The mycelial discs of 5 mm diameter, taken from the periphery of 10 days-old culture of *Colletotrichum capsici*, aseptically placed in the centre of solidified poisoned PDA in Petri plates and incubated at 25± 1 ^{0}C for 7 days. Four replications of each treatment were kept and control was maintained without adding any fungicide to the medium. The radial growth of pathogen was measured. The efficacy of a fungicide was expressed as per cent inhibition of mycelial growth over control that was calculated by using the formula suggested by Arora and Dwivedi (1979) :

$$I = \frac{C - T}{C} \times 100$$

where,

I = Per cent inhibition

C = Radial growth in control

T = Radial growth in treatment.

The per cent values were converted to arc sine values before statistical analysis.

Field experiment :

Experiments were conducted for two seasons at Agriculture Research Farm, Institute of Agriculture Science, B.H.U.,Varanasi, in a field with a history of chilli fruit rot incidence. Treatments were laid out in plots (10×4 meter) arranged in a Randomized Block Design (RBD). Thirty-day old seedlings were planted into the field plots in rows with row/plant spacing of 60-30 cm. Four replicate plots were maintained for each treatment. All fungicides were applied as water-based spray liquid at required concentrations through a hand-held low volume electric sprayer. Regular cultivation practices were followed as per the recommendation.

The first spray of fungicides was applied 10 days after inoculation and subsequent sprays done twice at 20-day intervals. A hand-held low-volume electric sprayer was used. Disease incidence was assessed on 155 days after sowing based on a disease rating scale (grades 0, 1, 2, 3, 4 for 0, 1–5%, 6–25%, 26–50% and 51–100% fruit area infected, respectively) as proposed by Bansal and Grover (1969). Per cent disease index (PDI) was calculated based on the formula:

$$PDI = \frac{\text{Sum of all rating} \times 100}{\text{Total no. of observation} \times \text{Maximum rating grade}}$$

Observations on fruit yield per plot were also recorded. First spray of the fungicides was done immediately after the initial appearance of disease symptoms.

Statistical analysis :

Analysis of variance (ANOVA) tests were performed on data to test for significant ($P<0.05$) differences between fungicides. Least significant difference (LSD) test was used to compare means of treatments. Percentage values were analyzed after arcsine transformation of the raw data.

RESULTS AND DISCUSSION

Among the fungicides, Propiconazole (100 %) gave maximum inhibition of the mycelial growth of pathogen and proved to be the best and found statistically (≤ 0.001) superior over rest of the fungicides. This was followed by Captan (100 %) and Thiram (93.45%). Least inhibition of mycelia growth was observed in Carbendazim (74.70 %). Among combination (Table 1) of systemic and non-systemic fungicides, the significant maximum growth inhibition was recorded in Vitavax power which inhibited the fungal growth 89.29 per cent.

Table 1 : Per cent inhibition of mycelial growth of *Colletotrichum capsici* by different systemetic and non-systemic fungicides

Sr. No.	Fungicides	Doses %	% Mycelium inhibition
1.	Propiconazole	0.1	100.00 (90.00)*
2.	Captan	0.2	100.00 (90.00)
3.	Carbendazim	0.2	74.70 (59.78)
4.	Vitavax power (Thiram+carboxin)	0.1	89.29 (70.98)
5.	Thiram	0.2	93.45 (75.26)
	C.D. (P=0.05)	0.82	

* Values given in paranthesis are Arc sine transformed

Table 2 : Efficacy of fungicides in control of chilli anthracnose under field conditions

Sr. No.	Fungicides	Dose (%)	PDI	Fruit yield (kg/plot)
1.	Propiconazole	0.1	20.32(26.78)*	18.76
2.	Captan	0.2	22.63(28.35)	14.53
3.	Carbendazim	0.2	36.81(37.35)	12.59
4.	Thiram+carboxin	0.1	21.12(27.35)	16.91
5.	Thiram	0.2	25.53(30.31)	14.00
6.	Control		62.15(52.04)	7.3
	C.D. (P=0.05)		3.69	2.96

* Values given in paranthesis are Arc sine transformed

All the five fungicides were found effective against anthracnose of chilli in comparison to control in checking the per cent disease intensity (Table 2). The data on per cent disease index (PDI) of anthracnose of chilli it was observed that all the treatments differed significantly (P< 0.001) over unprotected check. Propiconazole was found most effective among fungicides showing least PDI (20.32%) and obtained maximum (18.76 kg/plot) yield followed by Vitavax power (21.12 %) Captan (22.63 %) and Thiram (25.53 %) as compared to 62.15 per cent in control. There was significant increase in fruit yield in fungicide treated plots over control. However, maximum yield (18.76 kg/plot) was obtained in plots sprayed with Propiconazole, followed by Vitavax power (16.91 kg/ha), Captan (14.53 kg/plot). Yield was less in control (7.3 kg/plot) plots.

Among the five fungicides tested against *C. capsici* by poisoned food technique, fungicides Propiconazole and Captan were found effective as they inhibited mycelial growth to an extent of 100 per cent over control and were found to be statistically at par with each other. Similar results were obtained by Gopinath *et al.* (2006) who reported Propiconazole (0.1%) as most effective against colony growth and sporulation of *C. capsici*. They also reported yield of chilli increased in range of 86 per cent and 60 per cent for Propiconazole and Carbendazim.

Combination of systemic and non-systemic fungicides like Vitavax power (Vitavax + Thiram) will be much cheaper and more effective management of anthracnose of chilli. This strategy will also reduce the chance of evolution of new races of *Colletotrichum capsici* against the systemic fungicides.

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