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Evaluation of Fungicide Efficacy for the Management of *Alternaria* Leaf Spot Disease on Chilli

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Abstract: Chilli is an indispensable condiment as well as vegetable in every household in India. Diseases especially caused by fungal pathogens are the main biological constraints in chilli production and *Alternaria* leaf spot disease caused by *Alternaria alternata* is one of the most economically important diseases of chilli. Fungicide application is an effective way to control this disease. The current study tests the efficacy of various fungicides for controlling the *Alternaria* leaf spot disease of chilli.

Key words: Chilli, fungicide, *Alternaria alternata*, efficacy, evaluation

INTRODUCTION

Chilli (*Capsicum annuum* L.) is used as condiment as well as vegetable in every household of India. It has an important role in our daily diet. Leaf spot disease caused by *Alternaria alternata* (Fr) Keissler is becoming a limiting factor and posing a major problem in chilli production in Mainpuri (UP), India and adjoining areas (Narain *et al*., 2000). The pathogen has been reported to cause seed seeding, leaf and fruit diseases as well (Sreekantiah *et al*., 1973, Mehrotra, 1980; Alam *et al*; 1981, Singh, 2003). Post harvest decay of fruits and seeds has also been recorded due to this pathogen (Leyendecker 1954; Mathur and Agnihotri, 1961; Spalding and King, 1981). The current study evaluates the efficacy of fungicides against *Alternaria* leaf spot disease.

MATERIALS AND METHODS

Natural conditions (*In vivo*): Soil samples from the chilli rhizosphere infested with *Alternaria alternata* were taken from 3 places of the field and mixed well to make fine particles. Collection of soil samples were made for the root zone at 5-15 cm depth.

Ten gram of mixed soil samples was taken in a measuring cylinder and 100 mL of sterile distilled water was added to make homogenous mixture (1:10). A serial dilution was made from this mixture to get 1:10,000 strength. One mL of this suspension of sterile Petri plates and Potato dextrose agar medium was poured in the Petri plates. Petri plates were gently shacked and allowed to solidify. Now these Petri plates were incubated at room temperature. Observations were recorded after 4-5 days after development of colonies.

Artificial condition *(In vitro)*: The relative efficacy of twelve fungicides was tested against *Alternaria alternata* under laboratory conditions. The name of fungicides, their chemical name and doses are given in the Table 1.

For this purpose, poisoned-food technique devised by Schmitz (1930) was followed. The requisite quantities of fungicides were incorporated into 2 percent sterilized unsolidified Potato dextrose agar and shaken well to make it homogenous. Medium was then poured in 90 mm. Sterilized Petridishes with three replications of each

Table 1: Fungicides used for *in vitro* evaluation against *Alternaria alternata*

Fungicides	Chemical name	Dose (%)
Bavistin	Methoxy carbamyl (Benzimidazole)	0.10
Blitox-50	Copper oxycholride	0.20
Captafol	N-(1,1,2,2-tetrachloroethyl-thio)-4-cyclohexene-1,2-dicarboximide	0.20
Captan	N-(trichloromethylthio)-4-cyclohexene -1, 2-dicarboximide	0.20
Cholorothalonil	Tetrachloro isopthalonitrile	0.20
Indofil M-45	Managanese ethylene bidithio carbamate	0.20
Indofill Z-78	Zinc ethlene bisdithio-cabamate	0.20
Kitazin	5-benzyle-O-O-disopropyl-phosphorothioate	0.20
Thiram	Tetramethylthiuram disulphide	0.20
Topsin-M	Dimethyl 4,4-o-phenylene bis (3-thio allophanate)	0.20
Vitavax	5, 6-dithydro-2-methyl-1, 4-oxathin-3-carboxianilide	0.10
Ziram	Zinc dimethyl dithiocarbamate	0.20

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treatment and allowed to solidify. These dishes were then inoculated with 5 mm diameter circular discs of inoculums from 10 days old culture and these disc were placed in the centre of each Petri dish in such a way so that fungus may come in direct contact with the medium. The medium without any fungicide poured and inoculated similarly served as control. The Petri dishes were incubated at 28±1°C for 8 days. The efficiency of various fungicides was assessed by measuring the radial growth of the fungal colony in mm. Growth inhibition percentage of colony was calculated by formula gives below:

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

Where, I is inhibition percentage of colony; C is average diameter of colony in control; T is average diameter of colony in treatment.

RESULTS

Laboratory screening of fungicides against the pathogen: Table 1 shows a list of 12 fungicides with their generic names and dose value. These fungicides were tested against the pathogen on two percent Potato Dextrose Agar (PDA) medium under *in vitro* conditions using the techniques described by Schmitz (1930). Each treatment was replicated three times in 90 mm Petridishes. Culture medium without any fungicide served as control. The inoculated Petridishes were incubated at 28±1°C for 10 days and the data on radial growth were recorded for each treatment separately. Percent inhibition over control was calculated and presented in Table 2.

The results presented in Table 1, indicated that all the fungicides tested, were significantly inhibited the growth of *Alternaria alternata*. Out of 12 fungitoxicants, only 5 fungicides viz, Bavistin, Indofil M-45, Chlorothalonil, Vitavax and Thiram proved to be effective fungicides as they inhibited the growth of the pathogen completely. The remaining fungicides in order of their decreasing inhibitory effect against the pathogen were Indofil Z-78, Captafol, Ziram, Captan, Blitox-50, Kitazin, Topsin-M. They differed significantly from one another in checking the growth of the pathogen of the pathogen (Fig. 1).

The Chilli plant harbors the infection of *Alternaria alternata* through diseased seed or from the diseased debris of the previous crop left over in the soil or from the conidia borne on the affected aerial parts of the standing crop. In each case, it is necessary to protect the plants by timely application of fungicides for spread of the diseases.

Evaluation of fungicides in the field: All the fungicides employed *in vitro* were further evaluated *in vivo* during the two consecutive years (2007-08 and 2008-09), in order to assess their efficiency in controlling the disease. The experiments were conducted in randomized block design with three replications.

The method of inoculation and spraying schedule followed were the same as described under 'Material and Methods'. The data on disease intensity were recorded 15 d after the last spraying and yield data were recorded during the crop season (Table 3).

It is evident from Table 3 that in the year 2007-08, all the fungicides gave significantly better control of the disease as compared to checks. In this season, Indofill M-45 proved to be most effective in checking the disease, followed by Indofil Z-78 and Chlorothalonil. The

Table 2: Inhibitory effect of various fungitoximents of growth of *Alternaria alternata* in bio-assay test

Fungicides	Dose (%)	Avg. diameter of fungal colony (mm)	Inhibition over control (%)
Bavistin	0.1	0.0	100.0 (90.0)
Indofil M-45	0.2	0.0	100.0 (90.0)
Chlorothalonil	0.2	0.0	100.0 (90.0)
Vitavax	0.1	0.0	100.0 (90.0)
Thiram	0.2	0.0	100.0 (90.0)
Indofil Z-78	0.2	2.7	97.0 (88.9)
Captafol	0.2	5.3	94.1 (84.3)
Ziram	0.2	8.7	90.3 (79.8)
Captan	0.2	12.0	86.6 (75.5)
Blitox-50	0.2	16.7	81.4 (71.6)
Kitazin	0.2	19.2	78.6 (69.4)
Topsin-M	0.2	24.6	72.6 (64.9)

C. D. at 5% level of significance = 1.70, SED = 0.83

Table 3: Effect of fungicides spraying on the disease intensity of *Alternaria* leaf spot disease of chilli

		Disease intensity (%)		Disease control (%)	
Name of fungicides	Dose (%)	2007-08	2008-09	2007-08	2008-09
Indofil M-45	0.2	17.2(25.2)	16.3(22.9)	62.1(55.7)	62.3(59.5)
Indofil Z-78	0.2	18.3(25.2)	19.3(26.1)	60.3(57.2)	57.5(55.3)
Chlorothalonil	0.2	19.2(25.2)	20.1(25.8)	61.0(57.7)	58.0(55.2)
Bavistin	0.1	20.5(26.0)	18.9(25.0)	59.2(56.3)	58.7(57.0)
Blitox-50	0.2	24.6(30.3)	27.2(30.8)	48.1(48.7)	41.3(43.5)
Captafol	0.2	35.2(36.2)	34.2(36.3)	27.8(35.9)	27.2(33.2)
Kitazin	0.2	37.2(37.5)	37.7(38.4)	25.2(31.0)	19.0(27.6)
Topsin-M	0.2	37.5(58.2)	41.2(40.4)	22.5(33.0)	15.5(25.0)
Control	Water spray	49.3(44.5)	48.3(44.8)		

C.D. at 5% level of significance = 2.49, 2.86, SED = 1.17, 1.35

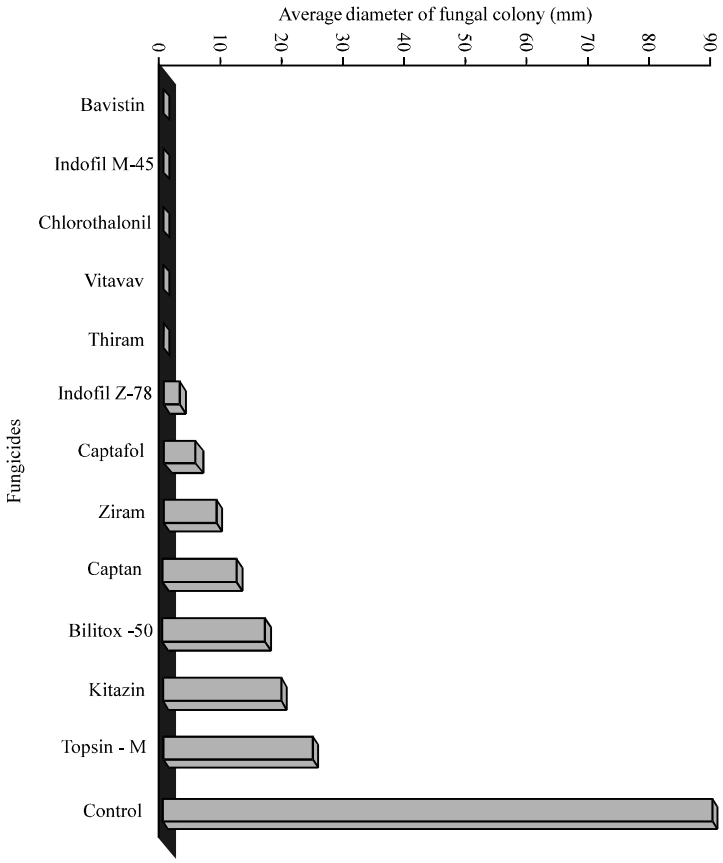

Fig. 1: Inhibitory effect to different fungicides on growth of *Alternaria alternata in vitro* after 10 days of incubation at 28±1°C

remaining fungicides viz, Blitox-50, Captafol, Kitazin, Topsin-M were found less effective to controlling the disease.

DISCUSSION

Chilly is a fruit of the plant '*Capsicum annuum'* and '*Capsicum frutecens*' that come from the *genus Capsicum*, belonging to the family of Solanaceae, which also include Tomato and Potato. These fruits are small in size and are known for their sharp acidic flavor and color. Chillies are said to have originated in the Latin American region and currently is used throughout the world as a spice and also used in making beverages and medicines.

Out of 12 chemicals screened against the pathogen *in vitro*, Bavistin, Indofil M-45 , Chlorothalanil, Vitavax and Thiram completely inhibited the growth of *Alternaria alternata*. Indofil Z-78, Captafol, Ziram, Captan, Blitox-50 and Kitazin, were found to be significantly superior as compared to control in inhibiting the fungal growth. These observations are similar to the findings of Singh and Milne (1974), Monga (1990), Vishwakarma and Pandey (1995) and Singh and Rai (2003) for *Alternaria alternata* and other species of *Alternaria*.

The results pertaining to relative efficiency of eight spray fungicides in pot culture experiments indicated that all the fungicides proved superior to unsprayed check in reducing the foliar infection of *Alternaria alternata*. However, Indofil M-45 proved most effective in reducing the disease intensity followed by Indofil Z-78 and Chlorothalonil. The remaining fungicides in order to superiority were Bavistin, Blitox-50, Captafol, Kitazin and Topsin-M. Which were significantly different from each other. Topsin-M was found to the least effective in controlling the disease, but it was superior to unsprayed check. These findings are in agreement with the observation made by Shurtleff and Linn (1963) on chilli for Alternaria fruit rot, Singh and Shukla (1984) on brinjal for Alternaria leaf spot and fruit rot, (Maheshwari *et al*., 1991) on tomato for early blight caused by *A. solani* on chilli for fruit rot.

The results of the field trials conducted during the two consecutive years indicated that Indofil M-45 proved most effective in controlling the disease, followed by

Indofil Z-78 and Chlorothalonil. The remaining fungicides in order of superiority were Bavistin, Blitox-50, Captafol, Kitazin and Topsin-M, which were significantly superior to control and statistically different from each other. These results are corroborated by the findings of Narain (1978) on sunflower for leaf spot, Thind and Jhooty (1985) on chillies for black rot caused by *A. alternata*. (Dabbas and Bais, 1977) on mungbean for Alternaria leaf spot on brinjal for *Alternaria* leaf spot, (Ratan *et al*., 2003) marigold for *Alternaria* blight, (Khan *et al*., 2004) on linseed for Alternaria blight. The results of all these workers fully supported present findings.

The current study concludes that fungicides like Indofil M-45 and Z-78, and Chlorothalonil were found effective against *Alternaria* leaf spot disease.

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