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In vitro efficacy of fungicides against *Colletotrichum capsici* causing die-back and fruit rot of chilli

N. RANASINGH[1]; S. K. BEURA[2] AND R. DAS[3]
[1]*SMS (Plant Protection), K.V.K. Rayagada, Gunupur, Orissa,*
[2]*Plant Pathology Section, Vegetable Improvement Project, OUAT, Bhubaneswar, and*
[3]*P. G. Department of Botany, Utkal University, Bhubaneswar, Orissa*

Chilli (*Capsicum annum* L.) is the universal spice of India grown for its biting pungency and used in different dishes, pickles and chutney's to add colour. Die-back and fruit rot of chilli caused by *Colletotrichum capsici* (Sydow) Butler and Bisby is seed, soil as well as air borne in nature affecting leaf, flower, stem and fruits of the chilli plant causing 20% yield loss in each year (Pandy, 2004). Fifteen fungicides viz. Fungy, Gem, Zineb Z-75, Conzole 5% EC, Calixin, Thiram, Captaf, Roko 70 WP, Emzeb-45, Acrobat, Blitox-50-, Saaf, Validamycin, Vitavax power, Sulfex were *in vitro* evaluated against *C. capsici* by Poison Food technique. The radial growth of the pathogen was measured after incubation for seven days and per cent growth inhibition was calculated. Complete inhibition of the growth of *C. capsici* was observed at minimum concentration of Fungy 50%WP (0.1%). Gem (0.3%), Zineb Z-75 (0.25%). Conzole (0.1%) Calixin (0.1%), Thiram (0.3%), and Roko 75 WP (0.3%). Restricted growth was observed in Captaf (0.3%) up to 73.8% followed by Vitavax power (0.3%) up to 69.2%. Reduction of the mycelial growth up to 69% was observed by Validamycin 3L(0.3%), Emzeb-45 (0.3%), Acrobat (0.2%). Blitox-50 at 0.3% showed 0.61% inhibition of radial growth followed by Saaf 0.3% up to (53.8%). The least per cent growth was observed by Sulfex at 0.3% up to 38.46%

Key words : *Capsicum annum, Colletotrichum capsici, in vitro* evaluation, fungicides

INTRODUCTION

The area cultivated with chilli worldwide is about 1,700,000 ha for producing fresh chilli, and around 1,800,000 ha for producing dried chilli; a total area of 3,729 900 ha with a total production of 20,000 000 t (FAO, 2003). India is the largest producer and consumer of chilli and contributes about 36% to the total world production and is No. 1 in terms of international trade, exporting 20-25% of its total production (Karvy COM trade Ltd, 2009). But *Collecotrichum capsici* is one of the most important plant pathogen worldwide causing the economically important disease, i.e. anthracnose in a wide range of hosts including cereals, legumes, vegetables, perennial crops and tree fruits (Bailey and Jeger, 1992). Among these hosts, chilli (*Capsicum annum* L.), an important economic crop worldwide (Poulos, 1997), is severely infected by anthracnose which may cause yield losses of up to 50% (Pakdeevaraporn *et al.,* 2005). Anthracnose is mainly a problem on mature fruits, causing severe losses due to both pre- and post-harvest fruit decay (Hadden and Black, 1989). Chemicals are the most common and practical method to control anthracnose diseases. However, fungicide tolerance often arises quickly, if a single compound is relied upon too heavily (Staub, 1991). The fungicide traditionally recommended for anthracnose management in chilli is Manganese ethylenebisdithiocarbamate (Maneb) (Smith, 2000), although it does not consistently control the severe form of anthracnose on chilli fruit. The Topsin-M, Contaf 5EC, Captaf, Saaf, Fungy, Gem, Calixin Copper oxychloride and Mancozeb have recently been labeled for the control of anthracnose of chilli, So *in vitro* evaluation of these chemicals has been reported in different concentrations to control this pathogen.

MATERIALS AND METHODS

Affected fruits showing typical symptom of anthracnose, die-back, and fruit rot were collected from different places of Orissa in the month of December, 2007 and April, May, 2008. Pathogens causing anthracnose/die-back or fruit rot of chili were isolated on Potato Dextrose Agar (PDA) plates. The affected fruits as well as leaf showing typical symptom of anthracnose/die-back or fruit rot measuring 2-3 mm size bearing healthy as well as diseased portions were sterilized using 0.1% $HgCl_2$ for period of 1-2 minutes. Then they were thoroughly washed with sterile distilled water, 2-3 times to remove the excess chemicals. Some disinfected segments were placed on 2% aqueous agar on Petri plates and incubated at 25°C for 5-7 days. The remaining segments were placed on nutrient agar slants for isolating bacterial pathogen. The pathogens were subcultured in early stage and were purified by single hyphal tip technique, tested for pathogenicity and maintained in PDA slants. Pure cultures were maintained on PDA slants at 24°C. The growth of the test fungus i.e. *Colletotrichum capsici* was measured both in control as well as in treated plates against fifteen selected fungicides available in the local market using Poisoned Food technique of inoculation. Efficacy of fungicides was tested by Poisoned Food technique using five concentrations such as 0.1%, 0.15%, 0.2%, 0.25% and 0.3% in the PDA medium. PDA plates without mixing of fungicides served as control. PDA plates mixing with fungicides served as treated plates. The inoculums of the test fungus measuring 6 mm disc of 7 days old culture were inoculated at the centre and maintained at 28±°C till the test fungi covered the PDA plate in control plates. The radial growth of the colony in each treatment replicated thrice was measured in two directions at right angles to each other. The per cent inhibition for stimulation of growth in each treatment was calculated after 4 days of inoculation In the Poison Food PDA media. *Colletotrichum capsici* was inoculated in the centre of the PDA plate to study the growth inhibition of the fungus. The concentration at which the maximum inhibition of mycelium was observed, noted down and presented only in the table. The % inhibition of the growth of test fungus against fungicides were calculated by using the following formula : PGI = dc-dt/dc×100, where PGI= Per cent growth inhibition; de = the mean colony diameter of test fungus in control plates, and dt = the mean colony diameter of test fungus in treated plates.

Three replications were maintained for each treatment. Inoculated plates were incubated at room temperature of (25°± 2°C). Observation of colony diameter were taken at an interval of 24 hrs till there was full-growth in control plates. The different fungicides used in the study are presented below.

Table 1 : Formulations of different fungicides used along with their commercial name and active ingredients

Commercial name	Chemical name	Formulations
Fungy	Carbendazin	50%W.P
Gem	Metalaxyl+Mancozeb	18%+64%
Indofil-Z-78	Zineb-Z-78	75% W.P
Conzole	Hexaconazole	5%EC
Calixin	Tridemorph	50%WP
Thiride	Thiram	75% W.P
Roko	Thiophanate methyl	70%W.P
Captaf	Heterocyclic nitrogenus	75% W.P.
Vitavax power	Carboxin+Thiram compounds	37.5%+37.5%W.P
Sheathmar	Validamycin	3L
Emzeb–M 45	Mancozeb	75%W.P
Acrobat	Dimethomorph	50%W.P
Blitox	Copper oxy chloride	50%W.P
Saaf	Carbendazin+Mancozeb	12%+63%W.P
Sulfex	Sulphur	80W.P

RESULTS AND DISCUSSION

Bioefficacy study of fifteen fungicides against *C. capsici* (Table 2) revealed that complete inhibition of the growth of *C. capsici* was observed at minimum concentration of Fungy 50% W.P (0.1%). Gem (0.3%), Zineb-Z-75 (0.25%). Conzole (0.1%) Calixin (0.1%). Thiram (0.3%) and Roko 75WP (0.2%). Restricted growth was observed in Captaf (0.3%) up to 76.95% followed by Vitavax power (0.3%) up to 69% which was correlated with the result of Kumar *et al.* (1986) and Mali and Joi (1985). Kumar *et al.* (1986) reported that the *C. capsici* can be best controlled with Aureofungin followed by Thiram, Captan, Bavistin and Difoltan. Mali and Joi (1985) supported that Difoltan, Captafol, Thiram and Vitavax were the most effective against colony

Table 2 : *In vitro* efficacy of fungicides against *Colletotrichum capsici* causing die-back and fruit rot of chilli

Name of the fungicides	Concentrations used (%)	Colony diameter (cm) in control plate	Colony diameter (cm) in text plate	Reduction in growth (%)	% age reduction in the growth
Fungy	0.1	6.5	nil	100	100
Gem	0.3	6.5	nil	100	100
Zineb	0.25	6.5	nil	100	100
Conzole	0.1	6.5	nil	100	100
Calixin	0.1	6.5	nil	100	100
Thiram	0.3	6.5	nil	100	100
Roko	0.2	6.5	nil	100	100
Captaf	0.3	6.5	1.7	4.8	73.8
Vitavax power	0.3	6.5	2	4.5	69.2
Validamycin	0.3	6.5	2	4.5	69.2
Emzeb	0.3	6.5	2.0	4.5	69.0
Acrobat	0.2	6.5	2.0	4.5	69
Blitox	0.3	6.5	2.5	4.0	61.0
Saaf	0.3	6.5	3.0	3.5	53.8
Sulfex	0.3	6.5	3.5	4.0	38.4

growth and sporulation of *C. capsici in vitro.* Data (1996) also suggested that the fruit rot of chilli caused by all the pathogens, namely, *C. capsici, Alternaria alternate, Aspergillus niger, Fusarium moniliforme, Dreschslera australiensis,* were found to be controlled by dipping the chilli fruits for 10 min in Carbendazim solution of 1000 µg/ml concentration *in vitro.* Hegde *et al.* (2002) also tested the significant inhibition of mycellial growth with the three fungicides such as Hexaconazole (0.1%), Propiconazole (0.1%), and Triadimefon (0.1%), by 85, 80 and 79% respectively against the fruit rot pathogen (*C. capsici*) of chilli by poison food technique. Restricted growth was observed in Captaf (0.3%) up to 73.8% followed by Vitavax power (0.3%) up to 69.2%. There was significant reduction of the mycelial growth up to 69% by Validamycin 3L (0.3%). Emzeb-45 (0.3%), and Acrobat (0.2%). But these fungicides (Validamycin, Emzeb and Acrobat) were not as effective as Roko, Fungy, Zineb, Thiram, Captaf, Conzole, Gem and Calixin as found during the present investigation. Blitox-50 at 0.3% showed resistance to Copper oxychloride against *C. capsici* showing reddish brown colouration to the media though there was significant inhibition of growth up to 0.61%. This corroborated the findings of Reddy *et al.* (1981) who attributed the resistance to Copper oxychloride. Radial growth inhibition by Saaf (0.3%) up to 53.8% was also observed followed by the least per cent growth inhibition by Sulfex at 0.3% up to 38.46%. Gupta *et al.* (1974) evaluated that complete inhibition of *C. capsici* was observed by Brestan-60 and Aureofungin (50 ppm). Similar type of result was also obstained by Deshmukh *et al.* (2000) by using Zetron which reduced the growth of the fungus significantly at 0.2, 0.25 and 0.4% relative to the control. Triazole fungicides exhibited the highest pathogen inhibition by Folicur 250 EW (Tebuconazle) was most effective with ED 50 value of 5.5 by Chandra *et al.* (2004). Rathore (2004) evaluated that Score at 0.05% was the most effective chemical in controlling fruit rot and reduced the percentage fruit rot of 13-9.5% compare to 26.3 – 20% in the control. Similarly Iprobenfos a chemical was found efective against *C. capsici* in the field condition suggested by Sharma, and Thakore (1999). Raju and Rao (1989) reported new fungicide i.e. Fenapanil against *C. capsici* that gave good result in the field condition as well as in the laboratory.

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