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Screening of systemic and non systemic fungicides against *Alternaria* blight of mustard (*Brassica juncea*)

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ABSTRACT

The experiments were conducted at College of Agriculture, Tikamgarh (M. P.) to identify suitable fungicides for the effective control of Alternaria blight in mustard. [Brassica juncea (L.) Czernj&Cosson] The studies were carried out in-vitro in the laboratory for their efficacy against A. brassicae and also tested in the field to identify the best fungicide in respect of controlling the intensity of Alternaria blight during rabi season of 2013-14. The results revealed that mancozeb was found to be the best fungicide in reducing the radial growth and germination of conidia in laboratory. In field, combination of Carbendazim + Mancozeb was more effective in controlling the intensity of Alternaria blight and minimum per cent disease intensity (22.0 %) was also recorded with this treatment. The highest efficacy in achieving per cent disease control was exhibited by Carbendazim + Mancozeb (49.2%) followed by Mancozeb (41.1%), Carbendazim (36.0%), Pyraclostrobin (35.1%) and Metalaxyl + Mancozeb (31.4%). The maximum seed yield was recorded with Carbendazim + Mancozeb (2530.0 kgha^{-1}) followed by Mancozeb (2305.8 kgha^{-1}), Carbendazim (2290.0 kgha^{-1}), Pyraclosrobin (2241.6 kgha^{-1}), Metalaxyl + Mancozeb (2221.6 kgha^{-1}) and control (1811.6 kgha^{-1}). The best treatment was observed to be Carbendazim + Mancozeb, which recorded 28.4 % increase of seed yield over control.

Key words: *Alternaria* blight, control, fungicide, mustard

INTRODUCTION

Mustard [*Brassica juncea* (L.) Czernj & Cosson] is an important oilseed crop of India and ranks first position with regard to area and production of mustard. It is the second most important edible oilseed after groundnut sharing 27.8% in the India's oilseed production. In India, mustard is cultivated in an area about 5.79 million hectare with the production of 6.31 million tonnes and productivity of about 1089 kg/ha. Whereas In Madhya Pradesh, mustard crop is cultivated in an area about 12.31million hectares with the production of about 11.36 million tonnes and productivity of about 1409 kg/ha (Anonymous, 2013). However, in Tikamgarh district, mustard crop is cultivated in an area about 0.40 million hectares with production of 0.21million tonnes and productivity of about539 kg/ha (Anonymous, 2014). The losses in oilseed crops due to biotic stresses are about 49.9% out of which diseases causes severe yield reductions at different growth Stage. Alternaria blight and white rust are two major diseases severely affecting Indian mustard crop during cool and humid weather causing 47% losses in yield (Singh *et al.,* 2009). Alternaria blight (*A. brassicae*) and white rust (*Albugo candida*) are the two major diseases of Indian mustard (*Brassica juncea)* causing heavy losses in Madhya Pradesh (Pandya *et al.,* 2000).The studies were carried out in two phases. Initially five fungicides were evaluated in-vitro in the laboratory for their efficacy in controlling *A. brassicae*. These fungicides were finally tested in the field to identify the best fungicide in respect of controlling the intensity of *Alternaria* blight and simultaneously increasing the yield of mustard.

MATERIALS AND METHODS

Evaluation of fungicides (In-*vitro)*

Radial growth: The bioassay studies were carried out by employing the poisoned food technique as described by Nene (1971). Five test fungicides viz. Metalaxyl + Mancozeb, Carbendazim + Mancozeb, Pyraclostrobin, Carbendazim and Mancozeb were incorporated aseptically in sterilized potato dextrose agar medium in a quantity to arrive at a final concentration of 125, 250, 500 and 100 ppm. Twenty ml of the poisoned medium was poured in each of the sterilized petri plates. These were then inoculated at the center with a 10 mm disc cut with a sterilized cork borer from an actively growing seven day old culture of *A. brassicae.*

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The inoculated Petri plats were inverted and incubated at 25 ± 2^0C. Each treatment was replicated four times. Suitable control (without fungicide) was also maintained. The radial growth of *A. brassicae* was recorded after seven days.

Spore-germination:

Freshly harvested conidia were collected in sterilized distilled water from a 7 day old culture of *Alternaria brassicae*. Stock solutions of the five test fungicides were prepared and each one was diluted in double concentration to achieve required concentration viz. 125, 250, 500 and 1000 ppm. A drop of the test solution was placed on a glass cavity slide and allowed to dry. A drop of spore suspension was placed on it. The cover slip was inverted on a cavity slide to give a hanging drop preparation. Four replications for each treatment were maintained and the slides were placed in petri dishes lined with moist blotting paper. Appropriate control was maintained using sterile water in place of the fungicidal test solution. The Petri dishes were incubated at 25 ± 2^0C for 24 hours and slides were examined for counting total germinated spores.

Field evaluation of fungicides:

Field experiments on the evaluation of the five test fungicides against Alternaria blight were conducted during *rabi* season (2013-14) on mustard cultivar Pusa bold. The experiments were laid out in a randomized block design with four replications for each treatment. The plot size was 5 x 3 m with ten rows per plot at a distance of 30 cm between the rows and 10 cm between the plants. Five treatments were applied with Metalaxyl + Mancozeb (0.25%), Carbendazim + Mancozeb (0.25), Pyraclostrobin (0.20%), Carbendazim (0.15%) and Mancozeb (0.25%) along with a control (water spray) for comparison. Two sprays of all the five treatments were given during the crop season. The first spray was given just after the appearance of the disease. The second spray was given at an interval of 15 days after the first spray. The final intensity of the disease was recorded 15 days after the second spray. The seed yield per plot was recorded and converted into kg ha^{-1}. The data were statistically analyzed.

RESULTS AND DISCUSSION

Effect on radial growth

The data on the effect of test fungicides and their concentrations on the radial growth of *Alternaria brassicae* are presented in Table 1. The mean radial growth in all the five fungicide varied from 18.1 to 38.5 mm against 45.5 mm in control. The minimum mean radial growth (18.1 mm) was recorded in Mancozeb followed by Pyraclostrobin (19.7 mm),, Metalaxyl+ Mancozeb (22.7 mm) and Carbendazim (38.5 mm). The mean redial growth in all the treatments was significantly lower as compared to control (45.5 mm). Increase in concentration of fungicide resulted in a decrease in the radial growth of Alternaria blight. The interaction effect between the fungicides and their concentrations was also significant indicating that all the five test fungicides at all their tested concentrations significantly inhibited the radial growth of *Alternaria brassicae* as compared to control.

At 125 ppm concentration, minimum radial growth was recorded in Pyraclostrobin (21.7 mm) followed by Metalaxyl + Mancozeb (26.0mm), Carbendazim + Mancozeb (27.2 mm), Mancozeb (28.0 mm) and Carbendazim (45.7 mm). At 250 ppm concentration, the lowest radial growth was recorded in Mancozeb and Pyraclostrobin (20.5 mm) followed by Metalaxyl + Mancozeb (23.0 mm). At higher concentrations of 500 and 1000 ppm, Mancozeb was significantly superior over all other fungicides in reducing the radial growth at these concentrations. Pyraclostrobin was significantly superior over Carbendazim + Mancozeb in reducing the radial growth of *Alternaria brassicae*. The mean data indicated that maximum reduction was recorded in Mancozeb (60.2 %) followed by Pyraclostrobin (56.7 %), Metalaxyl + Mancozeb (50.1 %), Carbendazim + Mancozeb (49.9 %) and Carbendazim (15.4 %). Meena *et al.* (2004) reported Mancozeb was effective in completely inhibiting the growth of the fungus *in -vitro*. Similarly Khan *et al.* (2007) have exhibited the efficacy of Mancozeb against *Alternaria brassicae* in-vitro.

Table 1: Effect of different fungicides and their concentrations on radial growth (mm) of *Alternaria brassicae* after 7 days of incubation

Treatments	Concentrations (ppm)				Mean*	
	125	250	500	1000	Radial growth (mm)	% Inhibition over control
Metalaxyl + Mancozeb	26.0	23.0	22.2	19.7	22.7	50.1
Carbendazim + Mancozeb	27.2	24.7	20.0	19.2	22.8	49.9
Pyraclostrobin	21.7	20.5	19.5	17.2	19.7	56.7
Carbendazim	45.7	43.7	28.5	26.0	38.5	15.4
Mancozeb	28.0	20.5	14.0	09.7	18.1	60.2
Control	45.5					
Treatment (T)	SEm±0.49	CD (P=0.05) 1.39				
Concentration (C)	SEm±0.49	CD (P=0.05) 1.39				
T x C	SEm±1.10	CD (P=0.05) 3.10	CV (%) 7.59			

** Mean of four replications*

Effect on Spore-germination

The mean spore germination in different chemicals varied from 34.7 to 47.3 % as against 57.1 % in control (Table 2). The minimum conidial germination was recorded in Mancozeb (34.7%) followed by Carbendazim (41.8%), Carbendazim + Mancozeb (46.2%), Pyraclostrobin 46.6%) and Metalaxyl + Mancozeb (47.3%). The mean conidial germination (34.7%) was significantly lower with three fungicides as compared to control. The increased concentration of the fungicides (except Metalaxyl + Mancozeb at 500 and 1000 ppm) tended to decrease conidial germination. Interaction effect between chemicals and concentrations significantly reduced per cent conidial germination at all the tested concentrations over control. At 125 ppm concentrations, Mancozeb recorded the lowest conidial germination (54.4%) followed by Carbendazim (46.2%), Carbendazim+ Mancozeb (51.4%), Pyraclostrobin (52.3%) and Metalaxyl+ Mancozeb (52.4%). The concentrations of Mancozeb and Carbendazim were found statistically at par. At concentration of 250 ppm the trained and inhibitory activity of different fungicides was almost similar.

Table 2: Effect of different fungicides and their concentrations on the percent spore germination of Alternaria *brassicae* after 24 hours of incubation

Treatments	Concentrations (ppm)				Mean*	
	125	250	500	1000	Percent spore germination	% D O C
Metalaxyl + Mancozeb	52.4* (46.4)**	51.3 (45.7)	45.8 (42.6)	45.6 (42.5)	47.3 (43.4)	17.2
Carbendazim + Mancozeb	51.4 (45.8)	49.3 (44.6)	44.1 (41.6)	39.9 (39.2)	46.2 (42.8)	19.1
Pyraclostrobin	52.3 (46.3)	51.2 (45.6)	47.3 (43.4)	35.9 (36.8)	46.6 (43.0)	18.4
Carbendazim	46.2 (42.8)	44.5 (41.8)	42.3 (40.6)	34.2 (35.8)	41.8 (40.3)	26.8
Mancozeb	44.4 (41.8)	32.2 (34.6)	31.1 (33.8)	31.0 (33.8)	34.7 (36.1)	39.3
Control					57.1 (49.1)	
Treatment	SEm± 0.92	CD (P=0.05) 0.92				
Concentration	SEm± 0.92	CD (P=0.05) 2.61				
T x C	SEm± 2.07	CD (P=0.05) 5.84	CV (%)9.68			

DOC = Decrease Over Control

**Mean of four replications, ** Figures in parenthesis are transformed (Angular) values*

In 500 ppm, the minimum spore germination was recorded for Mancozeb (31.1%) followed by Carbendazim (42.3%) and Carbendazim + Mancozeb (44.1%). At higher concentration of 1000 ppm the lowest spore germination was recorded in Mancozeb (31.0%) followed by Carbendazim (34.2%) and Pyraclostrobin (35.9%). At all the four concentration, all the test fungicides were statistically superior over control in reducing the spore germination. As for the as per cent decrease over control is concerned maximum decrease was recorded for Mancozeb (39.3%) followed by Carbendazim (26.8%), Carbendazim + Mancozeb (19.1%), Pyraclostrobin (18.4%) and Metalaxyl + Mancozeb (17.2%) respectively.Khan *et al.* (2007), evaluated three systemic fungicides viz. Toxin-M (Thiophinet mythil 7% WP), Ridomil-MZ (Mancozeb 64 % + Matalexil 8% WP, and Bavistin (Crrbandazim 50% WP), alone and in combination with four non systemic fungicide captan (captan 50% WP), Indofil M-45 (Mancozeb 75% WP), Indofil Z-78 (Zineb 75% WP) and Thiram (Thiram 75% WP), both In-Vitro and In Vivo for the management of *Alternaria* blight of rapeseed- mustard caused by *A. Brassicae*. They reported that all the fungicides significantly inhibit the mycelial growth and spore germination of conidia and reduced the severity of the disease.

Table 3: Efficacy of different fungicides on disease intensity and yield of mustard against Alternaria brassicae

Treatments	PDI	Yield Kg/h	PDC	Per centage Increase in yield over control
Metalaxyl + Mancozeb	29.7* (33.0)**	2221.6	31.4	18.4
Carbendazim + Mancozeb	22.0 (27.9)	2530.0	49.2	28.4
Pyraclostrobin	28.1 (31.9)	2241.6	35.1	19.2
Carbendazim	27.7 (31.8)	2290.0	63.9	20.9
Mancozeb	25.5 (30.3)	2305.8	41.1	21.4
Control	43.3 (40.4)	1811.6		
SEm±	2.00	11.93		
CD (P =0.05)	6.01	133.27		
CV%	12.26	401.58		

PDI = Per cent Disease Intensity; PDC = Percent Disease Control
** Mean of four replications; ** Figures in parenthesis are transformed (Angular) values*

Effect of fungicide on disease intensity and seed yield

The efficacy of Metalaxyl + Mancozeb, Carbendazim + Mancozeb, Pyraclostrobin, Carbendazim and Mancozeb and their concentrations were first tested for their effect on the radial growth and spore germination of *Alternaria brassicae*. All the five fungicides tested were effective in reducing both the radial growth and germination of spore. Mancozeb was found to be the best fungicide in reducing the radial growth and germination of conidia under *in vitro*. After that the tested fungicides were evaluated in the field to find out the efficacy of fungicide on disease intensity and seed yield. A perusal of the data (Table 3) reveals that all the tested five fungicides were significantly effective in controlling the intensity of *Alternaria* blight over control. The minimum disease intensity per cent was recorded for Carbendazim + Mancozeb (22.0%) followed by Mancozeb (25.5%), Carbendazim (27.7%), Pyraclostrobin (28.1%) and Metalaxyl + Mancozeb (29.7%), while maximum disease intensity was recorded in control (43.3%). The efficacy of Mancozeb and Carbendazim was statistically at par among the fungicides. The highest efficacy in achieving per cent disease control was exhibited by Carbendazim + Mancozeb (49.2%) followed by Mancozeb (41.1%), Carbendazim (36.0%), Pyraclostrobin (35.1%) and Metalaxyl +

Mancozeb (31.4%) respectively.All the treatments independently gave significantly higher seed yield as compared to control. The Carbendazim + Mancozeb treatment was most effective and produced significantly higher seed yield over all treatment. The maximum seed yield was recorded with Carbendazim + Mancozeb (2530.0 kg ha^{-1}) followed by Mancozeb (2305.8 $kgha^{-1}$), Carbendazim (2290.0 $kgha^{-1}$), Pyraclosrobin (2241.6 $kgha^{-1}$), Metalaxyl + Mancozeb (2221.6 $kgha^{-1}$) and control (1811.6 $kgha^{-1}$). The best treatment was observed to be Carbendazim+Mancozeb, which recorded an increase of 28.4 % in seed yield over control. The present investigation confirms the observations of Prasad *et al*., (2009) and Meena *et al.* (2004) on the efficacy of combination of fungicide, who observed that application of fungicide with combination is most effective to reduce the *Alternaria* blight severity and gave numerically higher yields.

Similar results were also reported by Yadav (2003) and Godik and Pathak (2002) on the efficacy of systemic and non systemic fungicides against *Alternaria* leaf blight of mustard and reported that all the fungicide treatments were significantly superior to the control in reducing leaf infection and in increasing grain yield. Girish *et al.* (2007) has also tested five fungicides against *Alternaria* blight (*A. brassicae*) of mustard and found that among the fungicides Mancozeb spray was effective against *Alternaria* blight with 9.8% disease as compared to the control with 33.2% severity. Yadav *et al.,* (2002) has also recorded that the chemical treatment significantly reduced the disease incidence of *Alternaria* blight of mustard and enhanced the yield over the untreated control.

Bases on the findings of present investigation, it may be concluded that fungicide application of Mancozeb decreased not only the maximum radial growth but also the spore germination of *Alternaria brassicae*. The efficacy in achieving per-cent disease control by the tested fungicides, the highest disease control was exhibited by combination of Carbendazim + Mancozeb followed by separately spray of Mancozeb. The maximum seed yield was recorded with the application of Carbendazim + Mancozeb followed by Mancozeb. Therefore, the control of *Alternaria* blight in mustard may be achieved by the application of Mancozeb alone in vitro conditions and with combined application of Mancozeb and Carbendazim in the field.

REFERENCES

Anonymous (2013) Area, production and productivity of mustard www.mpkrishi.mp.gov.in nonymous (2014) *Mustard Seed Survey Report* 2014-15.

Girish, G., Gowda, M.B., Saifulla, M., and Mahesh, M. Satheesh (2007) Management of White Rust and *A. blight* of mustard using fungicides. Environment and Ecology **25** S (Special 3 A): 830-833.

Godika, S. and Pathak, A.K. (2002) Efficacy of some fungicides against white rust and *Alternaria blight* disease of mustard. *Plant-Disease-Research.Ludhiana***17**(1):138-140.

Khan, M.M., Khan, R.U. and Mohiddin, F.A. (2007) Studies on the cost effective management of *A. blight* of rape-seed mustard (*Brassica Spp*.). *Phyto Pathologia mediterranea* 46 (2): 201-206.

Meena, P.D. Meena, R.L. Chattopadhyay, C. and Kumar, A. (2004) Identification of practical stage for disease development and biocontrol of *A. blight* of Indian mustard (*Brassica juncea*). *Journal of Phyto Pathology* **152** (4): 204-209.

Nene, Y.L. (1971) Fungicides in Plant Disease Control. Oxford & IBH publishing Co., New Delhi, pp. 286-287.

Pandya, R.K. Tripathi, M.L. and Reeti, Singh (2000) Efficacy of fungicides in the management of White Rust and A. blight of mustard. *Crop Research Hisar* 20(1): 137-139.

Prasad, Rajendra Maurya, K.K. and Srivastava, S.B.L. (2009) Ecofriendly management *of A. blight* of Indian mustard, *Brassica juncea L*. Journal if seeds Research **26** (1): 65.

Singh, Narendra Sriwastava, A.K. and Udit, Narain (2009) Status of *Alternaria* leaf spot of brassicae in Uttar Pradesh and role of climatic factors in the development of the disease. *International Journal of Plant Science* **3** (1): 37-39.

Yadav M.S. (2003) Efficacy of fungi toxicants in the management of *Alternaria* blight and White rust of mustard. *Journal of Mycology and Plant Pathology* **33** (2): 307-309.

Yadav, M.S., Dhillon, S.S. and Dhiman, J.S. (2002) Effect of date of sowing, varieties and chemical treatments on the development of *Alternaria* blight and White rust of mustard. *Journal of Research, Punjab Agric. University* **39**(4): 528-532.