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INTEGRATED MANAGEMENT OF ALTERNARIA BLIGHT IN INDIAN MUSTARD

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ABSTRACT
Field trials were carried out during *Rabi* 2008-09 and 2009-10 crop seasons to test the efficacy of different fungicides and bioagents, as seed treatment and foliar spray against Alternaria blight disease. Among the eight treatments, seed treatment combination of Metalaxyl with Carbendazim was most effective in reducing disease severity and increasing yield (35.0 and 24.0 %) followed by Carbendazim (31.5 and 23.3%) and Metalaxyl (29.3 and 20.3%) alone respectively. In case of seed treatment and foliar spray of Metalaxyl with Mancozeb was found most effective in reducing disease severity and increasing yield (44.0 and 37.6%) followed by Carbendazim with Ridomil MZ (41.2 and 33.5%), *Trichoderma harzianum* with *Pseudomonas fluorescence* (28.0 and 12.0%) and *T. harzianum* with *T. harzianum* (26.9 and 14.0%) compare to control.

INTRODUCTION

The oilseed *Brassica* plays a significant role in the Indian oil economy by contributing to approximately 23 percent of the total oilseed production. India produced 6.4 mt of rapeseed-mustard from 5.5 mh of land during the 2009-10 season, with the variable yield levels ranging from 854 (2002-03) to 1142 kg/ha (2009-10) over the past eight years; globally, India's production accounts for 17.5 and 10.8 percent of the total acreage and production, respectively (GOI, 2007; FAO, 2012). The crop can be ravaged by several diseases, including Alternaria blight [*Alternaria brassicae* (Berk.) Sacc.], white rust [*Albugo candida* (Pers. Ex Lev.) Kuntze], downy mildew [*Hyaloperonospora parasitica* (Pers.) Constant], Sclerotinia rot [*Sclerotinia sclerotiorum* (Lib.) de Bary] and powdery mildew (*Erysiphe cruciferarum* Opiz ex L. Junell), which remain a major cause behind the fluctuation in yields, apart from the wide gap that exists between the potential yield and the realized yield.

Among the biotic stresses, Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc. is a major factor limiting its productivity. Yield losses may vary from 10 to 70% depending on the type of crop species grown and prevailing environmental conditions; maximum (>70%) being in yellow sarson and low to moderate high (35-40%) in mustard (Chattopadhyay, 2008). The fungus, apart from leaves also infects stem, branches and pods and causes significant reduction in yield. In addition to direct loss yield, it also affects the quality of seed, its germination by reducing seed size, seed colour and oil content. (Kaushik *et al.,* 1984). There is no proven sources of resistance against the disease reported till date in any of the host (Kumar and Chauhan, 2005). In the absence of proven source, the disease is currently managed by selective application of fungicide (Chattopadhyay and Bagchi, 1994). Fungicide application can minimize disease and thus increase the genetic potential and ultimately yield. However, there are reports of resistances development against fungicides. Therefore, it is necessities to judicial use of fungicides at proper time. Biological control of plant pathogens has been considered as a potential control strategy in recent years and search for potential biological agents has increased. *Trichoderma* is the most commonly used fungal bio control agent and have long been known as effective antagonists against plant pathogenic fungi (Kumar and Mukerji, 1996). Thus the present study was aimed to evaluate combination of fungicides and effectiveness of *Trichoderma harzianum and Pseudomanas fluorescence* under field conditions and to determine optimal timing of their application for the management of Alternaria blight on mustard.

MATERIALS AND METHODS

Filed experiments were conducted in two consugative years at Tirhut College of Agriculture Dholi (Bihar) during 2008-09 and 2009-10 *Rabi* crop seasons to test the effectiveness of bio agents and fungicides in different combinations as seed treatment and foliar spray against Alternaria blight in Indian mustard. Experiment was laid out in plots of 5x3m at 30x10 cm spacing in Randomized Block Design with three replications using highly susceptible mustard variety (Varuna) of Indian mustard. All the experimental plots received recommended dose of fertilizers (80 kg N and 40 kg P_2O_5 ha^{-1}) and sowing

Table 1: Mean Alternation leaf blight severity and yield in different treatments during *Rabi* 2008-9 and 2009-10

Treatments	Mean ALB Severity (%)	%Decrease	Yield(kg/ha)	%Increase
ST Metalaxyl @ 6g/kg	46.0(42.8)	29.3	826.7	20.3
ST Carbendazim @ 1g/kg	44.6(41.9)	31.5	847.3	23.3
ST Metalaxyl @ 6g/kg + Carbendazim @ 1g /kg	42.3(40.6)	35.0	852.0	24.0
ST *Trichoderma harzianum* @ 10g/ kg seed + FS *Pseudomonas fluorescens* (oil based) @10 ml /l	46.8(43.2)	28.0	770	12.0
ST Metalaxyl 6g/kg + FS Mancozeb @ 2g/l	36.4(37.1)	44.0	945	37.6
ST Carbendazim @ 1g /kg + FS Ridomil MZ 72WP @ 2g/l	38.3(38.2)	41.2	917.3	33.5
ST *Trichoderma harzianum* @ 10g 47.6(43.6) kg seed + FS *Trichderma harzianum* @ 10ml/ l	26.9	783	14.0	
Untreated control	65.1(53.8)		687	
CD($P<0.05$)	3.26		73.1	
CV(%)	4.1		6.3	

Figures in parentheses are angular transformed values. ALB-Alternaria leaf blight, ST-Seed treatment, FS-Foliar spray

was done Nov.17, 2008 and Nov.27, 2009. Different treatments viz. seed treatments with Metalaxyl 35% @ 6g/kg, Carbendazim 50%@ 1g/kg and Metalaxyl 35% @ 6g/kg + Carbendazim 50%@ 1g /kg applied alone and integrated with different combination of foliar spray viz., seed treatment with Metalaxyl 35% 6g/kg + foliar spray of Mancozeb @ 2 g/l water and seed treatment with Carbendazim 50%@ 1g /kg + foliar spray of Ridomil MZ 72 WP @ 2g/l water. Combination of two bio agents were applied viz., seed treatment *Trichoderma harzianum* @ 10g/ kg seed + foliar spray of *Pseudomonas fluorescens* (oil based) @10 ml /l water and seed treatment with *Trichoderma harzianum* @ 10g kg seed + foliar spray with *Trichderma harzianum* @ 10ml/ l water along with untreated control were given. Foliar sprays were applied after 50 days after sowing. Observations on percent disease severity of Alternaria blight was recorded on leaves at 95 days after sowing. Alternaria blight was observed randomly selected 10 plants using revised rating scale of Conn *et al.* (1990).

Scale (0-9) for rating reaction to Alternaria blight

0 (Immune) = No lesions

(HR) = Non-sporulating pinpoint size or small brown necrotic spots, less than 5% leaf area covered by lesions.

(R) = Small roundish slightly sporulating larger brown necrotic spots, about 1-2 mm in diameter with a distinct margin or yellow halo, 5-10% leaf area covered by lesions

(MR) = Moderately sporulating, non-coalescing larger brown spots, about 2-4 mm in diam with a distinct margin or yellow halo, 11-25% leaf area covered by the spots

(S) = Moderately sporulating, coalescing larger brown spots about 4-5 mm in diam, 26-50% leaf area covered by the lesions

HS) = Profusely sporulating, rapidly coalescing brown to black spots measuring more than 6mm diam without margins covering more than 50% leaf area

$$\text{Average severity score} = \frac{(N\text{-}1 \times 0) + (N\text{-}2 \times 1) + (N\text{-}3 \times 3) + (N\text{-}4 \times 5) + (N\text{-}5 \times 7) + (N\text{-}6 \times 9)}{\text{Number of leaf samples}}$$

Where N-1 to N-6 represents frequency of leaves in the respective score

RESULTS AND DISCUSSION

All the treatments viz. seed treatment only; seed treatment followed by foliar spray were found effective using chemical fungitoxicants and seed treatment followed by foliar spray using *T. harzianum* in reducing the Alternaria leaf blight severity on the leave over control with differences in effectiveness (Table1). Highest reduction up to 44.0% Alternaria leaf blight was caused by seed treatment with Metalaxyl 35% 6g/kg + foliar spray of Mancozeb @ 2g/l water after 50 days sowing simultaneously significantly increasing yield level up to 37.6 % against control. Seed treatment with Carbendazim 50%@ 1g/ kg + foliar spray of Ridomil MZ 72WP @ 2g/l water also reduced Alternaria blight severity the tune of 41.1% and increase yield level 33.5% but was found at par with the best above mentioned treatment. Among various control measures involving seed treatment in alone namely Metalaxyl 35% @ 6g/kg and Carbendazim 50%@ 1g/kg or in combination namely Metalaxyl 35% @ 6g/kg + Carbendazim 50%@ 1g / kg were found at par in minimizing disease as well as increasing yield except seed treatment with Metalaxyl 35% @ 6g/kg + Carbendazim 50%@ 1g /kg was superior in minimizing Alternaria blight severity then seed treatment by Metalaxyl only. All the treatment combinations involving seed treatment only were significantly inferior in minimizing Alternaria blight severity than the treatments involving seed treatment followed by foliar spray using chemical fungitoxicants. The seed treatment Metalaxyl alone or combinations with the foliar spray manages the disease effectively and economically as reported (Sharan, 1992). Tripathi *et al.* (1987) also noted that effectiveness of Mancozeb against Alternaria blight at Hisar. Rathi and Singh (2010) tested efficacy of different bioagents and fungicides with different combinations as seed treatments with *T.harzianum* followed by foliar spray of Ridomil and Carbendazim significantly reduced alternaria leaf blight in mustard. Balai and Singh (2013) reported that seed treatment with foliar spray of mancozeb effectively reduced the disease intensity of pigeonpea alternaria blight. Sahu *et al.* (2013) reported Mancozeb as effective fungicide for the management of early blight of tomato caused by *A.solani*.

Among the bio control measures seed treatment by *Trichoderma harzianum* @ 10g/ kg seed + foliar spray of *Pseudomonas fluorescens* (oil based) @10 ml /l water after 50 days sowing reduced Alternaria blight up to 28.0 per cent followed by seed treatment with *Trichoderma harzianum* @ 10g kg seed + foliar spray with *Trichderma harzianum* @ 10ml/l water. Both the biocontrol measures were found at par

with fungicidal seed treatment alone, reducing Alternaria leaf blight severity as well as yield respectively. Success of the bioagent against Alternaria blight in Indian mustard has been also reported by Meena *et al.*(2004). Reshu and Khan (2012) tested biocontrol agents against *A. brassicae* in mustard in field found that *T.viride* proved to most effective in the reduction of disease intensity on leaves and pods. Singh *et al.* (2013) reported that *T.harzianum* and *P. fluorescens* and their combination enhance the plant growth and reduced sclerotium rot in tomato.Yadav *et al.* (2013) evaluated effect of *P.fluorescens* for the control of purple blotch in onion and found that application of *P. fluorescence* resulted in minimizing disease intensity and maximum bulb yield.

In present study seed treatment with Metalaxyl 35% 6g/kg + foliar spray of Mancozeb @ 2 g/l water after 50 days sowing was found most effective in reducing Alternaria blight and increased the yield . Despite fungicide remains more effective in reducing diseases in plants, increasing public concern about environmental health is proving to be major hindrance in use of chemical pesticides including fungicides. Hence, use of low dose of fungicides, integrated with other means like growing disease tolerant cultivars, sanitation, crop rotation, use of plant extracts and bio-agents seems to be best method of disease management without environmental pollution. Biological control has only recently been tried on commercial scale in India, but the results of farmer's acceptance of this method remain to be determined.

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