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Eco-friendly Approaches Managing Major Diseases of Indian Mustard

[1]P.D. Meena, [2]R.P. Awasthi, [3]Shailesh Godika, [4]J.C. Gupta, [5]Ashok Kumar, [6]P.S. Sandhu, [1]Pankaj Sharma, [1]P.K. Rai, [1]Y.P. Singh, [7]A.S. Rathi, [8]Rajendra Prasad, [9]Dinesh Rai and [2]S.J. Kolte

[1]Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321 303 (Raj), India
[2]GBPUAT, Pantnagar 263145, U.S. Nagar (Uttaranchal), India
[3]Regional Research Station, SKRAU, Navgaon 301025 (Rajasthan), India
[4]JNKVV, ZARS, Morena 476001 (MP), India
[5]Oilseeds Research Station, CSKHPKV, Kangra 176001 (HP), India
[6]PAU, Ludhiana 141004 (Punjab), India
[7]CCSHAU, Hisar-125 004 (Haryana), India
[8]CSAUAT, Kanpur 208002 (UP), India
[9]TCA, Dholi, RAU, Dist.-Muzaffarpur 843 121(Bihar), India

Abstract: In India, Indian mustard [*Brassica juncea* (L) Czern and Coss] ravaged by various diseases viz., Alternaria blight (*Alternaria brassicae*), white rust (*Albugo candida*), powdery mildew (*Erysiphe cruciferarum*) and Sclerotinia rot (*Sclerotinia sclerotiorum*). Experiments were conducted at various locations for the management of various diseases of rapeseed-mustard during 2006-2009. Eco-friendly treatments (garlic bulb extract, *Trichoderma harzianum* as seed treatment alone or in combination with foliar spray by garlic aqueous extract, *T. harzianum* and *Pseudomonas fluorescens*) did not differ significantly among themselves. Foliar sprays with chemical fungicides did significantly better than the non-chemical fungicides against Alternaria blight. Similar results were observed by garlic bulb extract, *T. harzianum* as seed treatment in combination with *Pseudomonas fluorescens* spraying was significantly superior for white rust on leaves, powdery mildew and Sclerotinia rot, which were at par with chemical fungicides for Sclerotinia rot management and was the best for powdery mildew. Foliar spray by garlic bulb extract increased the seed yield significantly as compared to control.

Key words: Indian mustard · Alternaria blight · White rust · Powdery mildew · Sclerotinia rot · Eco-friendly management

INTRODUCTION

Indian mustard [*Brassica juncea* (L.) Czern and Coss.] is alone contributing about 80 per cent of the total rapeseed-mustard which is one of the major oilseed crops cultivated in India. Out of 59.93 metric tone of rapeseed-mustard seed produced over 30.74 million hectares (m ha) with the productivity of 1,950 kg/ha in the world during 2009-10 [1]. India is having 21.7 and 10.7 per cent of the total global acreage and production respectively [1]. India produced 6.59 m t from 5.77 m ha rapeseed-mustard during 2009-10 [2]. The rapeseed-mustard production trends represent fluctuating scenario with an all time high production of 8.13 m t from 7.28 m ha acreage during 2005-06. The yield levels also have been variable ranging from 854 (2002-03) to 1142 kg/ha (2009-10) during the past eight years [2]. In India, mustard ravaged by several major diseases viz., Alternaria blight [*Alternaria brassicae* (Berk.) Sacc.], white rust [*Albugo candida* (Pers. Ex Lev.) Kuntze], powdery mildew (*Erysiphe cruciferarum*) and Sclerotinia rot (*Sclerotinia sclerotiorum* (Lib.) de Bary) which influences the quantity and quality of yield.

Alternaria blight disease has been reported from all the continents of the world and is one among the important diseases of Indian mustard causing up to 47 per cent yield losses [3] with no proven source of resistance

Corresponding Author: P.D. Meena, Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur-321 303 (Raj) India. E-mail: pdmeena@gmail.com.

against the disease reported till date in any of the hosts [4]. White rust caused by the biotrophic oomycete pathogen *A. candida* is an important disease affecting mustard crop in India. The pathogen can infect all aboveground parts of *B. juncea* plants, producing characteristic white blisters on cotyledons, leaves, stems and inflorescences [5]. Up to 60 per cent or more yield losses on *B. rapa* and *B. juncea* from this disease have been reported in India [6,7]. A few genotypes have recently been identified with high levels of resistance to *A. candida* in *B. juncea* germplasm in India. White rust and downy mildew together produced 37-47 per cent fewer pods and 17-32 per cent less seed in mustard [8]. Powdery mildew reduces the vigour of host plants and sometimes causes significant yield losses upto 17 per cent [9] and reduction in product quality. Rot of mustard has become important in recent times in India and elsewhere with high disease incidence and severe yield losses leading to discouragement of growers of the crop [10]. Sclerotinia rot is unusual among necrotrophic pathogens in its requirement for senescent tissues to establish an infection and to complete the life cycle. Earlier workers reported management of Sclerotinia rot of mustard by fungicides [11].

In recent years, an increasing consciousness about environmental pollution due to pesticides and development of fungicide-resistant strains in plant pathogens has challenged plant pathologists to search for ecofriendly tools for disease management. Fungicides are reported to be able to control the disease [12]. Management of fungal pathogens in agriculture has often relied on the behavior of pesticides and their impacts on microorganisms and non-target invertebrates that was collected in, or is applicable to cultivated field conditions [13].

Continuous use of specific fungicides could resulted in the development of resistance of some fungal pathogens targeted for control. Foliar applications at the two critical plant growth stages, viz. 45 and 75 d.a.s. reported earlier as most susceptible age of the mustard crop for the disease in order to reduce losses in seed yield due to Alternaria blight [14]. However, no effort has been made to use the plant extracts and bioagents as ecofriendly components for effective integrated management of Alternaria blight, white rust, PM and Sclerotinia rot of mustard. The present work studied effect of plant extracts, bioagents individually and in combination for integrated management of Alternaria blight (AB), white rust (WR) powdery mildew (PM) and Sclerotinia rot (SR) of mustard.

MATERIALS AND METHODS

A multi-location field experiment was conducted for integrated disease management in mustard during 2006-2009 in randomised block design in three replications using a common variety Varuna with plot size 5 m x 3 m with row to row spacing 30 cm and plant to plant 10 cm. Recommended doses of N P K fertilizers were applied. Different treatments *viz.*, seed treatment with aqueous bulb extract of *Allium sativum* @ 1% (w/v), *Trichoderm harzianum* @ 10g/kg, Bavistin 50 WP @ 2g/kg and Apron 35 SD @ 6g/kg integrated with different combinations of foliar sprays treatments (at 50-60 DAS) *viz*., bulb extract of *Allium sativum* @ 1% (w/v), *Trichoderma harzianum* (oil based) @ 10g/l water, *Pusedomonas flourescens* (oil based) @ 10g/l water, Bavistin 50 WP @ 2g/l water and Ridomil MZ 72 WP @ 2g/l wateralong with untreated control were taken. Observation on per cent disease severity or incidence of AB, WR, PM and SR was recorded on leaves and pods. AB, WR and PM were observed on randomly selected 10 plants per plot using revised rating scale of Conn *et al*. [15] as per cent infected area under disease.

Scale (0-9) for rating reaction to Alternaria blight, white rust and powdery mildew

0 (Immune for WR) = 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.

Sclerotinia rot was recorded as percent incidence and percent plant infected. SR (% plant affected) = (number of plants infected/ total number of plants) x 100. All data in percentage were analysed after arc sin transformation and both actual and transformed value of mean with C.D. ($P<0.05$). Data were analysed as per the design using ANOVA.

RESULTS AND DISCUSSION

Data obtained (table 1) from different locations for four years were pooled and analysed to conclude the results of applied integrated management of major disease. All the treatments provided significantly lower AB severity over control. Eco-friendly treatments including garlic bulb extract, *T. harzianum* as seed treatment alone or in combination with foliar spray by garlic extract, *T. harzianum* and *Pseudomonas fluorescens* were at par among themselves. Foliar spray with chemical fungicides did significantly better than the non-chemical fungicides for management of AB. Garlic bulb extract, *T. harzianum* as seed treatment in combination with *P. fluorescens* did not differ significantly among themselves for white rust on leaves. Similarly, the situation for SR and PM was observed. Although combination of seed treatment and foliar spray by garlic bulb extract resulted in least powdery mildew severity across the locations, the combination was at par with chemical fungicides for SR, the best for powdery mildew.

Seed treatment with *T. harzianum* @ 10 g/kg seed followed by foliar spray of Ridomil MZ 72 WP @ 2 g/ l water after 50-60 days of sowing, significantly reduced the Alternaria leaf and pod blight up to 43.6 and 30.8 per cent, respectively and white rust and stagheads up to 39.5 and 23.3 per cent, respectively. Aantagonistic use of *Trichoderma* species has been reported quite effective against different pathogens [16] particularly as seed treatment followed by fungicidal spray in managing many fungal diseases in various host pathogen combinations [17]. In the present investigation, seed treatment with *T. harzianum* @ 10g g/kg seed followed by foliar spray of Ridomil MZ 72 WP @ 2g/h water after 50-60 days of sowing, significantly reduced the Alternaria leaf and pod blight upto 43.6 and 30.8 per cent, respectively. Similarly, staghead reduced up to 39.5 and 23.3 per cent, respectively with increased the seed yield in Indian mustard [18]. However, fungicidal seed treatment with Apron 35 SD followed by foliar spray of Ridomil MZ 72 WP was found most effective in reducing Alternaria blight and white rust. 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.

Table 1: Effect of different treatment on Alternaria blight, white rust, powdery mildew and Sclerotinia rot in Indian mustard during 2006-2009 over eight locations*#

Treatments	% ABL severity	% ABP severity	% WR severity	% PM severity	% SR incidence
Aqueous garlic bulb extract @ 1% (w/v)-ST*	29.6 (27.8)	29.8 (29.3)	19.0 (17.7)	28.4 (27.0)	18.0 (13.8)
Metalaxy 1 or 6 g/kg Apron 35SD-ST	29.4 (27.8)	29.2 (28.6)	18.7 (16.7)	29.3 (28.3)	19.5 (15.0)
Carbendazim @ 1 g a. I or 2 g per kg of Bavistin 50 WP-ST	29.6 (28.0)	29.4 (28.7)	18.9 (17.2)	31.0 (31.0)	20.9 (15.8)
Apron 35 SD @ 6 g/kg + Carbendazim @ 1 g a. I or 2 g per kg of Bavistin 50 WP-ST	29.1 (26.5)	30.0 (29.5)	18.8 (16.6)	30.3 (30.1)	18.9 (14.1)
Trichonderma harzianum @ 10g / kg seed-ST	30.0 (28.7)	30.0 (29.5)	20.7 (19.2)	31.2 (31.2)	21.2 (16.6)
T. harzianum @ 10g / kg seed-ST + *Pseudomonas fluorescens* (oil-based)@ 10 ml/1 water-FS	28.5 (27.0)	29.9 (29.3)	19.3 (18.2)	28.5 (27.0)	18.9 (14.5)
Aqueous garlic bulb extract @ 1% (w/v)-ST + Aqueous garlic bulb extract @1% (w/v)-FS*	28.2 (26.0)	28.2 (36.5)	17.8 (15.1)	27.9 (27.2)	15.4 (11.4)
Metalaxy 1 or 6 g/kg Apron 35SD-ST + Metalaxy + Mancozeb or Ridomil MZ 72 WP @ 2 g/1-FS	25.1 (22.2)	25.3 (23.3)	15.2 (12.0)	27.6 (26.2)	18.7 (14.1)
Carbendazim @ 1 g a. I or 2 g per kg of Bavistin 50 WP-ST + Ridomil MZ 72 WP @ 2 g/1-FS	25.8 (22.6)	25.8 (23.7)	16.2 (13.2)	25.8 (23.7)	15.9 (11.8)
T. harzianum @ 10g / kg seed-ST + *T. harzianum* @ ml /1-FS	27.9 (26.4)	29.6 (29.1)	20.0 (19.0)	29.1 (26.5)	17.2 (13.3)
T. harzianum @ 10g/ kg seed-ST + T. *harzianum* + *T.virde* @ 2 g/1-FS at 50 days after sowing	31.3 (30.2)	33.6 (31.3)	20.1 (13.8)	35.0 (33.4)	12.6 {5.2)
Oxy-dematon methy1 @ 1 ml/I-FS when aphid population reaches ETL.	32.4 (32.7)	31.6 (31.1)	24.7 (25.0)	30.4 (30.5)	20.4 (16.2)
Control	35.3 (36.5)	33.3 (34.3)	26.8 (27.8)	35.4 ()38.5)	23.4 (18.7)
C.D.($P<0.05$)	2.1	1.6	3.1	3.6	0.4

*pooled data of 4year and eight locations; # Figures in parenthesis are arc sin transformed values; ABL= Alternaria blight on leaf; ABP= Alternaria blight on pods

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