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CONTENTS

Effect of some fungicides on Alternaria leaf blight disease and yield of mustard

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ABSTRACT: Among oilseeds *Brassica*, mustard (*Brassica juncea*) is one of the most important oilseed crops being cultivated in India. The crop is attacked by several diseases. Among them Alternaria leaf blight is one of the most destructive diseases caused by fungus *Alternaria brassicae*. The yield loss caused by this pathogen is between 10-70 per cent. Since no resistant variety against the disease is available, therefore farmers mainly dependent on the recommended fungicides which are not much effective when disease occurs in severe form. Keeping in view some new chemical fungicides were evaluated under field conditions in two successive years (2011-12 & 2012-13). Among them Nativo 75 WG (Tebuconazole 50 % +Trifloxystrobin 25% w/w) and Tebuconazole 43 EC each at 0.05% were found significantly most effective with minimum occurrence of the disease severity index (DSI) on leaves (0.0 & 0..0%) at 90 days after sowing (DAS), and on pods (5.56 & 7.41 %) at 110 DAS as compared to other treatments and standard check Mancozeb 75 WP @ 0.2% in which DSI on leaves and pods was 11.11 and 15.28 percent while in check it was 43.52 and 26.85 percent respectively. Maximum mustard grain yield was obtained with Nativo 75 WG (2550.67 kg/ha) followed by Tebuconazole 43 EC (2482.33 kg/ha) and Difenaconazole 25 EC (2392.33 kg/ha) and was at par with each other but significantly different from other treatments as well standard check Mancozeb 75 WP (2166.00 kg/ha) and check (1512.67 kg/ha). The highest net return was obtained with Tebuconazole 43 EC (Rs.31100.00/ha) followed by Nativo 75 WG (Rs. 25485.00/ha) and Propiconazole (Rs. 25273.00/ha) as compared to standard check Mancozeb (Rs. 19818.00/ha).

Key words: *Alternaria brassicae*, disease severity index, fungicides, mustard, net return, yield

Among oilseed Brassicas, mustard (*Brassica juncea*) is one of the most important oilseed crops being cultivated in India. The crop is attacked by several fungal pathogens like *Hyaloperonospora parasitica* (downy mildew), *Albugo candida* (white rust), *Alternaria brassicae* (Alternaria blight), *Sclerotinia sclerotiorum* (Sclerotinia rot) etc. However, Alternaria blight is a common occurrence at farmers' field in major mustard growing states of the India resulted an average yield loss of 46-57 per cent in yellow sarson, 35-38 per cent in mustard (Kolte *et al*., 1987; Chattopadhyay *et al*., 2008; Meena *et al*., 2010; Kumar *et al*., 2014) and 10-70 per cent in both rapeseed and mustard (Kolte, 1985; Ram and Chauhan, 1998). The disease also reduced seed size and seed colour (Kaushik *et al*., 1984) and oil content between 14.5-29.0 per cent (Ansari *et al*., 1998). Keeping above in view, the present attempts were made to work out an effective fungicidal management.

MATERIALS AND METHODS

Field experiments were conducted at Crop Research Centre, GBPUAT, Pantnagar, Uttarakhand. The experimental field is situated in the humid and subtropical Tarai region between 29° North and 79.73°East longitude with an altitude of 243.8 m above the mean sea level. Field experiments were conducted in two successive cropping season (2011-12 & 2012-13). The seeds of *Brassica juncea* var. Kranti were sown on Oct. 10 in each cropping season. In the present studies eight fungicides *viz*., Difenoconazole 25 EC @ 0.05%, Propiconazole 41.8 EC @ 0.05% , SAAF 75 WP (Carbendazim 12% + Mancozeb 63% WP) @ 0.2%, Nativo 75WG (Tebuconazole 50%+Trifloxystrobin 25% w/w) @ 0.05% , Tebuconazole 43 EC @ 0.05%, Hexaconazole 75 WG @ 0.05%, Mancozeb 75 WP @ 0.2% (standard check), Ridomil MZ-72 WP (Metalaxyl 12% + Mancozeb 64%) @ 0.2% ; combination of bio-products *viz*., Cow urine +Garlic bulb+ *Trichoderma* (5:5:1%), Cow urine +Garlic bulb+ Eucalyptus +*Trichoderma* (5:5:5:1%) along with check (water spray) were evaluated against the disease at crop research centre reported as hot spot of Alternaria blight. Plot size was kept 3x5 sq m. Plant population was maintained by keeping row to row distance of 30 cm and plant to plant distance at 15 cm apart by proper thinning after 30 DAS. All agronomic practices were followed as per recommendations for the cultivation of mustard. The fungicides and combination of bio-products each were applied separately on foliage of mustard crop at 10 days interval before appearance of the disease i.e., 1st at 50, 2nd at 60 and 3rd at 70 DAS. Battery operated knapsack sprayer with a nozzle size of 900 ml/min. was used for the foliar

application of fungicides and bio-products. In each treatment 3 lit. solution was used in 1st spray, 3.5 lit. solution in 2nd spray, and 4.0 lit. solution in 3rd spray.
Ten plants/ plot were randomly selected for the observations. Based on average per cent infected area on leaves and pods of each plant, the data of disease rating were recorded at 90 and 110 DAS respectively (Table 1) and Disease Severity Index (DSI) was calculated using following formula:
DSI (%) = Sum [(number of plants x rating scale)] / (total number of plants x maximum disease rating) x 100

The crop was harvested at 140 DAS. The net return from each treatment was also calculated in which cost of three spraying in each treatment and sale price of mustard @ Rs. 3350.00 /q were considered. The cost of other factors which included seed, agronomic practices, labor charges etc. was constant for all the treatments and considered Rs. of 18000.00/ha.

Statistical Analysis
Field experiment was conducted in Randomized Block Design (RBD) with single factor and three replicates. Per cent disease severity index was calculated before analysis. Treatments were compared using critical differences (CD) at 5 per cent level of significance. Statistical software STPR was used for analysis of variance (ANOVA) test.

RESULTS AND DISCUSSION

Pooled data (2011-12 & 2012-13) of disease severity index (Table 2) showed that among various fungicides and combination of bio-products disease severity index on leaves at 90 DAS was observed minimum in Nativo 75 G @ 0.05% and Tebuconazole 43 EC 0.05% (0.0% in each) followed by Difenaconazole 25 EC @ 0.05% (5.56 %), as compared to standard check Mancozeb 75 WP @ 0.2% (11.11%) and check (43.52%) and was significantly different from each other as well with other treatments. The disease severity index on pods at 110 DAS was observed minimum in Nativo 75 G (5.56 %) followed by Difenaconazole 25 EC (6.48%), Tebuconazole 43 EC (7.41%), and Propiconazole 41.8 EC (8.33%) and was at par with each other but significantly different from other treatments and standard check *viz.,* Mancozeb 75 WP (15.28%) and check (26.85 %) (Table 2). The present findings are also supported by findings of Singh *et al.* (2018) who observed minimum DSI in Nativo 75 G followed by Difenaconazole 25 EC (each at 0.05%). However, Choudhary *et al.* (2018) reported minimum disease severity index when 1st sprayed with Mancozeb 75 WP (0.2%) and 2nd sprayed with Difenoconazole 25 EC (0.05%); Singh and Singh (2005) and Meena *et al.* (2011) observed minimum DSI in Mancozeb 75 WP (0.2%) followed by Ridomil MZ-72WP (0.2%).
Maximum grain yield was obtained in Nativo 75 WG (2550.67 kg/ha) followed by Tebuconazole 43 EC (2482.33 kg/ha) and Difenaconazole 25 EC (2392.33 kg/ha) and was at par with each other but significantly different from other treatments and standard check Mancozeb 75 WP (2166.00 kg/ha) and check (1512.67 kg/ha) (Table 2). The present findings are also supported by Singh *et al*. (2018) who reported maximum grain yield in Nativo followed by Difenaconazole. However, Choudhary *et al*. (2018) reported maximum grain yield when 1st sprayed with Mancozeb 75 WP and 2nd sprayed with Difenoconazole. Meena *et al.* (2011) observed maximum grain yield in Mancozeb 75 WP (0.2%) followed by Ridomil MZ-72WP (0.2%).
The highest net return over check was obtained in Tebuconazole 43 EC (Rs.31100/ha) followed by Nativo 75 WG (Rs. 25485/ha) and Propiconazole (Rs. 25273/ha) as compared to standard check Mancozeb (Rs. 19818/ha) (Table 3).

Among bio-product, minimum disease severity index was observed in Cow urine + Garlic bulb+ Eucalyptus +*Trichoderma* @ 5:5:5:1% v/v i.e. in leaves (26.85%) and pods (21.29%) and yield (1680.66 kg/ha) and was significantly better than the check (43.52% & 26.85% &

Table 1: 0-9 rating scale (Anonymous, 2011)

Disease Rating	Description of the symptoms
0	No lesion
1	Non sporulating pinpoint size or small brown necrotic spots, less than 5% leaf area covered by the lesions
3	small roundish slightly sporulating larger brown necrotic spot, about 1-2 mm in diameter with a distinct margin or yellow halo, 5-10% leaf area covered by lesions
5	moderate sporulation, non-coalescing larger brown spots, about 2-4mm in diameter with a distinct margin or yellow halo, 11-25% leaf area covered by the lesions
7	moderately sporulating, coalescing, larger brown spots about 4-5 mm in diameter, 26-50% leaf area covered by the lesions
9	profusely sporulating, rapidly coalescing, brown to black spots measuring more than 6 mm in diameter without margins covering more than 50% leaf area

Table 2: Effect of different chemical fungicides and combination of bio-products on disease severity (Alternaria blight) and yield of mustard under field conditions

Sl. No.	Treatments	Crop season (2011-2012)				Crop season (2012-2013)				Pooled data (2011-12 & 2012-13)			
		Disease severity of AB		Yield (kg/plot) 15 sq m	Yield (kg/ha)	Disease severity of AB		Yield (kg/plot) 15 sq m	Yield (kg/ha)	Disease severity AB		Yield (kg/plot) 15 sq m	Yield (Kg/ha)
		Leaves	Pods			Leaves	Pods			Leaves	Pods		
1.	Difenaconazole 25% EC @ 0.05%	5.56 (13.64)	5.56 (13.64)	3.906	2604.00	5.56 (13.64)	7.40 (15.72)	3.270	2180.33	5.56 (13.64)	6.48 (14.68)	3.588	2392.33
2.	Propiconazole 41.8% EC @ 0.05%	16.66 (24.10)	7.41 (15.58)	3.797	2531.67	18.52 (25.48)	9.26 (17.68)	3.049	2032.67	17.59 (24.79)	8.33 (16.63)	3.423	2282.17
3.	SAAF 75 WP (Carbendazim 12%+ Mancozeb 63%) @ 0.2%	21.00 (26.15)	11.9 (19.1)	3.12	2080.00	25.30 (30.25)	13.0 (21.4)	2.70	1800.00	23.15 (28.20)	12.45 (20.25)	2.910	1940.00
4.	Nativo 75 WG (Tebuconazole 50%+ Trifloxystrobin 25% w/w) @ 0.05%	0.00 (0.00)	3.71 (11.1)	4.201	2800.67	0.00 (0.00)	7.41 (15.58)	3.451	2300.67	0.00 (0.00)	5.56 (13.34)	3.826	2550.67
5.	Tebuconazole 43 EC @ 0.05%	0.00 (0.00)	5.56 (13.64)	4.122	2748.00	0.00 (0.00)	9.26 (17.82)	3.324	2216.33	0.00 7.41 (0.00)	3.723 (15.73)	2482.33	
6.	Hexaconazole 75 WG @ 0.05%	23.15 (28.75)	12.96 (21.01)	3.090	2060.22	26.85 (31.25)	15.74 (23.45)	2.268	1512.55	25.00 (30.00)	14.35 (22.23)	2.679	1786.38
7.	Cow urine +Garlic bulb +Trichoderma @ 5:5:1% v/v	26.85 (31.20)	24.07 (29.35)	2.885	1923.33	29.63 (33.00)	22.23 (28.15)	2.095	1397.33	28.24 (32.1)	23.15 (28.75)	2.490	1660.33
8.	Cow urine+ Garlic bulb+ Eucalyptus +Trichoderma @ 5:5:5:1% v/v	24.07 (29.35)	18.52 (25.44)	2.855	1903.33	29.63 (33.04)	24.06 (29.44)	2.187	1458.33	26.85 (31.2)	21.29 (27.44)	2.520	1680.66
9.	Mancozeb 75 WP @ 0.2%	11.11 (19.47)	12.96 (21.20)	3.684	2456.00	11.11 (19.47)	17.59 (24.80)	2.814	1876.00	11.11 (19.47)	15.28 (23.0)	3.249	2166.00
10.	Ridomil MZ -72 WP (Metalaxyl 8% + Mancozeb 64%) @ 0.2%	20.37 (26.82)	14.82 (22.55)	3.543	2362.00	20.37 (26.82)	20.36 (26.78)	2.655	1770.00	20.37 (26.82)	17.59 (24.67)	3.099	2066.00
11.	Check (water spray)	42.59 (40.74)	24.07 (29.35)	2.711	1807.67	44.43 (41.80)	29.63 (33.05)	1.826	1217.67	43.521 (41.27)	26.85 (31.2)	2.269	1512.67
	CD (0.05)	2.94 (1.99)	3.08 (4.18)	0.334	222.71	4.32 (3.05)	4.96 (3.42)	0.332	221.69	3.63 4.08 (2.52)	0.333 (3.8)	146.20	
	CV (0.05)	14.61 (8.45)	17.34 (12.75)	11.3	11.3	16.06 (9.51)	14.72 (7.61)	9.7	9.7	15.34 (8.98)	16.03 (10.8)	10.5	10.5

The values in parenthesis are Transformed value

Table 3: Effect of chemicals and bio-products on gross net return during cultivation of mustard

Sl. No.	Treatment	Cost of chemicals* (Rs/ha)	Yield (q/ha)	Grass Net return (Rs/ ha)	Incremental yield (q/ha)	Incremental gain over check (Rs/ha) **	Grass net return over check (Rs/ha)
		A	B	C (BxRs.3350**)-(Rs. 18000***)	D (Treat -Check)	E (D x Rs. 3350)	F (E-A)
1.	Difenoconazole 25 EC @ 0.05% (Rs. 4000/L)	5160.00	23.92	62132.00	8.80	29480.00	24320.0
2.	Propiconazole 41.8 EC @ 0.05% (Rs. 1300/L)	1677.00	22.82	58447.00	7.70	26950.00	25273.0
3.	SAAF 75 WP (Carbendazim 12%+ Mancozeb 63% WP) @ 0.2% (Rs. 590/Kg)	3009.00	19.40	46,990.00	4.28	14338.00	11329.00
4.	Nativo-75 WG (Tebuconazole 50% +Trifloxystrobin 25% w/w) @ 0.05% Rs. 7200/Kg)	9288.00	25.50	67425.00	10.38	34773.00	25485.00
5.	Tebuconazole 43 EC @ 0.05% (Rs. 2210/L)	2850.00	24.82	65147.00	9.70	33950.00	31100.0
6.	Hexaconazole 75 EC @ 0.05% (Rs 600/L)	774.00	17.86	41831.00	2.74	9179.00	8405.00
7.	Cow urine +Garlic bulb+ *Trichoderma* @ 5:2:1% v/v	1000.00	16.60	37610.00	1.48	4958.00	3959.00
8.	Cow urine +Garlic bulb +Eucalyptus +*Trichoderma* @ 5:2:5:1% v/v	1200.00	16.80	38280.00	1.68	5628.00	4428.00
9.	Mancozeb 75 WP @ 0.2% (Rs410/Kg)	2091.00	21.66	54561.00	6.54	21909.00	19818.00
10.	Ridomil MZ 72 WP (Metalaxyl 8% + Mancozeb 64%) @ 0.2% (Rs. 1440/Kg)	7344.00	20.66	51211.00	5.54	18559.00	11215.00
11.	Check (water spray)	-	15.12	32652.00	-	-	-

*Cost of three spraying (fungicides/ bio-products), **Cost of other factors viz. seed, agronomic practices, labor charges etc (Rs. 18000.00/ha), ***Sale price of mustard grain @ Rs 3350.00 /q

1512.67/kg/ha) (Table 2). The net return of the combination of this bio-product over check was Rs. 4228.00/ha (Table 3). No literature was found regarding economics of fungicidal application for the management of Alternaria blight disease and net return over check.

In the present investigation application of bio-products was not much effective in managing Alternaria blight disease of mustard; therefore application of such bio-products alone, should be discourage for the effective management of the disease which is also supported by findings of earlier workers (Meena *et al.,* 2008; Yadav, 2009; Singh *et al*., 2013; Singh *et al*., 2016 ; Singh *et al*., 2018; Kumar *et al*., 2016) who reported efficacy of bio-products (Garlic bulb extract, Neem, Eucalyptus, Madar, Dhatura and *Trichoderma harzianum*) under Integrated Disease Management strategies.

CONCLUSION

The present findings revealed that foliar application of new generation fungicide, Nativo 75 WG (Tebuconazole 50%+Trifloxystrobin 25%) or Tebuconazole 43 EC @ 0.05 % alone or in alternating with each other 1st at 50, 2nd at 60 and 3rd at 70 DAS could be best exploited for the effective management of Alternaria leaf blight disease and to increase yield as well net return in terms of money. However, plant extract, bioagent and animal product in their combinations are cost effective in use but do not provide effective control against the pathogen so use of these bio-products is recommended along with chemicals in IDM module.

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