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Efficacy of fungicides against Alternaria blight disease of linseed (*Linum usitatissimum*)

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ABSTRACT

The study on efficacy of fungicides against Alternaria blight disease of linseed caused by Alternaria lini was conducted at Research farm of Bihar agricultural university, Sabour, Bhagalpur (Bihar) during Rabi season of 2020-21 to select suitable fungicides against this disease. Six fungicides were evaluated in vitro and in vivo condition. The results revealed that all the tested fungicides showed significantly better performance to minimize the Alternaria blight disease over control. Among the tested fungicides, Propiconazole 25 EC proved the best at all the concentrations (100, 150 and 200 ppm) as it showed 100% of mycelial growth inhibition over control. In the field condition too, Propiconazole 25EC proved superior among all the fungicides with the lowest disease severity (10.66%). It showed the highest disease control over check (77.6 %) and also highest yield (884.33 kg ha^{-1}) which was followed by Azoxystrobin 23%SC and Carbendazim 12% + Mancozeb 63% WP.

Key words: Fungicides, Alternaria blight, linseed, yield

INTRODUCTION

Linseed (*Linum usitatissimum* L.) is one of the oldest oilseed crops which is also known as flax. Among the oilseed crops grown during *Rabi* season, linseed is next to rapeseed and mustard in area and production. It is a multipurpose crop and is grown in India mainly for oil, whereas in western countries, it is grown especially for fiber. Its cultivation is mostly confined to Madhya Pradesh, Maharashtra, Chhattisgarh, Uttar Pradesh, Bihar and Orissa. Almost every part of the linseed plant is utilized commercially, either directly or after processing. On a very small scale, the seed is directly used for edible purposes, about 20% of the total oil produced is used in farmers home and about 80% of the oil goes to industries. The oil is also utilized for manufacturing paints, varnishes, oilcloth, linoleum, pad ink, printers ink, soaps, patent leather and other products. The components present in flaxseed attract the food technologists and nutritionists to explore its activities in health sector (Mishra and Verma, 2013). Linolenic fatty acids (omega-3) reduce the risk of cardiovascular disease. Linseed protein was found more effective in lowering triglycerides (TAG) and plasma cholesterol. The antioxidant activity of it has been found to reduce total cholesterol and platelet aggregation.But this crop is ravaged by a number of diseases and insect pests at various phases of its growth which reduce the crop yield and quality. Amongst diseases Alternaria blight caused by *Alternaria lini* Dey is a major biotic stress, limiting crop yield in hot and humid environment (Singh and Singh, 2005). Low production of linseed occurs mainly due to this disease. Considering the importance of the crop and destructive nature of the disease the present study was undertaken to find out the efficacy of the fungicides under *in vitro* and *in vivo* condition against Alternaria blight of linseed.

MATERIALS AND METHODS

Six commonly available fungicides namely Mancozeb 75% WP, Propiconazole 25 EC, Carbendazim 50% WP, Azoxystrobin 23% SC, Carbendazim 12% + Mancozeb 63% WP and Metalaxyl 18% + Mancozeb 64% WP were evaluated against *Alternaria lini in vitro* as well as in field. For *in-vitro* evaluation of fungicides, poison food technique potato dextrose agar as basal medium was followed. The fungicides (Mancozeb, Propiconazole, Carbendazim, Azoxystrobin, Carbendazim+Mancozeb and Metalaxyl+Mancozeb) were tested at three different concentrations of 100, 150 and 200 ppm. The calculated quantities of fungicides were thoroughly mixed in the medium before pouring into Petri plates so as to get the desired

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concentration of active ingredient of each fungicide separately. Fungicide amended medium (20 ml) was poured in each of 90 mm sterilized Petri plates and allowed to solidify. The plates were inoculated centrally with 8 mm disc of 10 days old young sporulating culture of *Alternaria lini.* Controls without fungicides were also maintained. The inoculated Petri plates were incubated at room temperature 28±1 ^{O}C in the laboratory. The colony diameter was measured after 7days when the control plates were full of fungal grow. Three replications were maintained for each treatment. Radial growth was converted into per cent growth inhibition by using following formulae:

$$\text{Per cent growth inhibition} = \frac{C-T}{C} \times 100$$

Where, C = Colony diameter in check plate (mm), T= Colony diameter in the treated plate (mm). The per cent inhibition were transformed into ArcSin percentage transformation and then analyzed statistically.

Field trail was conducted during *Rabi* season of 2020-21at research farm of Bihar Agricultural University, Sabour, Bhagalpur. Field trials were laid out in randomized block design with 3 replications and Sabour Tisi-1 variety. Recommended dose of fertilizers and spacing was followed. In fungicidal trial, two sprayings at 10 days interval were given in all cases. Observations on disease severity were recorded at flowering stage following 0-5 scale. The yields were recorded after harvest of the crop. Plant disease index was calculated by the formula as given by McKinney (1923).

RESULTS AND DISCUSSIONS

All the fungicides tested were able to inhibit the growth of *Alternaria lini* (Table 1). Higher concentration was more effective as compared to lower concentration in all the cases. Among different fungicides at 100 ppm concentration, mycelial growth of *Alternaria lini* ranged from 0-62.75 mm, being minimum (0 mm) in Propiconazole 25 EC and maximum (62.75 mm) in Carbendazim 50% WP. Azoxystrobin 23% SC was found second most effective fungicide at 100 ppm by giving 59.68% mycelial inhibition which was followed by Carbendazim 12% + Mancozeb 63% WP, which inhibited 51.35% of mycelial growth. Carbendazim 50% WP was found least effective growing 27.96% mycelial inhibition. Same trends were followed at 150 and 200 ppm concentrations where highest inhibition (100%) was recorded by Propiconazole 25 EC and lowest inhibition in Carbendazim 50% WP. The results were closely supported with the findings of Brahmankar *et al.* (2021), Saqib *et al.* (2020), Verma *et al.* (2020) and Jackson and Kumar (2019).

Table 1: Effect of different fungicides on mycelial growth (mm) and inhibition over control against Alternaria blight of linseed

Treatments	Radial growth (mm)			Mean	Inhibition over control (%)
	100 ppm	150 ppm	200 ppm		
Mancozeb 75% WP	49.00	46.80	33.50	43.10	47.60
Propiconazole 25EC	00.00	0.00	0.00	0.00	100.00
Carbendazim 50% WP	62.75	59.50	55.50	59.25	27.96
Azoxystrobin 23% SC	45.60	33.40	20.50	33.17	59.68
Carbendazim 12% + Mancozeb 63% WP	49.75	37.80	32.50	40.02	51.35
Metalaxyl 18% + Mancozeb 64% WP	54.20	43.80	38.40	45.47	44.72
C.D. at 1%	2.69	1.67	1.34		
SE(m)±	0.93	0.57	0.46		
C.V. (%)	3.68	2.54	2.31		

**Average of three replications*

Field trials were conducted to test the efficacy of different fungicides and the data obtained were statistically analyzed and presented in Table 2. The efficacy of fungicides was significantly effective against the Alternaria blight disease over the check. The minimum (10.66%) disease severity was found with Propiconazole 25 EC followed by Carbendazim 12% + Mancozeb 63% WP (22.66%), Mancozeb 75% WP (22.66%), Metalaxyl 18% + Mancozeb

64% WP (28.00%) and Carbendazim 50% WP (32.66%). Both the treatment Carbendazim 12% + Mancozeb 63% WP (22.66 %) and Mancozeb 75% WP (22.66 %) were statistically at par with each other. The maximum (47.66 %) disease severity of Alternaria blight was obtained in check. The present findings were in congruent with the findings of Kumar *et al.* (2021), Gussian and Ravi (2020), Biswas and Ghosh (2018) and Das *et al.* (2017).

Table 2: Economics of different fungicides for management of Alternaria blight of linseed

Fungicides	Disease severity* (%)	Yield (kg ha^{-1})	Additional yield over Check (kg ha^{-1})	Cost of protection (Rs ha^{-1})	Net return (Rs ha^{-1})	Benefit : cost ratio
Mancozeb 75% WP @ .20%	24.33 (29.51)	705.00	185.67	1184.0	7330.0	6.2
Propiconazole 25EC@ .20%	10.66 (19.03)	884.33	365.00	3254.0	13275.0	4.1
Carbendazim 50% WP@ 0.20%	32.66 (34.82)	645.00	125.67	2764.0	3195.0	1.2
Azoxystrobin 23% SC @ 0.20%	18.33 (25.32)	743.33	224.00	6854.0	3530.0	0.5
Carbendazim12%+Mancozeb 63% WP @ 0.20%	22.66 (28.34)	732.33	213.00	2794.0	7095.0	2.5
Metalaxyl 18%+Mancozeb 64% WP @ 0.20%	28.00 (31.91)	688.33	169.00	3584.0	4325.0	1.2
Check	47.66 (43.64)	519.33	-	-	-	-
C.D. (P= 0.05)	3.87	141.63				
SE(m)±	1.24	46.04				
C.V. (%)	7.08	12.79				

**Average of three replications*

Yield

There was a significant increase in linseed seed yield in the fungicide treated plots in contrast to untreated plots. Highly significant difference was observed among treatments in-terms of harvested seed yield expressed kg ha^{-1} basis. The efficacy of fungicides was reflected on the produced seed yield. In this regard, plots sprayed with fungicides produced the highest seed yield, being 884.33, 743.33, 732.33, 705.00, 688.33 and 645.00 kg ha^{-1}obtained from Propiconazole, Azoxystrobin, Carbendazim + Mancozeb, Mancozeb, Metalaxyl + Mancozeb and Carbendazim sprayed twice at 10 days interval, respectively. However, the lowest yield was recorded from unsprayed plot (519.33 kg ha^{-1}). Yield advantage which ranged from 125.67 to 265.00 kg ha^{-1} was observed among treatments as compared to the non-sprayed plots. The results were closely supported with the findings of Singh *et al.* (2017) and Biswas and Ghosh (2018).

Economics

The economics of different fungicides revealed that the Mancozeb was most economical fungicide for management of Alternaria blight disease of linseed in comparison to other fungicides. The benefit cost ratio (B:C) was maximum (6.2) with net returns of Rs.7330.0 ha^{-1} in Mancozeb followed by Propiconazole (4.1 B:C ratio and net return of Rs.13275.0 ha^{-1}) and Carbendazim+ Mancozeb with 2.5 B:C ratio and net return of Rs.7095.0 ha^{-1}. Azoxystrobin also proved second most effective fungicide to control Alternaria blight disease of linseed but it was practically not economical (0.5 B:C ratio and net return Rs.3530.0 ha^{-1}). Singh *et al.* (2009) also reported that fungicide *Companion* (a mixture of Carbendazim and Mancozeb) as most effective and economical for management of linseed blight disease in comparison to Mancozeb alone. Propiconazole too, manage this disease efficaciously but less economically.

It may be concluded from the results that *in-vitro* minimum mycelial growth was recorded with Propiconazole 25 EC at all the tested concentrations as compared to control. Maximum inhibition (100 %) was recorded with Propiconazole 25 EC at all the tested concentration as compared to control after 15 days of incubation. Among the fungicides Propiconazole 25 EC proved to be the best in reducing the disease severity and producing maximum yield of linseed crop.

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