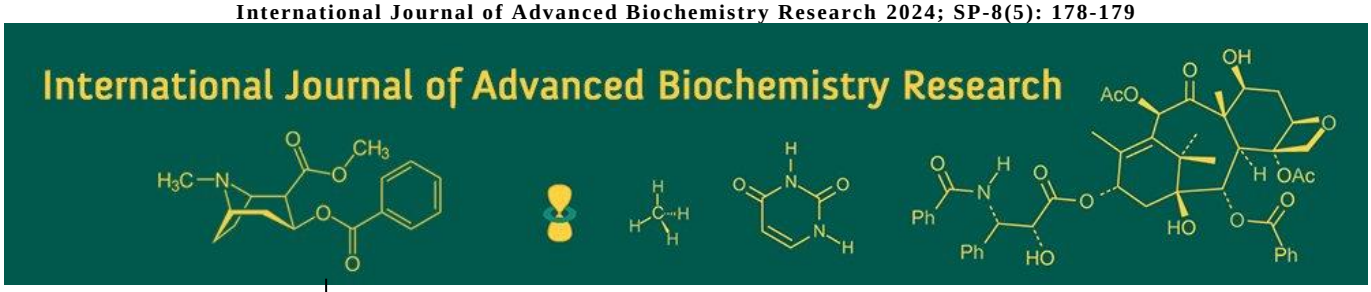

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Evaluation of different fungicides against Alternaria blight of linseed

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Abstract
The study on the evaluation of fungicides against Alternaria blight of linseed caused by *Alternaria alternata* was conducted at the Department of Plant Pathology, College of Agriculture, Nagpur, Maharashtra, during the Rabi season of 2022-23 to select a suitable fungicide against this disease. Six fungicides were evaluated against *Alternaria alternata in vitro*. The pathogen causing Alternaria blight (*Alternaria alternata*) was isolated on PDA media. *In vitro* evaluation of different fungicides by the poisoned food technique revealed that the minimum colony diameter was recorded in Tebuconazole 50% + Trifloxystrobin 25% WG (0.05) and Carboxin 37.5% + Thiram 37.5% 75 WP (0.1), with the highest 100 percent inhibition of growth of *Alternaria alternata*, and was found to be significantly superior to the rest of the fungicides.

Keywords: *Alternaria alternata*, fungicides, linseed

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 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 used for manufacturing paints, varnishes, oilcloth, linoleum, pad ink, printer 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) [2]. 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 is ravaged by a number of disease 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) [4]. Low production of linseed occurs 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* condition against Alternaria blight of linseed.

Materials and Methods
Six commonly available fungicides namely Penflufen 13.28 + Trifloxystrobin 13.28% w/w FS, Azoxystrobin 23% SC, Tebuconazole 50% + Trifloxystrobin 25% WG, Carboxin 37.5% + Thiram 37.5% 75 WP, Flupicolide 5.56% w/w + Promocarb hydrochloride 55.5% w/w SC, Azoxystrobin 18.2% w/w + Difenoconazole 11.4% SC were evaluated against *Alternaria alternata 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 (Penflufen 13.28 + Trifloxystrobin 13.28% w/w FS, Azoxystrobin 23% SC, Tebuconazole 50% + Trifloxystrobin 25% WG, Carboxin 37.5% + Thiram 37.5% 75 WP, Flupicolide 5.56% w/w

+ Promocarb hydrochloride 55.5% w/w SC, Azoxystrobin 18.2% w/w + Difenoconazole 11.4% SC) were tested at different concentrations.

The calculated quantity of fungicides were thoroughly mixed in the medium before pouring into petri plates so as to get the desired 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 alternata*. Controls without fungicides were also maintained. The inoculated petri plates were incubated at room temperature 28±1 °C in the laboratory. The colony diameter measured after 7 days when the control plates were full of fungal grow. Three replications were maintained for each treatment. Radial growth was converted into percent growth inhibition by using following formulae Colony diameter was recorded in mm and percent mycelial growth inhibition was calculated as per Vincent's formula (1927) based on the average colony diameter. The data was subjected to statistical analysis wherever necessary.

$$PI = \frac{C-T}{C} \times 100$$

Where,

PI = Percent inhibition on fungal growth

C = Growth in mm on the 7th day after inoculation in control (mm)

T = Growth in mm on the 7th day after inoculation in treatment (mm)

Result and Discussions

In vitro efficacy of fungicides against *Alternaria alternata* by Poison Food technique from the data it was revealed that the most promising fungicides which restricted 100% growth of the pathogen were tebuconazole 50% + Trifloxystrobin 25%WG @ 0.05%, and Carboxin 37.5%+ Thiram 37.5% 75 WP @ 0.1%. Thus, there was 100% growth inhibition. The other effective fungicides were, Azoxystrobin 18.2%w/w + Difenoconazole 11.4% SC @ 0.05%, Penflufen 13.28 + Trifloxystrobin 13.28% w/w FS @ 0.1%, Azoxystrobin 23% SC @ 0.1% recorded 83%, 80% and 32.7 percent growth inhibition respectively. In the present investigation Flupicolide 5.56% w/w + Promocarb hydrochloride 55.5% w/w SC were found least effective as recorded as the minimum percent inhibition against *A. alternata*.

The present findings are in agreement with Hariprasad *et al.*, (2017) [1] who reported 78.83% mean mycelial growth inhibition of *Alternaria tenuissima* by Carboxin+ Thiram. Waghe *et al.* (2015) [6] also recorded highest 90.36% mycelial growth inhibition by Carbendazim + Mancozeb against the *Alternaria solani* followed by Azoxystrobin 72.96%. Similarly complete mycelial growth inhibition of *Alternaria macrospora* with Carbendazim + Mancozeb and with Copper oxychloride (75.44%) inhibition was recorded by Mohan *et al.*, (2018) [2].

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

Tr. no	Treatment Details	Conc used (%)	*Alternaria alternata*					
			Mean colony diameter (mm)			Percent inhibition		
			3 DAI	5 DAI	7 DAI	3 DAI	5 DAI	7 DAI
T_1	Penflufen 13.28 +Trifloxystrobin 13.28% w/w FS	0.1	00.00	6.30	11.00	100.00	82.90	80.00
T2	Azoxystrobin 23% SC	0.1	7.30	15.30	22.00	54.30	58.60	60.00
T_3	Tebuconazole 50% + Trifloxystrobin 25% WG	0.05	00.00	00.00	00.00	100.00	100.00	100.00
T_4	Carboxin 37.5% + Thiram 37.5% 75 WP	0.1	00.00	00.00	00.0	100.00	100.00	100.00
T_5	Flupicolide 5.56% w/w + Promocarb hydrochloride 55.5% w/w SC	0.1	10.30	17.30	37.00	35.60	53.20	32.70
T_6	Azoxystrobin 18.2% w/w + Difenoconazole 11.4% SC	0.05	00.00	6.30	9.30	100.00	82.90	83.00
T_7	Control	-	16.00	37.00	55.00			
	Mean		4.77	11.54	19.1			
	F Test		Sig	Sig	Sig			
	SE(m)±		0.22	0.22	0.43			
	C.D (P=0.01)		0.92	0.93	1.83			

***** Average of three replications

Conclusion

The study concludes that Tebuconazole 50% + Trifloxystrobin 25% WG and Carboxin 37.5% + Thiram 37.5% 75 WP were the most effective fungicides against Alternaria blight of linseed caused by Alternaria alternata. These fungicides showed the highest inhibition of pathogen growth *in vitro* and can be considered as suitable options for controlling this disease. Further field trials are recommended to confirm their efficacy under practical conditions.

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