



## Field evaluation of some newer fungicides against leaf spot of safflower caused by *Alternaria carthami*

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### Abstract

An experiment on field evaluation of some newer fungicides against leaf spot of safflower (*Carthamus tinctorius* L.) caused by *Alternaria carthami* Chowdhury was conducted for three years from *rabi* 2004-05 to 2006-07 at Agricultural School Farm, All India Coordinated Research Project on Oilseeds (Safflower), Solapur. Among the seven different fungicides tested against the disease, carbendazim 0.1% spray was found most effective as it recorded significantly lowest disease intensity (30.29%) and highest seed yield (955 kg/ha), oil yield (266 kg/ha) and IBC ratio (8.67) than rest of the treatments including recommended check mancozeb 0.25% spray which recorded the disease intensity of 45.19%, seed yield (821 kg/ha), oil yield (227 kg/ha) and IBC ratio (6.76). The water spray as control treatment, on the other hand, recorded the highest average disease intensity (79.75%) and lowest seed yield of 348 kg/ha. The seed samples of all the treatments except hexaconazole 0.1% and salicylic acid 100 ppm were analyzed for the presence of residues in the oil. The results indicated that the residues of all these fungicides in the safflower oil were also found below detectable limits. The *in-vitro* inhibition studies using poison food technique also indicated 100% inhibition of *Alternaria carthami* by carbendazim 0.1% followed by 80.81% inhibition with mancozeb 0.25%. The rate of disease build-up during crop growth period was correlated with the weather parameters for all the three years. The correlation studies indicated that, the rainfall, number of rainy days, minimum temperature and relative humidity (RH-I and II) had a significant positive correlation with the disease development, whereas, the maximum temperature showed significant negative correlation. The overall results indicated that for effective and economical management of *Alternaria* leaf spot of safflower, first spray of carbendazim 0.1% should be given immediately after disease appearance (generally at rosette stage i.e. 25 DAS), followed by need-based second and third sprays at 15 days after first spray and during flowering/seed setting stage, respectively under congenial climatic conditions (if rains received / high humidity above 80%).

**Key words:** Safflower leaf spot - *Alternaria carthami* - *Carthamus tinctorius*

### Introduction

The leaf spot disease caused by *Alternaria carthami* Chowdhary is a major destructive disease of safflower (*Carthamus tinctorius* L.) in India. The disease occurred in epidemic form during 1997 in all safflower growing areas of Maharashtra, Andhra Pradesh and Karnataka states of India due to high humidity coupled with continuous rains during pre-flowering period. The disease caused severe losses in seed yield in the trials in most of the locations in Maharashtra and Karnataka (Anonymous, 1998). The disease has been reported to cause seed yield losses to the tune of 10 to 25 per cent (Indi *et al.*, 1988). Under severe conditions, it has been reported to cause 50 per cent loss in seed yield (Indi *et al.*, 1986). An extensive survey work carried out by Deokar *et al.* (1991) revealed the predominance of *Alternaria* leaf spot disease on safflower in the traditional safflower growing areas in the scarcity zone of Maharashtra state. With this view, the present investigation was undertaken to evaluate the efficacy of different newer fungicides for the control of *Alternaria* leaf spot of safflower.



## Materials and methods

A field experiment was conducted during *rabi* season of 2004-05, 2005-06 and 2006-07 at Agricultural School Farm, All India Coordinated Research Project on Oilseed (Safflower), Solapur, Maharashtra (India). A total of eight treatments (Table 1) were evaluated in randomized block design with three replications. The gross and net plot size maintained was 2.70 x 5.0 m and 1.80 x 4.60 m, respectively.

The *Alternaria* leaf spot disease of safflower is favoured by temperature around 25 to 30°C and relative humidity above 80%. Taking into consideration these predisposing factors, a technique of early sowing during second fortnight of August was followed to create natural epiphytotics of the disease. The early sown crop succumbs to early infection by the disease and gets exposed to the congenial conditions for a longer period due to intermittent rains and high humidity during September and October offering a severe disease pressure. The crop was fertilized with 50 kg N and 25 kg P<sub>2</sub>O<sub>5</sub> per hectare as a basal dose. The efficacy of different newer fungicides was evaluated by spraying the fungicides as per the following spray schedule.

**Spray schedule :**

- 1<sup>st</sup> spray : Immediately after disease appearance
- 2<sup>nd</sup> spray: 15 days after first spray (need based)
- 3<sup>rd</sup> spray: Immediately after receipt of rains during flowering/seed setting (need based)

The first fungicidal spray was given immediately after disease appearance during rosette stage of the crop i.e. 25 DAS (average 48.5 mm rainfall in 4 rainy days coupled with 89% relative humidity) in 38 MW and second spray 15 days thereafter at 40 DAS i.e. immediately after congenial climatic conditions (average rainfall 19.1 mm in 2 rainy days with 90% relative humidity) in 40 MW. The third spray was given immediately after receipt of rains during flowering/seed setting stage of the crop i.e. 75 DAS (average rainfall 31.1 mm coupled with 80% relative humidity) in 45 MW.

The crop was protected against aphid and capsule borer by spraying Dimethoate 30EC and Endosulfan 35 EC @ 0.05 %, respectively. Ten randomly selected plants from each plot were scored for the disease reaction at 15 days interval using 1-9 scale (Anonymous, 2006). The per cent disease intensity (PDI) was calculated by using the formula suggested by Mayee and Datar (1986). The data on seed yield was also recorded at harvest. The percent disease control by different fungicidal treatments over water sprayed control was computed and the economics of different fungicidal treatments was worked out.

## Results

### Effect on disease intensity

The intensity of *Alternaria* leaf spot was significantly influenced by different treatments during *rabi* 2004-05 to 2006-07 (Table 1). The pooled analysis of the data also revealed significant differences. Across the seasons, carbendazim 0.1% spray recorded significantly lowest disease intensity (30.29%) followed by mancozeb 0.25% (45.19%), which was used as a recommended check. The water spray as control treatment, on the other hand, recorded the highest average disease intensity (79.75%). Thus, carbendazim 0.1% registered the highest disease control i.e. 62.02% followed by recommended check mancozeb 0.25% (43.34%). The *in-vitro* study conducted by using poison food technique also showed 100% inhibition of *Alternaria carthami* by carbendazim 0.1% followed by 80.81% inhibition with mancozeb 0.25%.

### Correlation studies

The rate of disease build-up during crop growth period was correlated with the weather parameters for all the three years (Figure 1). The correlation studies indicated that, the rainfall, number of rainy days, minimum temperature and relative humidity (RH-I and II) had a significant positive correlation with the disease development, whereas, the maximum temperature showed significant negative correlation. The weather conditions during the period from 36 to 45 MW were observed to be the most congenial for the crop infection and further



rapid build-up of the disease. During this period, on an average, 250.9 mm rainfall was received in 16 rainy days. The maximum and minimum temperature and relative humidity-I and II during this period ranged from 30.9 to 33.0 °C and 17.1 to 22.3 °C, 75 to 90 % and 40 to 62 %, respectively.

### **Effect on seed yield and oil yield**

The seed yield of safflower was significantly influenced by different treatments (Table 2). The pooled analysis of the data on seed yield indicated that, carbendazim 0.1% spray recorded significantly highest seed yield of 955 kg/ha. It was followed by the recommended check mancozeb 0.25% (821 kg/ha). The water sprayed control treatment, on the other hand, recorded the lowest seed yield of 348 kg/ha. Thus, carbendazim 0.1% recorded 175% increase in seed yield over the water spray control followed by mancozeb 0.25% (136%).

The data on oil yield (Table 2) also showed that carbendazim 0.1% registered significantly highest oil yield (266 kg/ha) followed by mancozeb 0.25% (227 kg/ha). The water sprayed control recorded only 105 kg/ha oil yield.

### **Cost-benefit analysis**

The economics of different fungicidal treatments was also studied (Table 2). Carbendazim 0.1% spray was proved to be the most economical treatment (IBC ratio = 8.67) followed by currently recommended practice of spraying mancozeb 0.25% (IBC ratio= 6.76).

### **Residue studies**

The seed samples of all the treatments except hexaconazole 0.1% and salicylic acid 100 ppm were analyzed for the presence of residues in the oil. The results indicated that the residues of all these fungicides were below detectable limits.

### **Discussion and Conclusion**

From the above results, it could be seen that carbendazim 0.1% spray was the most superior treatment for the management of *Alternaria* leaf spot of safflower. It recorded significantly lowest disease intensity (30.29%) and the highest seed yield (955 kg/ha), oil yield (266 kg/ha) and IBC ratio (8.67). This was followed by the recommended check mancozeb 0.25% with the disease intensity of 45.19%, seed yield of 821 kg/ha, oil yield of 227 kg/ha and IBC ratio of 6.76. Raju *et al.* (2001) also reported that out of the five fungicides evaluated against the disease, carbendazim (0.1%) was found quite effective in controlling disease (37.9% disease index) as against untreated check (65.1%). Further, the results of the field experiment conducted at Agricultural Research Station, Tandur revealed carbendazim 0.1% spray to be the most effective for control of *Alternaria* leaf spot of safflower at flowering stage of the crop with highest B:C ratio (Anonymous, 2005).

The overall results indicated that for effective and economical management of *Alternaria* leaf spot of safflower, first spray of carbendazim 50 WP (0.1%) should be given immediately after disease appearance (generally at rosette stage i.e. 25 DAS), followed by need-based second and third sprays at 15 days after first spray and during flowering/seed setting stage, respectively under congenial climatic conditions (if rains received / high humidity above 80%).



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**Table 1 Intensity of *Alternaria* leaf spot of safflower as influenced by different Fungicides (2004-05 to 2006-07)**

Sr. No	Treatments	Disease Intensity (%)			Pooled Mean	% disease control over check	<i>In-vitro</i> study (% inhibition)
		2004-05	2005-06	2006-07			
1.	Carbendazim 0.1 % (Bavistin 50 WP)	28.89 (32.44)	40.89 (39.73)	21.10 (27.34)	30.29 (33.17)	62.02	100
2.	Propiconazole 0.1 % (Tilt 25 EC)	42.22 (40.52)	57.11 (49.10)	53.33 (46.91)	50.89 (45.51)	36.19	80.20
3.	Hexaconazole 0.1 % (Contaf 5 EC)	51.85 (46.07)	61.48 (51.63)	47.33 (43.53)	53.55 (47.08)	32.85	80.10
4.	Chlorothalonil 0.2 % (Kavach 75 WP)	54.08 (47.35)	54.81 (47.75)	46.67 (43.09)	51.85 (46.06)	34.98	35.38
5.	Salicylic acid 100 ppm (Bion)	64.45 (53.43)	65.93 (54.29)	60.00 (50.77)	63.46 (52.83)	16.29	75.00
6.	Difenconazole 0.05% (Score 25 EC)	53.33 (46.92)	60.74 (51.20)	47.40 (43.51)	53.82 (47.21)	32.51	74.66
7.	Mancozeb 0.25 % (Tata-M-45 75 WP) (Recommended check)	37.04 (37.49)	49.63 (44.76)	48.90 (44.37)	45.19 (42.21)	43.34	80.81
8.	Control (Water spray)	79.26 (63.11)	78.52 (62.50)	81.47 (63.11)	79.75 (62.91)		
	SE ±	2.25	1.12	1.80	1.03		
	CD at 5 %	6.82	3.39	5.44	2.94		
	CV %	8.48	3.86	6.86	6.55		

\*Figures in parentheses are the arc-sines to which the statistical analysis pertains.



**Table 2 Seed and oil yield of safflower as influenced by different fungicides (2004-05 to 2006-07)**

Sr. No.	Treatments	Seed yield (kg/ha)			Pooled Mean (kg/ha)	% increase in yield over control	Addl. yield over control (kg/ha)	Addl. returns over control (Rs./ha)	Addl. expd. on treatment (Rs./ha)	IBC ratio	Oil Yield (kg/ha)	Residue level
		2004-05	2005-06	2006-07								
1.	Carbendazim 0.1 % (Bavistin 50 WP)	950.08	996.76	918.28	955	175	607	9105	1050	8.67	266	BDL
2.	Propiconazole 0.1 % (Tilt 25 EC)	821.25	740.72	723.03	762	119	414	6210	2400	2.59	224	BDL
3.	Hexaconazole 0.1 % (Contaf 5 EC)	684.38	692.42	718.60	698	101	351	5250	1380	3.80	181	-
4.	Chlorothalonil 0.2 % (Kavach 75 WP)	685.19	603.85	602.26	630	81	282	4230	2820	1.50	184	BDL
5.	Salicylic acid 100 ppm (Bion)	552.34	585.73	540.00	559	61	211	3165	396	7.99	144	-
6.	Difenconazole 0.05 % (Score 25 EC)	652.98	615.93	711.76	660	90	312	4680	2100	2.23	179	BDL
7.	Mancozeb 0.25 % (Tata-M-45 75 WP) (Recommended check)	849.44	873.97	739.13	821	136	473	7095	1050	6.76	227	BDL
8.	Control (Water spray)	399.36	364.32	280.19	348	-	-	-	300		105	
	SE +	34.0	19.0	40.48	18.82						11.30	
	CD at 5 %	105.0	57.64	122.80	53.72						34.29	
	CV %	8.54	4.81	10.72	8.31						10.31	

Where, BDL = Below Detectable Limit, IBC ratio = Incremental Benefit:Cost ratio

**Market rates:** 1) Safflower- Rs. 1500/q2) Carbendazim- Rs. 500/kg 3) Propiconazole- Rs.1400/lit. 4) Hexaconazole- 720/lit.  
5) Chlorothalonil- Rs.840/kg 6) Bion – Rs. 610/kg 7) Difenconazole-Rs.2400/lit. 8) Mancozeb- Rs. 200/kg  
9) Labour - Rs. 100/spray



Figure 1 Correlation of different weather parameters with the development of *Alternaria* leaf spot disease of safflower

