

**RESEARCH ARTICLE :**

# Development of leaf spot of safflower (*Alternaria carthami*) in relation to weather parameters

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**SUMMARY :** A field experiment was conducted successively for 2 years (2013-14 and 2014-15) with an objective to study the effect of different weather parameters viz., rainfall, temperature and humidity on the development of *Alternaria* leaf spot of safflower caused by *Alternaria carthami*. Correlation-coefficient studies revealed significantly and positively correlation between temperature (Max. and Min.), relative humidity (RH - I and RH - II) and rainfall with *Alternaria* blight disease intensity (during *Rabi*, 2013-14). Whereas, during *Rabi*, 2014-15, temperature (minimum), relative humidity (RH - I and RH - II) and wind velocity were positive and significantly correlated with the disease intensity.

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**KEY WORDS :**

*Carthamus tinctorius* L., *Alternaria carthami*, Correlation, Weather parameters

**BACKGROUND AND OBJECTIVES**

Safflower, (*Carthamus tinctorius* L.), is one of the world's oldest important oilseeds crop of the semi-arid regions. Among the major factors responsible for lower yields, diseases play an important role. Safflower is also affected by many biotic and abiotic stresses. Of the biotic agents, fungi cause major diseases, followed by bacteria, viruses and nematodes.

Among these diseases, at present leaf spot / blight caused by *Alternaria carthami* (Chowdhury) is widespread and have continued to be the major constraints in the production and productivity of safflower all over the country in general as well as in the state of Maharashtra particularly. The disease

(*A. carthami*) has been reported to cause 25 to 60 per cent yield losses all over India (Singh and Prasad, 2005) and 20 to 80 per cent in Maharashtra state (Anonymous, 2010), along with drastic reduction in seed size, seed volume, seed test weight as well as per cent oil content.

An understanding of the role of environmental factors and their consequences on infection, development and spread of the pathogen / diseases is needed to develop sustainable disease management practices (Murumkar *et al.*, 2008; Suresh *et al.*, 2012 and Bal and Kumar, 2014). Keeping in view, all of the above evidences, present investigations were planned and conducted on *Alternaria carthami*, causing safflower blight / leaf spot disease at Department of Plant

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## RESOURCES AND METHODS

### Effect of weather parameters :

The influence of weather variables (temperature, relative humidity, rainfall, rainy days and wind velocity) on safflower *Alternaria* blight disease intensity and their corresponding effect on seed yield was studied during *Rabi*, 2013-14 and *Rabi*, 2014-15. For the purpose, observations on *Alternaria* blight disease intensity were recorded starting at its first appearance and further at weekly interval and continued till 90 DAS on all three safflower cultivars viz., PBNS-12, Sharda and Manjira sown on 15.09.2013 and 20.09.2014 during *Rabi*, 2013-14 and 2014-15 seasons, respectively. The data on weather parameters of the corresponding meteorological weeks during both experimental years was obtained from the Central Meteorological Observatory VNMKV, Parbhani and correlated with *Alternaria* blight disease intensity.

## OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

### Effect of weather parameters on *Alternaria* blight intensity :

Results (Table 1 to 4) revealed that the weather variables viz., temperature (maximum and minimum), relative humidity (morning and evening), rainfall, rainy days and wind velocity etc. significantly influenced the *Alternaria* blight disease intensity in all three safflower cultivars sown on 20<sup>th</sup> September during *Rabi*, 2013-14 and 2014-15. From first appearance of the disease, its intensity was found to be increased steadily in all three cultivars upto 90 DAS.

For the purpose, observations on *Alternaria* blight intensity were recorded at weekly interval on three safflower cultivars viz., PBNS-12, Sharda and Manjira sown 20<sup>th</sup> September during both *Rabi*, 2013-14 and 2014-15 and correlated with corresponding weekly weather parameters.

During 2013-14 seasons (Table 1) from sowing to physiological maturity of the safflower crop, the major weather parameters prevailed were total rainfall 171.10 mm (10 rainy days), relative humidity RH-I in the range of 71-93 per cent and RH-II 28-70 per cent, temperatures maximum in the range of 28.5-32.5 °C and minimum in the range 9.30-21.7 °C. During the season, the disease appeared 1<sup>st</sup> at 25-30 DAS (41 MW) on all the safflower cultivars viz., PBNS-12 (5.15 %), Sharda (6.15 %) and Manjira (15.35 %), which further progressed at steady

**Table 1 : Effect of weather parameters on *Alternaria* blight disease intensity\* in safflower cultivars during *Rabi*, 2013-14**

MW	Av. PDI**			Temperature (°C)		Relative humidity		Rainfall (mm)	Rainy days	Wind velocity (km/hr)
	PBNS - 12	Sharda	Manjira	Max.	Min.	Mor.	Eve.			
41	5.15	6.15	15.35	30.7	21.7	93	70	66.2	5	3
42	6.34	7.54	18.35	32.5	19.5	83	46	0	0	2.3
43	8.31	8.48	26.27	30.8	21.2	85	56	10.3	2	5.1
44	8.84	9.15	29.87	31.7	15.0	78	37	0	0	2.3
45	9.05	10.35	37.48	30.4	13.3	71	36	0	0	2.9
46	13.25	14.35	40.34	29.2	12.1	79	35	0	0	3.8
47	14.05	15.47	48.42	30.4	14.5	81	41	14	2	3.8
48	14.6	15.98	56.37	30.7	15.9	75	43	0	0	3.6
49	17.25	19.21	59.87	29.0	12.3	84	35	26.6	1	2.7
50	17.87	19.85	63.28	28.9	7.5	80	28	0	0	2.3
51	17.87	19.85	67.48	29.5	9.3	71	33	0	0	2.3
52	20.43	21.35	75.13	28.5	11.3	75	39	0	0	3.4
1	23.49	24.87	78.35	29.2	11.5	79	37	0	0	2.9
Av.	13.58	14.82	47.43	30.11	14.24	79.40	41.23	--	--	--

MW : Meteorological Week, Av.: Average, PDI : Per cent Disease Intensity, Max.: Maximum, Min.: Minimum, Mor. : Morning, Eve. : Evening,

\* Crop sown on 20.09.2013, \*\* Average of three replications

rate and continued to increase upto physiological maturity of the crop (90 days 1<sup>st</sup> MW). However, from 49 MW, the disease intensity was found to be increased from 17.25 to 23.49 per cent, 19.21 to 24.87 per cent and 59.87 to 78.35 per cent, respectively in safflower cultivars PBNS-12 (tolerant), Sharda (tolerant) and Manjira (susceptible). During this period (49 MW to 1 MW), the congenial weather parameters prevailed were maximum temperature (28.5 to 29.5 °C), minimum temperature (7.5-12.30 °C), RH-I (71-84 %), RH-II (28-39 %), total rainfall of 26.6 mm (1 rainy day) and wind velocity (2.3-3.4 km/hr).

The results in Table 2 indicated the correlation-coefficient between weather parameters and *Alternaria* blight intensity on three safflower cultivars during 2013-14. The study indicated that maximum temperature and number of rainy days were negatively correlated with

the disease intensity in all three safflower cultivars. However, maximum temperature (r value : 0.399, 0.390 and 0.578), RH-I (r values : 0.655, 0.659 and 0.422), RH-II (r values : 0.516, 0.498 and 0.491) and total rainfall (r values : 0.625, 0.726 and 0.734) were significant and positively correlated with the blight disease intensity in all three safflower cultivars viz., PBNS-12, Sharda and Manjira, respectively.

Whereas, wind velocity was significant and positively correlated with the disease intensity in Sharda (r = 0.355) and Manjira (r = 0.630). Thus, overall results indicated that temperatures (maximum and minimum), relative humidity (RH-I and RH- II) and rainfall had significantly positive correlation with *Alternaria* disease initiation, its development and spread in safflower crop sown during second fortnight of September.

During 2014-15 season (Table 3) from vegetative

**Table 2 : Correlation-coefficient between weather parameters and *Alternaria* blight intensity\* on safflower cultivars during Rabi, 2013-14**

Weather parameters	Correlation co-efficient (r)		
	PBNS -12	Sharda	Manjira
Temperature (Max.) <sup>o</sup> C	-0.253	-0.162	-0.154
Temperature (Min.) <sup>o</sup> C	0.399*	0.390*	0.578*
Relative humidity (RH-I) %	0.655*	0.659*	0.422*
Relative humidity (RH-II) %	0.516*	0.498*	0.491*
Total rainfall (mm)	0.625*	0.726*	0.734*
Rainy days (number)	-0.550*	-0.600*	-0.819*
Wind velocity (km/hr)	0.262	0.355*	0.630*

Table value r at 5 % = 0.325, at 1 % = 0.418, \* Crop sown on 20.09.2013

**Table 3 : Effect of weather parameters on *Alternaria* blight disease intensity\* in safflower cultivars during Rabi, 2014-15**

MW	Av. PDI**			Temperature (°C)		Relative humidity		Rainfall (mm)	Rainy days	Wind velocity (km/hr)
	PBNS-12	Sharda	Manjira	Max.	Min.	Mor.	Eve.			
43	3.24	2.98	5.15	30.9	17.8	76	47	9.2	1.0	4.4
44	3.8	4.37	7.54	32.9	13.9	74	27	0.0	0.0	3.7
45	7.25	8.35	15.35	31.9	15.1	81	33	2.2	0.0	4.0
46	11.35	11.45	24.35	31.6	23.0	86	55	10.8	3.0	3.2
47	11.72	11.48	35.14	31.3	12.8	77	27	0.0	0.0	3.0
48	12.08	12.87	43.13	31.1	10.8	80	23	0.0	0.0	2.9
49	12.56	12.98	49.17	29.9	9.9	81	25	0.0	0.0	3.0
50	12.89	13.56	52.31	27.9	14.8	80	43	0.0	0.0	4.7
51	13.12	13.67	54.34	27.3	6.3	74	23	0.0	0.0	3.8
52	13.67	13.89	57.48	28.8	8.9	72	24	0.0	0.0	4.0
1	16.24	17.84	64.31	27.0	15.1	89	52	9.2	1.0	3.7
2	16.24	18.02	66.43	28.3	5.8	76	20	0.0	0.0	3.1
3	20.43	21.58	68.48	28.9	10.2	72	28	0.0	0.0	4.4
Av.	11.89	12.54	41.78	29.83	12.65	78.31	32.85	--	--	--

MW: Meteorological Week, Av.: Average, PDI : Per cent Disease Intensity, Max.: Maximum, Min.: Minimum, Mor. : Morning, Eve. : Evening,

\* Crop sown on 20.09.2014, \*\* Average of three replications

**Table 4 : Correlation-coefficient between weather parameters and *Alternaria* blight intensity\* on safflower cultivars during Rabi, 2014-15**

Weather parameters	Correlation co-efficient (r)		
	PBNS -12	Sharda	Manjira
Temperature (Max.) <sup>0</sup> C	-0.202	-0.178	-0.466*
Temperature (Min.) <sup>0</sup> C	0.636*	0.606*	0.533*
Relative humidity (RH-I) %	0.288	0.427*	0.616*
Relative humidity (RH-II) %	0.627*	0.632*	0.366*
Total rainfall (mm)	-0.669*	-0.659*	-0.386*
Rainy days (number)	-0.597*	-0.472*	-0.401*
Wind velocity (km/hr)	0.346*	0.333*	0.543*

Table value r at 5 % = 0.325, at 1 % = 0.418, \* Crop sown on 20.09.2014

growth to physiological maturity of the safflower crop, the major weather parameters prevailed were total rainfall 31.4 mm (05 rainy days), relative humidity (RH-I) in the range of 72-89 per cent and RH-II in the range of 20-55 per cent, temperatures maximum in the range of 27-32.9<sup>0</sup> C and minimum in the range 5.8-23.0<sup>0</sup> C. During the season, the disease appeared 1<sup>st</sup> at 35-40 DAS (43 MW) on all the safflower cultivars viz., PBNS-12 (3.24 %), Sharda (2.98 %) and Manjira (5.15 %), which further progressed at steady rate and continued to increase upto physiological maturity of the crop (90 days, 3<sup>rd</sup> MW). However from 51 MW the disease intensity was found to be increased from 13.12 to 20.43 per cent, 13.67 to 21.58 per cent and 54.34 to 68.48 per cent, respectively in safflower cultivars PBNS-12 (tolerant), Sharda (tolerant) and Manjira (susceptible). During this period (51 MW to 03 MW) the congenial weather parameters prevailed were maximum temperature (27.0 to 28.9 °C), minimum temperature (5.8 – 10.2 °C), RH-I (72-89 %), RH-II (20-52 %), total rainfall of 9.2 mm (1 rainy day) and wind velocity (3.1-4.4 km/hr).

The results presented Table 4 indicated correlation-co-efficient between weather parameters and *Alternaria* blight intensity on three safflower cultivars during Rabi, 2014-15. The study indicated that maximum temperature, total rainfall and number of rainy days were negatively correlated with the disease intensity in all three safflower cultivars. However, minimum temperature (r value : 0.636, 0.606 and 0.533), RH-I (r values : 0.288, 0.427 and 0.616), RH-II (r values : 0.627, 0.632 and 0.366) and Wind velocity (r values : 0.346, 0.333 and 543) were significant and positively correlated with disease intensity in the safflower cultivars viz., PBNS-12, Sharda and Manjira, respectively. Thus, overall results indicated that temperature (minimum), relative humidity (RH-I and RH-II) and wind velocity had significant and positive

correlation with *Alternaria* disease initiation, its development and spread in the safflower crop sown during second fortnight of September 2014-15.

Thus, from the perusal of the ongoing results it could be inferred that the weather variables viz., temperature (max. and min.), relative humidity (morning and evening) and rainfall had significantly positive correlation with *Alternaria* blight disease intensity, which favoured the initiation, development and spread of *Alternaria* blight disease in safflower cultivars grown during Rabi, 2013-14; whereas, during Rabi, 2014-15, minimum temperature, relative humidity (RH-I and RH-II) and wind velocity were positively correlated with the blight disease intensity. These results of the present study are in conformity with those of the earlier workers such as Krishna Prasad and Basuchaudhary (1989) who reported maximum *Alternaria* leaf blight disease severity (68.10 and 72.80 %) in safflower and which was positively correlated with maximum temperature, relative humidity and rainfall. Murumkar *et al.* (2008) reported that rainfall, minimum temperature and relative humidity (RH I and II) had positively correlated with safflower *Alternaria* disease development and rains coupled with high humidity above (80 %) and temperature in the range of 21 to 33<sup>0</sup> C favoured primary infection of *A. carthami*. Prasad and Anjani (2008) reported that continuous cloudy and wet weather conditions favored the development and spread of leaf spot / blight of safflower. On the contrary, Suresh *et al.* (2012) reported that in the safflower crop sown during September (1<sup>st</sup> fortnight) there had negative correlation between maximum temperature relative humidity (RH-I, RH-II) and rainfall with *Alternaria* blight disease intensity; while minimum temperature had positive correlation.

Similar, results on the influence of weather parameters viz., temperature, relative humidity and

rainfall on severity / intensity of the leaf spot / blight disease in rapeseed-mustard were earlier reported by Biswas and Ghosh (2012) and in sesamum *Alternaria* blight (Singh *et al.*, 2008).

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