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IMPACT OF WEATHER PARAMETERS ON ALTERNARIA BLIGHT OF INDIAN MUSTARD [(*BRASSICA JUNCEA* (L.) CZERN. & COSS.)]

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Abstract

Progression of Alternaria blight disease was measured on two susceptible Indian mustard varieties *viz*., RH 30 and RH 0749 sown at three different dates. The maximum increase in disease severity was recorded between first weeks of February and last week of February. During this period, the maximum and minimum temperature, relative humidity at morning and evening, average vapour pressure of morning and evening, maximum and bright sunshine hours and wind speed were higher, which resulted in congenial conditions for severe infection by the pathogen. The disease severity was positively correlated with maximum and minimum temperature, average vapour pressure, wind speed, sunshine hours and evaporation, while relative humidity and rainfall negatively correlated with Alternaria blight on both the varieties. A maximum value of area under disease progress curve was observed on cultivar RH 30 (651.1 cm^2) as compared to RH 0749 (578.9 cm^2), when crop was sown on 9th November.

Introduction

Indian mustard [*Brassica juncea* (L.) Czern. & Coss.] is one of the major oilseed crops cultivated in India and around the world. Among the various oilseed crops cultivated in India, the rapeseed mustard is accounted for 25 per cent of total area and 1/3 of total oil production in the country after groundnut. India ranked third after Canada and China in area (19.3%), and production i.e. 11.1 per cent (Saharan *et al*. 2016). This crop is affected by various biotic and abiotic stresses. Among biotic stresses, Alternaria blight disease has been reported to be one of the most widespread and destructive fungal diseases of rapeseed-mustard throughout the world. In Haryana state, the Alternaria disease occurs every year in severe form at pod initiation stage (Rathi and Singh 2009) that affects the seed germination as well as quality and quantity of oil (Meena *et al*. 2010). Losses due to Alternaria blight in Indian mustard are mainly related to its prevalence on siliquae, as it causes shattering, discoloration and shriveling of seeds (Yadav 2007). Epidemiology of Alternaria blight of Indian mustard in Haryana in relation to weather factors under field conditions has not been studied in detail. Sangeetha and Siddaramaiah (2007) reported that maximum temperature of 26 - 29ºC with high relative humidity (RH > 70%) favoured the disease development. The highest intensity of Alternaria blight was noticed with a mean maximum temperature of 19.3 - 24.4ºC, mean minimum temperature of 13.5 - 19.3ºC and an average relative humidity of more that 70 per cent (Bal and Kumar 2014). Since, Indian mustard is very important Rabi oilseed crop in north western region of Haryana state and all the varieties cultivated in Haryana are susceptible to Alternaria blight disease; hence the knowledge about the time of attack of pathogen and its progression in relation to weather conditions needs to be investigated for appropriate management of disease through adjustment in date of sowing.

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Materials and Methods

Field experiment was carried out at Oilseeds research area, Department of Genetics and Plant Breeding during Rabi 2015 - 2016 and 2016 - 2017 using two mustard varieties *viz*., RH 30 and RH 0749. Three dates of sowing were maintained and the varieties were sown in RBD with three replications having plot size of 3 × 3 m length at ten days intervals starting from 20th October, 30th October and 9th November. All the plots were examined daily for first appearance of spot on leaves. The leaves showing the initial symptoms were tagged and observations on disease severity were recorded starting from the first appearance of symptoms at an interval of three days. The disease severity was calculated by using 0 - 6 disease rating scale (Conn *et al.* 1990).

For comparative study of disease progression over a time in these two Indian mustard varieties, the area under disease progressive curve was also calculated by the formula given by Van der Plank (1963).

$$AUDPC = \sum_{i=1}^{n-1} [(t_{i+1} - t_i)(y_i + y_{i+1})/2],$$

where t is time in days of each reading, y is the percentage of affected foliage at each reading and n is the number of readings.

Results and Discussion

The two years pooled data of 2015 - 2016 and 2016 - 2017 on the progression of Alternaria blight disease severity with weather conditions during Rabi season on variety RH 30 and RH 0749 is presented in Table 1. The results revealed that, the per cent disease severity was increased with time starting from the first appearance of the disease in field. However, in first two dates of sowing i.e. 20th and 30th October the first appearance of disease was recorded on 28th January, while the disease delayed in 9th November sown crop. The per cent disease severity was periodically increased with time in all the dates of sowing. From 28th January to 31st January the disease progression was slow and non-significant among different date of observations in first two dates of sowing in both the cultivars. Among the all dates of sowing, the maximum disease severity was recorded in late sown i.e. 9th November sown crop, while minimum disease severity was recorded in early sown crop i.e. 20th October in both the cultivars.

The progression of disease was high during the period between 6th February and last week of February. During this period, the disease severity increased from 2.09 - 14.03, 1.53 - 20.70 and 1.15 - 32.78 per cent in 20th October, 30th October and 9th November sown crops, respectively. This may be due to exposure to favourable weather for disease development. In this period, the mean maximum and minimum temperatures were 24.2 and 7.8ºC, respectively, with an average relative humidity 91.2 per cent. Average morning and evening vapour pressure during this period were 7.6 and 9.2 mm and mean sunshine hrs during this period was 6.3 hrs. After this period, the disease severity increased gradually. The maximum increase in disease severity was observed during 18th to 24th February in all the dates of sowing during both the years. During this period, the mean maximum and minimum temperatures were 25.5 and 9.6ºC, respectively, average relative humidity was 91.3 per cent, morning and evening average vapour pressure was 9.6 and 11.0 mm, mean sunshine hours was 7.5 hrs. These weather conditions and wind during this period might have created the congenial conditions for severe infection of the pathogen.

The disease severity was positively correlated with maximum and minimum temperature, morning and evening average vapour pressure, wind speed, sunshine hours and evaporation, while it was negatively correlated with morning and evening relative humidity and rainfall for both the variety (Table 2). The prediction equations explained 99.72, 99.07 and 99.86% for RH 30 and

99.84, 98.93, and 99.81% for RH 0749 disease development as influenced by the temperature maximum, morning average vapour pressure, evening relative humidity, sunshine hours and evaporation in 20th October, 30th October and 9th November sown crops, respectively (Table 3). On the basis of two years pooled data, the maximum area under disease progress curve (AUDPC) was recorded as 651.1 cm^2 in variety RH 30, 578.9 cm^2 in case of RH 0749, when crop was sown on 9th November (Table 4). However, minimum AUDPC of 287.9 and 262.2 cm^2 was recorded on varieties RH 30 and RH 0749, respectively when crop was sown on 20th October.

Table 1. Relationship of Alternaria blight disease development on varieties RH 30 and RH 0749 with different dates of sowing.

Date of observation	Per cent disease severity on var. RH 30			Per cent disease severity on var. RH 0749		
	20th October	30th October	9th November	20th October	30th October	9th November
28th January	0.61 (4.08)	0.48 (3.77)	0.00 (1.28)	0.49 (3.75)	0.31 (2.67)	0.00 (1.28)
31st "	0.74 (4.56)	0.55 (3.91)	0.00 (1.28)	0.57 (3.84)	0.41 (3.33)	0.00 (1.28)
3rd February	1.53 (6.98)	1.24 (6.30)	0.61 (4.24)	1.25 (6.35)	0.97 (5.45)	0.49 (3.75)
6th "	2.09 (8.28)	1.53 (6.98)	1.15 (5.99)	1.81 (7.64)	1.25 (6.35)	1.04 (5.72)
9th "	2.64 (9.30)	2.36 (8.78)	2.92 (9.77)	2.22 (8.44)	2.09 (8.27)	2.64 (9.30)
12th "	3.47 (10.71)	2.92 (9.81)	6.53 (14.77)	3.06 (9.99)	2.64 (9.30)	5.38 (13.39)
15th "	4.31 (11.96)	4.72 (12.47)	10.42 (18.81)	4.03 (11.48)	4.31 (11.96)	9.17 (17.60)
18th "	5.42 (13.46)	5.70 (13.76)	14.03 (21.98)	5.14 (13.06)	5.14 (13.09)	12.22 (20.44)
21st "	8.20 (16.62)	9.31 (17.74)	20.00 (26.55)	7.50 (15.88)	7.92 (16.33)	18.47 (25.44)
24th "	11.81 (20.08)	16.39 (23.85)	28.06 (31.97)	10.28 (18.68)	13.33 (21.40)	23.08 (28.69)
27th "	14.03 (21.98)	20.70 (27.04)	32.78 (34.91)	13.06 (21.16)	18.19 (25.23)	30.00 (33.19)
2nd March	16.11 (23.65)	26.11 (30.71)	39.03 (38.64)	14.86 (22.66)	19.86 (26.44)	33.06 (35.08)
5th "	16.67 (24.08)	29.17 (32.67)	40.00 (39.21)	15.42 (23.10)	21.39 (27.53)	37.92 (37.99)
8th "	17.36 (24.61)	29.86 (33.10)	43.06 (40.99)	15.97 (23.54)	22.36 (28.21)	39.03 (38.64)

	CD (p 0.05)	SE (m)	CD (p 0.05)	SE (m)
Observation	(1.00)	0.16	(1.04)	0.17
Date of sowing	(0.46)	0.35	(0.48)	0.36
Correlation (Observation and date of sowing)	(1.73)	0.61	(1.80)	0.63

The disease development under field conditions was influenced by various environmental factors, the type of the host cultivar and availability of inoculum load. Weather factor played an important role in the severity of Alternaria blight of Indian mustard, which governed the variability in onset of the disease and epidemics development. It was apparent from the present work that a non significant difference in per cent disease severity was observed in the initial two dates of observations in both the varieties in first two dates of sowing, this might be due to non availability of adequate amount of inoculum in the field in the form of infection court or conidia, the pathogen must have required time to acclimatize the host to gain momentum and coupled with less suitable weather conditions prevailed during that period. Later on, after first week of February significant differences in disease severity was observed in all dates of sowing,

Table 2. Correlation matrix between weather parameters and per cent disease severity in different dates of sowing on RH 30 and RH 0749.

Variety	Date of sowing	Percent disease severity at different weather parameters									
		Temp (°C)		Av. vapour pressure (mm)		RH (%)		Wind speed (km/hr)	Sunshine hour	Evapo-ration (mm)	Rain-fall (mm)
		Max.	Min.	Morning	Evening	Morning	Evening				
RH 30	20th Oct.	0.948**	0.458	0.546*	0.186	–0.470	–0.661**	0.201	0.679**	0.874**	–0.106
	30th "	0.908**	0.461	0.569*	0.223	–0.404	–0.598*	0.215	0.624*	0.846**	–0.048
	9th Nov.	0.946**	0.481	0.568*	0.206	–0.466	–0.644*	0.194	0.660*	0.867**	–0.082
RH 0749	20th Oct.	0.949**	0.464	0.554*	0.196	–0.469	–0.655*	0.196	0.673**	0.870**	–0.102
	30th "	0.925**	0.444	0.543*	0.192	–0.447	–0.632*	0.210	0.657*	0.874**	–0.071
	9th Nov.	0.944**	0.493	0.580*	0.215	–0.462	–0.637*	0.186	0.645*	0.859**	–0.076

*,** Represent significant at 5 and 1% , respectively.

Table 3. Multiple regression equation for prediction of progress of Alternaria blight severity at different dates of sowing in relation to weather parameters on RH 30 and RH 0749.

Variety	Date of sowing	Regression equation	R2 value
RH 30	20th October	Y = –88.931 + 1.222 T max. + 5.05 Avp M + 0.133 RH + 0.945 SS + 2.453 Evp	0.9972
	30th October	Y = –122.56 + 0.12 T max. + 14.094 Avp M – 0.647 RH + 0.279 SS + 3.748 Evp	0.9907
	9th November	Y = –215.29 + 3.923 T max. + 11.946 Avp M + 0.523 RH + 1.671 SS + 6.905 Evp	0.9986
RH 0749	20th October	Y = –86.454 + 1.696 T max. + 4.651 Avp M + 0.236 RH + 0.51 SS + 2.171 Evp	0.9984
	30th October	Y = –128.39 + 1.976 T max. + 7.579 Avp M + 0.236 RH + 0.531 SS + 4.325 Evp	0.9893
	9th November	Y = –145.98 + 3.635 T max. + 11.11 Avp M + 0.115 RH – 0.611 SS + 5.775 Evp	0.9981

Table 4. Area under disease progress curve of Alternaria blight on RH 0749 and RH 30 cultivars in different dates of sowing.

Date of sowing	Area under disease progress curve (cm^2) of cultivars	
	RH 30*	RH 0749*
20th October	287.9	262.2
30th "	407.6	326.5
9th November	651.1	578.9

*Mean of two years data.

when favourable environment for disease development occurred. The results are in conformity with Singh *et al.* (2008) that the disease progression in initial weeks of January after onset of disease was slow and non-significant, and later during February a significant difference in disease progression was observed. Alternaria blight disease of Indian mustard is known to be favoured by

high maximum and minimum temperature; morning and evening relative humidity, maximum morning and evening vapour pressure and bright sunshine hours coupled with higher wind speed during the months of mid February to mid March in Haryana. Alternaria blight disease development on *Brassica juncea* in the field in relation to environmental conditions in India has been reported by Sangeetha and Siddaramaia (2007). Date of sowing is an important factor for disease incidence and severity of the crops. The Alternaria blight disease severity increased gradually in crops with delay in sowing between 20th of November and 5th December and decreased with early sowing 20th of October to 5th of November (Singh *et al.* 2008, Mahapatra and Das 2015).

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