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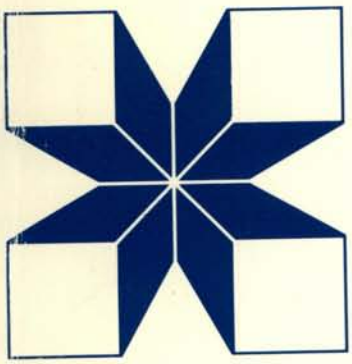

CANADA

OIL CROPS:
PROCEEDINGS OF THE THREE MEETINGS HELD AT PANTNAGAR AND HYDERABAD, INDIA, 4 – 17 JANUARY 1989

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OIL CROPS:
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1. The Brassica Subnetwork-II
2. The Other Oil Crops Subnetwork-I
3. The Oil Crops Network Steering Committee-I

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International Development Research Centre, Ethiopia/Canada

CONTENTS

Part 2. Other Oilcrops Subnetwork-I

Part 3. Oilcrops Network Steering Committee-I

EFFECT OF SOME EPIDEMIOLOGICAL FACTORS ON OCCURRENCE AND SEVERITY OF ALTERNARIA BLIGHT OF RAPESEED AND MUSTARD

R.P. Awasthi and S.J. Kolte

Abstract

Correlations between weather factors and severity of *Alternaria blight* (AB) on rapeseed yellow sarson cv T-151 and mustard cv Varuna (T-59) were established based on the data obtained over a seven-year crop period (1980-1987). Relative humidity (>67%), total rainy days (>6), rainfall (>70mm) and minimum temperature (7-10°C) concomitant with maximum temperature (20-23°C) were found to be positively correlated (r = 0.511-0.805) with AB severity on leaves, whereas the former two factors only showed significant positive correlation (r = 0.758 and 0.962) for the spread of pod infection. Relative humidity below 67% was less conducive for a severe development of the disease. The prediction equations for AB severity were derived by regression analysis. The severity of AB was found to be favoured by the above weather factors beyond 30 days of age and the increase in age was positively correlated (r = 0.777-0.980) with the increase in the susceptibility of the crop; the maximum leaf disease severity being at rosette to flowering stage of the crop.

Alternaria blight of rapeseed-mustard is a disease of economic importance in India (2). It occurs quite regularly every year during the crop season (October to March) resulting in 35-46% yield loss (3). In certain cultivars of yellow sarson, the loss in yield may go to the extent of 70%. Though effects of fungicidal sprays, planting dates, etc. have been studied on control of the disease, basic information with respect to epidemiological factors on occurrence and severity of the disease have not been well documented. The present investigation deals with the study of some weather factors and the effect of plant age on the development of the disease. The results obtained over seven-year crop season (1980-1987) are presented herein.

Materials and Methods

1. Growing of the Brassicaspecies and the field layout

Two susceptible *Brassica* species viz., *B. juncea* cv T-59 (Varuna) and *B. campestris* var yellow sarson cv T-151 along with four other exotic *Brassica* species (*B. alba*, *B. carinata*, *B. juncea* and *B. napus*) were grown at the Crop Research Centre, Pantnagar, in seven consecutive crop seasons (from 1980-81 to 1986-87). Randomized block design using 3 x 4 m plot size with four replications was followed each year. The sowing was done in rows spaced at 40 cm distance keeping plant-to-plant spacing at 15 cm. A distance of 1.5 m was maintained between plots and replications. Nitrogen @ 100 kg/ha was applied along with phosphorus (40 kg/ha) and potash (40 kg/ha). The sowing was done in the middle of October in 1982 and 1986 and in the last week of October in the other five crop seasons. Other agronomic practices including weeding, irrigation, etc. were followed whenever needed to maintain the proper growth. The crop was protected against aphid infestation by a spray of Metasystox @ 0.1%

2. Recording the AB severity

Average disease severity on leaf and pod was taken separately at weekly interval using 0-5 rating scale which is given in Table 1.

Twenty five leaves/pods were collected randomly from each plot and rated. The disease index was

then calculated using the formula:

$$\text{Disease index (\%)} = \frac{\text{Sum of all numerical ratings}}{25 \times 5} \times 100$$

Table 1. Rating scale used to measure AB disease severity.

Rating Scale	Area covered by spots (%) Leaf	Pod
0	No symptoms	No symptoms
1	1-10	1-10
2	11-25	11-20
3	26-50	21-30
4	51-75	31-50
5	> 75	> 50

3. Studying the relationship of weather factors associated with the development of AB

Final severity of AB on middle leaf (on the main stem) referred to as Y_1 and on pod (on the main raceme) referred to as Y_2 in different crop seasons were pooled together cultivar-wise and correlated with the meteorological factors viz., mean maximum (x_1) and mean minimum (x_2) temperatures, per cent relative humidity (x_3), total rainfall (x_4), total number of rainy days (x_5) and sunshine hours/day (x_6) recorded for the period between the 5th and the 15th week after sowing for leaf infection and for the period between the 10th and the 18th week after sowing for pod infection. The correlation coefficient (r) between the average disease index and weather factors was computed as per the method given by (5). Similarly the predicted mean disease severity index "y" equation ($Y = a + b_1 x_1 + b_2 x_2 + \ldots\ldots + b_6 x_6$) was derived by multiple regression analysis, where "y" denotes the predicted AB severity on leaf (Y_1) and on pod (Y_2); "a" denotes the intercept and "b_1" to "b_6" denote partial regression coefficients for x_1 to x_6 weather factors. Significance of correlation coefficient (r) and coefficient of determination (R^2) was followed at 5% level of probability.

4. Computation of apparent infection Rate

Apparent infection rates (ir) were calculated from the AB severity index at different week times of the plant growth using the formula given by:

$$ir = \frac{2.3}{t_2 - t_1} \log 10 \frac{x_2(1 - x_1)}{x_1(1 - x_2)}$$

where ir = apparent infection rate in non-logarithmic phase; x_1 disease index at initial week time t_1 and x_2 = disease index at subsequent week times t_2. The apparent infection rates were further used to assess the maximum and minimum infection periods with respect to each crop species in relation to age.

Results and Discussion

In order to understand the effect of weather factors on the most commonly grown susceptible cultivars of mustard (Varuna) and yellow sarson (T-151), the results obtained with respect to these two only are described below. The results on other *Brassica* species which are not cultivated in India will be described in a separate research article.

1. Leaf infection severity of AB on yellow sarson and mustard

Significant positive correlations (r = 0.764 to 0.804) were observed between AB severity index on the yellow sarson leaf and relative humidity (RH), total rainfall (RF) and minimum temperature (Mi Temp). Similar results were obtained with respect to AB severity on leaf of the mustard (r = 0.725 to 0.805), but the "r" values in respect of the RH and RF factors were non-significant, Table 1. The values of the R^2 values revealed that a combined effect of RH, RF and Mi temp accounted for more than 98%

variation in AB severity on leaves of both yellow sarson and mustard, (Table 2). The AB severity prediction equations as derived in the present studies for leaf infection phase in respect of yellow sarson and mustard are given below:

i. AB leaf infection severity on yellow sarson:

$$(Y_1) = -49.95 + (8.28\ X_2) + (0.12\ X_3) + (0.85\ X_4) + (-0.95\ X_5) + (1.13\ X_6).$$

ii. AB leaf infection severity on mustard:

$$(Y_1) = 63.78 + (10.80\ X_2) + (-2.38\ X_3) + (1.19\ X_4) + (-2.58\ X_5) + (3.64\ X_6).$$

The crops were found to be susceptible to leaf infection phase during rosette to flowering stage when the maximum temperature (Max Temp) ranged between 20 and 23°C and the Mi Temp was in the range of 7-10°C with average RH of 67-73% concomitant with total RF of 70mm and sunshine period (SP) of 5-7 h/day, (Fig. 1). Less than 67% RH and less than 7°C Mi Temp, irrespective of other favourable factors, did not result in severe occurrence of the leaf infection phase.

Table 1. Relationship of weather factors associated with AB severity on leaves of yellow sarson and mustard, as measured by correlation coefficient (r).

Brassica species	Max. Temp. (°C) x_1	Min. Temp. (°C) x_2	R.H. (%) x_3	Total rainfall (mm) x_4	Total rainy days x_5	Sunshine (h/day) x_6
B. campestris var. yellow sarson cv T-151	0.190	0.764*	0.804*	0.784*	0.527	-0.608
B. juncea cv T-59	0.302	0.805*	0.706	0.725	0.511	-0.582

*Significant at 5% level of probability.

Table 2. R^2 values of different stepwise multiple regression equations for prediction of AB severity on leaves (Y_1) of yellow sarson and mustard.

Stepwise predication equations	R^2
B. campestris var yellow sarson cv T-151:	
1. $Y_1 = a + b_3 x_3$	0.65*
2. $Y_1 = a + b_3 x_3 + b_2 x_2$	0.79*
3. $Y_1 = a + b_3 x_3 + b_2 x_2 + b_4 x_4$	0.99*
4. $Y_1 = a + b_3 x_3 + b_2 x_2 + b_4 x_4 + b_5 x_5$	0.99*
5. $Y_1 = a + b_3 x_3 + b_2 x_2 + b_4 x_4 + b_5 x_5 + b_6 x_6$	0.99*
B. juncea cv T-59:	
6. $Y_1 = a + b_2 x_2$	0.65*
7. $Y_1 = a + b_2 x_2 + b_4 x_4$	0.98*
8. $Y_1 = a + b_2 x_2 + b_4 x_4 + b_3 x_3$	0.98*
9. $Y_1 = a + b_2 x_2 + b_4 x_4 + b_3 x_3 + b_5 x_5$	0.99*
10. $Y_1 = a + b_2 x_2 + b_4 x_4 + b_3 x_3 + b_5 x_5 + b_6 x_6$	0.99*

*Significant at 5%.

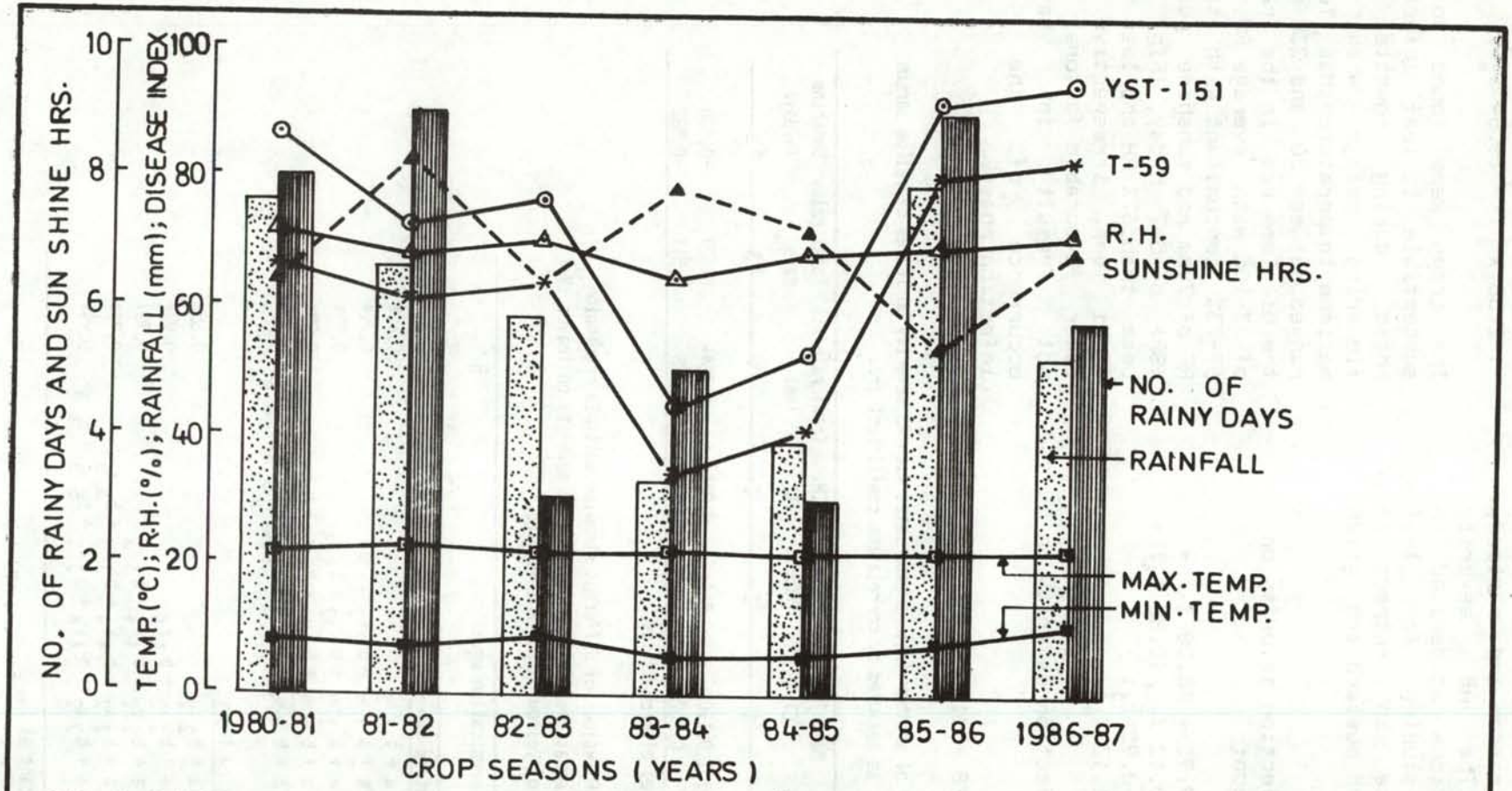

Fig. 1 AVERAGE WEATHER FACTORS FROM 5-15th WEEK AFTER SOWING ASSOCIATED WITH DISEASE SEVERITY ON LEAF OF T-59 AND YST-151 UNDER DIFFERENT CROP SEASONS (1980-81 TO 1986-87).

2. Pod infection severity of AB on yellow sarson and mustard

Total rainy days (TRD) (r = 0.962 and 0.758, respectively) showed significant positive correlation with AB development on pods of yellow sarson and mustard, (Table 3). When TRD was included in the prediction equation for yellow sarson, the value of R^2 was more than 93%, (Table 4), indicating, there by, that AB severity on yellow sarson pods was mainly influenced by the frequency of TRD during the time from flowering to yellow pod stage of the crop. But in the case of mustard, R_2 values for RH showed maximum (57%) variation suggesting, thereby, the importance of RH factor in pod infection of mustard. Thus it is concluded that high frequency of TRD and RH appear to be more important factors for the spread of AB infection on pods, (Fig. 2). Similar results have been reported under the Punjab (1) and West Bengal (4) conditions.

Table 3. Relationship of weather factors associated with AB severity on pods of yellow sarson and mustard as measured by correlation coefficient (r).

Brassica species	Max. Temp. (°C)	Min. Temp. (°C)	R.H. (%)	Total rainfall (mm)	Total rainy days	Sunshine (h/day)
	x_1	x_2	x_3	x_4	x_5	x_6
B. campestris var. yellow sarson cv T-151	-0.635	-0.001	0.645	0.590	0.962*	-0.324
B. juncea cv T-59	-0.387	0.334	0.758*	0.144	0.670	-0.511

*Significant at 5%.

Table 4. R^2 values of different stepwise multiple regression equations for prediction of AB severity on pods (Y_2) of yellow sarson and mustard.

Stepwise predication equations	R^2
B. campestris var yellow sarson cv T-151:	
1. $Y_2 = a + b_5 x_5$	0.93*
2. $Y_2 = a + b_5 x_5 + b_1 x_1$	0.94*
3. $Y_2 = a + b_5 x_5 + b_1 x_1 + b_6 x_6$	0.98*
B. juncea cv T-59	
4. $Y_2 = a + b_3 x_3$	0.57*
5. $Y_2 = a + b_3 x_3 + b_1 x_1$	0.66*
6. $Y_2 = a + b_3 x_3 + b_1 x_1 + b_5 x_5$	0.91*
7. $Y_2 = a + b_3 x_3 + b_1 x_1 + b_5 x_5 + b_2 x_2$	0.99*
8. $Y_2 = a + b_3 x_3 + b_1 x_1 + b_5 x_5 + b_2 x_2 + b_6 x_6$	0.99*

*Significant at 5%.

Keeping other factors constant, sunshine period (h/day) showed negative correlation with AB severity in the present study. The prediction equation for pod infection in respect of yellow sarson and mustard are given below.

i. AB infection severity on yellow sarson pod:
$(Y_2) = 16.18 + (3.75\ X_1) + (3.52\ X_5) + (-4.23\ X_6)$.

ii. AB infection severity on mustard pod:
$(Y_2) = -316.24 + (10.84\ X_1) + -4,29\ X_2) + (2,76\ X_3) + (2.38\ X_5) + (-2.62\ X_6)$.

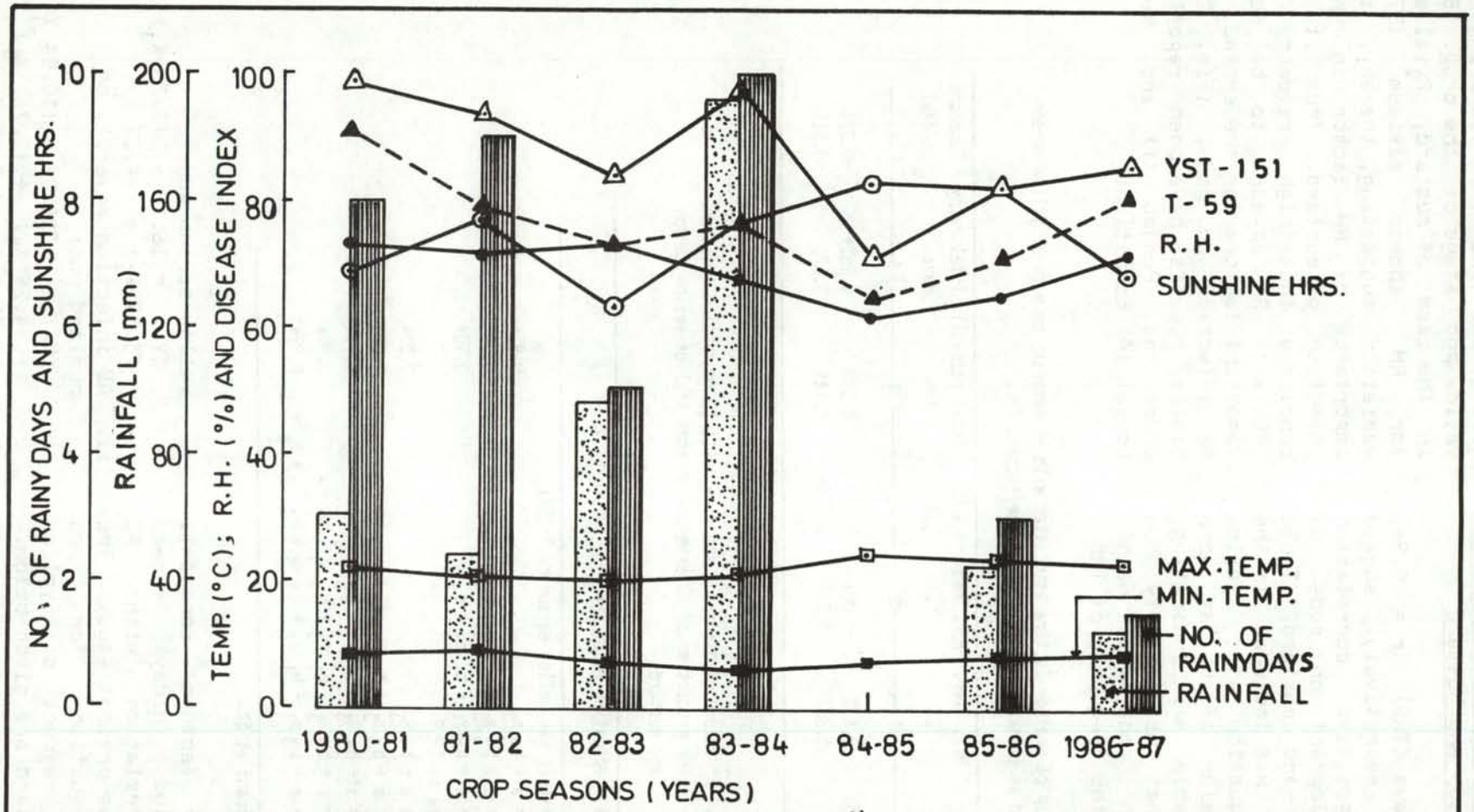

Fig. 2 AVERAGE WEATHER FACTORS FROM 10 TO 18th WEEK AFTER SOWING ASSOCIATED WITH DISEASE SEVERITY ON POD OF T-59 AND YST-151 UNDER DIFFERENT CROP SEASONS (1980-81 TO 1986-87).

3. Relationship between age of the plant and susceptiblity to AB

Plant age showed high degree of singificant positive correlation with AB severity on leaf (r = 0.777 to 0.850) as well as on pod (r = 0.980 to 0.938). Maximum apparent infection rate (ir = 0.763) on leaf was observed between 10 and 12 weeks after sowing in the case of yellow sarson and mustard, indicating thereby the maximum susceptibility of the plants, beyond 60-90 days after sowing. Young plants, less than 30 days of age, did not show development of symptoms on the leaf under field conditions.

This suggests that with increase in the age beyond 30 days, the susceptiblity of the crop increases and becomes at its peak at 60-90 days. This information, thus, becomes a useful guide for time of application of the fungicides for maximum efficacy of the fungicidal control.

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