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Research Article

# Impact of Sowing Environment and Weather Parameters on Progression of Alternaria Blight Disease of Mustard

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## Abstract

Alternaria blight disease of mustard caused by *Alternaria brassicae* (Berk.) Sacc., is an economically destructive disease of mustard. In the present investigation, a field experiment was conducted to know the effect of date of sowing and weather parameters on alternaria blight disease severity progression. The twenty eight genotypes of mustard were sown on three different dates i.e., 22nd October (Early), 13th November (Mid) and 3rd December (Late). A progressive increase in Alternaria blight disease severity, apparent infection rate and area under disease progress curve (AUDPC) were observed on both leaves and siliqua in almost all the genotypes irrespective of sowing conditions. Maximum infection was recorded in 3rd December followed by 13th November and least infection was recorded in 22nd October planting. Maximum yield was recorded in genotypes sown on 22nd October whereas minimum yield was recorded in 3rd December sowing. A correlation was also established between disease severity and weather parameter to comprehend the influence of weather parameters on disease development. The correlation analysis exhibited a positive correlation between disease severity with maximum and minimum temperature and negative correlation with maximum and minimum relative humidity for mid and late sown conditions while negative correlation with maximum temperature, positive correlation with minimum temperature as well as maximum and minimum relative humidity. The early sown mustard crops could escape severe infection of alternaria blight disease due to susceptible stage of host surpass before the alternaria blight epidemic and increase the yield of the mustard.

**Keywords**: Mustard; Alternaria Blight; Weather Parameters; Disease Progression; Sowing Environment

## Introduction

Mustard is the third most important oilseed crop globally after Soybean and Palm oil and is grown in both tropical and subtropical regions of the world. Out of all the Rapeseed-mustard crops cultivated in India, mustard occupies about 75-80 % of the total area. 35 % of the total vegetable oil produced in India comprise of mustard oil. Mustard is sensitive to numerous biotic and abiotic stresses which further widen the existing gap between potential yield and actual yield realized at the farmer's field. Globally, mustard is attacked by 16 diseases, 37 insect pests and various species of nematodes and slugs [34]. Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc. is one of the most destructive disease and is predominant in every mustard growing regions of the world. It causes an average yield loss of 35-38 % in mustard [13-16]. The loss in oil content of seeds from diseased plants of rapeseed cultivars over the seeds from healthy plants ranged 14.6-36 % [1].

Reduction in oil content from 1-10% has been recorded in infected seeds. Infected seeds show loss in oil, protein content and poor germination [2,3,5,32]. Alternaria infection not only causes qualitative and quantitative changes (seed weight, color of seed and percent oil content in seed) but also affects the normal seed development [18]. A reduction in quality seed production was reported due to spots on leaves and siliqua which reduced the photosynthetic area and induced immature ripening [17]. The pathogen also penetrates the tissue of pods and infects the seed. Abundant spores are produced in wet weather and are dispersed locally by rain splash or wind. In areas where crops are grown in sequence, *A. brassicae* overwinters saprophytically on diseased plant debris which acts as primary source of inoculums for new crops [33]. It was reported that the pathogen's survives for more than six months at a lower temperature than at room temperature [18]. In temperate climatic countries, the seeds from infected plant also act as primary source of initial infection [9].

The severity of alternaria blight disease depends upon multiple weather parameters, varieties, age of host plants and virulence of the pathogen. Its incidence and severity is greatly influenced by leaf wetness, inoculums density, soil condition at time of planting and weather parameters such as temperature, RH, rain and wind velocity also play a vital role in disease development [3,21,22,26,27]. The maximum disease incidence is reported in wet season and in area with comparatively higher rainfall [10]. [15] and [25] reported that Alternaria blight can cause an average yield loss of 10-70% depending on disease severity and prevailing weather conditions. Alternaria blight disease severity on leaves and pods are reported to be higher in late sown crop [21,27]. A delay in date of sowing results in coincidence of warm and humid weather with vulnerable growth stages of plant. The knowledge of first appearance of alternaria blight disease on leaves, siliqua or the timing of attack in relation to weather factors could help predict the occurrence and severity of alternaria blight disease. In consideration of various environmental factors that influenced and governed the onset of disease and epidemic development, the present investigation was undertaken to study the effect of date of sowing and weather parameters on alternaria blight disease severity progression.

## Materials and Methods

The field experiment was conducted at research farm of Bihar Agricultural University, Bhagalpur, Bihar. Twenty eight genotypes of mustard (*Brassica juncea*) were sown on three different dates (22nd October, 13th November and 3rd December) at interval of 20 days. The experiment was carried out in Randomized Block Design (RBD) in three replications with a spacing of 30 X 10 cm. Recommended dose of Nitrogen, Phosphorus and Potassium @ 80:40:40 was given as basal dose in the form of Urea, DAP and MOP. All the other agronomical practices were carried out as per normal package of practices. Weekly weather data (maximum temperature and minimum temperature, maximum and minimum RH) during the period of investigation was collected from metrological observatory of Bihar Agricultural University, Sabour.

### Isolation of *Alternaria brassicae* pathogen for artificial inoculation

*Alternaria brassicae* pathogen was isolated from infected leaves of mustard in radish root sucrose agar (RRSA) medium and pure culture was obtained through single spore isolation. After pathogenicity test, pathogen was re-isolated and maintained in RRSA slants and Petri plates and stored at 4 °C for further investigation. Artificial inoculation was done with spore suspension of actively growing *Alternaria brassicae* culture. An inoculum load of $10^4$ spores per ml was used for inoculating the genotypes at 15 days after sowing. The inoculum was sprayed on the leaves during dusk when the temperature was comparatively low.

### Disease severity

Alternaria blight disease severity on leaves was recorded at 70, 80 and 90 days after sowing (DAS). Ten leaves from randomly tagged plants of each genotype were selected and scored on the basis of 0-5 rating scale (Conn *et al.,* 1990) where 0= no symptom, 1= 1-10 % leaf area infection, 2= 11-25 % leaf area infection, 3= 26-50 % leaf area infection, 4= 51-75 % leaf area infection, 5= >75 % leaf area infection. Disease severity on siliqua was recorded at 80, 90 and 100 DAS. 25 siliqua from each genotype was randomly tagged and scored using the same 0-5 rating scale. Disease severity was calculated using the following formula [20].

$$\text{Disease index (\%)} = \frac{\text{Sum of all numerical rating}}{\text{Number of leaves examined} \times \text{Maximum grade}} \times 100$$

### Apparent infection rate

For each genotype, the apparent infection rate on leaves and siliqua was computed on the basis of percent disease index and subsequent infection rate (r) was calculated using following formula [31].

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

Where,

- r = Apparent infection rate
- $x_1$ = disease index at time $t_1$
- $x_2$ = disease index at time $t_2$
- $t_1$ = time of initial disease rating ($x_1$)
- $t_2$ = time of second disease rating ($x_2$)

### AUDPC (Area under disease progress curve)

Area under disease progress curve on leaves and siliqua was also calculated on the basis of percent disease index using following formula given below [28].

$$AUDPC = \sum_{i=1}^{n} [(Y_{i+1} + Y_i)/2][X_{i+1} - X_i]$$

Where,

$Y_i$ = disease index (per unit) at $i^{th}$ observation

$X_i$ = time (day)

N= total number of observation

### Correlation between disease severity and weather parameters

A correlation was established between weather parameters (maximum and minimum temperature, maximum and minimum RH) and alternaria blight disease severity on leaves and siliqua of twenty eight genotypes at all the three dates of sowing to form a relation between weather parameters and disease development. Correlation analysis between weather factors and disease severity on leaves of 28 genotypes at different dates of sowing was done using OPSTAT software. Yield (q/ha) was assessed after harvest from each genotype.

## Results and Discussion

### Effect of date of sowing on Alternaria blight disease of mustard

### Effect on disease severity on leaves

The severity of alternaria blight disease on leaves increased significantly with delay in date of sowing and it was evidently observed in all the twenty-eight genotypes. Minimum disease severity was observed in plots sown on 22nd October (i.e. early sown) whereas maximum disease severity was observed from plots sown on 3rd of December (i.e. late sown) followed by 13th November sowing (i.e. mid sown). An advance in disease development was observed in genotypes with age and delay in date of sowing (Figure 1). The genotype 34-1-2-3 showed maximum disease severity in early sown (22.66 %) whereas, Kranti showed maximum disease severity in both mid and late sown plots (28.45 % and 33.56 % respectively). The minimum disease severity was found in RGN-73 genotype in early sown (13.56 %) while in BRRM-104 in mid (16.22 %) and late sown (22.11 %) conditions respectively. The result corroborates the findings of [11] who reported that crops sown on 1st December recorded highest disease severity followed by crops sown on 5th November and 10th October. It was reported that disease severity increased gradually in crops sown between 20th November to 5th December whereas, it decreased with early sowing between 20th October to 5th November [19]. The findings are also in the agreement with [7] who reported that rapeseed-mustard can be saved from heavy infection of alternaria blight disease by manipulating the date of sowing between 21st October and 5th November.

### Effect on apparent infection rate on leaves

A progressive increase in apparent infection rate of alternaria blight disease from 22nd October to 3rd December was also observed. The maximum mean apparent infection rate was observed in genotype Kranti for early, mid and late sowing (0.638, 0.680 and 0.729 respectively) whereas minimum mean apparent infection rate was calculated in genotype 6-3-2 in early sown (0.550) and BRRM-104 in mid and late sown (0.547 and 0.636) respectively (Figure 2).

### Effect on disease severity on siliqua

PPercent siliqua infection was also increased significantly with delay in sowing with maximum infection at 100 DAS. Maximum

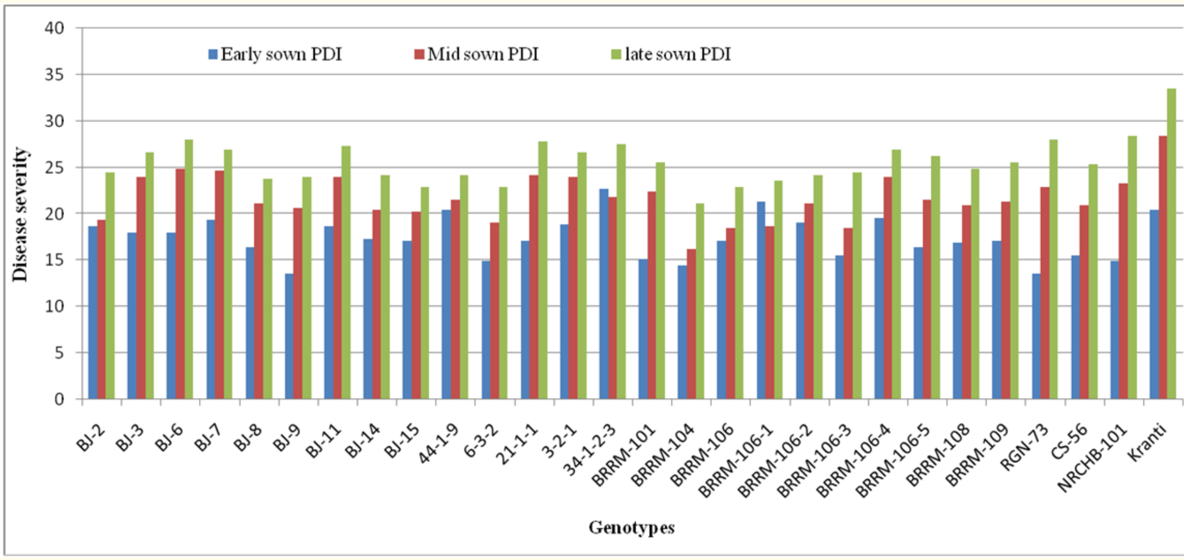


**Figure 1:** Effect of date of sowing on alternaria blight disease severity on leaves of different genotypes of mustard.

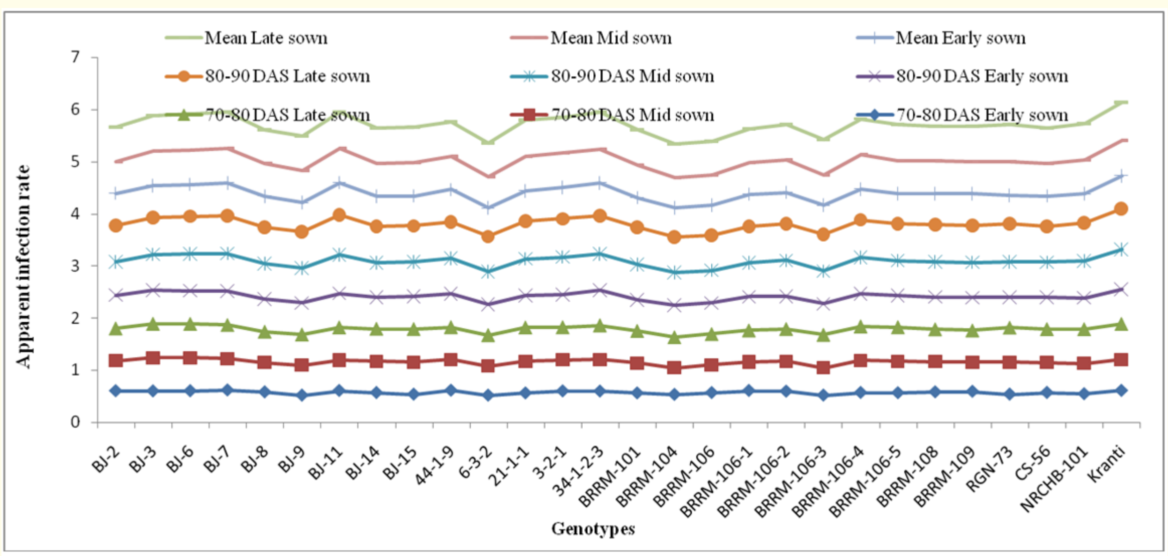


**Figure 2:** Effect of date of sowing on apparent infection rate of alternaria blight disease on leaves of different genotypes of mustard.

mean disease severity was observed in genotype BRRM-101 (5.24 %), 21-1-1 (20.86 %) and Kranti (23.53 %) for early, mid and late sown respectively. The minimum mean siliqua infection in early sown was observed in BJ-14 (1.47 %) and 6-3-2 (11.46 %, 15.76 %) at mid sown and late sown respectively (Figure 3). The result advocates the findings of [21] and [27] who reported that the intensity of alternaria blight severity on leaves and siliqua were observed to be higher in late sown crops. The findings are also in agreement with [12], [30] and [29].

## Effect on Apparent infection on siliqua

The apparent infection rate was observed to increase progressively with age of plant and delay in date of sowing. Genotype Kranti (0.677) recorded maximum apparent infection rate in late sown whereas in mid and late sown, the maximum apparent infection rate was recorded in genotype BRRM-101(0.299) and 21-1-1(0.642) respectively (Figure 4).

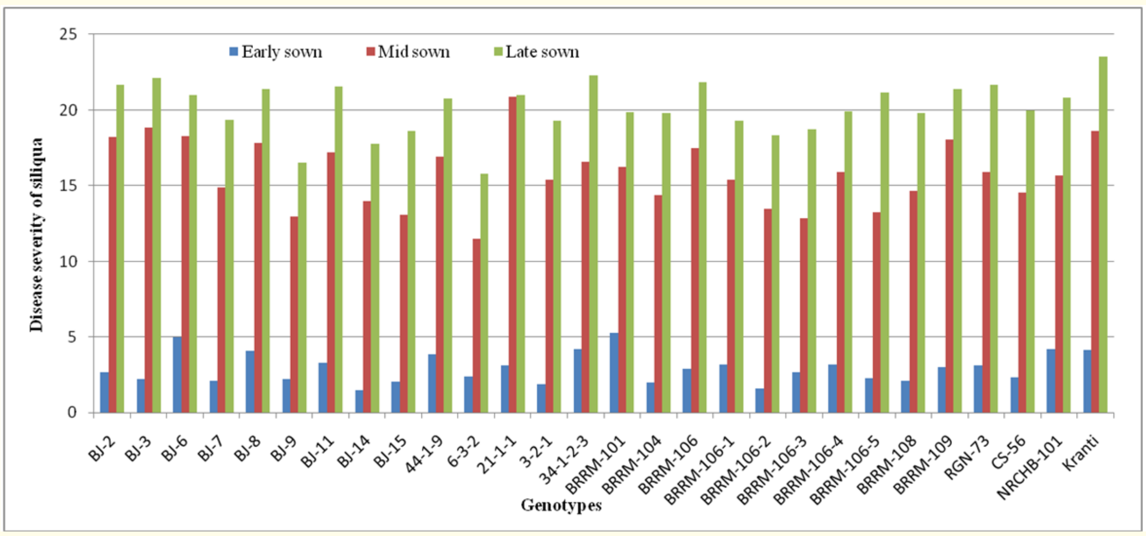


**Figure 3:** Effect of date of sowing on alternaria blight disease severity on siliqua of different genotypes of mustard.

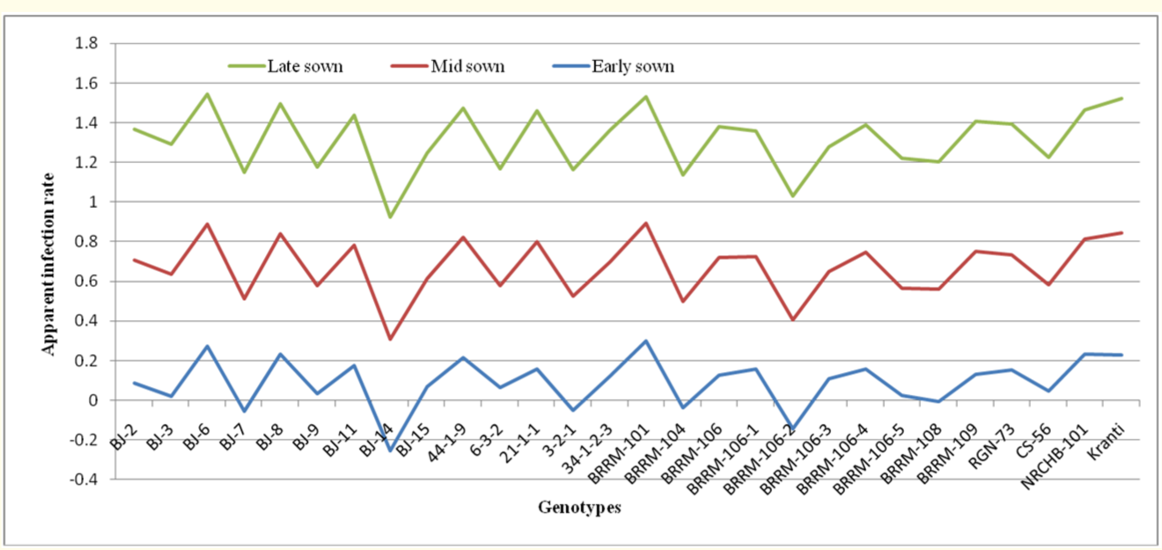


**Figure 4:** Effect of date of sowing on apparent infection rate of alternaria blight disease on siliqua of different genotypes of mustard.

## Effect on area under disease progress curve (AUDPC) on leaves and siliqua

Area under disease progress curve (AUDPC) was also observed to increase in most of the genotypes. The maximum AUDPC was observed in genotypes Kranti in late and mid sown (660, 530.05) followed by 34-1-2-3 (446.60) in early sown. Similar finding was observed by [11] who reported that maximum AUDPC was observed in late sown crops followed by timely and early sow crops. The result also corroborates the findings of [19] who observed an increase in AUDPC in crops with delay in sowing from 20th October to 5th December. Similarly, [24] also reported that crops sown on 9th November recorded higher AUDPC as compared to crops sown on 20th October. The maximum AUDPC on siliqua was recorded in genotypes BRRM-101(99.65), 21-1-1(415.70) and Kranti (486.00) at early, mid and late sown respectively i.e., AUDPC was observed to increase progressively. Among the different dates of sowing, maximum AUDPC was observed in late sown crops followed by timely and early sown crops [11] (Figure 5).

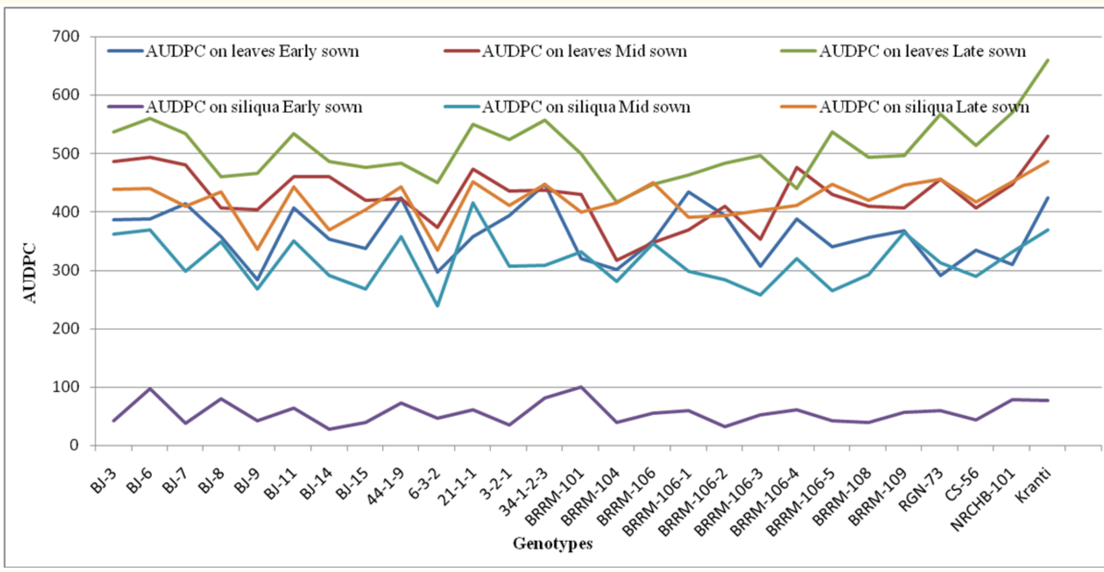


**Figure 5:** Effect of date of sowing on AUDPC of alternaria blight disease on leaves and siliqua of different genotypes of mustard.

## Effect on yield of mustard

Yield of mustard was greatly influenced by date of sowing and it decreased with corresponding increase in disease severity from 22nd October to 3rd December (Table 1). Late sown genotypes recorded least yield as compared to mid and late sown genotypes. The maximum yield was recorded in genotype BRRM-104 in early sown plots (33.83 q/ha) followed by genotype BRRM-106 in mid and late sown plots (33.20 q/ha, 26.93 q/ha) respectively. Khatun *et al.,* (2011) also reported that yield of mustard was greatly influenced by the date of sowing and highest yield was recorded in crops sown under 5th November followed by crops sown on 21st October. The seed yield was found minimum in case of 5th December sowing whereas; the maximum seed yield was recorded in crops sown on 5th November followed by 20th October [19]. The results was also confirms the findings of [23] who recommended early sowing of mustard to minimize loss from alternaria blight disease. Crops sown on 2nd November or seven days before it recorded highest yield and showed least infection in field, reduction in yield was observed with delay of sowing [8].

## Effect of weather parameters on Alternaria blight disease of mustard

A correlation was established between disease severity and weather parameters such as maximum and minimum temperature and relative humidity (Table 2). It was observed that correlation between disease severity and weather parameters showed different reaction with different date of sowing. In 22nd October (i.e. early) sowing, the genotypes showed a negative correlation with maximum temperature (20.7-24.1°C) whereas it showed a positive correlation with minimum temperature (8.8-10.3°C), maximum RH (91.4-93 %) and minimum RH (76-80.3%). In 13th November (i.e. mid) sowing, a positive correlation was observed between disease severity and maximum (19.9-24.3°C) and minimum temperature (7.7-11.6°C) whereas, maximum (86.3-98.9%) and minimum RH (59.9-80.3 %) showed a negative correlation with disease severity. In 3rd December (late) sowing, a similar correlation was observed. Maximum (28-31.3°C) and minimum temperature (14.7-17.6°C) showed a positive correlation while maximum (82.3-91.9 %) and minimum RH (63.6-67 %) showed a negative correlation with disease severity. Overall, maximum and minimum temperature positively influenced the disease development in mid and late sown genotypes whereas; maximum and minimum RH negatively influenced the disease development. The result supports the finding of [29] who reported that maximum and minimum temperature showed significant positive relation while rainfall and RH showed negative correlation with varieties sown on 22nd October and 5th November. The result also corroborates the findings of [7] who observed that maximum and minimum temperature showed positive correlation with disease severity and it increased with increase with temperature. It was reported that maximum and minimum temperature positively influenced disease severity while relative humidity and rainfall were negatively correlated with alternaria blight disease [24].

| S. No | Genotypes | Yield (q/ha) | | |
|---|---|---|---|---|
| | | Early sown | Mid Sown | Late sown |
| 1 | BJ-2 | 31.00 | 24.66 | 23.86 |
| 2 | BJ-3 | 28.66 | 22.13 | 21.20 |
| 3 | BJ-6 | 29.00 | 24.00 | 22.80 |
| 4 | BJ-7 | 30.16 | 21.60 | 21.06 |
| 5 | BJ-8 | 30.83 | 24.53 | 23.33 |
| 6 | BJ-9 | 31.00 | 23.06 | 22.26 |
| 7 | BJ-11 | 30.66 | 23.46 | 22.80 |
| 8 | BJ-14 | 29.33 | 24.13 | 23.20 |
| 9 | BJ-15 | 32.00 | 23.86 | 22.13 |
| 10 | 44-1-9 | 30.66 | 27.06 | 24.80 |
| 11 | 6-3-2 | 29.33 | 27.86 | 25.20 |
| 12 | 21-1-1 | 27.00 | 24.66 | 24.00 |
| 13 | 3-2-1 | 31.66 | 27.86 | 23.60 |
| 14 | 34-1-2-3 | 28.16 | 26.26 | 26.40 |
| 15 | BRRM-101 | 32.33 | 25.46 | 24.13 |
| 16 | BRRM-104 | 33.83 | 22.80 | 22.00 |
| 17 | BRRM-106 | 30.83 | 33.20 | 26.93 |
| 18 | BRRM-106-1 | 30.33 | 23.20 | 23.20 |
| 19 | BRRM-106-2 | 24.33 | 15.20 | 14.00 |
| 20 | BRRM-106-3 | 30.33 | 27.86 | 24.93 |
| 21 | BRRM-106-4 | 26.16 | 24.26 | 23.06 |
| 22 | BRRM-106-5 | 26.66 | 20.80 | 19.33 |
| 23 | BRRM-108 | 27.83 | 24.80 | 24.00 |
| 24 | BRRM-109 | 25.66 | 26.26 | 24.93 |
| 25 | RGN-73 | 30.66 | 25.06 | 24.00 |
| 26 | CS-56 | 32.83 | 24.53 | 23.46 |
| 27 | NRCHB-101 | 31.16 | 23.60 | 22.53 |
| 28 | Kranti | 32.16 | 26.00 | 25.86 |
| | C.D at 5% | 0.29 | 0.39 | 0.33 |

**Table 1:** Effect of date of sowing on yield of different genotypes of mustard.

| S. No | Genotypes | Date of sowing | Correlation coefficient | | | |
|---|---|---|---|---|---|---|
| | | | X1 | X2 | X3 | X4 |
| 1 | BJ-2 | D1 | -0.247 | 0.710 | -0.045 | 0.760 |
| | | D2 | 0.823 | 0.411 | -0.669 | -0.994 |
| | | D3 | 0.999 | 0.999 | -0.767 | -0.975 |
| 2 | BJ-3 | D1 | -0.224 | 0.726 | -0.069 | 0.744 |
| | | D2 | 0.684 | 0.209 | -0.496 | -0.950 |
| | | D3 | 0.996 | 0.994 | -0.700 | -0.992 |
| 3 | BJ-6 | D1 | -0.198 | 0.744 | -0.096 | 0.726 |
| | | D2 | 0.815 | 0.399 | -0.658 | -0.993 |
| | | D3 | 0.999 | 0.999 | -0.741 | -0.983 |
| 4 | BJ-7 | D1 | -0.198 | 0.745 | -0.096 | 0.725 |
| | | D2 | 0.870 | 0.491 | -0.733 | -1.000 |
| | | D3 | 0.999 | 0.999 | -0.781 | -0.970 |
| 5 | BJ-8 | D1 | -0.195 | 0.746 | -0.098 | 0.724 |
| | | D2 | 0.932 | 0.612 | -0.823 | -0.992 |
| | | D3 | 0.972 | 0.976 | -0.890 | -0.902 |
| 6 | BJ-9 | D1 | -0.399 | 0.588 | 0.114 | 0.854 |
| | | D2 | 0.882 | 0.512 | -0.749 | -1.000 |
| | | D3 | 0.982 | 0.985 | -0.867 | -0.922 |
| 7 | BJ-11 | D1 | -0.187 | 0.752 | -0.107 | 0.718 |
| | | D2 | 0.882 | 0.513 | -0.749 | -1.000 |
| | | D3 | 0.994 | 0.996 | -0.823 | -0.950 |
| 8 | BJ-14 | D1 | -0.369 | 0.614 | 0.082 | 0.836 |
| | | D2 | 0.708 | 0.243 | -0.526 | -0.960 |
| | | D3 | 0.998 | 0.996 | -0.718 | -0.988 |
| 9 | BJ-15 | D1 | -0.736 | 0.211 | 0.507 | 0.991 |
| | | D2 | 0.588 | 0.086 | -0.385 | -0.903 |
| | | D3 | 0.955 | 0.949 | -0.533 | -0.995 |
| 10 | 44-1-9 | D1 | -0.279 | 0.686 | -0.013 | 0.780 |
| | | D2 | 0.854 | 0.463 | -0.711 | -0.999 |
| | | D3 | 0.999 | 0.999 | -0.755 | -0.979 |
| 11 | 6-3-2 | D1 | -0.646 | 0.330 | 0.396 | 0.968 |
| | | D2 | 0.930 | 0.607 | -0.820 | -0.992 |
| | | D3 | 0.989 | 0.991 | -0.846 | -0.936 |
| 12 | 21-1-1 | D1 | -0.475 | 0.518 | 0.198 | 0.895 |
| | | D2 | 0.840 | 0.440 | -0.692 | -0.997 |
| | | D3 | 0.998 | 0.999 | -0.794 | -0.965 |
| 13 | 3-2-1 | D1 | -0.234 | 0.719 | -0.059 | 0.751 |
| | | D2 | 0.894 | 0.534 | -0.766 | -0.999 |
| | | D3 | 0.995 | 0.996 | -0.820 | -0.952 |
| 14 | 34-1-2-3 | D1 | -0.750 | 0.189 | 0.526 | 0.994 |
| | | D2 | 0.759 | 0.313 | -0.587 | -0.978 |
| | | D3 | 0.995 | 0.993 | -0.692 | -0.993 |
| 15 | BRRM-101 | D1 | -0.224 | 0.726 | -0.070 | 0.744 |
| | | D2 | 0.958 | 0.672 | -0.865 | -0.979 |
| | | D3 | 0.984 | 0.987 | -0.861 | -0.926 |
| 16 | BRRM-104 | D1 | -0.410 | 0.578 | 0.126 | 0.860 |
| | | D2 | 0.867 | 0.486 | -0.728 | -1.000 |
| | | D3 | 0.998 | 0.999 | -0.797 | -0.963 |
| 17 | BRRM-106 | D1 | -0.301 | 0.669 | 0.011 | 0.795 |
| | | D2 | 0.930 | 0.607 | -0.820 | -0.992 |
| | | D3 | 0.978 | 0.981 | -0.877 | -0.913 |
| 18 | BRRM-106-1 | D1 | -0.404 | 0.584 | 0.120 | 0.856 |
| | | D2 | 0.890 | 0.527 | -0.760 | -1.000 |
| | | D3 | 0.979 | 0.977 | -0.166 | -0.998 |
| 19 | BRRM-106-2 | D1 | -0.307 | 0.664 | 0.017 | 0.799 |
| | | D2 | 0.881 | 0.510 | -0.747 | -1.000 |
| | | D3 | 0.992 | 0.860 | -0.471 | -0.964 |
| 20 | BRRM-106-3 | D1 | -0.750 | 0.189 | 0.525 | 0.994 |
| | | D2 | 0.890 | 0.527 | -0.760 | -1.000 |
| | | D3 | 0.985 | 0.834 | -0.514 | -0.950 |
| 21 | BRRM-106-4 | D1 | -0.774 | 0.153 | 0.556 | 0.997 |
| | | D2 | 0.805 | 0.383 | -0.646 | -0.991 |
| | | D3 | 0.994 | 0.952 | -0.264 | -0.998 |
| 22 | BRRM-106-5 | D1 | -0.341 | 0.637 | 0.052 | 0.819 |
| | | D2 | 0.783 | 0.349 | -0.617 | -0.985 |
| | | D3 | 0.999 | 0.917 | -0.358 | -0.989 |
| 23 | BRRM-108 | D1 | -0.252 | 0.706 | -0.040 | 0.763 |
| | | D2 | 0.855 | 0.464 | -0.711 | -0.999 |
| | | D3 | 0.999 | 0.899 | -0.398 | -0.982 |
| 24 | BRRM-109 | D1 | -0.203 | 0.741 | -0.091 | 0.729 |
| | | D2 | 0.959 | 0.676 | -0.868 | -0.977 |
| | | D3 | 0.998 | 0.934 | -0.314 | -0.995 |
| 25 | RGN-73 | D1 | -0.220 | 0.729 | -0.073 | 0.741 |
| | | D2 | 0.781 | 0.347 | -0.616 | -0.985 |
| | | D3 | 0.999 | 0.922 | -0.345 | -0.991 |
| 26 | CS-56 | D1 | -0.208 | 0.737 | -0.085 | 0.733 |
| | | D2 | 0.888 | 0.524 | -0.758 | -1.000 |
| | | D3 | 0.998 | 0.933 | -0.318 | -0.994 |
| 27 | NRCHB-101 | D1 | -0.357 | 0.624 | 0.070 | 0.829 |
| | | D2 | 0.935 | 0.619 | -0.828 | -0.991 |
| | | D3 | 0.989 | 0.849 | -0.490 | -0.958 |
| 28 | Kranti | D1 | -0.395 | 0.592 | 0.110 | 0.851 |
| | | D2 | 0.959 | 0.674 | -0.867 | -0.978 |
| | | D3 | 0.993 | 0.955 | -0.253 | -0.999 |
| | Overall mean | D1 | -0.291 | 0.564 | 0.038 | 0.713 |
| | | D2 | 0.784 | 0.434 | -0.656 | -0.910 |
| | | D3 | 0.973 | 0.910 | -0.308 | -0.969 |

**Table 2:** Correlation-coefficient between weather parameters and alternaria blight disease severity (leaves) on different genotypes of mustard.

X1: Maximum temperature; X2: Minimum temperature; X3: Maximum RH & X4: Minimum RH

D1: Early sown; D2: Mid sown & D3: Late sown

## Conclusions

It could be concluded that alternaria blight disease severity and yield of mustard was greatly influenced by delay in date of sowing. Genotypes sown on 22nd October showed least disease severity, apparent infection rate and AUDPC. These genotypes also recorded highest yield over mid and late sown genotypes. Delay in date of sowing resulted in coincidence of favorable conditions for disease development with vulnerable growth stages which resulted in severe infection in late sown crops. In the present investigation, temperature and relative humidity played a crucial role in disease development and progression. Thus, sowing of crops on or before 22nd October could help escape severe infection and there is an increased chance that host will pass its most susceptible stage before the pathogen reaches the host. Therefore, selection of proper planting dates could help in the avoidance or evasion of pathogen by host.

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