ISSN 0258-7122
Bangladesh J. Agril. Res. 36(4): 583-594, December 2011

EFFECT OF SOWING DATES AND VARIETIES ON THE SEVERITY OF *ALTERNARIA* BLIGHT OF MUSTARD

F. KHATUN[1], M. S. ALAM[2], M. A. HOSSAIN[3]
P. K. MALAKER[4] AND M. H. RASHID[5]

Abstract

A study was carried out to find out the effect of sowing dates and varieties on the severity of *Alternaria* blight of mustard. Seeds of eight mustard varieties were sown on four different dates. Data on severity of the disease and seed yield were recorded. Disease severity differed significantly among the varieties. *B. campestris* varieties showed the higher disease severity compared to *B. napus* and *B. juncea*. The lowest disease severity was recorded in BARI Sarisha 11 which produced the highest seed yield. Percentages of leaf area diseased, leaf infection, siliqua infection, and spots per siliqua were found lowest under 21 October sowing, which were statistically lower than other sowing dates. The highest seed yield (1727 kg/ha) was recorded under 01 November sowing followed by 21 October sowing. Combination of sowing dates and varieties had a significant influence on disease severity and seed yield. Early sown (21 October and 1 November) BARI Sarisha 11 showed less disease severity and gave higher seed yield than other treatment combinations.

Keywords: Sowing dates, mustard, alternaria blight.

Introduction

Mustard (*Brassica juncea*, *B.campestris* and *B.napus*) is an important oilseed crop in Bangladesh. The average yield of mustard in the country is only 1001 kg/ha (BBS, 2008), which is low compared to many other mustard growing countries of the world (Ahmed *et al.*, 1988). There are several reasons that can explain this yield variation, which cover abiotic and biotic factors. Among the biotic factors, unavailability of high yielding varieties (Akber *et al.*, 1994; Rerkasem *et al.*, 1993) and incidence of diseases and pests (Rajendra *et al.*, 2003; Gupta *et al.*, 1990) are important.

Diseases play an important role in reducing the quantity and quality of mustard (Ahmed and Ahmed, 1994). *Alternaria* blight is the most serious and devastating disease of mustard in Bangladesh (Ahmed and Ahmed, 1994). The disease causes blight of leaf, pod and stem and seed abnormalities (Howlider *et*

[1]Senior Scientific Officer, Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Jessore, [2]Professor, Dept. of Botany, Rajshahi University (RU), Rajshahi [3]Senior Scientific Officer, Pulses Research Centre (PRC), BARI, Gazipur and [4]Principal Scientific Officer, Wheat Research Centre (WRC), Bangladesh, BARI, Dianjpur, [5]Senior Scientific Officer, Pulses Research Sub-Station, BARI, Madaripur.

al., 1991). It is endemic in the country and most of the cultivated varieties are susceptible to the disease. The disease causes yield losses of 40-70% in India (Vishwanath and Kolte, 1997) and 30-60% in Bangladesh (Ahmed and Ahmed, 1994; Meah and Hossain, 1988). In addition to direct yield losses, the disease adversely affects the seed quality by reducing seed size and causing seed discolouration and reduction in oil contents (Howlider *et al.,* 1991). Pod of mustard is the main component of seed yield and normal filling of seed takes place if pod can be protected from infection (Hossain and Mian, 2004). Protection of seedpod from *Alternaria* blight infection should, therefore, be the most important aim for higher yield of mustard. The most economical and environmentally safe method of controlling the disease is use of resistant varieties. Information on resistance source is not available, although some sort of tolerance may be available (Shah *et al.,* 2005; Rajendra *et al.,* 2002). Date of planting or sowing is an important factor for incidence and severity of crop diseases. There are reports that *Alternaria* blight of mustard and cauliflower can be avoided to a large extent by adjusting sowing time (Ayub, 2001; Mian and Akanda, 1989). Keeping the above points in view, the present experiment was undertaken to find out the effect of sowing dates and varieties on the severity of *Alternaria* leaf blight of mustard.

Materials and Method

The experiment was conducted in the calcareous soil of Regional Agricultural Research Station (RARS), Jessore, Bangladesh during the winter season of 2005-2006 and 2006-2007 with four sowing dates and eight mustard varieties. The sowing dates were 21 October (D_1), 1 November (D_2), 11 November (D_3), and 21 November (D_4). Among the varieties, three were taken from *Brassica campestris* (BARI Sarisha 6, BARI Sarisha 9 and BARI Sarisha 12), three from *Brassica napus* (BARI Sarisha 7, BARI Sarisha 8, and BARI Sarisha 13) and two from *Brassica juncea* (BARI Sarisha 10 and BARI Sarisha 11). It was 4 x 8 factorial experiment in randomized complete block design with 3 replications. The unit plot size was 4 m x 3 m. Seeds were sown as per treatments maintaining a spacing of 30 cm between the rows. Every year, the crop received 120-30-60-30-2-1 kg NPKSZnB per hectare, respectively. The sources of nutrients were urea, TSP, MOP, gypsum, zinc sulphate, and boric acid, respectively. Full amount of P, K, S, Zn, B, and half of N was applied at the time of final land preparation. The remaining N was applied as top-dress before flowering. Intercultural operations viz., weeding, irrigation, and insecticide spray were done as and when required. Development of *Alternaria* blight was assessed by recording data on % leaf infection, % leaf area diseased, % siliqua infection, and number of spots/siliqua 3 times during crop growth stage. The crops were harvested at maturity and data on seed yield were also recorded.

Results and Discussion

Effect of sowing date on severity of *Alternaria* leaf spot

The lowest percentage of leaf infection and percentage of leaf area diseased were recorded from the plots sown on 21 October. The highest percentage of leaf infection and percentage of leaf area diseased were recorded from 21 November sowing plant. The leaf area diseased was 11.28% (mean of two year's) in early sowing and 20.52% in late sowing. Average of two years the early sowing had lower percentage of leaf infection compared to 1 November, 11 November and 21 November sowing. Both the parameters significantly differed when sowing was gradually delayed (Fig. 1).

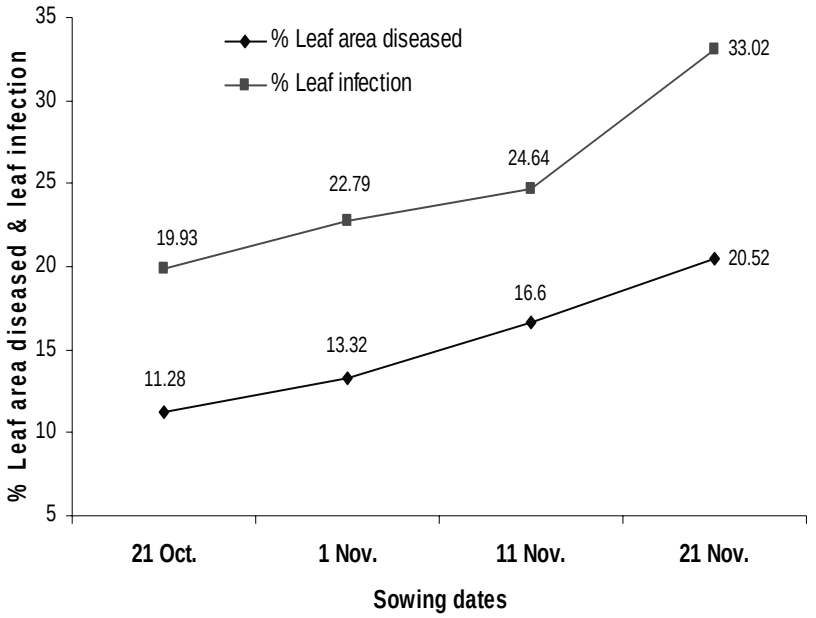

Fig. 1. Effect of sowing dates on % leaf area diseased and leaf infection of mustard (mean of two years).

Effect of variety on severity of *Alternaria* leaf spot

The *Brassica campestris* group showed the higher percentage of leaf area diseased compared to *B. napus* and *B. juncea*. BARI Sarisha 12 showed the highest percentage of leaf area diseased, which was at par with that of BARI Sarisha 9, but differed significantly from other varieties. The lowest percentage of leaf area diseased was observed in BARI Sarisha 11. Like percentage of leaf area diseased, percentage of leaf infection was also higher in *B. campestris*

group and it was the highest in BARI Sarisha 9, which was significantly higher than those of all other varieties. *Brassica juncea* group (BARI Sarisha 11) had the lowest percentage of leaf infection as compared to other groups and varieties (Fig. 2).

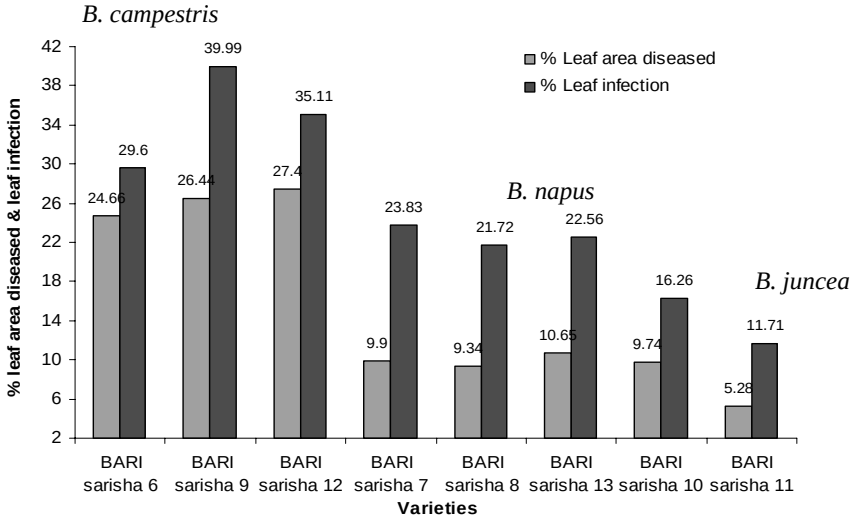

Fig. 2. Effect of varieties on % leaf area diseased and leaf infection of mustard (mean of two years).

Interaction effect of sowing date and variety on severity of *Alternaria* leaf spot

Interaction effect of sowing dates and varieties had significant effect on percentage of leaf area diseased and percentage of leaf infection (Table 1). The effect was more pronounced when BARI Sarisha 9 was sown on 21 November, and it was significantly higher than those of all other treatment combinations. The treatment $D_4 \times V_3$ produced the second highest percentage of leaf area diseased and percentage of leaf infection which was significantly different from all other treatment combinations in both the years. Again *B. juncea* variety BARI Sarisha 11 performed better than all other varieties of *B. campestris* and *B. napus* on 1 November and 11 November sowing. Percentage of leaf area diseased and percentage of leaf infection were minimum in D_1 x V_8, which was followed by D_2 x V_8 treatment.

Effect of sowing date on severity of *Alternaria* spot on siliqua

In both the crop season the highest percentage of infected siliqua and spot number per siliqua were recorded from the plots sown on 21 November followed by 11 November, 1 November, and 21 October. Difference in both the parameter recorded from the plants sown on different dates were significant (Table 2).

Table 1. Interaction effect of sowing dates and varieties caused by *Alternaria brassica* on incidence of *Alternaria* leaf blight of mustard.

Group	Sowing dates and varieties	% Leaf area diseased		% Leaf infection	
		2005-06	2006-07	2005-06	2006-07
1st sowing (D_1)					
B. campestris	$D_1 \times V_1$	21.36h	20.36g	22.59h-l	25.34g-l
	$D_1 \times V_2$	18.21ij	16.04h	27.97fg	32.46ef
	$D_1 \times V_3$	24.47g	20.14g	24.52g-j	27.94fgh
B. napus	$D_1 \times V_4$	7.63lm	6.58k-n	18.07m-q	21.61k-n
	$D_1 \times V_5$	6.50mn	5.29mn	16.89opq	19.98mno
	$D_1 \times V_6$	6.43mn	5.74lmn	17.55n-q	20.89l-o
B. juncea	$D_1 \times V_7$	7.93lm	6.85k-n	11.92rst	14.93pq
	$D_1 \times V_8$	4.23o	2.62o	6.61u	9.61r
2nd sowing (D_2)					
B. campestris	$D_2 \times V_1$	23.98g	22.44ef	24.23g-j	27.66f-i
	$D_2 \times V_2$	20.15hi	20.80fg	32.37de	35.86de
	$D_2 \times V_3$	27.20ef	24.12de	29.05ef	31.98ef
B. napus	$D_2 \times V_4$	8.32lm	7.83kl	22.23h-m	25.65g-l
	$D_2 \times V_5$	8.47lm	6.78k-n	18.76l-p	22.01j-n
	$D_2 \times V_6$	9.15l	7.62kl	19.66k-o	22.89i-n
B. juncea	$D_2 \times V_7$	9.19l	7.21klm	13.77qrs	16.69opq
	$D_2 \times V_8$	5.03no	4.70n	9.15tu	12.71qr
3rd sowing (D_3)					
B. campestris	$D_3 \times V_1$	25.25fg	24.53d	26.32fgh	28.66fgh
	$D_3 \times V_2$	29.02de	25.86cd	34.08d	37.32d
	$D_3 \times V_3$	29.98d	27.64c	34.39d	37.94d
B. napus	$D_3 \times V_4$	12.51k	10.98i	23.63g-k	26.33g-k
	$D_3 \times V_5$	12.62k	10.08ij	21.57i-n	24.79m
	$D_3 \times V_6$	14.02k	10.25ij	20.63j-o	23.71n
B. juncea	$D_3 \times V_7$	12.73k	8.38jk	14.17qrs	17.50nop
	$D_3 \times V_8$	6.71mn	5.0mn	10.05stu	13.20pqr
4th sowing (D_4)					
B. campestris	$D_4 \times V_1$	32.60c	26.76c	39.17c	42.83c
	$D_4 \times V_2$	46.90a	34.54a	57.83a	61.98a
	$D_4 \times V_3$	34.87b	30.77b	45.70b	49.33b

Table 1. Cont'd.

Group	Sowing dates and varieties	% Leaf area diseased		% Leaf infection	
		2005-06	2006-07	2005-06	2006-07
B. napus	D_4 x V_4	14.13k	11.22i	25.01f-j	28.07fgh
	D_4 x V_5	13.85k	11.10i	22.97h-l	26.76g-j
	D_4 x V_6	16.33j	15.65h	25.92f-i	29.25fg
	D_4 x V_7	13.37k	12.24i	18.96l-p	22.14j-m
B. juncea	D_4 x V_8	7.63lm	6.31k-n	14.68pqr	17.68nop
CV (%)		7.30	8.41	10.09	9.60
SE (±)		0.699	0.693	1.366	1.491

Means within a column followed by same letter(s) are not significantly different at 5% level by DMRT.

V_1 = BARI Sarisha 6, V_2 = BARI Sarisha 9, V_3 = BARI Sarisha 12, V_4 = BARI Sarisha 7, V_5 = BARI Sarisha 8, V_6 = BARI Sarisha 13, V_7 = BARI Sarisha 10, V_8 = BARI Sarisha 11.

Table 2. Effect of sowing dates on incidence of *Alternaria* blight *(Alternaria brassicae)* and seed yield of mustard.

Sowing dates	% Siliqua infection		Spots/siliqua (no.)		Seed yield (kg/ha)	
	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
21 October	13.05d	13.83d	5.82d	5.98d	1728b	1586a
1 November	16.96 c	17.80c	7.24c	7.38c	1832a	1621a
11 November	32.86b	32.83b	9.82b	10.14b	1353c	1321b
21 November	40.71a	40.66a	14.36a	16.00a	913d	838c
CV (%)	8.81	11.16	4.00	3.73	7.29	6.56

Means within a column followed by same letter(s) are not significantly different at 5% level by DMRT.

Effect of variety on severity of *Alternaria* spot on siliqua.

In both the years of experimentation, the maximum siliqua infection as well as spot number per siliqua were found on variety BARI Sarisha 12 followed by BARI Sarisha 9 and BARI Sarisha 6. The incidence of the diseases on theses varieties were significantly different and higher compared to other varieties. Significantly the lowest siliqua infection and spot number per siliqua were found on BARI Sarisha 11 followed BARI Sarisha 10 under *Brassica juncea*. The incidence of the disease on siliqua of varieties under *B napus* was intermediate (Table 3).

Interaction effect of sowing date and variety on severity of *Alternaria* spot on siliqua

In case of percentage of siliqua infection and spots/siliqua, the interaction effects of variety and sowing date were significant (Table 4). It was observed that BARI Sarisha 11 sown on 21 October produced significantly lower percent of siliqua infection and spots/siliqua than all other treatments. The maximum % siliqua infection and spots/siliqua were recorded in D_4 x V_3 flowed by D_4 x V_2, and D_4 x V_1 treatments.

Effect of sowing date, variety and their interaction on seed yield

Seed yield of mustard was greatly influenced by sowing dates. The seed yield obtained from 1 November and 21 October sowing was similar but significantly higher compared to other two sowing dates. Significantly the lowest seed yield was obtained from 21 November sowing followed by 11 November sowing. This was probably due to high temperature prevailed at reproductive stage and higher incidence of *Alternaria* blight (Table 2).

The varieties exhibited remarkable influence on the seed yield of mustard in both the years. The *B. juncea* variety BARI Sarisha 11 gave significantly the highest seed yield. The second highest seed yield was obtained from BARI Sarisha 10 which was statistically similar to BARI Sarisha 8. The lowest yield was obtained from BARI Sarisha 9 followed by BARI Sarisha 12. Nevertheless, the *B. juncea* varieties gave higher seed yield compared to the other groups/varieties. The differences in seed yield among the genotypes might be due to their genetic potentiality (Table 3).

Table 3. Effect of varieties on the incidence of *Alternaria* blight *(Alternaria brassicae)* and seed yield of mustard.

Group	Varieties	% Siliqua infection		Spots/siliqua (no.)		Seed yield (kg/ha)	
		2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
B.campestris	BARI Sarisha 6	36.44c	37.30c	13.04c	1353c	1445b	1268cd
	BARI Sarisha 9	50.41b	50.09b	13.64b	14.44b	1284c	1107e
	BARI Sarisha 12	57.73a	58.10a	14..09a	14.87a	1275c	1197d
B. napus	BARI Sarisha 7	11.41f	11.83e	7.91d	8.27d	1358c	1350c
	BARI Sarisha 8	12.87ef	13.52de	7.51e	7.75e	1468b	1423bc
	BARI Sarisha 13	14.52de	15.03d	7.29e	7.96e	1457b	1359c
B. juncea	BARI Sarisha 10	15.58d	15.65d	6.80f	7.21f	1532b	1440b
	BARI Sarisha 11	8.20g	8.71f	4.25g	4.77g	1832a	1587a
CV (%)		8.81	11.16	4.00	3.73	7.29	6.56

Means within a column followed by same letter(s) are not significantly different at 5% level by DMRT.

Seed yield was significantly influenced by the interaction effect of sowing dates and varieties in both crop seasons. The highest seed yield obtained when BARI Sarisha 11 was sown in 1 November. Seed yield of BARI Sarisha 11 was statistically similar to those of BARI Sarisha 10 and BARI Sarisha 8 (V_5 x D_2) under the same sowing date. Seed yield of BARI Sarisha 11 and BARI Sarisha 10 gradually reduced after 1 November sowing. Similar trends were also found in BARI Sarisha 6, 7, 8, 9, 12 and 13. However, BARI Sarisha 11 and 10 gave higher seed yields under both late and early sowing conditions (Table 4).

Table 4. Interaction effect of sowing dates and varieties on the incidence of *Alternaria* spot (*Alternaria* brassicae) on siliqua and seed yield of mustard.

Group	Sowing dates and varieties	% Siliqa infection		Spots/siliqua (no.)		Seed yield (kg/ha)	
		2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
1st sowing (D_1)							
	D_1 x V_1	17.21hi	18.28ghi	7.37 jk	7.47 kl	1663ef	1441g-j
B. campestris	D_1 x V_2	26.98g	29.28f	7.92 j	8.13 ij	1559fg	1419hij
	D_1 x V_3	31.11ef	32.64ef	8.00 j	8.47 i	1411gh	1470e-j
	D_1 x V_4	6.18lm	6.48mn	5.21 no	5.32 pqr	1651ef	1590c-g
B. napus	D_1 x V_5	11.40jk	11.10klm	5.06 no	5.12 r	1729c-f	1648bcd
	D_1 x V_6	6.09lm	6.57mn	5.05 no	5.15 r	1878cd	1655bcd
	D_1 x V_7	11.40jk	11.10klm	4.96 o	5.17 r	1736c-f	1630b-e
B. juncea	D_1 x V_8	3.56m	3.92n	2.96 q	3.03 t	2199b	1837a
2nd sowing (D_2)							
	D_2 x V_1	18.52h	20.52gh	9.10 i	9.32 h	1746c-f	1500d-i
B. campestris	D_2 x V_2	27.99fg	29.66f	10.13 h	10.31 g	1574efg	1463f-j
	D_2 x V_3	40.58d	42.02d	11.00 g	11.21 f	1688def	1463b-j
	D_2 x V_4	9.84jkl	9.22lmn	6.23 l	6.28 no	1697def	1635b-e
B. napus	D_2 x V_5	12.21jk	13.16i-m	5.90 lm	5.95 op	1915c	1759ab
	D_2 x V_6	8.56kl	8.82lmn	5.92 lm	6.01 o	1870cd	1580c-h
	D_2 x V_7	11.77jk	12.50jkl	5.69l mn	5.83 opq	1770cde	1709abc
B. juncea	D_2 x V_8	3.80m	4.33n	3.92 p	4.13 s	2292a	1857a
3rd sowing (D_3)							
	D_3 x V_1	34.28e	37.40de	14.79 d	15.21 d	1407gh	1315j
B. campestris	D_3 x V_2	71.79c	67.57c	15.21 cd	15.63 cd	1233hij	963klm
	D_3 x V_3	78.70ab	75.67b	15.47 c	15.99 c	1200ij	1055k
	D_3 x V_4	13.72ij	13.90i-l	7.48 jk	7.79 jk	1201ij	1350ij
B. napus	D_3 x V_5	16.44hi	15.89h-k	7.13 k	7.19 klm	1289hi	1389ij
	D_3 x V_6	18.76h	19.64gh	7.09 k	7.16 klm	1211ij	1371ij
	D_3 x V_7	18.84h	17.01g-j	6.86 k	6.99 lm	1633ef	1501d-i
B. juncea	D_3 x V_8	8.81kl	9.14lmn	4.73 o	5.21 qr	1648ef	1622b-f

Table 4. Cont'd.

Group	Sowing dates and varieties	% Siliqa infection		Spots/siliqua (no.)		Seed yield (kg/ha)	
		2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
4th sowing (D_4)							
	D_4 x V_1	75.15bc	73.0b	20.92 b	22.19 b	963klm	816m
B. campestris	D_4 x V_2	75.74b	73.83b	21.31 ab	23.68 a	770m	585m
	D_4 x V_3	80.53a	82.07a	21.90 a	23.82 a	800lm	801m
	D_4 x V_4	18.28h	19.88gh	12.72 e	13.69 e	882lm	825m
B. napus	D_4 x V_5	18.57h	20.56gh	11.93 f	13.48 e	941klm	894lm
	D_4 x V_6	27.19fg	27.73f	11.08 g	13.51 e	870lm	830m
	D_4 x V_7	20.32h	21.99g	9.67 hi	10.86 fg	990kl	920klm
B. juncea	D_4 x V_8	11.68jk	12.62jkl	5.39 mno	6.71 mn	1089jk	1033kl
CV (%)		8.81	11.16	4.0	3.73	7.29	6.56

Means within a column followed by same letter(s) are not significantly different at 5% level by DMRT

V_1 = BARI Sarisha 6, V_2 = BARI Sarisha 9, V_3 = BARI Sarisha 12, V_4 = BARI Sarisha 7, V_5 = BARI Sarisha 8, V_6 = BARI Sarisha 13, V_7 = BARI Sarisha 10, V_8 = BARI Sarisha 11.

Results of the present study demonstrated that the severity of *Alternaria* leaf blight was the minimum when the crop was sown on 21 October, which was followed by 1 November sowing. Severity of the disease was the highest in crop sown on 21 November. It indicated that the disease severity increased gradually with delay in sowing. The findings were in agreement with the reports of Rashid *et al.* (1995), Meah (1992), Mian and Akanda (1989), Howlider *et al.* (1989), Rahman and Shahjahan (1986) who also found that mustard sown in October or before 2 November had lower infections from *A. brassicae* and the infection increased with delay in sowing.

Generally, higher infection was observed when the crop was sown later than October and this might be attributed largely to weather factors. *Alternaria brassicae* needs soil and leaf wetness for 6 to 9 hours at 10°C and a low temperature of <20°C for infection (Mridha and Wheeler, 1992). In Bangladesh, these conditions prevail during the period from mid November to the mid December. When the crop is sown at the end of October, siliqua formation starts from the end of November and siliqua formation is completed within middle of December which can escape heavy infection. On the other hand, crops sown later than first week of November lead to heavy infection of *A. brassicae* in the middle of December when siliqua formation starts. This situation advocates sowing of mustard crop by first week of November in Bangladesh. These findings are in agreement with the findings of Rashid *et al.* (1995).

Disease severity of mustard was also affected by varieties showing that BARI Sarisha 12 had the highest % leaf area diseased, % siliqua infection, and spots/siliqua. On the other hand, BARI Sarisha 9 had the highest % leaf infection. Significantly lower diseased severity was recorded in BARI Sarisha 11 than all other varieties. BARI Sarisha 11 showed the minimum % leaf infection, % leaf area diseased, % siliqua infection, and spots/siliqua. *Brassica* spp. varied greatly with respect to disease severity. Disease severity was comparatively minimum in BARI Sarisha 11 which indicated that *B. campestris* group was the most susceptible followed by *B. napus* and *B. juncea*. The findings corroborates with the results of Singh and Bhowmik (1985) who reported that plants of *B. campestris* (Yellow Sarson) are in general more susceptible to *Alternaria brassicae* than those of *B. juncea* because of the presence of thick waxy coating on the epidermal layer of the plants of *B. juncea.* That is why the varieties belonging to *Brassica juncea* group like BARI Sarisha 11 had less infection than *B. campestris* varieties such as BARI Sarisha 6, BARI Sarisha 9 and BARI Sarisha 12.

Disease severity and seed yield were significantly influenced by the interaction effect of sowing dates and varieties. Early sown crop of BARI Sarisha 11 showed less disease severity and gave higher yield than any other treatment combinations. BARI Sarisha 11 was also affected by *Alternaria* blight in different sowing date and gave higher yield. This result supported the findings of Khatun and Hossain (2007) who evaluated the variety BARI Sarisha 11 as resistant to *Alternaria*. Meah (1992) showed 80% reduction in *Alternaria* blight severity and 50% increasing yield when variety Sampad/BINA-3 was sown between 18 October and 2 November. Under the late sowing condition (21 November) BARI Sarisha 11 performed better than all other varieties.

From the results of two consecutive years, it may be concluded that 1 November sowing is suitable followed by 21 October sowing for increasing seed yield of mustard in Jessore region. Among the varieties BARI Sarisha 11 is high yielder followed by BARI Sarisha 10, BARI Sarisha 8, and BARI Sarisha 13.

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