



## Efficacy of Amistar in Controlling *Alternaria* Blight and Yield of Mustard Variety Rai-5

I. Hossain\*, M. A. Akter and M. B. Anwar

Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

\*Corresponding author: dhossain69@gmail.com

### Abstract

The effect of Amistar in controlling *Alternaria* blight of mustard was investigated and the selected mustard variety Rai-5 was used. Amistar @ 0.05% (1 spray), 0.05% (2 spray), 0.05% (3 spray), 0.1% (1 spray), 0.1% (2 spray) and 0.1% (3 spray) were sprayed at 14 days interval beginning from 40 days after sowing (DAS). Amistar resulted significant reduction of the disease *Alternaria* blight (*Alternaria brassicae* and *Alternaria brassicicola*) severity and increased seed yield. Out of the doses of Amistar used, 0.1% (3 spray) showed marked effect in reducing the disease over control in terms of reduction of % *Alternaria* blight incidence, % leaf infection and % leaf area diseased up to 90.72%, 90.42% and 98.17%, respectively as well as reduction of % siliqua infection and % area of siliqua diseased up to 96.17% and 98.80%, respectively and thus increased seed yield up to 56.47% over control.

**Key words:** *Alternaria* blight, Amistar, Mustard, Yield

### 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). Many factors are associated with the poor yield of mustard in Bangladesh. Diseases have been identified as one of the major factors (Ahmed, 1992). Mustard suffers from at least 10 diseases in Bangladesh (Meah *et al.*, 1985). *Alternaria* blight of mustard has been recognized as the most serious and devastating disease in this country (Khatun *et al.*, 2011); this disease causes an average yield loss of 30-60% in Bangladesh (Meah *et al.*, 1988). It can some extent be managed through the use of fungicides (Meah *et al.* 1988, Howlider *et al.* 1985). Multifarious efforts have been made worldwide to control the disease. There is no information available on the resistance source although some sort of tolerance to the disease has been reported (Rai *et al.*, 1976). Chemicals have been successfully used in controlling the diseases (Meah *et al.*, 1988; Howlider *et al.*, 1985 and Kolte and Tewari, 1978). Amistar (azoxystrobin) is a class of fungicide having favorable environment profile and novel mode of action leading to a high efficacy against all major groups of plant pathogens under Ascomycetes, Basidiomycetes, Deuteromycetes and Oomycetes (Godet *et al.*, 1997). Amistar has been reported to control fungal and bacterial infection in cabbage (Robak, 1998), oilseed rape (Weber and Karolewski, 2000), barley and cucumber (Timmer, 1999; Robak and Sobolewski, 1997) and in rice and chilli (Firoz and Hossain, 2000 and Rahman, 2002). As

Amistar have wide range of fungicidal action, therefore, the present research work was designed to achieve the following objectives: To find out the efficacy of Amistar in controlling *Alternaria* blight of mustard and to determine the effect of Amistar on yield of mustard.

### Materials and Methods

The experiments were carried out in the Field Laboratory as well as in the Laboratory of Plant Pathology and Seed Pathology Center (SPC), Bangladesh Agricultural University (BAU), Mymensingh. The experiments were carried out from November 2004 to April 2005. Seeds of mustard (*Brassica campestris*) variety Rai-5 were collected from Department of Genetics and Plant Breeding Bangladesh Agricultural University, Mymensingh. The experiment was in Completely Randomized Block Design (RCBD) with three replications. Amistar (azoxystrobin), a fungicide used in the experiment. The treatments were used in the experiment were T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray) T<sub>5</sub> = 0.1% (Single spray) T<sub>6</sub> = 0.1% (Double spray) T<sub>7</sub> = 0.1% (Triple spray). Data were collected on the following parameters: i) Plant infection (%), ii) Leaf infection (%), iii) Leaf area diseased (%), iv) Siliqua infection (%), v) Area of siliqua diseased (%), vi) Plant height (cm), vii) Number of branches/plant, viii) Total number of seeds/plant, ix) Weight of seeds/plant (g), x) Weight of seeds/plot (g) and xi) Seed yield/ha (t). Data on the first eight parameters were recorded before harvest. Progress in plant infection, leaf infection and leaf area diseased were monitored at 45 DAS, 60 DAS,

and 75 DAS. Total siliqua infection and area of siliqua diseased were recorded at 70 DAS, 77 DAS, and 84 DAS. Plant height (cm) and number of branches per plant were recorded at 90 DAS.

**Results and Discussion**

The crop was infected by *Alternaria* blight (*Alternaria brassicae* and *Alternaria brassicicola*) under natural condition (Fig. 4). Characteristics ring spots of the disease first appeared mostly on the older leaves at 40 days after sowing. Gradually, whole leaf area became covered with spots and the leaves turned yellow, blighted and defoliation occurred. Stem infection was characterized by elongated dark brown lesions. Later on, the siliqua was infected showing round to irregular dark brown spots. The cause of the *Alternaria* blight of mustard was identified as *Alternaria brassicae* (Beak.) Sacc. And *Alternaria brassicicola* (Schw.) Wiltshire. The fungi were identified by studying the morphological characters (Mathur and Kongsdal, 1994). The conidia of *A. brassicae* is straight, obclavate, rostrate with transverse and longitudinal of oblique septa, pale or grayish olive, smooth, long beak about 1/3 to 1/2 the length of the conidium. The conidia of *A. brassicicola* is straight, cylindrical (conical) usually tapering slightly towards the apex, basal cell rounded, mostly with transverse septa, pale to dark olivaceous brown and beak not visible or absent. The effect of Amistar on disease incidence (%) of mustard variety Rai-5 was determined at 45, 60, 75 days after sowing (DAS). Data regarding the effect of

Amistar of the incidence of *Alternaria* blight of mustard are presented in Table 1. Amistar showed significant influence on *Alternaria* blight incidence (%) at different days after sowing. The disease incidence (%) varied from 9.16% to 98.75% under different treatments, where the highest disease incidence was found in control plot (T1) and the lowest disease incidence was found in the plot treated with Amistar 0.1% (3 spray) which was statistically similar to Amistar 0.05% (3 spray) and Amistar 0.1% (2 spray) at 75 DAS. Different concentration of Amistar spray resulted profound effect in reducing % leaf infection as shown in Table 2. Amistar showed significant influence on % leaf infection at different days after sowing. % leaf infection was significantly different among the treatments. Percent leaf infection ranged from 6.76 to 70.53, where the maximum % leaf infection was found in control plot (T1) and the minimum % leaf infection was found in the plot treated with Amistar 0.1% (3 spray) at 75 DAS. Percent leaf area diseased was found significantly different in different days after sowing, except 45 DAS. At 45 DAS, % leaf area diseased ranged from 1.70 to 1.74 which was not significantly different from one to another (Table 3). At 75 DAS, the highest % leaf area diseased was found in control plot (Ti) at 60 DAS and the lowest % leaf area diseased was found in the plot treated with Amistar 0.1% (3 spray) which was statistically similar to Amistar 0.1% (2 spray) and Amistar 0.05% (3 spray) at 75 DAS.

**Table 1.** Effect of Amistar on disease incidence (%) of mustard variety Rai-5 at different days after sowing (DAS)

Treatments	Disease incidence (%)		
	45 DAS	60 DAS	75 DAS
T <sub>1</sub> = Control	24.37a	82.48a	98.75a
T <sub>2</sub> = Amistar 0.05% (1 spray)	24.32a	23.33b	40.92b
T <sub>3</sub> = Amistar 0.05% (2 spray)	22.44ab	19.11bc	24.85c
T <sub>4</sub> = Amistar 0.05% (3 spray)	21.12ab	15.81bcd	12.30d
T <sub>5</sub> = Amistar 0.1% (1 spray)	20.97b	18.34bcd	24.15c
T <sub>6</sub> = Amistar 0.1% (2 spray)	16.32c	11.41cd	9.77d
T <sub>7</sub> = Amistar 0.1% (3 spray)	16.26c	11.21d	9.16d
LSD (P> 0.05)	3.077	7.168	3.735

DAS= Days after sowing

T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray), T<sub>5</sub> = 0.1% (Single spray), T<sub>6</sub> = 0.1% (Double spray), T<sub>7</sub> = 0.1% (Triple spray).

**Table 2.** Effect of Amistar on % leaf infection of mustard variety Rai- 5 at different days after sowing (DAS)

Treatments	% leaf infection		
	45 DAS	60 DAS	75 DAS
T <sub>1</sub> = Control	26.97a	47.20a	70.53a
T <sub>2</sub> = Amistar 0.05% (1 spray)	20.70bcd	15.03bc	31.45c
T <sub>3</sub> = Amistar 0.05% (2 spray)	22.82abc	13.17cd	27.71d
T <sub>4</sub> = Amistar 0.05% ( 3 spray)	18.94cd	13.58bc	12.29e
T <sub>5</sub> = Amistar 0.1% ( 1 spray)	25.50a	16.93b	42.28b
T <sub>6</sub> = Amistar 0.1% (2 spray)	24.01 ab	12.40cd	9.76e
T <sub>7</sub> = Amistar 0.1% (3 spray)	18.47d	9.92d	6.76 f
LSD (P> 0.05)	3.979	3.383	2.942

DAS= Days after sowing

T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray), T<sub>5</sub> = 0.1% (Single spray), T<sub>6</sub> = 0.1% (Double spray), T<sub>7</sub> = 0.1% (Triple spray).

**Table 3.** Effect of Amistar on % leaf area diseased of mustard variety Rai-5 at different days after sowing (DAS)

Treatments	% leaf area diseased		
	45 DAS	60 DAS	75 DAS
T <sub>1</sub> = Control	1.70	12.97a	11.49a
T <sub>2</sub> = Amistar 0.05% (1 spray)	1.57	1.53b	2.66b
T <sub>3</sub> = Amistar 0.05% (2 spray)	1.59	0.39c	1.30d
T <sub>4</sub> = Amistar 0.05% ( 3 spray)	1.50	0.47c	0.42e
T <sub>5</sub> = Amistar 0.1% ( 1 spray)	1.82	1.68b	2.00c
T <sub>6</sub> = Amistar 0.1% (2 spray)	1.77	0.51c	0.27e
T <sub>7</sub> = Amistar 0.1% (3 spray)	1.74	0.39c	0.21e
LSD (P> 0.05)	NS	0.718	0.252

DAS= Days after sowing NS= Not significant

T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray), T<sub>5</sub> = 0.1% (Single spray), T<sub>6</sub> = 0.1% (Double spray), T<sub>7</sub> = 0.1% (Triple spray).

The effects of different doses of Amistar on % siliqua infection of mustard variety Rai-5 is given in Table 4. Wide variations in % siliqua infection were observed amongst the different treatments of Amistar and the variations were found to be statistically significant. % siliqua infection ranged from 2.44 to 63.67, where the highest % siliqua infection was found in control plot (T<sub>1</sub>) at 84 DAS, and the lowest % siliqua infection was found in the plot treated with Amistar 0.1% (3 spray) which was statistically similar to Amistar 0.1% (2 spray). The effect of Amistar on % area of siliqua diseased of mustard variety Rai-5 at 70, 77 and 84 days after sowing (DAS) are presented in Table 5. Percent area of siliqua diseased was significantly different in different days after sowing. At 84 DAS, significantly highest % area of siliqua diseased was found in control plot (T<sub>1</sub>) and the lowest % area of siliqua diseased was recorded in the plot treated with Amistar 0.1% (3

spray) which was statistically similar to Amistar 0.05% (1 spray), Amistar 0.05% (3 spray), Amistar 0.1% (1 spray) and Amistar 0.1% (2 spray) at 70 DAS. The effect of Amistar on plant height, number of branches/plant and number of seeds/plant of mustard variety Rai-5 infected with *Alternaria* blight was recorded and results are shown in Table 6. Respective plant height of Amistar treated plants under field conditions varied from 107.30 cm to 120.00 cm. The maximum plant height was found the plot treated with Amistar 0.1% (3 spray) and the minimum height was found in control plot (T<sub>1</sub>). The number of branches/plant varied from 2.33 cm to 3.95 cm, where the maximum number of branches/plant was recorded in the plot treated with Amistar 0.1% (3 spray) which was statistically similar to Amistar 0.1% (2 spray) and the minimum number of branches/plant was recorded in the control plot (T<sub>1</sub>). The number of seeds/plant

ranged from 520.00 to 985.10, where the maximum number of seeds/plant was found in the plots treated with Amistar 0.1% (3 spray) and the minimum number of seeds/plant was recorded in the control plot (T<sub>1</sub>). The effect of Amistar on weight of seeds/plant, weight of seeds/plot and seed yield/ha of mustard variety Rai-5 was recorded and the results are presented in Table 7. Amistar spraying resulted significant effect on the yield of Rai-5. Weight of seeds/plant under different treatments ranged from 1.13g to 2.35g, where the highest seed weight was obtained in the plot treated with Amistar 0.1 % (3 spray) and the lowest seed

weight was found in the control plot (T<sub>1</sub>). Weight of seeds/plot under different treatments ranged from 340.30g to 530.40g, while the maximum weight of seeds/plot was obtained from Amistar 0.1% (3 spray) and the minimum weight of seeds/plot recorded in the control plot (T<sub>1</sub>). Seed yield/ha under different treatments ranged from 0.85t to 1.33t, while the significantly highest seed yield/ha was obtained from the plots that received Amistar 0.1% (3 spray) and the lowest seed yield/ha obtained from the control plot (T<sub>1</sub>). Application of Amistar resulted an increase of up to 56.47% seed yield over the untreated control.

**Table 4.** Effect of Amistar on % siliqua infection of mustard variety Rai-5 at different days after sowing (DAS)

Treatments	% siliqua infection		
	70 DAS	77 DAS	84 DAS
T <sub>1</sub> = Control	15.59a	30.01a	63.67a
T <sub>2</sub> = Amistar 0.05% (1 spray)	2.89bc	6.97b	22.44b
T <sub>3</sub> = Amistar 0.05% (2 spray)	3.42b	4.01d	6.96c
T <sub>4</sub> = Amistar 0.05% (3 spray)	2.11de	2.46e	3.80d
T <sub>5</sub> = Amistar 0.1% (1 spray)	2.34cd	5.20c	21.13b
T <sub>6</sub> = Amistar 0.1% (2 spray)	1.54ef	1.87e	3.04d
T <sub>7</sub> = Amistar 0.1% (3 spray)	<b>1.14f</b>	1.53e	2.44d
LSD (P> 0.05)	0.626	0.998	1.805

DAS= Days after sowing

T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray), T<sub>5</sub> = 0.1% (Single spray), T<sub>6</sub> = 0.1% (Double spray), T<sub>7</sub> = 0.1% (Triple spray).

**Table 5.** Effect of Amistar on % area of siliqua diseased of mustard variety Rai-5 at different days after sowing (DAS)

Treatments	% area of siliqua diseased		
	70 DAS	77 DAS	84 DAS
T <sub>1</sub> = Control	0.16b	0.38a	1.67a
T <sub>2</sub> = Amistar 0.05% (1 spray)	0.023c	0.08b	0.40b
T <sub>3</sub> = Amistar 0.05% (2 spray)	0.22a	0.04cd	0.35b
T <sub>4</sub> = Amistar 0.05% (3 spray)	0.02c	0.03dc	0.05c
T <sub>5</sub> = Amistar 0.1% (1 spray)	0.02c	0.06c	0.39b
T <sub>6</sub> = Amistar 0.1% (2 spray)	0.02c	0.02e	0.04c
T <sub>7</sub> = Amistar 0.1% (3 spray)	0.01c	0.02e	0.02c
LSD (P> 0.05)	0.01779	0.01779	0.1949

DAS= Days after sowing

T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray), T<sub>5</sub> = 0.1% (Single spray), T<sub>6</sub> = 0.1% (Double spray), T<sub>7</sub> = 0.1% (Triple spray).

**Table 6.** Effect of Amistar on plant height (cm), number of branches/ plant and number of seeds/plant of mustard variety Rai-5 infected with *Alternaria* blight

Treatments	Plant height (cm)	Number of branches/plant	Number of seeds/plant
T <sub>1</sub> = Control	107.30c	2.33c	520.00g
T <sub>2</sub> = Amistar 0.05% (1 spray)	111.70bc	2.98ab	545.00f
T <sub>3</sub> = Amistar 0.05% (2 spray)	112.10bc	2.99ab	583.00e
T <sub>4</sub> = Amistar 0.05% (3 spray)	114.406	3.60ab	798.20c

T <sub>5</sub> = Amistar 0.1% (1 spray)	113.90b	2.70bc	611.50d
T <sub>6</sub> = Amistar 0.1% (2 spray)	117.00ab	3.80a	897.806
T <sub>7</sub> = Amistar 0.1% (3 spray)	120.00a	3.95a	985.10a
LSD (p?_ 0.05)	5.357	0.252	16.13

DAS= Days after sowing

T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray), T<sub>5</sub> = 0.1% (Single spray), T<sub>6</sub> = 0.1% (Double spray), T<sub>7</sub> = 0.1% (Triple spray).

**Table 7.** Effect of Amistar on weight of seeds/plant (g), weight of seeds/plot (g) and seed yield (t/ha) of mustard variety Rai-5

Treatments	Weight of seeds/plant (g)	Weight of seeds/plot (g)	Seed yield (t/ha)
T <sub>1</sub> = Control	1.13e	340.30e	0.85e
T <sub>2</sub> = Amistar 0.05% (1	1.23de	390.20d	0.97d (+14.12)
T <sub>3</sub> = Amistar 0.05% (2	1.51c	439.60c	1.10c (+29.41)
T <sub>4</sub> = Amistar 0.05% (3	1.96b	470.50b	1.18b(+38.82)
T <sub>5</sub> = Amistar 0.1% (1	1.44cd	402.40d	1.01d(+18.82)
T <sub>6</sub> = Amistar 0.1% (2	2.026	480.00b	1.20b(+41.18)
T <sub>7</sub> = Amistar 0.1% (3	2.35a	530.40a	1.33a(+56.47)
LSD (13? 0.05)	0.2516	13.69	0.0563

(+) = Percent yield increase over control

T<sub>1</sub> = Control (untreated), T<sub>2</sub> = 0.05% (Single spray), T<sub>3</sub> = 0.05% (Double spray), T<sub>4</sub> = 0.05% (Triple spray), T<sub>5</sub> = 0.1% (Single spray), T<sub>6</sub> = 0.1% (Double spray), T<sub>7</sub> = 0.1% (Triple spray).

Altogether six spray doses and frequency were used such as: Amistar @ 0.05% (1 spray), Amistar @ 0.05% (2 spray), Amistar @ 0.05% (3 spray), Amistar @ 0.1% (1 spray), Amistar @ 0.1% (2 spray) and Amistar @ 0.1% (3 spray). From the results it was observed that Amistar 0.1% (3 spray) was more effective in reducing the incidence of leaf infection compared to the untreated control plants. Amistar 0.1% (3 spray) was better in reducing the disease compared to other treatments with the increasing age of the plants in the variety Rai-5. Amistar 0.05% (3 spray) was also effective but its effect was not as good as Amistar 0.1% (3 spray). At 75 DAS, remarkable effect was recorded with Amistar 0.1% (3 spray) on reduction of disease incidence and severity over control. This is in accordance with the findings of Weber and Karolewski (2002). They reported that in Autumn application of Amistar 250 SC on oil seed rape cultivars (Mar and Siliva) at 4-6 leaf stage and flowering stage resulted often more efficiently control of light blight spot on Mat, while Mejia and Hernandez (2001) supported that azoxystrobin at 100 and 200g ai/ha gave only 3 to 5 % disease incidence in leaves. Sidlauskiene *et al.* (2003) investigated the effects of different methods of controlling *Alternaria* leaf spot (*Alternaria* spp.) in

cabbage, tomato and cucumber and reported that Amistar was the most effective among the fungicides which reduced disease incidence by 88.3-93.3%. Ansari *et al.* (2004) reported that Amistar @ 0.1% (2 spray) showed marked effect in reducing the *Alternaria* blight of mustard over control and increased 43.48% yield over control. Siliquae are important component of yield of mustard. It is fact that infection in siliqua greatly affects seed yield. The results of the present study have revealed that Amistar 0.1% (3 spray) is more effective in reducing the disease intensity on siliqua compared to control plots. Amistar 0.05% (3 spray) was also effective but its effects were not as good as Amistar 0.1% (3 spray). Mejia-Arreaza and Hernandez (2001) compared the efficacy of azoxystrobin with mancozeb and reported that azoxytrobin at 100 and 200 a.i./ha gave 2.5-3% disease incidence in fruits, whereas mancozeb at same rates registered 30 to 57% disease incidence. Though the intensity of siliqua infection was gradually increased with the age of the plants but the effect of Amistar was better to decrease the siliqua infection over control. Minimum disease intensity and maximum seed yields were obtained from Amistar 0.1% (3 spray) treated plants than other treatments which indicate a

tremendous influence of sprays of Amistar over *Alternaria* blight severity and maximizing seed yield. Amistar significantly increased plant height and number of branches/plant of mustard variety Rai-5 than that of control. Amistar 0.1% (3 spray) was found more effective in increasing plant height and branches/plant than any other dose and significantly increased number of seeds/plant. The findings of the present study showed that Amistar has a significant effect on yield of mustard. Amistar resulted an increase in weight of seed/plant, weight of seeds/plot and seed yield/ha of mustard. Amistar 0.1% (3 spray) showed the best effect and increased seed yield by 56.47% over control. This result is strongly supported by Ansari *et al.* (2004). Amistar was found to show positive influence increasing yield which has been reported by Jensen (1999); Hossain (2002); Bayles (2000) and Zahradnicek and Svachula (2002). They reported that this product was highly potential in arresting the pathogenesis of a wide range of fungi including *Alternaria* spp.

#### Conclusions

According to the findings of the present study as well as the published research reports of the other workers it has been confirmed that Amistar has the strong potentiality of controlling *Alternaria* blight of mustard with subsequent increase of yield. Amistar can successfully be used for controlling *Alternaria* blight of mustard in Bangladesh.

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