



## Effect of Plant Extracts and Fungicides on the Severity of *Alternaria* Blight of Mustard

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### Abstract

A study was carried out during the rabi season of 2006-07 and 2007-08 at Regional Agricultural Research Station (RARS), Jessore, Bangladesh. Seven different plant extracts viz. neem leaf boil water, neem leaf, onion bulb, garlic bulb, ginger rhizome, alamonda leaf, dholkalmi leaf, and nine fungicides namely, Rovral 50 WP, Dithane M-45, Bavistin, Ridomil Gold, Indofil M-45, Tilt 250 EC, Kencozeb M-45, Supervit 80 WDG and Mine 50 WP were evaluated as foliar spray to find out their efficacy in controlling *Alternaria* blight of mustard. All the plant extracts and fungicides significantly reduced the disease severity and produced higher 1000-seed weight, seeds siliqua<sup>-1</sup> and seed yield over control. Application of Rovral gave the highest seed yield (1361 kg ha<sup>-1</sup>) and reduced maximum disease severity. The results of the present study indicates that fungicides like Rovral 50 WP, Dithane M-45, Ridomil Gold and Indofil M-45; and neem leaf, garlic bulb and ginger rhizome extracts were found effective as foliar spray to control *Alternaria* blight of mustard.

**Keywords:** *Alternaria* blight, plant extracts, fungicides and mustard.

### INTRODUCTION

Diseases are responsible in reducing the quantity and quality of mustard/rapeseed (Ahmed and Ahmed, 1994). Mustard and rapeseed suffer from 14 diseases in Bangladesh (Bakr *et al.* 2007, Meah 1986). Out of these, nine are fungal, one bacterial, two viral, one nematode and one parasitic higher plant (Hossain and Rahman 2006, Ahmed 1985). *Alternaria* blight caused by *Alternaria brassicae* (Berk) Sacc. has been recognized as the most serious and devastating disease of mustard in Bangladesh (Kaul and Das 1986, Ahmed and Ahmed 1994, Begum *et al.* 1993, Meah *et al.* 1992). This disease causes blight of leaf, pod and stem (Ahmed and Ahmed, 1994) and seed abnormalities (Howlider *et al.* 1991). It is endemic in

Bangladesh and most of the cultivated varieties are susceptible to this disease. It 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). Siliqua of *Brassica* spp. is the main component of seed yield and normal filling of seed takes place if siliqua can be protected from infection (Hossain and Mian 2004). Protection of siliqua from *Alternaria* blight infection should, therefore, be the most important aim for higher yield of mustard.

Crop disease control with fungicide is very much popular because of its quick action, broad spectrum activity and easy availability to the growers. Different fungicides have been used successfully in controlling the *Alternaria* blight of mustard (Bakr *et al.* 2007, Rajendra and Lailu 2006, Yadav *et al.* 2002, Anwar and Khan 2001). But now-a-days people are very conscious about environmental pollution due to excessive and non judicious use of fungicides. Risk of evolving virulent races/biotypes in pathogen population is also likely to be associated with indiscriminate use of various chemical pesticides. Use of plant extracts is, however, a recent and environment friendly approach to plant disease management and it has drawn special attention of the plant pathologists all over the world. Many research results revealed that plant extracts possess antifungal properties and thus having potential to be used against many plant diseases (Meena *et al.* 2004, Kohinoor *et al.* 2003, Miah *et al.* 1990). The present research was undertaken to determine the potentialities of some botanicals and fungicides as foliar spray to reduce *Alternaria* blight incidence of rapeseed.

## MATERIALS AND METHODS

### Used Botanicals and fungicides

The experiment was conducted at Regional Agricultural Research Station (RARS), Jessore, Bangladesh during rabi season of 2006-07 and 2007-08. Seven botanicals namely, neem leaf (*Azadirachta indica*), garlic bulb (*Allium sativum*), onion bulb (*Allium cepa*), ginger rhizome (*Zingiber officinale*), alamonda leaf (*Alamonda cathartica*) and dhol kalmi leaf (*Ipomoea fistulosa*) and nine chemicals, Rovral 50 WP, Dithane M-45, Bavistin 50 WP, Ridomil Gold, Indofil M-45, Tilt 250 EC, Kencozeb M-45, Supervit 80-WDG and Mine 50 WP were used in this experiment. The botanicals and fungicides were sprayed four times at ten days interval beginning from initiation of infection. Plots under control treatment were sprayed with plain water. Fungicides were applied at 0.2% (formulated product) and botanicals at 30% concentration

### Preparation of Extract

To prepare plant extracts the obtained plant parts (leaf, bulb or rhizome) were washed thoroughly in tap water, blended with distilled water in the ratio of 1:1 (w/v) and then filtered through folds of fine cloth to remove particulate matter. The filtrate was mixed with desired amount of tap water to make 30% concentration. The suspension of fungicides was also prepared in tap water @ 0.2% concentration. The experiment was laid out in a

RCBD with three replications. After final preparation of land, the field was divided into 3m x 3m unit plots maintaining a distance of 1m between plots and 2m between the blocks to prevent drifting of spray from plot to plot. Seeds of BARI sarisha 6 were sown on 18 and 20 November in 2007 and 2008, respectively maintaining a spacing of 30 cm between the rows. Every year the crop had received 120 kg N, 30 kg P, 60 kg K, 30 kg S, 2 kg Zn and 1 kg B per hectare. The sources of nutrients were urea, TSP, mop, gypsum, Zinc sulphate and boric acid for N, P, K, S, Zn and B respectively. Intercultural operations viz, weeding, irrigation and insecticide spray were done as and when required. Development of *Alternaria* blight was assessed by recording data (% leaf infection, % leaf area diseased, % siliqua infection and number of spots siliqua<sup>-1</sup>) 3 times during crop growth stage. The crops were harvested at maturity. Data on the yield and yield contributing characters from all plots were recorded. The data were statistically analyzed following the principle of F-statistics and the mean values were separated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez 1984).

## RESULTS

### Percentage of leaf infection and leaf area diseased

The lowest percentage of leaf infection (LI) was recorded with Rovral (T8) followed by neem leaf extract (T2) (Table 1). In the first year, Rovral failed to reduce the percentage of leaf infection significantly compared to neem leaf extract but in the second year it was significantly better. Among the botanicals, the antifungal effect of neem leaf extract, garlic bulb extract and ginger rhizome extract were statistically similar but differed with Rovral (except 2006-07) and were at par with Dithane M-45, Ridomil Gold, Indofil M-45 and Bavistin (Table 1). The % leaf area diseased was significantly reduced due to spray of Rovral (T8) followed by neem leaf extract (T2). Similar effect was also observed in Dithane M-45, garlic bulb extract, ginger rhizome extract, Ridomil Gold, Indofil and Bavistin application but the reduction was significantly lower compared to Rovral and at par with neem leaf extract. Average of two years, the percentage of leaf area diseased ranged from 12.29 to 25.03. All the extracts and fungicides reduced the severity of *Alternaria brassicae* significantly as compared to control. Neem leaf extract, garlic bulb extract and ginger rhizome extract had statistically similar effect on the reduction of leaf area diseased.

Table 1. Effect of botanicals and fungicides on the % leaf infection and leaf area diseased of mustard

Treatment	Name of botanicals and fungicides	% Leaf infection		% Leaf area diseased	
		2006-07	2007-08	2006-07	2007-08
T <sub>1</sub>	Neem leaf boil water	24.90b	27.90bc	17.10b	22.00bcd
T <sub>2</sub>	Neem leaf extract	20.20de	22.40f	13.16cd	17.01e
T <sub>3</sub>	Onion bulb extract	24.99b	27.60bcd	17.22b	22.03bcd
T <sub>4</sub>	Garlic bulb extract	20.60cd	22.73f	14.65bcd	17.17e
T <sub>5</sub>	Ginger rhizome extract	21.70bcd	23.27ef	14.51bcd	18.07e
T <sub>6</sub>	Alamonda leaf extract	25.17b	28.20bc	17.41b	23.32bc
T <sub>7</sub>	Dholkalmi leaf extract	25.0b	27.30b-e	17.36b	23.01bc
T <sub>8</sub>	Rovral 50 WP	17.11e	18.19g	11.82d	12.76f
T <sub>9</sub>	Dithane M-45	21.00cd	23.02f	14.48bcd	17.31e
T <sub>10</sub>	Bavistin	21.92bcd	24.01c-f	15.01bcd	19.01de
T <sub>11</sub>	Ridomil Gold	21.38bcd	23.69def	14.98bcd	18.75de
T <sub>12</sub>	Indofil M-45	21.67bcd	23.72def	14.82bcd	18.08e
T <sub>13</sub>	Tilt 250 EC	23.78bcd	28.03bc	15.13bc	20.13cde
T <sub>14</sub>	Kencozeb M-45	23.99bcd	28.20bc	16.33bc	23.04bc
T <sub>15</sub>	Supervit 80 WDG	24.18bc	28.90b	16.97b	24.32b
T <sub>16</sub>	Mine 50 WP	24.33bc	30.80b	17.02b	24.67b
T <sub>17</sub>	Control	29.72a	35.90a	21.13a	28.92a
CV (%)		9.67	8.69	10.63	9.67

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

### Percentage of Siliqua Infection and Spots Siliqua<sup>-1</sup>

Average of two years, the maximum of 22.76 % siliqua was infected in control treatment (T<sub>17</sub>) (Table 2). Percentage of siliqua infection (SI) was significantly reduced by all the botanicals and fungicides compared to control (Table 2). The lowest percentages of infected siliqua 10.31 and 11.29 (2006-07 and 2007-08, respectively) were recorded in Rovral, which were statistically similar to those of neem leaf extract and garlic bulb extract in the first year but differed in second year. The effectiveness of Dithane M-45, Ridomil Gold, Indofil M-45, and Bavistin in reducing the percentage of siliqua infection was statistically similar to those of Tilt 250 EC and Kencozeb M-45 but significantly differed from control.

The maximum numbers of spots siliqua<sup>-1</sup> 13.63 and 16.30 (2005-06 and 2006-07, respectively) were observed in the control plots, which significantly differ from all other

treatments. The spots siliqua<sup>-1</sup> reduced significantly over all other botanicals and fungicides due to application of Rovral (Table 2). Neem leaf extract also performed better. In the first year, Rovral significantly differ with neem leaf extract but in the second year it was at par. Again garlic bulb extract, ginger rhizome extract, Dithane M-45, Ridomil Gold, Indofil M-45 and Bavistin were statistically similar to neem leaf extract but the number of spots siliqua<sup>-1</sup> was comparatively lower with neem leaf extract treated plots.

Table 2. Effect of botanicals and fungicides on the % siliqua infection and spots siliqua<sup>-1</sup> of mustard

Treatment	Name of botanicals and fungicides	% Siliqua infection		%Spots siliqua <sup>-1</sup> (no.)	
		2006-07	2007-08	2006-07	2007-08
T <sub>1</sub>	Neem leaf boil water	14.76b-e	17.31b-e	10.40c	11.67b
T <sub>2</sub>	Neem leaf extract	12.21fg	14.12f	8.20d	8.90cd
T <sub>3</sub>	Onion bulb extract	14.88bcd	17.69bcd	11.67b	12.80b
T <sub>4</sub>	Garlic bulb extract	12.30fg	14.29ef	8.30d	9.00cd
T <sub>5</sub>	Ginger rhizome extract	12.39f	14.69def	8.67d	9.30c
T <sub>6</sub>	Alamonda leaf extract	14.81b-e	17.88bc	11.00bc	12.40b
T <sub>7</sub>	Dholkalmi leaf extract	14.69b-e	17.65bcd	11.20bc	12.10b
T <sub>8</sub>	Rovral 50 WP	10.31g	11.29g	7.10e	7.70d
T <sub>9</sub>	Dithane M-45	12.62ef	14.72def	8.80d	9.90c
T <sub>10</sub>	Bavistin	13.01c-f	15.51b-f	9.10d	10.10c
T <sub>11</sub>	Ridomil Gold	12.91def	15.01c-f	9.30d	10.30c
T <sub>12</sub>	Indofil M-45	12.81def	15.00c-f	8.70d	9.70c
T <sub>13</sub>	Tilt 250 EC	13.11c-f	16.12b-f	11.40bc	12.30b
T <sub>14</sub>	Kencozeb M-45	13.98b-f	17.13b-f	11.60b	12.70b
T <sub>15</sub>	Supervit 80 WDG	15.13bc	18.32b	12.0b	12.90b
T <sub>16</sub>	Mine 50 WP	15.98b	18.10b	12.0b	13.10b
T <sub>17</sub>	Control	20.21a	25.31a	13.63a	16.30a
CV (%)		8.24	9.69	6.03	7.23

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

### Plant Height and Siliquae Plant<sup>1</sup>

Botanicals and fungicides have no significant effect on plant height (Table 3). However, the maximum plant height (117.5 cm) was recorded in T<sub>3</sub> where neem leaf extract was sprayed and the minimum (108.3 cm) in T<sub>17</sub> (control). In general, higher plant height was observed in 2006-07 compared to 2007-08 season.

The effect of different botanicals and fungicides on the number of siliqua plant<sup>-1</sup> was not statistically significant (Table 3). Average of two years, the highest number of siliquae plant<sup>-1</sup> (84.5) was obtained in T<sub>4</sub> and the minimum (76.4) in T<sub>17</sub> (control). The second highest siliquae plant<sup>-1</sup> (84.0) was recorded in T<sub>8</sub> where Rovral was sprayed. On the other hand, neem leaf extract produced 83.9 siliquae plant<sup>-1</sup>.

Table 3. Effect of botanicals and fungicides on the plant height and siliqua plant<sup>-1</sup> of mustard

Treatment	Name of botanicals and fungicides	Plant height (cm)		Siliqua plant <sup>-1</sup> (no.)	
		2006-07	2007-08	2006-07	2007-08
T <sub>1</sub>	Neem boil water	122.2	109.4	82.3	78.3
T <sub>2</sub>	Neem leaf extract	124.1	110.4	84.8	82.9
T <sub>3</sub>	Onion bulb extract	121.7	113.2	83.1	80.2
T <sub>4</sub>	Garlic bulb extract	118.3	114.7	84.3	84.7
T <sub>5</sub>	Ginger rhizome extract	112.8	111.3	83.2	77.7
T <sub>6</sub>	Alamonda leaf extract	115.9	109.6	83.4	81.3
T <sub>7</sub>	Dholkalmi leaf extract	117.2	110.1	80.3	76.7
T <sub>8</sub>	Rovral 50 WP	118.3	115.7	85.7	82.3
T <sub>9</sub>	Dithane M-45	115.7	112.1	84.5	80.7
T <sub>10</sub>	Bavistin	113.8	106.1	81.9	80.3
T <sub>11</sub>	Ridomil Gold	117.9	111.2	82.7	79.7
T <sub>12</sub>	Indofil M-45	115.3	110.3	82.3	82.3
T <sub>13</sub>	Tilt 250 EC	113.3	112.3	83.7	77.7
T <sub>14</sub>	Kencozeb M-45	114.7	114.7	80.9	77.7
T <sub>15</sub>	Supervit 80 WDG	113.6	113.1	81.3	75.7
T <sub>16</sub>	Mine 50 WP	114.5	109.0	82.1	79.3
T <sub>17</sub>	Control	110.9	105.7	79.0	73.7
	CV (%)	3.93	4.22	5.69	5.84

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

### Seeds Siliqua<sup>-1</sup> and 1000-seed Weight

Different treatments of botanicals and fungicides showed a significant effect on the number of seeds siliqua<sup>-1</sup> (Table 4). The highest number of seeds siliqua<sup>-1</sup> (24.12) was recorded in T<sub>8</sub> (Rovral 50 WP) and the lowest (19.67) in T<sub>17</sub> (control). The second highest number of seeds siliqua<sup>-1</sup> was observed in T<sub>2</sub> (Neem leaf extract) and T<sub>9</sub> (Dithane M-45) treatments which were statistically at par with those of T<sub>1</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>10</sub>, T<sub>11</sub>, T<sub>12</sub> and T<sub>13</sub> in both

the years. Again T<sub>13</sub>, T<sub>14</sub>, T<sub>15</sub> and T<sub>16</sub> were statistically similar with control treatment (T<sub>17</sub>).

Table 4. Effect of botanicals and fungicides on the seeds siliqua<sup>-1</sup> and 1000-seed weight of mustard

Treatments	Name of botanicals and fungicides	Seeds siliqua <sup>-1</sup> (no.)		1000-seed weight (g)	
		2006-07	2007-08	2006-07	2007-08
T <sub>1</sub>	Neem boil water	23.83a-d	21.13abc	3.33a-d	3.18ab
T <sub>2</sub>	Neem leaf extract	24.53ab	22.00ab	3.53a	3.27a
T <sub>3</sub>	Onion bulb extract	22.57b-e	20.67a-d	3.21b-c	2.99bc
T <sub>4</sub>	Garlic bulb extract	24.17abc	21.33abc	3.50ab	3.19ab
T <sub>5</sub>	Ginger rhizome extract	23.97abc	21.67abc	3.35a-d	3.18ab
T <sub>6</sub>	Alamonda leaf extract	23.93abc	20.80a-d	3.13cde	3.12ab
T <sub>7</sub>	Dholkalmi leaf extract	23.77a-d	20.77a-d	3.26a-e	3.18ab
T <sub>8</sub>	Rovral 50 WP	25.57a	22.67a	3.54a	3.30a
T <sub>9</sub>	Dithane M-45	24.20abc	22.33a	3.27a-e	3.19ab
T <sub>10</sub>	Bavistin	22.57b-e	21.33abc	3.19cde	3.01bc
T <sub>11</sub>	Ridomil Gold	24.13abc	22.33a	3.40abc	3.25a
T <sub>12</sub>	Indofil M-45	24.17abc	22.33a	3.36a-d	3.24a
T <sub>13</sub>	Tilt 250 EC	22.57b-e	20.33a-d	3.20cde	2.90c
T <sub>14</sub>	Kencozeb M-45	22.07cde	19.67bcd	3.15cde	2.87c
T <sub>15</sub>	Supervit 80 WDG	21.87cde	19.33cd	3.07de	2.87c
T <sub>16</sub>	Mine 50 WP	21.57de	19.33cd	3.11cde	2.86c
T <sub>17</sub>	Control	20.73e	18.60d	2.99e	2.63d
	CV (%)	5.15	5.72	4.57	3.46

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

Thousand seed weight was significantly influenced by the treatments of botanicals and fungicides (Table 4). The highest seed weight 3.42 g (average of two years) was found in T<sub>8</sub> treatment where Rovral was sprayed. Next to Rovral, neem leaf extract produced the second highest 1000-seed weight 3.40 g. The effect of Rovral and neem leaf extract on 1000-seed weight was statistically similar. In both the years, control treatment (T<sub>17</sub>) gave the lowest 1000-seed weight. Tilt 250 EC (T<sub>13</sub>), Kencozeb M-45 (T<sub>14</sub>), Supervit 80 WDG (T<sub>15</sub>), Mine 50 WP (T<sub>16</sub>) produced statistically similar 1000-seed weight with control in the 1<sup>st</sup> year but in the second year these four fungicides produced significantly different 1000-seed weight from the control (T<sub>17</sub>).

## Seed Yield

The seed yield of mustard ranged from 1016 (T<sub>17</sub>) to 1361 kg ha<sup>-1</sup> (T<sub>8</sub>) due to the effect of different botanicals and fungicides (Fig. 1). The highest seed yield was obtained from the treatment T<sub>8</sub> where Rovral 50 WP was sprayed and the lowest from the control (T<sub>17</sub>) having no botanicals or fungicide sprayed. The second highest seed yield was produced in T<sub>2</sub> where neem leaf extract was sprayed. Yield obtained from Rovral sprayed plot was statistically

similar to those under neem leaf extract, garlic bulb extract, ginger rhizome extract, Dithane M-45, Ridomil Gold and Indofil M-45. The effect of Kencozeb M-45, Supervit 80 WDG (T<sub>15</sub>) and Mine 50 WP (T<sub>16</sub>) were insignificant. Neem boil water (T<sub>1</sub>), onion bulb extract (T<sub>3</sub>), alamonda leaf extract (T<sub>6</sub>), dholkalmi leaf extract (T<sub>7</sub>), Bavistin (T<sub>10</sub>), Tilt 250 EC (T<sub>13</sub>) and Kencozeb M-45 (T<sub>14</sub>) produced statistically similar yields but those were significantly lower compared to that recorded under Rovral 50 WP (T<sub>8</sub>).

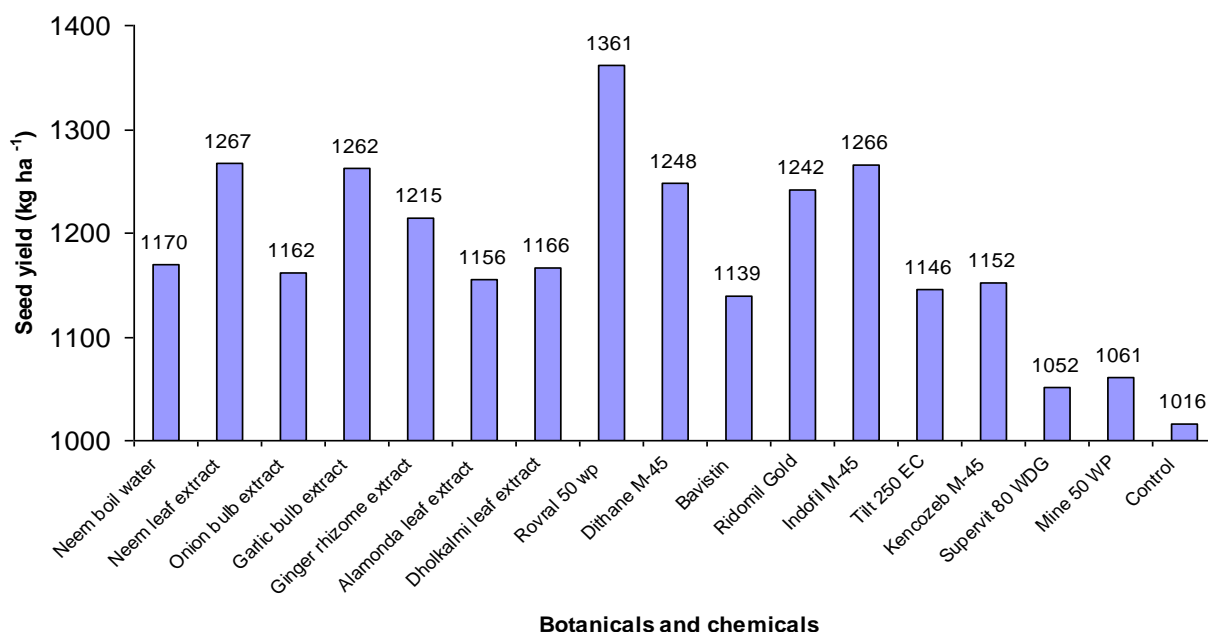


Fig. 1. Effect of botanicals and fungicides on seed yield of mustard (mean of two years)

## DISCUSSION

The present study indicates that spray with Rovral was most effective in reducing the severity of *Alternaria* leaf blight and to increase seed yield of mustard. The results also suggested that neem leaf extract and garlic bulb extract were effective botanicals where as Dithane M-45, Ridomil Gold and Indofil M-45 were effective fungicides to control the disease. These botanicals and fungicides caused significant reduction in percentage of leaf area diseased, percentage of leaf and siliqua infection and spots siliqua<sup>-1</sup> and produced higher 1000-seed weight and seeds siliqua<sup>-1</sup>. The effectiveness of Rovral to control *Alternaria* leaf blight of mustard was demonstrated by Pandya *et al.* (2000), Jalaluddin and Anwar 1993, Chattopadhyay and Bhunia (2003) and Meah *et al.* (1999). The efficacy of Rovral against species of *Alternaria* namely i.e. *A. porri*, *A. brassicicola*, *A.*

*alternata* and *A. mali* has also been reported by other workers (Maude and Humpherson 1980, Sharma 1984, Srivastava *et al.* 1995, Ayub *et al.* 1996, Datar 1996, Filajdic and Sutton 2002).

Chattopadhyay and Bhunia (2003) advocated that Rovral is highly effective fungicide for treating seeds of mustard against *A. brassicae*. It reduced siliqua infection and prevented development of seed-borne infection. Humpherson and Ainsworth (1983) suggested that Rovral reduced the rate of seed infection by *A. brassicae* when applied to kale seed crop at young pod development stage. Pandya *et al.* (2000) also reported that Rovral successfully controlled *Alternaria* leaf blight of mustard and increased seed yield by about 24-59% over control. Neem leaf extract, garlic bulb extract, Dithane M-45, Ridomil Gold, Indofil M-45 and ginger rhizome extract also played vital role in controlling siliqua infection and

seed-borne infection. Meah and Hossain (1989) reported that *Alternaria* leaf blight of mustard can be controlled with botanicals. Singh and Dwivedi (1987) and Achimu and Schlosser (1992) reported that extracts of neem leaf and neem seed have strong antifungal properties. Ryan *et al.* (1984) reported that Ridomil is an effective fungicide against *Alternaria brassicicola* and *Alternaria brassicae*. The results of the present study indicated that fungicides like, Rovral 50 WP, Dithane M-45, Ridomil Gold and Indofil M-45 and botanical extracts of neem leaf, garlic bulb and ginger rhizome may be used as foliar spray to control *Alternaria* blight of mustard.

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