EFFECT OF SOWING DATE AND IPRODIONE ON THE ALTERNARIA BLIGHT OF MUSTARD (*Brassica juncea*)

A THESIS

BY

MD. MONIRUZZAMAN
Student No. 0605023
Session: 2006-2008
Semester: January - June 2008

MASTER OF SCIENCE
IN
PLANT PATHOLOGY

DEPARTMENT OF PLANT PATHOLOGY
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR

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Submitted to the
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June 2008

Dedicated

to

MY BELOVED PARENTS

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The Author

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ABSTRACT

A field study had been carried out during the period from October 2006 to February 2007 at Syedpur in Nilphamari district to determine the effect of sowing date and Iprodione in controlling the Alternaria blight of mustard cv. Tori 7. The three sowing dates were 23 October (early), 07 November (normal) and 22 November (late), 2006. Iprodione (0.25%) was applied three times, viz. single spray, two sprays and three sprays at 10-days interval starting from the first disease initiation on the lower older leaves of 30-40 days old plants. Control plots were sprayed with plain water. The manipulation of early sowing date as non-monetary input decreased the leaf area diseased, pod area diseased, number of pod infection, number of spot per pod and increased 1000-seed weight, seed yield per plant and yield per hectare over late sowing. Results obtained in this study indicated a tremendous effect of sowing date on the disease severity and seed yield of mustard. The application of three sprays of Iprodione provided the maximum control of Alternaria blight and increased seed yield per hectare. Iprodione three sprays in combination with early sowing (23 October) displayed the best performance in controlling the Alternaria blight disease. Three sprays of Iprodione (0.25%) or 23 October (early) sowing alone significantly brought down the disease severity while in combination reduced the disease significantly and increased seed yield by 28.42 % over control (non-sprayed) of late sowing crop. Finally, it may be concluded that Iprodione three sprays in combination with early sowing was found superior for management of Alternaria blight of mustard oilseed crop.

CHAPTER I

INTRODUCTION

Mustard (*Brassica juncea* L. 2n=4x=36) belonging to the family Cruciferae is the most important oil seed crops in Bangladesh. Oilseed crop specially mustard and rapeseed are widely cultivated throughout the world as condiments, spices and for edible vegetable oil production. The amount of edible oil from mustard seed does not meet the current requirements of the 140 millions people of Bangladesh. Most of the common people of this country are traditionally fond of mustard oil. This country is in deficit of about 90,000 metric tons of edible oil annually (Lutfor Rahman *et al.*, 1993) which is imported from other countries. About 2.17 lakh hectares land are use in mustard cultivation. As an edible oil in Bangladesh, mustard hold the second position next to soyabean. Mustard fleshy leaves are used as a very popular green vegetable in the country. It contributes significantly to the national economy of the country (Anon., 2006). Mustard shared 183 thousand tons, which constitutes 70 percent of the total edible oilseeds in Bangladesh (Anon, 2006). As compared to the developed countries, the yield of mustard is too low. The yield of this crop in Bangladesh is only 0.84 t/ha (Anon, 2006) which is poor compared to that of advanced countries like Japan, U.K., French and Poland producing 1.73, 3.43, 2.68 and 2.04 t/ha, respectively.

Many factors are associated with the poor yield of mustard in this country. Among the prevailing biotic factors, Alternaria blight caused by *Alternaria brassicae* (Berk) Sacc. is the most destructive one which is responsible for low oil-seed production (Talukder, 1974; Ahmed, 1985 and Meah *et al.*, 1985). *Alternaria brasica* is seed borne organism (Fakir, 1976 b; Anon., 1988 and Mridha, 1985). There are about fourteen diseases occurring on

mustard in our country (Hossain *et al.*, 1992). Among them, Alternaria blight caused by *Alternaria brassicicae* (Berk) Sacc. is a wide spread, the most damaging foliar disease and foremost important constraint. The disease causes blight of leaf, pod and stem (Meah *et al.*, 1988) and seed abnormalities (Howlider *et al.*, 1991). It is endemic in Bangladesh and all the cultivated varieties are susceptible to this disease. This disease causes an average yield loss of 40-70% in India (Vishwanath and Kolt, 1997) and 30-60% in Bangladesh (Meah *et al.*, 1988). Early siliquae infection leads to seed infections (Humpherson-Jones and Maude, 1983, Humpherson-Jones *et al.*, 1983).

In addition to direct yield losses, the disease adversely affects the seed quality reducing seed size, seed discolouration and reduction in oil contents (Howlider *et al.*, 1991; Kaushik *et al.*, 1984). There have been multifarious efforts to control the disease, both success and failures have been achieved. There is no information available on the resistance source, although sort of tolerance to the disease has been reported (Rai *et al.*, 1976). Chemicals have been successfully used in controlling the disease (Meah *et al.*, 1988; Howlider *et al.*, 1985 and Kolte and Tewari, 1978). Single spray of Iprodione in early sown mustard significantly reduced leaf area infection by 24% and pod infection by 288% over untreated (control) late sown mustard (Rashid *et al.*, 1995). However, the issue of environmental pollution is linked with indiscriminate and unplanned use of pesticides, which causes health hazards. People are now very conscious about environmental deterioration due to excessive use of spray chemicals. Therefore, it is necessary to find out a suitable integrated disease management using minimum dosages of fungicide along with possible cultural practices

(Kendrick, 1988 and Bhardwaj and Thanka 1991). Benefits of cultural practice like sowing date on the management of Alternaria blight have been demonstrated (Meah, 1992). Sowing dates had been shown significant effect on disease severity and yield of mustard (Howlider *et al.,* 1989). Further, with proper adjustment of different cultural practices and use of pesticides Alternaria blight of mustard can be brought under control (Shivpuri et al., 1988; Begum *et al.,* 1992 and Meah, 1992).

Only two or three fungicides have been screened as effective against this disease (Atika and Ahmed, 1985). Iprodione (Rovral 50 wp) has been proved very effective against Alternaria blight under Bangladesh condition (Ferdous, 1990 and Meah, 1992). However, continuous applications of chemicals cause environmental pollution and the practice is too costly.

Information on the control of Alternaria blight of mustard in this region is not available. Sowing date had been shown to have significant effect in Alternaria blight and yield of mustard (Howlider *et al.* 1989 and Rashid *et al.*1995). Effect of one or two cultural practices such as sowing time or Iprodione sprays on Alternaria blight of mustard have been tried (Anon, 1988 and Ferdous, 1990) but combined effect of dates of sowing and fungicidal application have not yet been done in the Nilphamari region of Bangladesh. Therefore, an investigation was made under taken to find out the influence of Iprodione and date of sowing on Alternaria blight and yield of mustard. Hence, the main objectives of the present investigations were

i) To find out the effective date of sowing in minimizing Alternaria leaf blight of mustard cv. Tori 7.
ii) To find out the effective dosage of Iprodione in controlling the Alternaria leaf blight of mustard cv. Tori 7.

CHAPTER II

REVIEW OF LITERATURE

Mustard (*Brassica juncea* L. 2n=4x=36) belonging to the family Cruciferae, is the most important oil seed crop in Bangladesh. It suffers from many diseases. Rangaswami (1984) listed 11 diseases of mustard in India. Alternaria blight caused by *Alternaria brassicae* (Berk) *Sacc.* is an endemic one causing substantial losses of the crops both yield and quality. Evidences of research work regarding Alternaria blight of mustard and its control in northern part of our country is rare. But the possibilities of controlling the disease through chemical and cultural practices like effect of dates of sowing have been explored in many mustard growing countries. Some of the pertinent literatures have been reviewed below:

2.1. Effect of Sowing Dates

Mian and Akanda (1989) reported the effect of sowing time on the severity of Alternaria blight of mustard. They planted seeds in mid October, early November, mid November and early December. They opined that sowing time had a significant effect on disease severity. They found lowest disease severity in October and highest in December sown plants.

Howlider *et al.* (1989) reported that crops sown on 2 November or a week earlier developed the least infection of Alternaria blight of mustard caused by *Alternaria brassicae* in the field and gave the highest seed yield. With delay in sowing, a progressive increase in disease severity and reduction in yield were observed.

Bains and Dhaliwal (1989) conducted an experiment on development of *Alternaria brassicae* on *Brassica juncea* in relation to certain cultural factors. They reported that the rate of infection by *Alternaria brassicae* was similar on cultivars RLM 198, RLM 514 and RLM 619. October sown *Brassica juncea* (Indian mustard) was infected faster than sown in September / November.

Rooted cutlings of four commonly grown carnation cvs. namely, Artheer sim, Exquisite, Sam,s pride and white sim were planted on different dates 29 January (D1), 6 February (D2), 28 February (D3) and 8 March (D4) to assess their proneness to Alternaria blight caused by *Alternaria alternata* in Northern India. The disease decreased as the planting date delayed (Dhiman et al., 1991).

Meah (1992) proposed an integrated model for controlling the alternaria blight (*Alternaria brassicae*) of mustard consisting of the following components of land preparation with 3 plowings and 2 laddering, application of cowdung (5 t/ha) and mustard oilcake (0.5 t/ha); use of fertilizers (N_2 P_1K_1 Gypsum1 $ZnSO_4$), sowing seeds between October 18-November 2, one weeding and one irrigation at 30 days age of the crops, fungicide (Rovral) and insecticide spray at the onset of fruiting stage and variety Sampad/BINA 3 which gave 80% reduction in disease severity and 50% increase in yield as against cost : benefit ratio of 1:3.

Kant *et al.* (1998) mentioned that yield and yield contributing components of Indian mustard generally decreased with delay in sowing but were not affected by spacing.

Singh *et al.* (1998) conducted an experiment on Indian mustard seed sown in 30 September, 15 or 30 October or November. Yield and yield components were decreased with delay in sowing. They found lowest incidence of Alternaria blight (*Alternaria brassicae*) from 30 September sowing plants.

Singh *et al.* (2001) conducted an experiment on the effects of sowing time in case of yield and yield components of Indian mustard cultivars. Crops sown on the second and third week of October were superior in terms of plant height, number of branches, siliquae, and seeds; as well as seed yield. Sowing on the third week of October and first week of November reduced seed yield by 14.4% and 24.7% respectively.

Gupta *et al.* (2003) conducted an experiment on mustard cultivar sown at different dates of sowing from 21 November to 5 January. The crop sown on 21 October recorded significantly less Alternaria blight disease (caused by *Alternaria brassicae*) severity, which was enhanced in subsequent sowing dates. Eighty five-day-old plants showed high disease severity because temperature had significant negative correlation, while relative humidity had significant correlation with disease severity.

2.2. Effect of Iprodione

Maude and Humpherson (1980) reported that 2-3 sprays of Rovral applying from early pod stage significantly reduced the Alternaria disease of mustard caused by *Alternaria brassicae* in the field.

Rai and Singh (1983) conducted an experiment on the influence of foliar application of three different concentrations (0.2, 0.4 and 0.8%) of Dithane

M-45 and Zincop on the leaf surface mycoflora of young mustard plants (*Brassica campestris* L. *var* Ys-42) in the natural field at different intervals. The fungicides significantly decreased the number of fungi cm -2 of leaf and reduced species diversity.

Humpherson and Maude (1983) reported that three sprays of Rovral at 0.5-10.0 kg a.i. per hac. applied on *Brassica oleracea* seed crops at three week intervals from the young green siliqua stage to until controlled pod infection caused by *Alternaria brassicola*. Rovral increased the seed yields and improved germination. Bordeaux mixture also was as effective as Rovral when disease levels were low but was ineffective when infection pressure was high.

Humpherson *et al.* (1983) described that seed treatment (Brassica seed crop) with Rovral formulation resulted effective control of *Alternaria brassicae* and *Alternaria brassicicola* while Thiobendazole was effective against the *Alternaria spp.* In natural field conditions no infected plants were obtained when infested seed of kole seed crop was sown after treatment with Rovral (2.5 g a.i./hac).

Ogilvy (1984) reported about the effect of *Alternaria brassicae* in reducing the yield of winter oil seeds rape (*Brassica napus*). In trials in New York, yield was increased when fungicide was used to control the disease. Rovral in a flowable form proved to be the most effective and varied from season to season. Sprays applied to pods immediately post-flowering consistently gave the most effective and economic control.

Sharma (1984) reported that best results in controlling Alternaria blight of mustard were obtained with 4 sprays of Dithane M-45 at 10 days intervals starting with the onset of disease followed by Daconil, Difolatan (0.3%) and Dithane Z-78 (0.2%). The fungicide reduced the infection rate by 16.6-30.1%.

Ayub and Ahmed (1985) evaluated the efficacy of five fungicides namely Duter (0.2%), Benlate (0.05%), Cuman-L (0.10%), Trimilox forte (0.2%) and Dithane M-45 (0.2%) in controlling alternaria blight of mustard.Sprayings were started at 40, 50 and 60 days after sowing with three applications at 10 days intervals. Disease incidence was evaluated 7 days before each application and graded using a 0-8 rating scale. They reported that all the fungicides except Benlate were effective in controlling the disease. They concluded that Duter was the best fungicide followed by Trimiltox Forte, Dithane M-45 and Cuman-L. Disease control was maximum when application were initiated at 40 days after emergence.

Gupta *et al.* (1985) studied in field tests the efficacy of six fungicides against Alternaria blight of Indian mustard caused by *Altarnaria brassicae*. They found minimum defoliation when 4 sprays were given at 10 intervals.

Shivpuri *et al*, (1988) evaluated six fungicidal treatments Rovral (iprodione), Captafol, Dithane M-45 (mancozeb), Thiram, Blitox-50 (copper oxychloride), Bavistin (carbendazim) on Indian mustard infected by *Alternaria brassicae* in field trials. All of the fungicides controlled the disease but copper oxychloride showed phytotoxicity. The best treatment was Iprodione followed by Captafol and Mancozeb, Iprodione resulted minimum defoliation.

Orphan-Wisessang (1988) assessed the efficacy of certain fungicides to control leaf spot disease on Chinese mustard. Rovral at 30 g/20 litre of water performed a good control of the disease. The disease severity index were 2.7, 2.36 and 2.77 when the spraying intervals were 5, 10 and 15 days respectively. The control plots showed their severity index between 5.56-5.83. The seed yield from Rovral spraying plot was higher than the others. Captafol sprayed with intervals of 5 or 10 days, performed a good control as well. According to the result of this experiment Rovral at the rate of 30 g/20 litre of water sprayed with 10-15 days intervals was recommended to control the disease.

Meah *et al.* (1992) conducted an experiment on the effects of dosages and time of application of fungicides, insecticides and their combination controlling Alternaria blight (*Alternaria brassicae*) of mustard (*Brassica campestris*) in two consecutive cropping seasons under natural field conditions. Disease severities and yield did not differ statistically for number of chemical sprays from either flowering or fruiting stage, but increase in dosage had significant effect. Rovral flow alone (1.0 1/hac) significantly ($P<0.01$) reduced disease severities and increased seed yield by 147% over control when applied for 2 times commencing from fruting stage (50 days age) at 10 days intervals. Dithane M-45 and Malathion were proved less effective.

Anonymous (1993) reported minimum disease incidence from Rovral sprayed plot and maximum from unsprayed i.e., control plot of mustard which differed significantly. Rovral sprayed plot, on an average produced seed yield of 1291.11 kg/ ha which was significantly higher than that of unsprayed plot.

Mridula *et al.* (1994) conducted an in vitro experiment on five fungicides such as Blitox-50 (copper oxychloride), Bavistin (carbendazim), Dithane M-45 (mancozeb),Topsin-M(thiophanate-methytl) and Thiram against Alternaria brassicae which caused leaf blight in mustard. Mancozeb was the most effective fungicide for inhibiting fungal growth

Ashok-Kumar (1996) found minimum Alternaria blight infection of mustard in Rovral (iprodione, 0.2%) sprayed plots followed by Difolatan (captafol, 0.2%), Indofil M-45 (mancozeb + thiophanate-methyl, 0.2%) and Ridomil MZ (mancozeb + metalaxyl, 0.25%). Maximum yield was recorded in case of Iprodione spray.

Ayub *et al.* (1996) conducted an experiment to evaluate the efficacy of 7 fungicides to control Alternaria blight of mustard caused by *Alternaria brassicae* and *Alternaria brassicicola.* Carbendazim (as Bavistin) and Benomyl (as Benlate) at 0.1%, Ziram (as Cuman L), Mancozeb (as Dithane M-45), Fentin hydroxide (as Duter), Iprodione(as Rovral) and Copper salts + Mancozeb (as Trimiltox forte) at 0.2% were applied 3 times to plants which were 40, 50 and 60 days old. Iprodione reduced disease severity the most and increased seed weight and yield. Maximum reduction of disease severity and significantly higher yield were achieved when spraying was carried out on plants at 40-days-old.

Aziz (1998) has reported that there were significant difference among the treatment of varities, sowing time and Zinc treated plants in percent seed germination. The interaction between variety and Zinc did not differ significantly in percent seed germination. The average seed germination of early sown crop was 97.25%, 88.25%, 76.13% and 67.63%, respectively in

August, September, October and November. He detected both *Alternaria brassicae* and *Alternaria brassicicola* in seeds of mustard on blotter. The infection of seeds caused by *Alternaria brassicae* was higher than that of *Alternaria brassicicola* and decreased with passage of time. The incidence of seed infection was 2.88% and 2.50% in August, 2.25% and 1.88% in September, 1.57% and 1.13% in October and 1.13% and 0.75% in November, respectively for *A. brassicae* and *A. brassicicola* in variety Agrani.

Pandya *et al.* (2000) studied in field test by using four sprays of fungicides against Alternaria blight of mustard. Four sprays of Iprodione (0.2%) gave the maximum control of Alternaria blight.

Anwar and Khan (2001) reported that seed dressing fungicide has significant effect in controlling the leaf blight disease (*Alternaria brassicae*) and the yield of Indian mustard. Indian mustard was treated with four fungicides at 2 g/kg. All the fungicides reduced the disease incidence. Benlate showed the best performance and reduced disease incidences by 76.6% followed by Vitavax, Ridomil and Thiovit which reduced disease incidences by 70.0%, 63.3% and 53.5%, respectively over control (untreated seed).

Godika and Pathak (2002) studied in a field experiment the efficacy of five fungicides for the control of Alternaria blight of Indian mustard. All treatments resulted in lower disease severity and higher crop yield compared to the control. Antracol spraying resulted the lowest Alternaria blight severity.

2.3. Effect of sowing dates and Iprodione

Rashid *et al.* (1995) reported that single spray of Iprodione in early sown mustard crop significantly reduced leaf area infection by 24% and pod infection by 288% over untreated (control) late sowing. This treatment also increased yield by 62% with a cost benefit ratio of 1:3.

Yadav *et al.* (2002) conducted field experiments during 1998/99 and 1999/2000 to investigate the effects of sowing dates (18 October and 4 and 20 November) on the development of Alternaria blight of the Indian mustard. Delay in sowing increased the intensity of disease. Early sowing (18 October) exhibited only moderate attack of disease and gave more yield irrespective of the cultivar and chemical treatment. However, late sowing (20 November) recorded high intensity of Alternaria blight on leaf and inflorescence. The chemical treatments significantly reduced the disease incidence and enhanced the yield over the untreated control.

Singh and Singh (2006) conducted an experiment to develop spray schedule for the management of blight caused by *Alternaria brassicae* and *Alternaria brassicicola* in Indian mustard sown on 15 and 30 October, and 15 November. Mancozeb and Ridomil were sprayed in spray schedule combinations. Sowing on 15 October resulted in the lowest incidence of leaf blight, pod blight intensity and the highest 1000-seed weight and yield. Three consecutive sprays of Mancozeb 75 WP (0.2%) at fortnightly intervals, beginning at the disease initiation resulted the lowest leaf blight incidence and pod blight intensity.

CHAPTER III

MATERIALS AND METHODS

3.1. Experimental Site

The field experiment was conducted at Syedpur in Nilphamari district during the period October 2006 to February 2007 to determine the effect of sowing date and Iprodione in controlling the Alternaria blight of mustard cv. Tori 7.

3.2. Land topography and soil

The place of the field experiment falls under the AEZ-3 (Agro-Ecological-Zone) of Bangladesh. The soil type and other characteristics of the Agro-Ecological-Zone are given below (Amin, 1990):

Characteristics of AEZ-3

Name	:	Tista Meander Flood Plain
Land type	:	Medium High land
Texture	:	Loam to Sandy loam
Soil pH	:	5.4-5.6
Organic matter	:	Low
Field level	:	Above flood level
Water holding capacity	:	Low
General soil type	:	Non-calcareous grey flood plain

3.3. Seed collection

Seeds of mustard cv. Tory-7 from Lal tir seed of East-West Seed Bangladesh Ltd. were used for this study and collected in October, 2006 (harvesting time, March-April, 2005) from local market of Dinajpur town.

3.4. Land preparation and fertilizer application

The land was first plowed in the late October. Later four- plowings and cross plowings followed by 3 ladderings were done during the course of land preparations. The following doses of manures and fertilizers were applied in the field as recommended by BARC (Anonymous, 2004).

Manures and fertilizers	Dosages per hectare
Cow dung	25 t
Urea	200-250 kg
TSP	150-170 kg
MOP	70-85 kg
Gypsum	120-150 kg
Zinc Sulphate	4-5 kg
Boric Acid	10-15 kg

The well-decomposed cow dung was incorporated with soil during first plowing. Half of the urea and all other fertilizers were incorporated with during final land preparation. Rest half of urea was top dressed at 25 days after sowing.

3.5. Design and layout of the experiment

The experiment was laid out in two-factors Randomized Block Design (RBD) with three replications. The whole plot was divided into three blocks each containing twelve plots of 1m × 1m size giving 36 unit plots. Each of the treatment combination was randomly assigned to unit plot so as to locate one treatment combination only in each block. The space kept between the blocks was 1.0 meter and plot to plot was 0.5 meter.

3.6. Treatments of the experiment

Treatment combination

T_1 = 23 October, 2006 (early) sowing X Control (plain water spray)

T_2 =23 October, 2006 (early) sowing X One spray

T_3 =23 October, 2006 (early) sowing X Two sprays

T_4 =23 October, 2006 (early) sowing X Three sprays

T_5 =7 November, 2006 (normal) sowing X Control (plain water spray)

T_6 =7 November, 2006 (normal) sowing X One spray

T_7 =7 November, 2006 (normal) sowing X Two sprays

T_8= 7 November, 2006 (normal) sowing X Three sprays

T_9= 22 November, 2006 (late) sowing X Control (plain water spray)

T_{10}= 22 November, 2006 (late) sowing X One spray

T_{11}= 22 November, 2006 (late) sowing X Two sprays

T_{12}= 22 November, 2006 (late) sowing X Three sprays

3.7. Seed sowing

Seeds were sown in rows at the rate 8 kg/ha with a distance of 15 cm and 25cm plant to plant and row to row, respectively. Cultivar Tori-7 (highly susceptible to Alternaria blight) was used for this study.

3.8. Intercultural operations

Two irrigations were given at 15 days and 30 days age of the crop. One weeding was done at 14 days age of the crops to keep the plots free from weeds. Asataf 75 SP (Acephate) @ 0.2% was applied twice at 40 and 50 days age of the crops.

3.9. Spray material

3.9.1. Iprodione (as Rovral 50 wp)

The details of Rovral 50WP is given below:

Sl. No.	Fungicide	Trade name	Chemical name	Active ingradient	Conc. used
1	Iprodione	Rovral	3-(3,5 dichlorophenyl)-N-(1 methyl ethyl)-2,4 dioxuimidazolidene Carbosxamide $(C_{12}H_{13})_3N_3C_{l2}$	50%	0.25 %

3.9.2. Preparation and application

Fungicidal solution of Iprodione(as Rovral 50 wp) was prepared by dissolving 2.5 g of fungicides per 1000 ml water (i.e. 0.25%). First spray was given at 36 days, second at 46 days and third at 56 days age of the crop. Therefore, some plants received no fungicides, some received one time at 36 days after sowing, some received twice at 36 & 46 days and some received thrice at 36, 46 & 56 days after sowing of the crop.

3.10. Parameters studied and data collection procedure

i) Leaf Area Diseased (%)

ii) Pod Area Diseased (%)

iii) Pod Infection (%)

iv) Number of spot / pod

v) 1000-seed weight (g)

vi) Seed yield / plant (g)

vii) Yield / hectare (t/ha)

Progress in leaf infection was monitored during 35-55 days age of the crops while that of pod was monitored during 55-75 days age. For collection of data 10 plants of middle rows in each unit plot were randomly selected and tagged for all counts. Leaf area diseased (LAD) were estimated on the basis of 5 leaves recorded successively from the top discarding the most older and younger leaves in the rachis of each of 10 plants. Diseased spots on 10 siliqua in the main rachis from 10 cm below the top were counted on each of 10 plants to calculate the number of alternaria spots per pod. Pod area diseased was estimated once on the basis of 10 pod per plant tagged in the field at 75 days age of the plants.

3.11. Harvesting, threshing and weighting

Crop was harvested at optimum time (90-100 days age). During harvesting the ten tagged plants were bundled separately and threshed carefully. After proper processing, seeds were dried fully and weighed to determine the differences among treatments regarding 1000 seed weight and yield per plant. Yield per plot was calculated adding the seed yield of ten tagged plants to that of rest of the plants in a specific plot. Conversion of yield per plot gave the yield per hectare.

3.12 Analysis of the data

Data were subjected to statistical analysis to find out the levels of significance of the experimental results. The mean of all the treatments were calculated and analysis of variance was performed. The significance of differences among the treatment means were evaluated by Duncan's New Multiple Range Test (DMRT) at 5% level of probability. All the data were calculated carefully and analyzed with the help of a personal computer in MSTAT-C computer package program.

3.13 General Information

Details of the meteorological data in respect of temperature, rainfall, relative humidity evaporation and total sunshine during the growing period of the experimental site were collected from the Weather Station of Wheat Research Centre (WRC), Dinajpur and presented in Appendix I.

CHAPTER IV

RESULTS

4.1. Effect of sowing date on percent leaf area diseased (LAD) at different countings in 2006-2007

Leaf area diseased of mustard cv. Tori 7 was studied and the results were significantly different in three dates of sowing at all the subsequent countings. The highest LAD (3.00%, 6.51%, 10.78% and 14.93%) were found in 22 November (late) sowing plots and the lowest (2.66%, 6.03%, 10.33% and 14.58%) were recorded in 23 October (early) sowing plots at the first, second, third and fourth countings, respectively. The percent LAD in 7 November (normal) sowing and 22 November (late) sowing did not differ significantly at the fourth countings (Table 1).

Table 1. Effect of sowing date on percent leaf area diseased (LAD) at different countings in 2006-2007

Date of sowing	1st	2nd	3rd	4th
23 October (early) sowing	2.66	6.03	10.33	14.58
7 November (normal) sowing	2.75	6.37	10.55	14.80
22 November (late) sowing	3.00	6.51	10.78	14.93
LSD $\geq$ 0.05	0.05	0.13	0.13	0.19

Data represent the means of three replications

4.2. Effect of Iprodione on percent leaf area diseased (LAD) at different countings in 2006-2007

At the first counting, the LAD were remained almost similar and the results were diminished at all three dates of sowing. At second countings, the highest LAD (8.10%) was in the control plots where the lowest (5.64%) was obtained in the three sprayed plots with Iprodione. The highest LAD

(14.84% and 22.83%) were recorded in the control plots where the lowest (8.65% and 11.12%) were found in the Iprodione three sprayed plots at 55 DAS and 65 DAS, respectively. The LAD at third and fourth countings were statistically similar, incase of two and three sprayed plots (Table 2).

Table 2. Effect of Iprodione on percent leaf area diseased (LAD) at different countings in 2006-2007

Iprodione spray	1st	2nd	3rd	4th
Control	2.81	8.10	14.84	22.83
Single spray	2.82	5.76	10.07	13.94
Two sprays	2.79	5.70	8.66	11.20
Three sprays	2.77	5.64	8.65	11.12
LSD ≥ 0.05	0.05 NS	0.13	0.13	0.19

Data represent the means of three replications

4.3. Interaction effect of sowing date and Iprodione on percent leaf area diseased (LAD) at different countings in 2006-2007

The interaction effects of three dates of sowing (23 October, 07 November and 22 November) and different Iprodione sprays revealed that the highest LAD (3.03%) was recorded in the single sprayed plots of 22 November (late) sowing where the lowest percent LAD (2.63% and 2.63%) was found in the plots of 23 October (early) sowing in control and three sprayed plots, respectively at first counting. At second countings, the highest LAD (8.25%) was recorded in the control plots of 22 November (late) sowing and significantly the lowest (5.34%) was found in 23 October (early) sowing of Iprodione two sprayed plot which was preceded by three sprayed plots (5.39%) of the same date of sowing.The highest LAD (14.99%) was found in the control plots of 22 November (late) sowing and the lowest (8.32%)

was recorded in the plots of 23 October (early) sowing where three sprays of Iprodione were applied at third countings. The two and three sprays of Iprodione in all dates of sowing were statistically at par for LAD (Table 3).

Table 3. Interaction effect of sowing date and Iprodione on percent leaf area diseased (LAD) at different countings in 2006-2007

Date of sowing	Iprodione spray	1st	2nd	3rd	4th
23 October (early) sowing	Control	2.63	7.98	14.66	22.39
	Single spray	2.66	5.42	10.00	13.78
	Two sprays	2.66	5.34	8.34	11.11
	Three sprays	2.63	5.39	8.32	11.05
7 November (normal) sowing	Control	2.79	8.09	14.88	22.94
	Single spray	2.76	5.87	10.00	13.93
	Two sprays	2.73	5.79	8.67	11.21
	Three sprays	2.73	5.73	8.67	11.13
22 November (late) sowing	Control	3.01	8.25	14.99	23.17
	Single spray	3.03	5.99	10.20	14.11
	Two sprays	2.99	5.93	8.98	11.28
	Three sprays	2.96	5.84	8.96	11.18
LSD ≥ 0.05		0.05	0.13	0.13	0.19

Data represent the means of three replications

At fourth countings, the highest LAD (23.17%) was recorded in the control plots of 22 November (late) sowing and the lowest LAD (11.05%) was found in 23 October (early) sowing plots which received three sprays of Iprodione that was preceded by two sprays plots (11.11%) at the same sowing date (Table 3).

4.4. Effect of sowing date on percent pod area diseased (PAD) at different countings in 2006-2007

Crop sown at three dates of sowing were significantly different regarding PAD at all the subsequent countings. The highest PAD (54.09%, 74.90% and 87.06%) were found in 22 November (late) sowing plots where significantly the lowest (28.84%, 59.18% and 77.07%) were recorded in 23 October (early) sowing plots at first, second and third counting, respectively (Table 4).

Table 4. Effect of sowing date on percent pod area diseased (PAD) at different countings in 2006-2007

Date of sowing	1st	2nd	3rd
23 October (early) sowing	28.84	59.18	77.07
7 November (normal) sowing	45.78	68.44	83.17
22 November (late) sowing	54.09	74.90	87.06
LSD ≥ 0.05	5.31	3.50	5.507

Data represent the means of three replications

4.5. Effect of Iprodione on percent pod area diseased (PAD) at different countings in 2006-2007

At first counting, the highest PAD was obtained (48.30%) in the control plots and significantly the lowest (38.64%) was recorded in the three sprayed plots with Iprodione which was preceded by two sprayed plots (40.09%). The percent PAD were the highest (75.21% and 85.65%) in the control plots where the lowest (60.53% and 74.04%) were in the three sprayed plots at second and third countings, respectively (Table 5).

Table 5. Effect of Iprodione on percent pod area diseased (PAD) at different countings in 2006-2007

Iprodione spray	1st	2nd	3rd
Control	48.30	75.21	85.65
Single spray	42.57	68.17	78.25
Two sprays	40.09	66.13	77.45
Three sprays	38.64	60.53	74.04
LSD ≥ 0.05	5.31	3.50	5.51

Data represent the means of three replications

4.6. Interaction effect of sowing date and Iprodione on percent pod area diseased (PAD) at different countings in 2006-2007

The interaction effects of three dates of sowing and different Iprodione sprays revealed that the highest PAD (58.50%) was obtained in the control plots of 22 November (late) sowing and significantly the lowest (23.68%) was recorded in the 23 October (early) sowing plots where three sprays of Iprodione were applied at the first counting which was preceded by two sprayed plots (25.38%) of same date of sowings. At 65 DAS, the highest PAD (81.86%) was recorded in the control plot of 22 November (late) sowing and significantly the lowest (48.11%) was found in the three sprayed plots of 23 October (early) sowing plots. At the last countings (75 DAS), the highest PAD (91.18%) was obtained in the control plots of 22 November (late) sowing and significantly the lowest (73.88%) was recorded in Iprodione three sprayed plots which was followed by two sprayed plots (75.92%) of 23 October (early) sowing (Table 6).

Table 6. Interaction effect of sowing date and Iprodione on percent pod area diseased (PAD) at different countings in 2006-2007

Date of sowing	Iprodione spray	1st	2nd	3rd
23 October (early) sowing	Control	36.48	70.33	80.30
	Single spray	29.83	61.43	78.17
	Two sprays	25.38	56.85	75.92
	Three sprays	23.68	48.11	73.88
7 November (normal) sowing	Control	49.94	73.44	85.46
	Single spray	46.64	69.36	83.24
	Two sprays	44.27	67.48	80.53
	Three sprays	42.27	63.51	79.45
22 November (late) sowing	Control	58.50	81.86	91.18
	Single spray	57.25	73.72	88.35
	Two sprays	50.63	74.08	84.89
	Three sprays	49.98	69.97	83.80
LSD ≥ 0.05		5.31	3.50	5.51

Data represent the means of three replications

4.7. Effect of sowing date on percent pod infection and number of spot per pod in 2006-2007

The highest number of pod infection (38.91%) was found in 22 November (late) sowing and significantly the lowest (25.18%) was recorded in 23 October (early) sowing. The lowest number of spot per pod (11.37) was found in 23 October (early) sowing where the highest number of spot per pod (21.32) was recorded in 22 November (late) sowing (Table 7).

Table 7. Effect of sowing date on percent pod infection and number of spot per pod in 2006-2007

Date of sowing	Pod infection (%)	Number of spot / pod
23 October (early) sowing	25.18	11.37
7 November (normal) sowing	32.13	16.94
22 November (late) sowing	38.91	21.32
LSD $\geq$ 0.05	3.83	3.40

Data represent the means of three replications

4.8. Effect of Iprodione on percent pod infection and number of spot per pod in 2006-2007

The highest number of pod infection (34.91%) was found in control plot and significantly the lowest (29.43%) was recorded in the three sprayed plots with Iprodione which was preceded by two sprayed plots (30.55%). Percent number of pod infections was statistically similar incase of two and three sprayed plots. The highest number of spot per pod (22.52) was recorded in control plot which were followed by single sprayed plots (17.71) while the lowest number of spot per pod (11.70) was found in three sprayed plots. There was no significant difference between two and three sprayed plots regarding number of spots per pods (Table 8).

Table 8. Effect of Iprodione on percent pod infection and number of spot per pod in 2006-2007

Iprodione spray	Pod infection (%)	Number of spot / pod
Control	34.91	22.52
Single spray	33.42	17.71
Two sprays	30.55	14.25
Three sprays	29.43	11.70
LSD ≥ 0.05	3.83	3.40

Data represent the means of three replications

4.9 Interaction effect of sowing date and Iprodione on percent pod infection and number of spot per pod during 2006-2007

The interaction effects of three dates of sowing and different Iprodione sprays revealed that the highest number of pod infection (43.17%) was obtained in the control plots of 22 November (late) sowing and significantly the lowest (23.64%) was recorded in the 23 October (early) sowing plots which received three sprays of Iprodione. It was preceded by two sprayed plots (24.30%).

The highest number of spot per pod (29.01) was obtained in the control plots of 22 November (late) sowing and significantly the lowest (8.00) was recorded in the three sprayed plots which was preceded by two sprayed plots (9.98) of 23 October (early) sowing crop.

Table 9. Interaction effect of sowing date and Iprodione on percent pod infection and number of spot per pod during 2006-2007

Date of sowing	Iprodione spray	Pod infection (%)	Number of spot / pod
23 October (early) sowing	Control	26.67	15.78
	Single spray	26.10	11.75
	Two sprays	24.30	9.98
	Three sprays	23.64	8.00
7 November (normal) sowing	Control	34.87	22.78
	Single spray	33.35	16.79
	Two sprays	30.83	15.82
	Three sprays	29.49	12.36
22 November (late) sowing	Control	43.17	29.01
	Single spray	40.80	24.59
	Two sprays	36.51	16.94
	Three sprays	35.16	14.73
LSD ≥ 0.05		3.83	3.40

Data represent the means of three replications

4.10. Effect of sowing date on 1000-seed weight, yield per plant and yield per hectare in 2006-2007

The lowest 1000-seed weight (2.34 g) was recorded in 22 November (late) sowing and significantly the highest (2.74 g) was obtained in 23 October (early) sowing plots. The highest yield per plant (6.06 g) was found in 23 October (early) sowing where the lowest yield per hectare (5.36 g) was recorded in 22 November (late) sowing. In case of yield per hectare, the lowest yield per hectare (0.92 t/ha) was found in 22 November (late) sowing and the highest (1.10 t/ha) was recorded in 23 October (early) sowing plots (Table 10).

Table 10. Effect of sowing date on 1000-seed weight, yield per plant & yield per hectare in 2006-2007

Date of sowing	1000- seed weight	Yield per plant (g)	Yield (t/ha)
23 October (early) sowing	2.74	6.06	1.10
7 November (normal) sowing	2.53	5.47	0.98
22 November (late) sowing	2.34	5.36	0.92
LSD ≥ 0.05	0.08	0.08	0.05

Data represent the means of three replications

4.11. Effect of Iprodione on 1000-seed weight, seed yield per plant and yield per hectare in 2006-2007

The highest 1000-seed weight (2.89 g) was found in the three sprayed plots while significantly the lowest (2.30 g) was recorded in control plots which was preceded by single sprayed plots (2.41 g). The lowest yield per plant (3.35 g) was found in control plots and significantly the highest (5.84 g) was recorded in three sprayed plots which was followed by two sprayed plots (5.75 g). The highest yield per hectare (1.10 t) was obtained in the three sprayed plots which significantly the lowest (0.89 t) was recorded in control plots which was preceded by single sprayed plots (0.89 t) (Table 11).

Table 11. Effect of Iprodione on 1000-seed weight, seed yield per plant and yield per hectare in 2006-2007

Iprodione spray	1000-seed weight	Yield per plant (g)	Yield (t/ha)
Control	2.30	5.35	0.89
Single spray	2.41	5.58	0.99
Two sprays	2.62	5.75	1.03
Three sprays	2.89	5.84	1.10
LSD ≥ 0.05	0.08	0.08	0.05

Data represents the mean of three replications

4.12. Interaction effect of sowing date and Iprodione on 1000-seed weight, seed yield per plant and yield per hectare during 2006-2007

The interaction effects of three dates of sowing and Iprodione sprays revealed that the highest 1000-seed weight (3.05 g) was obtained in the three sprayed plots of 23 October (early) sowing and significantly the lowest (2.16 g) was recorded in the control plots. The highest yield per plant (6.27 g) was obtained in the three sprayed plots which was followed by two sprayed plots (6.17 g) of 23 October (early) sowing. The lowest (5.09 g) was recorded in the 22 November (late) sowing control plots.

The highest yield per hectare (1.22 t/ha) was found in the three sprayed plots of 23 October (early) sowing and significantly the lowest (0.81 t/ha) was recorded in the control plots of 22 November (late) sowing. The second highest yield (1.14 t/ha) was found in two sprays of 23 October sowing plots (Table 12).

Table 12. Interaction effect of date of sowing and Iprodione on 1000-seed weight, seed yield per plant & yield per hectare during 2006-2007

Date of sowing	Iprodione spray	1000-seed weight	Yield per plant (g)	Yield (t/ha)	Increased yield (+) over control (%)
23 October (early) sowing	Control	2.48	5.85	0.95	-
	Single spray	2.59	5.93	1.09	+14.74
	Two sprays	2.81	6.17	1.14	+20.00
	Three sprays	3.05	6.27	1.22	+28.42
7 November (normal) sowing	Control	2.27	5.09	0.90	-
	Single spray	2.37	5.49	0.95	+5.56
	Two sprays	2.63	5.67	1.00	+11.12
	Three sprays	2.83	5.64	1.07	+18.89
22 November (late) sowing	Control	2.16	5.09	0.81	-
	Single spray	2.28	5.31	0.89	+9.88
	Two sprays	2.42	5.41	0.96	+18.52
	Three sprays	2.63	5.62	1.00	+23.45
LSD ≥ 0.05		0.08	0.08	0.05	

Data represent the means of three replications

CHAPTER V
DISCUSSION

Alternaria blight caused by *Alternaria brassicae* is the most devastating disease of mustard in Bangladesh. It is quite evident that *Alternaria brassicae* cause disease to mustard plants and distributed all over the world wherever mustard is grown. This disease causes an average yield loss of 30-60% in Bangladesh (Meah *et al.*, 1988).

5.1. Effect of sowing date

The Alternaria disease symptoms were found to appear on lower leaves at 30-40 day old plants during 2006-2007. To investigate the effect of sowing date on the severity of Alternaria blight of mustard, seeds were sown on 23 October, 7 November and 22 November, 2006. The first observation revealed that 23 October sowing crop was initially less infected by disease whereas higher infection was observed in case of 7 November and 22 November sowing crop. Rest of the subsequent observations revealed that disease increased when sowing was delayed from 23 October to 7 November and again to 22 November. The similar result was found by Mian and Akanda (1989). They found the lowest disease severity in October and highest in December sown plants. Most of the literature available indicated that a progressive increase in disease severity was observed with delay in sowing (Gupta *et al.* 2003; Kant *et al.* 1998; Rashid *et al.* 1995; Howlider *et al.*1989; Bains and Dhaliwal 1989). Early sowing (23 October) significantly reduced disease severities and increased 1000-seed weight by 17.09 %, seed yield per plant by 13.05 % and yield per hectare by 19.57 % over late sowing crops (22 November). From the above discussion, it is obviously

clear that all the disease parameters were the highest in late sowing and the lowest in early sowing. This study revealed that pod infection displayed a major role for yield. Significantly less infection in early sown crops may be attributed to factors like unavailability of host surrounding the crop field, lacking plant debris which act as a source of primary infection in the soil, high presence of juvenile green tissue that not liked by *Alternaria brassicae* and unfavorable weather conditions by escaping critical time of maximum spread of disease to the standing crops. The sources of inoculum were increased later and therefore late sowing crops became the venues of secondary infection. In addition, early sowing may result in vigorous plant growth, less prone to infection. Late sowing on the other hand, results in stunted growth and greater incidence of insect pests leading to disease development. It was also might be enhanced by changing temperature and relative humidity. Minimum disease incidence and maximum seed yield were obtained in crop sown on 23 October which indicated that the period on and around this date was most suitable for both minimizing the leaf and pod infection and for getting maximum yield. Many authors also found similar effect of dates of sowing on disease severity and seed yield in different crops. Mian and Akanda (1989) reported that severity of the alternaria blight of mustard increased with the delay in sowing time and as such it was lowest in October and highest in December sown plants. However, Bains and Dhaliwal (1989) reported that October sown *Brassica juncea* vars. RLM 198, RLM 514 and RLM 619 were infected faster than sown in September / November sowing crop. Sowing dates were found to affect disease development in some other crops also. In potato, earlier planting was found to reduce alternaria leaf spots,where as late planting reduced phyllody infection in Indian rape, cercospora leaf spot in urbean

(Sud and Singh 1984) and alternaria blight of carnation (Dhiman *et al.*, 1991). showed that crop sown on and around 20 October developed minimum leaf spots on potato and gave the maximum yields in India. Moreover, the increase in yield and reduction in disease incidence may not be entirely due to shifting sowing dates but many other agronomical and environmental factors might be involved in it.

Therefore, it may be concluded that an early sowing of mustard seeds is a well coming approach to avoid hazard of Alternaria blight severity and maximize seed yield.

5.2. Effect of Iprodione spray

To avoid yield loss, fungicidal spray schedule has been initiated at the begining of the disease initiation on the older leaves of growing crops. Iprodione three sprays significantly reduced disease severities and increased 1000-seed weight by 25.65 %, seed yield per plant by 9.15 % and yield per hectare by 23.60 % over control plots. Results of the present experiment revealed that fungicide had a greater significant role on pod infection for all parameters. In case of number of pod infection and pod area diseased 19% and 25% lower infection were observed in favour of Iprodione spray, respectively. On the other hand a reduction of number of spots per hundred pods were observed respectively in the observation in favours of Iprodione sprays. Iprodione (0.25%) sprayed at the onset of the disease on the crops proved to be the most effective and reduced 73.67 % leaf area diseased, 21.67 % pod area diseased, 18.62 % percent pod infection, 92.48 % number of spot per pod where increased 25.65 % 1000-seed weight, 9.15 % yield per plant and 23.60 % yield per hectare, respectively over control plots. In case

of leaf and pod infection significant differences were always obtained due to only three Iprodione (0.25%) spray. This spray was the best for reducing the disease intensity and obtaining higher yields from unsprayed plot. Pod is the main component of yield and it received less infection of *Alternaria brassicae* due to fungicidal spray. Therefore, it is an important findings obtained in the present study. The performance of Iprodione as found in this study is also supported by the findings of Howlider *et al.* (1985) and Meah *et al.* (1992). Disease severity and yield at different dosages of Iprodione regarding the different sowing dates were statistically differents. In the present study, it was also found that Iprodione (0.25%) sprays in combinations with sowing time caused reduction in disease severity. Percent pod infection 82.61 % and 263.63% number of spot per pod decreased and increase of 1000-seed weight by 41.20 %, yield per plant by 23.18 % and yield per hectare by 50.62 % in the 23 October (early) sowing three sprayed plots were achived over control plots of 22 November (late) sowing. In the 23 October (early) sowing, yield per hectare 28.42 % increase in the three sprayed plots over control plots was recorded,while in the 22 November (late) sowing just 23.45 % increased. Rashid *et al.*, (1995) reported that single spray of Iprodione in early sown mustard crop significantly reduced leaf area infection by 24% and pod infection by 288% over untreated (control) late sowing. This treatment also increased yield by 62% over control plots. Meah *et al.* (1992) obtained 93% reduction in leaf area infection, 98% reduction in pod spotting and yield increased by 168% over control with six sprays of Rovral starting from flowering stage. The same authors from another experiment also found that two sprays of Rovral starting from fruiting stage reduced leaf area diseased by 64%, pod infection by 63% and pod spotting by 81% and obtained 147% yield increase over

untreated plot. The present study indicated similar trend as that of Meah *et al.* (1992), that only single spray of Iprodione gave 27% yield increase but in combination with optimum sowing time more benefits with 62% increased yield were obtained, escaping higher magnitude of disease severity. Therefore, an early sowing of mustard with Iprodione spray might be a good approach to avoid the disease and increase seed yield. This approach also offers relief of environmental pollution. An early sowing on 23 October in combination with three sprays of Iprodione (0.25%) gave fruitful results in reducing leaf area diseased and increase higher seed yield.

Therefore, it is concluded that Alternaria blight of mustard may be controlled by sowing seed on 23 October and by applying three sprays of Iprodione for increasing the seed yield significantly.

CHAPTER VI

SUMMARY AND CONCLUSION

Mustard (*Brassica juncea* L, 2n=4x=16) belonging to the family cruciferae is the first most important oilseed crop in Bangladesh. The widely cultivated variety Tori 7 was used in this investigation. Nilphamari district is one of the most favourable region of the northern part of Bangladesh for mustard cultivation. Therefore, the present field study has been carried out at Nayatola in Syedpur under Nilphamari district during the period from October 2006 to February 2007 to determine the effect of sowing dates and Iprodione in controlling the Alternaria blight of mustard. The three sowing dates were 23 October, 07 November and 22 November, 2006. Three foliar sprays of Iprodione (0.25%) were applied at 10-day interval starting from the first disease initiation on the lower older leaves. The experiment was laid out in Randomized Complete Block Design (RCBD) having three replications.

The manipulation of sowing dates as non-monetary input decreased the leaf area diseased, pod area diseased, number of pod infection, number of spot per pod and increased 1000-seed weight, seed yield per plant and yield per hectare over late sowing (22 November). Results obtained in this study indicated a tremendous effect of sowing date on the disease severity and seed yield of mustard.

The application of Iprodione showed that three sprays of Iprodione provided the maximum control of Alternaria blight and increased seed yield per hectare. Minimum chances of leaf area diseased (LAD), pod area diseased (PAD), percent pod infection and number of spots per pod and maximum

chances of increase in 1000-seed weight, yield per plant and yield per hectare were observed in Iprodione three sprayed plots of early sowing (23 October) which indicated that the critical portion of time on and around this date was most sustainable both for minimizing the infection and for getting significantly higher seed yields in that particular region. Change in a environmental conditions might have influenced the minimum occurrence of Alternaria blight infections during the crop season.

Iprodione three sprays in combination with early sowing (23 October) displayed the best performance among the twelve combinations of sowing dates and Iprodione sprays in controlling the Alternaria blight disease. Three sprays of Iprodione (0.25%) or early sowing (23 October) alone brought the significant reduction in disease severity while in combination caused greater reduction and gave the higher seed yield which increased by 28.42% increased over late sowing (22 November) control (non-sprayed) plots. It was also observed that early (23 October) sowing in control plots resulted statistically similar yield to late (22 November) sowing of Iprodione three sprayed plots. Iprodione in combination with early (23 October) sowing produced higher seed yield and found to be economic in management of the disease.

Therefore, the following conclusions may be drawn for controlling the Alternaria blight of mustard cv. Tori 7.

i) Early sowing (23 October) was found to be the best for minimizing the Alternaria disease.

ii) Out of different dosage of Iprodione, three sprays were found the more effective.

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Appendix

Appendix 1 Daily temperature, Relative Humidity and Rainfall of AEZ 3 from August 2006 to February 2007.

October, 2006

Date	Temperature (C)			Rainfall (mm)	Humidity (%)
	Maximum	Minimum	Average		
1	33.60	24.50	29.05	0	72
2	34.10	26.70	30.40	0	73
3	34.50	27.20	30.85	0	72
4	32.90	26.20	29.55	0	71
5	33.70	26.50	30.10	0	69
6	35.00	26.20	30.60	0	66
7	35.20	25.70	30.45	0	65
8	33.00	26.20	29.60	19.2	70
9	33.00	22.90	27.95	0	66
10	32.10	25.20	28.65	0	68
11	33.20	24.20	28.70	0	63
12	33.10	23.90	28.50	0	67
13	31.90	25.00	28.45	13.2	74
14	28.50	21.90	25.20	0.4	79
15	29.70	23.00	26.35	0	76
16	30.20	23.70	26.95	0	71
17	32.50	22.60	27.55	0	69
18	28.50	23.50	26.00	13.8	85
19	28.40	24.00	26.20	4.8	93
20	31.20	23.20	27.20	0	74
21	31.70	23.70	27.70	0	71
22	32.10	22.30	27.20	0	66
23	31.70	21.90	26.80	0	62
24	32.00	20.90	26.45	0	62
25	32.30	22.00	27.15	0	64
26	33.90	21.60	27.75	0	63
27	32.70	21.90	27.30	0	60
28	31.20	20.70	25.95	0	55
29	31.10	19.00	25.05	0	54
30	30.70	19.60	25.15	0	56
31	30.30	19.20	24.15	0	58

Appendix 1. Continued
November, 2006

Date	Temperature (C)			Rainfall (mm)	Humidity (%)
	Maximum	Minimum	Average		
1	31.30	18.90	25.10	0	63
2	30.10	21.70	25.90	0	70
3	31.30	21.20	26.25	0	67
4	31.90	21.60	26.75	0	65
5	30.20	21.90	26.05	0	68
6	30.90	22.00	26.45	0	71
7	32.20	20.30	26.25	0	65
8	33.20	21.20	27.20	0	66
9	32.20	20.00	26.10	0	64
10	31.00	20.60	25.80	0	70
11	28.50	22.50	25.50	45.0	79
12	22.20	21.00	21.60	156.20	95
13	24.10	19.70	21.90	0	88
14	27.50	19.10	23.30	0	73
15	28.30	19.00	23.65	0	69
16	29.60	17.00	23.30	0	64
17	28.20	17.20	22.70	0	65
18	29.30	17.00	23.10	0	64
19	29.00	17.40	23.20	0	63
20	28.10	18.20	23.15	0	70
21	28.20	17.70	22.95	0	69
22	28.40	16.00	22.20	0	63
23	28.20	16.50	22.35	0	65
24	28.90	16.90	22.90	0	65
25	29.70	16.70	23.20	0	64
26	29.90	17.60	23.75	0	62
27	30.30	17.50	23.90	0	64
28	30.40	17.20	23.80	0	61
29	30.60	17.60	24.10	0	63
30	30.50	17.20	23.85	0	62

Appendix 1. Continued
December, 2006

Date	Temperature (C)			Rainfall (mm)	Humidity (%)
	Maximum	Minimum	Average		
1	30.10	17.70	23.90	0	63
2	29.10	17.00	23.05	0	63
3	29.20	16.00	22.60	0	63
4	28.70	15.00	21.85	0	65
5	28.00	14.90	21.45	0	63
6	28.90	14.70	21.80	0	63
7	28.20	14.10	21.15	0	65
8	27.70	15.00	21.35	0	62
9	28.10	15.20	21.65	0	63
10	27.70	14.90	21.30	0	60
11	26.70	15.30	21.00	0	61
12	26.50	13.90	20.20	0	64
13	27.50	13.60	20.55	0	60
14	27.90	15.20	21.55	0	67
15	27.20	17.70	22.45	0	67
16	27.40	15.10	21.25	0	62
17	27.40	15.30	21.35	0	63
18	26.90	15.70	21.30	0	63
19	28.10	15.20	21.65	0	65
20	27.10	17.70	22.15	0	68
21	26.20	14.70	20.45	0	78
22	24.20	16.70	20.45	0	83
23	22.60	15.30	18.95	0	82
24	22.40	14.10	18.25	0	83
25	24.40	11.30	17.85	0	77
26	25.60	12.70	19.15	0	73
27	24.30	12.10	18.20	0	71
28	24.10	10.90	17.50	0	71
29	23.60	10.60	17.10	0	64
30	22.20	9.20	15.70	0	74
31	22.50	11.50	17.00	0	76

Appendix 1. Continued
January, 2007

Date	Temperature (C)			Rainfall (mm)	Humidity (%)
	Maximum	Minimum	Average		
1	23.50	10.20	16.85	0	69
2	25.20	11.20	18.20	0	74
3	28.20	11.10	19.65	0	60
4	25.40	13.10	19.25	0	62
5	22.60	12.00	17.30	0	59
6	21.20	11.90	16.55	0	75
7	19.70	12.00	15.85	0	73
8	15.00	11.90	13.45	0	91
9	14.10	10.60	12.35	0	90
10	16.60	10.20	13.40	0	88
11	15.40	10.60	13.00	0	85
12	17.30	10.90	14.10	0	85
13	15.10	9.90	12.50	0	91
14	17.50	11.20	14.35	0	85
15	17.00	12.10	14.55	0	88
16	22.20	9.70	15.95	0	83
17	25.60	8.90	17.25	0	78
18	26.90	10.50	18.70	0	62
19	26.70	11.90	19.30	0	59
20	25.70	10.20	17.95	0	55
21	22.90	8.20	15.55	0	60
22	19.50	6.40	12.95	0	75
23	23.00	7.00	15.00	0	68
24	22.20	8.20	15.20	0	56
25	25.30	8.70	17.00	0	61
26	25.70	9.20	17.45	0	60
27	24.40	9.70	17.05	0	58
28	26.50	10.30	18.40	0	60
29	25.90	11.70	18.80	0	64
30	25.70	14.70	20.20	0	64
31	26.10	13.60	19.85	0	59

Appendix 1. Continued
February, 2007

Date	Temperature (C)			Rainfall (mm)	Humidity (%)
	Maximum	Minimum	Average		
1	26.70	13.90	20.30	0	60
2	27.20	14.00	20.60	0	59
3	28.10	15.00	21.55	0	61
4	28.60	15.40	22.00	0	59
5	23.70	16.60	20.15	0	68
6	26.80	13.10	19.95	0	60
7	27.20	14.00	20.60	0	58
8	28.10	15.10	21.60	0	64
9	27.50	16.60	22.05	0	65
10	28.60	17.70	23.15	0	66
11	28.10	17.20	22.65	4.2	57
12	26.20	17.90	22.05	1.2	70
13	27.90	17.70	22.80	0	60
14	27.20	15.70	21.45	0	62
15	27.90	14.20	21.05	0	61
16	28.70	12.40	20.55	0	57
17	28.20	14.50	21.35	0	57
18	30.10	14.30	22.20	0	55
19	31.20	15.70	23.45	1.0	54
20	29.20	17.20	23.20	0	55
21	27.70	16.40	22.05	0	57
22	27.20	14.40	20.80	0	54
23	28.00	13.20	20.60	0	55
24	29.20	14.00	21.60	0	56
25	30.50	15.10	22.80	0	54
26	31.20	18.20	24.70	0	59
27	31.00	18.90	24.95	0	64
28	32.20	18.70	25.45	0	57