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Efficacy of Environmental Factors on Alternaria Blight Disease of Mustard (*Brassica campestris*)

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Abstract

The experiment was conducted at Plant Pathology Field, Bangladesh Agricultural Research Institute (BARI), Gazipur-1701; Regional Agricultural Research Station (RARS), Jamalpur and Regional Agricultural Research Station, Rangpur during the cropping season 2014-17. Efficacy of environmental factors on alternaria blight disease of mustard was studied with six different dates of sowing. The highest disease score 5.1 was recorded at Gazipur in December 10 sowing followed by 5.0 at Rangpur in December 01 and December 10 sowing. The lowest disease score 2.2 was recorded in November 01 sowing at Jamalpur. The highest seed yield 1.55 ton/ha was observed at Rangpur and the lowest seed yield 0.54 ton/ha was found in December 10 sowing at Gazipur.The average air temperature was 23.6º C, 22.2º C and 23.1º C at Gazipur, Jamalpur and Rangpur locations during November and it was below 20º C in all three locations during December and January and then rises at February and later.

Keywords: *Environmental factors, alternaria blight disease, mustard, Bangladesh*

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1. INTRODUCTION

Rapeseed-mustard is the major oilseed crop in Bangladesh. The edible oil requirement in our country is around 5.75 lac tones (11g/head/day). One third (1/3rd) edible oil requirement is fulfilled by local production of oilseed crops. Out of country's total oilseed crop production, 71 % comes from mustard. More than Tk. 3500/00 core is spending to import the edible oil per year. The per hectare yield of rapeseed/mustard in our country is about 0.74 tones which is very low yield compared to other countries. Many factors are associated with the low yield of mustard. Diseases have been identified as one of the major factors (Ahmed, 1995). Mustard suffers from at least 14 diseases in Bangladesh (Hossain *et. al*, 1992). Alternaria blight has been recognized as the most serious and devastating, and endemic disease of rapeseed-mustard which is caused by *Alternaria brassicae* (Berk) Sacc and *Alternaria brassicicola*. All cultivated varieties are susceptible to this disease. It causes an average yield loss of 30-70% in Bangladesh (BARI, 1985; Meah *et al*. 1988). The issue of pesticides which provokes health hazards. So non-chemical methods of disease control may be preferred such as use of biological agents, botanicals, adjustment in cultural practices etc. Shifting date of sowing (Howlider *et al.*, 1989), irrigation frequency (BINA, 1989), use of manures and adjustment in intercultural operations (Begum *et al*., 1995) have been found to contribute in reducing the intensity of alternaria infection in mustard.

Alternaria blight of mustard is an endemic in Bangladesh and all cultivars of mustard variety are susceptible. On the other hand, due to prevailing climatic changes, i.e. increase or decrease of temperature, humidity or CO_2 concentration in the air**,** the nature of the pathogens frequently changes, resulting alteration of host pathogen relationship. Climatic change has negative, positive or no effect on individual plant disease. But recent studies have demonstrated that due to climatic changes there are many changes in the plant pathogens that deteriorated the situations. It has been observed that increased CO_2 concentration can increase spore production of loose smut of wheat 15-20 folds than normal conc. New strain developments of many pathogens have been accelerated in the altered weather condition. Abnormal rainy season create humid conditions during dry period can cause increased foliar disease in many crops. Though the climate change has a great impact on crop health but it is not critically evaluated earlier in our country. Crop diseases are increasing day by day. Among the factors responsible for increasing diseases climate change is the

most important one. This trend is greatly favored by changing climate conditions (Hossain *et al*.2008). Climatic factors on global basis particularly the trend of increasing ambient temperature seems to have contributed in wide spread out break of the damaging diseases due to which some minor disease is becoming factor major diseases. Rainfall is another important factor responsible for causation crop diseases. Change in relative humidity is also responsible for increasing disease severity resulting higher magnitude of crop losses (Bakr *et al*. 2008). Crop production in Bangladesh would be extremely vulnerable under climate change scenarios, and as a result, food security of the country will be at risk. The increase in air temperature will be shorter our winter season and the productivity of some crop will be greatly affected by the increase of plant diseases (Sultana *et al.* 2008).

It is let alone that rapeseed and mustard are the most important oilseed crops of Bangladesh which production practices in unfavorable ecosystem are tremendously affected by climate change. The productivity of mustard is low due to short and mild winter and also for biotic stresses. The optimum condition for crop growth is also favorable for disease and pest's development. The disease scenario in rape seed and mustard is changing rapidly due to climate change. Among the diseases, Alternaria blight is one of the most important diseases in new-alluvial agro-climatic zone in the char land of Bangladesh. The disease is reported to be influence by different weather factors but in Bangladesh the relationship of weather factors with the severity of alternaria blight is yet to be investigated. This is why the experiment has been undertaken to observed the efficacy of environmental factors on alternaria blight disease of mustard.

2. MATERIALS AND METHODS

Mustard varieties BARI Sarisa-14 of *Brassica campestris* L. group was used in the experiments during 2013-14, 2014-15 and 2015-16 cropping seasons respectively. There were six dates of sowing in 2013-14, 2014-15 and 2015-16 beginning in October – 20 with 10 days' intervals viz. 20 October(S_1), 01 November(S_2), 10 November(S_3), 20 November(S_4), 01 December (S_5) and 10 December(S_6).

The experiments were set at Plant Pathology Field, Bangladesh Agricultural Research Institute (BARI), Gazipur-1701, Regional Agricultural Research Station (RARS), Jamalpur and Regional Agricultural Research Station, Burirhat, Rangpur in RCB design following 3 replications. The unit plot size was 2 x 3 m. The seed rate and spacing between lines were 10 kg/ha and 25 cm. The crop was allowed to grow under natural condition. Fertilizers and irrigation were applied as recommended (Anon.2012). The incidence of disease was recorded from randomly selected 100 leaves per plot starting from 30 – day- old plants following a rating scale (0 – 5). The record was taken at 10 days' interval and continued up to maturity of crop. The scale was 1= 0.1 – 6 %, 2 = 6.1 – 12 %, 3 = 12.1 – 25 %, 4 = 25.1 -50 % and 5 = above 50 % leaf area covered by the disease following the procedure of Meah (1994) and formula of Singh (1984). Only the final disease data were converted into per cent disease index (PDI) suggested by Sarma (1984) and Rahman *et al.* (1986) as follows:

$$\text{Percent Disease Incidence} = \frac{\text{Number of diseased plants counted}}{\text{Total number of plants counted}} \times 100$$

Data on per cent leaf area diseased (leaf spot severity), average number of spots per siliqua (siliqua spotting), seed yield per plant and per hectare were recorded (Howlider *et al.* 1985). Disease severities were recorded at 30, 40 and 50 days' age of crop for each date of sowing. Average data of three years were statistically analyzed.

3. RESULTS AND DISCUSSION

It appears from the results that lower disease severity with higher seed yield was recorded from plots sown on 1 to 20 November in all the three locations (Table 1). The plots sown on December 01 and December 10 appeared to be severely affected by the disease and decreased seed yield. From the weather data in table 2, it appears that during November the average air temperature was 23.0º **C**, 22.2º **C** and 23.1º **C** at Gazipur, Jamalpur and Rangpur locations, respectively and it was decreasing gradually. During the month of December and January it was below 20º C in all three locations and then rises at February and later (Table 2). As the crop (BARI Sarisa-14) is a short duration mustard variety (75 – 82 days' life span) the crop sown during November 30 and December 10 and 20 got the benefit of lower temperature and higher relative humidity throughout the flowering and pod formation stages. The low temperature retarded the growth of *A. brassicae* but enhance the pollination and fertilization process of the crop and these might be the lower disease with higher seed yield of early sown plots (Table 1). Similar trend was also observed on pod formation and seed setting and thus November sown plots had higher number of pod/plant and higher seed/pod (Table 3).

Table 1. Severity of *Alternaria* blight and seed yield at three locations

Sowing date	Leaf spot (0-5 scale)			Seed yield/ha (ton)		
	Gazipur	Jamalpur	Rangpur	Gazipur	Jamalpur	Rangpur
20 Oct	4.1	2.3	4.3	1.14	1.02	1.09
01 Nov	3.1	2.2	3.9	1.22	1.23	1.41
10 Nov	3.1	2.9	3.9	1.22	1.20	1.55
20 Nov	4.1	3.7	3.9	1.20	1.15	1.36
01 Dec	4.8	4.3	5.0	0.74	0.91	1.15
10 Dec	5.1	4.5	5.0	0.54	0.60	1.06
$LSD_{(0.05)}$	0.11	0.36	0.49	0.051	0.07	0.31

Table 2. Weather data collected from Meteorological Department, Dhaka

Sowing date	Average temperature C			Average relative humidity (%)		
	Gazipur	Jamalpur	Rangpur	Gazipur	Jamalpur	Rangpur
October	28.6	28.0	27.0	81.3	76.7	82.2
November	23.6	22.2	23.1	79.5	75.1	80.2
December	19.4	18.1	18.1	79.4	78.9	78.2
January	18.3	17.1	14.5	74.3	79.2	84.2
February	21.1	20.5	19.8	66.2	76.6	74.2
March	26.6	23.8	23.7	64.6	75.1	70.2

Table 3. Yield contributing characters as affected by weather factors

Sowing date	Number of pod/plant			Number of seed/pod		
	Gazipur	Jamalpur	Rangpur	Gazipur	Jamalpur	Rangpur
20 Oct	90	61	115	11	29	19
01 Nov	105	60	142	14	29	20
10 Nov	102	60	139	13	24	23
20 Nov	82	50	136	13	26	20
01 Dec	57	30	160	7.5	20	18
10 Dec	27	17	124	6.5	17	15
$LSD_{(0.05)}$	19.11	11.27		1.01	3.19	

Rahman *et al.* 1988 was conducted an experiment at the Bangladesh Agricultural University Farm, Mymensingh to find out the optimum time of sowing of mustard. Seed yield was the highest when the crop was sown on November 13. Delayed and early sowing (before and after of first fortnight of November) encountered adverse climatic conditions and alternaria blight disease infection which reduced the seed yield drastically.

Mondal *et al.* (1989) conducted an experiment with four mustard varieties viz. Tori-7, SS-75, TS-72 and J-5005 planted at Regional Agricultural Research Station, Jessore on four date of planting October 1 and 16, November 1 and 16 to find out the effects of planting dates on the yield and yield components of four mustard varieties. The authors reported that the planting dates significantly influenced seed yield/plant and seed yield/ha.

The effects of date of sowing on the incidence of alternaria blight of mustard were assessed by the scientist of BARI, during 2011-12, 2012-13 and 2013-14. The seeds were sown on 21 October, 01 November, 11 November, 11 November, 01December and 11 December during 2011-12, 2012-13 and 2013-14. The results revealed that time of sowing had a significant influence on the incidence of alternaria blight disease and yield of mustard. It was found that the disease gradually increased with the gradual late and early sowing. It might be inferred that the disease incidence might be minimized by sowing mustard seeds in the first fortnight of November (BARI, 2013, BARI, 2014 and BARI, 2015). It might be due to the effect of temperature and relative humidity.

Mustard crops sown in October had significantly lower leaf and siliqua infection by *A. brassicae* with delay in sowing, an increase in disease intensity was observed. The findings are in agreement with the reports of Rashid (1993), Meah (1992), Mian and Akanda (1989), Howlider *et al*. (1989), Rahman and Shajahan (1986) who found the October sown crops or crops sown before November 2 having lower infections from *A. brasssicae* and they have also reported an increase in infection with delay in sowing. Singh *et al*. (1996) from Bihar also suggested to sow mustard between 30 September and 15 October in order to reduce disease incidence. However, an earlier report of Bains and Dhaliwal (1989) contradicts the above suggestions indicating that in their experiments, entries of *Brassica juncea*, sown in October were infected faster by *A. brassicae* than that sown in September/November. The general trend of higher infection in crops sown later than October may be attributed largely to weather factors. *A. brassicae* needs soil and leaf wet (6 to 9 hours at 10^0C) and low temperature of 20^0C for infection (Mridha and Wheeler, 1992). These conditions prevail during the period from the end of November to the end of December in Bangladesh. If a crop is sown in the middle of October, pod formation starts from the middle of November which ends up by the beginning of December. So, green pods can escape heavy infection. On the contrary, crops had sown late i.e later than third week of November

fall prey to heavy infection of *A. brassicae* in the middle of December when pod formation starts. This situation advocates sowing mustard crops by first fortnight of November in Bangladesh and this suggestion is in line with the findings of Rashid *et al.* (1995).

Early sown crops yielded higher and healthier seeds than late sown ones. This is possible as early sown crops escape heavy infection of *A. brassicae* (Rashid *et al.* 1995, Howlider *et al.* 1989). The reasons of higher yield in early sown crops (i.e. sometime in October) have been attributed to better development of yield components (Kandil, 1983), avoiding adverse weather conditions (Vasi *et al.* 1986) and escape disease (Howlider *et al.* 1989, Rahman and Shajahan, 1986; Sud and Singh, 1984). Similar views have been expressed by Bajpai *et al.* (1981); Bishoni and Singh (1979), Bhattacharjee and Pal (1973). In Bangladesh, 15 November or around this date has been found best for higher yield of mustard (Mondal *et al*. 1989; Raman and Shajahan, 1986, Rahman and Biswas, 1985 and Hossain *et al.*, 1984). Last fortnight of October as also been found the best time of sowing mustard in west Bengal (Sen and Sur, 1964), the neighbouring country of Bangladesh. The results of the present investigation indicate a higher disease severity and lower yield in crop sown later and early of November 1 to 20 which is might be the effect of temperature and relative humidity.

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