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STUDIES ON ALTERNARIA BLIGHT OF RAPESEED-MUSTARD (*BRASSICA JUNCEA* L.) CAUSED BY *ALTERNARIA BRASSICAE* (BERK.) SACC. AND ITS INTEGRATED MANAGEMENT

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Abstract

The fungus causing leaf blight of rapeseed mustard was identified as *Alternaria brassicae* (Berk). Sacc. The survey conducted during 2013-14 different locations of Jhansi district, revealed that the disease occurred widely, with the average disease severity varying for 23.9-62.0 per cent. The highest disease severity 62.0 per cent was recorded at Research Farm, Bundelkhand University, Jhansi whereas, lowest 23.9 per cent at Farmer's field, Baruasagar Jhansi. Basal application with Mancozeb and foliar spray was found reducing the disease severity.

Key words : Leaf blight, rapeseed mustard, disease severity.

Introduction

India is one of the major players in the global oilseeds/ vegetable oil economy. India has the largest area in groundnut, rapeseed-mustard, sesame, safflower and castor in the world. However, the productivity of all oilseeds in India is just 50-60 per cent of the world average and only 15 to 25 per cent of the productivity observed in the country with the highest productivity except in case of castor. India production 31.10 million tonnes oilseeds during 2010-2011, which is nearly 2-6 times more than produced during 1985-86.

The different forms of rapeseed and mustard grown in India, include toria (*Brassica campestris* or *Brassica rapo*), yellow and brown sarson (*Brassica campestris* or *Brassica rapa*), gobhi sarson (*B. napus*), raya or mustard (*B. juncea*), black mustard (*B. nigra*), karan rai (*B. carinata*) and Taramira (*Eruca sativa*) and important group of oilseed crops in India.

India has about 6 million hectare area, 6 million tonnes of production annually with an average yield of 1150 kg/ ha which is for below the international standard (1631 kg/ha). India is the third largest producer of rapeseed-mustard in the world after China and Canada. In 2001-02, India was next only to China in production. However, the yield is highest in European counties, maximum being is United Kingdom (3993 kg/ha) followed by France (3038 kg/ha). U.P. is the second largest producer of rapeseed-mustard after Rajasthan, having area 1.2 million hectare, production 0.7 million tonnes and productivity being 10.13 q/ha (Anonymous, 1999).

The origin and early culture of rapeseed and mustard is obscure. Boron mustard or Chinese mustard or rai is the name used for varieties of *B. juncea* cultivated in China, India, Pakistan and Bangladesh *B. juncea,* is a plant of Asiatic origin with its major center of diversity in China (Vaughan, 1977).

Disease are important as they cause yield losses ranging from 10-70 per cent. Intermittent rains with cloudy weather and more than 80 per cent relative humidity during the crop growth period are considered favourable conditions for the occurrence of pest and disease, which ultimately, adversely affect the production. More than 22 disease caused by fungi, bacteria, virus, phytoplasma and nematode have been reported to affect rapeseed-mustard group of oilseed crops in India.

Among these, *Alternaria blight* of rapeseed-mustard caused by *Alternaria brassicae* (Berk.) Sacc. is a severe one and is of great economic importance.

This is one of the most widespread and destructive disease of mustard under normal conditions. *Alternaria blight* was first reported by Dey (1948) at Kanpur in U.P. which caused severe losses in yield.

Materials and Methods

The experiment was conducted in a Randomized Block Design with four replication at University Farm, Jhansi of the university during *Rabi* 2013-2014. The Susceptible variety varuna was sown at spacing of 40 × 10 cm between row and plant in 3m × 5m plot size. All recommended agronomical practices were adopted bio-agent was collected from C.S.A. University of Agriculture and Technology, Kanpur (U.P.), India.

A regular and constant observation of mustard crop grown at Bundelkhand University Farm of the and other adjoining areas of such as Bijoli, Baruasagar, Babina was made during the month of Nov.-December to February-March during 2013-2014 season. During the survey, the affected leaves of mustard showing characteristics symptoms of *Alternaria blight* were brought into the laboratory of Plant Pathology Department for detection and isolation of the pathogen responsible for the disease.

Fifty leaves were randomly selected from each one sq meter plot of each field during the course of survey. These leaves were arranged into six groups from zero to five on the basis of the percentage leaf area affected. Disease intensity was recorded at the maturity stage as per the scale suggested by Conn *et al*. (1990). The percentage disease index was calculated by the following formula.

$$\text{Disease index (\%)} = \frac{\text{Sum of numerical ratings}}{\text{Total number of leaves examined} \times 5} \times 100$$

Results and Discussion

The observations revealed that *Alternaria blight* was prevalent in all the areas where this crop was grown. The maximum disease intensity (62%) was recorded at Institute of Agriculture Science, Bundelkhand University, Jhansi and minimum (23.9%) was recorded at Farmer's Field, Baruasagar, Jhansi. The intensity of disease varied from 23.9-62.0% at all the surveyed fields. At the farmer's field, the maximum disease intensity was recorded at Babina (34.4%) and lowest disease intensity was recorded at Baruasagar (23.9%).

The symptom of the disease was first appear on the lower in the month of November-December and reach at its peak towards the upper leaves. Subsequently, the lesions are also observed on all the above ground parts of the plants. Different species of Alternaria in feet different varieties of rapeseed-mustard and produce characteristics symptoms.

The disease appears in the farm of small brown to black, lesions on the leaves, stems and siliquae. On the leaves, the spots are dark brown, pin-head in structure but gradually enlarge measuring 0.5-10 mm in diameter and became almost with distinct concentric zonations.

The formulation of concentric rings in the lesions with brownish growth of fungus become the diagnostic criteria for the identification of the disease. The lesions on the stems were at first linear and then expand but remain usually elongated with pointed ends. On siliquae, the spots were circular, dark brown to black lesions. As the disease advanced, several lesions coalesce and cover larger areas of leaves branches and siliquae and causing eventually death of plants. The advanced stage of the disease development, the leaves fall off from the plants. The profuse sporulation of the fungus can be observed on the spots, which are often arranged in concentric rings.

For pathogenicity test, artificial inoculations were made on 45 days old plant of mustard variety, Varuna from which the fungus was originally isolated. The inoculation was carried out with spore suspension of *Alternaria brassicae.* The symptoms began to develop after 4-5 days of inoculation and were characterized by the formation of small round, initially pale greyish spots on the leaves which later enlarged and typical symptoms were formed.

The symptoms resembled with the natural ones after 15 days of inoculation. The observations regarding the development of symptoms were recorded.

The result presented in table 1 clearly indicate that he maximum leaf infection (91.3%) was observed when the inoculation was made on injured leaves while uninjured leaves showed only 73.91% infection. It is suggestive that when the inoculation was made after injury on leaf surface, it provided suitable avenue for the rapid entry of the pathogen.

The morphological studies of *Alternaria brassicae* were made in nature (host) and in culture (PDA) under the compound microscope. The step wise morphological observations of the fungus are given below.

Colony was moderately, fast growing, amphigenous usually in the beginning ashey grey, fluffy, circular and later turning into dark greenish olive with abundant sporulation.

The mycelium was septate and branched. In initial stage, it is light brown in colour which becomes darker

Table 1 : Pathogenicity test of *A. brassicae* on leaves of mustard.

Fungus inoculated	Number of leaves inoculated		Number of leaves infected		% of leaves infected	
	Uninjured	Injured	Uninjured	Injured	Uninjured	Injured
Alternaria brassicae	23	23	17	21	73.91%	91.30%
Control (Uninoculated)	50	50	-	-	-	-

Table 2 : Screening of Brassica germplasm and breeding material against Altenaria blight of mustard under artificial condition.

S. no.	Entry	% (at 100days) Alternaria blight severity on leaves	% (at 100 days) Alternaria blight severity on pod
1	UDN-11-01	65.4(54.0)	36.4(37.1)
2	UDN-11-02	59.3(50.4)	26.1(30.7)
3	UDN-11-03	26.9(31.2)	14.2(22.1)
4	UDN-11-04	19.9(26.5)	13.6(21.7)
5	UDN-11-05	13.0(21.1)	15.0(22.8)
6	UDN-11-06	58.3(49.8)	24.3(29.6)
7	UDN-11-07	73.6(59.3)	26.9(31.2)
8	UDN-11-08	65.1(53.9)	27.2(31.4)
9	UDN-11-09	68.5(55.9)	18.8(25.7)
10	UDN-11-10	24.1(29.4)	23.4(28.9)
11	UDN-11-11	60.0(50.8)	12.7(20.8)
12	UDN-11-12	26.3(30.8)	10.8(19.2)
13	UDN-11-13	30.2(33.3)	22.9(28.6)
14	UDN-11-14	25.6(30.4)	22.9(28.6)
15	UDN-11-15	45.8(42.6)	31.8(34.2)
16	UDN-11-16	56.4(48.7)	26.6(31.1)
17	UDN-11-17	35.0(36.2)	29.7(33.0)
18	UDN-11-18	24.1(29.4)	29.8(33.1)
19	UDN-11-19	47.6(43.6)	18.1(25.2)
20	UDN-11-20	58.4(49.9)	13.4(21.5)
21	UDN-11-21	38.4(38.3)	15.0(22.8)
22	UDN-11-22	49.4(44.7)	24.2(29.4)
23	UDN-11-23	62.8(52.4)	23.8(29.2)
24	UDN-11-24	70.3(57.0)	31.7(34.2)
25	UDN-11-25	71.5(57.8)	30.5(33.5)
26	UDN-11-26	61.1(51.4)	29.5(32.9)
27	UDN-11-27	75.1(60.2)	25.3(30.2)
28	UDN-11-28	52.8(46.6)	25.2(30.1)
29	UDN-11-29	14.6(22.5)	12.4(20.6)
30	UDN-11-30	72.9(58.7)	31.2(33.9)
	SE(treatment mean)	**1.63**	**0.85**
	CD at 5%	**4.51**	**2.35**
	CV	**6.43**	**5.18**

Angular transformed values are given in parenthesis.

with advance in age of mycelial growth, cylender, radiating branched, filaments of hyphae measure 3.0-5.9 micron in width.

Conidiophores arising in group of 2-10, emerging from stomata usually simple, septate (0-8), amphigenous with slightly swellon base and rendered apices unbranched, even conidiophore 3-5 geniculate with prominent scans, 34.5-184.5 micron in length, olive brown, formed single, either as side branches or terminally on the hyphae 4.7 micron diameter.

Conidia usually produced singly at the apex of the conidiophores but some times in short acropetal chain (2-4). They were obelavate to obyriform, ovate elongated. Conidia measure 86.4-240.5 × 15.5 – 30.0 micron in size with 5-16 transverse septa and 0-8 longitudinal or oblique septa.

Beak was usually pale brown, short, cylindrical, 10-130 micron in length and 3-8micron in width.

Among the disease management table 3 approaches, the use of resistant varieties are considered to be the best and cheapest method of managing the plant disease. the present study was therefore, carried out for finding out the source of resistance against Alternaria leaf blight of rapeseed- mustard caused by *Alternaria barassicae*, under artificial conditions.

It is clear from the table 2 that's out of tested 30 genotype cultivars none were found free to this disease. Two genotype *viz*., UDN- 11-05 and UDN-11-29 on leaves and two genotype *viz*., UDN-11-12 and UDN-11-11 resistant on pod were observed to be moderately resistant to the disease. Remaining genotypes were found as moderately susceptible, susceptible and highly susceptible, against the alternaria blight.

Integrated Disease Management

Evaluation of different fungicides, chemical and bio-agent with different combination *viz*. $\mathbf{T_1}$- Seed Treatment (ST), *Trichoderma harzianum* @ 10g/kg seed + *psudomonas floreseance,* $\mathbf{T_2}$- Zink sulphate (soil application) @ 15kg + Borax @ 10kg + sulphur @ 15kg/h, $\mathbf{T_3}$- Removal of three lower leaves $\mathbf{T_4}$-(ST), Iprodione + carbendazim (1:1) @ 2g/kg followed by two spray of carbendazim + mancozeb @ 0.2%, $\mathbf{T_5}$- Zink sulphate +

Table 3 : Effect of different combination of fungicide, nutrients and bio-agent for the integrated disease management of Alternaria blight.

S. no.	Treatment	Disease intensity on leaves (%)	Disease intensity on pod (%)	Yield (kg/ha)	Test seed weight (gm)
1	T_1	47.50(43.56)	37.50(37.74)	2576	5.01
2	T_2	44.90(42.07)	34.50(35.96)	2587	4.89
3	T_3	45.60(42.47)	32.50(34.75)	1987	4.2
4	T_4	46.40(42.93)	36.30(37.04)	2398	4.09
5	T_5	32.30(34.62)	26.50(30.97)	2234	4.22
6	T_6	20.40(26.84)	6.34(14.58)	2598	5.06
7	T_7	48.90(44.37)	37.70(37.87)	2134	4.4
8	T_8	43.60(41.32)	32.50(34.75)	2354	5.02
9	T_9	51.00(45.57)	40.60(39.58)	2544	4.45
10	T_{10} (control)	73.50(59.15)	38.40(38.28)	1865	3.98
SE(treatment mean)		**1.83**	**1.29**	**70.95**	
CD at 5%		**5.32**	**3.75**	**205.89**	
CV		**8.08**	**8.00**	**6.07**	

Angular transformed values are given in Parenthesis.

Table 4 : Effect of different combination of nutrients and fungicide for management of major disease of Indian mustard.

S. no.	Treatment	Disease intensity on leaves (%)	Disease intensity on pod (%)	Yield (kg/ha)	Test seed weight (gm)
1	T_1	47.12(43.33)	37.30(37.60)	2245	3.75
2	T_2	36.34(37.06)	26.43(30.92)	1912	3.56
3	T_3	41.54(40.12)	30.56(33.55)	2343	4.87
4	T_4	41.60(40.16)	34.70(36.08)	2412	4.35
5	T_5	34.56(36.00)	32.80(34.93)	2376	4.74
6	T_6	44.65(41.92)	34.80(36.13)	2098	3.82
7	T_7	37.70(37.87)	21.80(27.81)	2008	3.75
8	T_8	51.20(45.69)	38.67(38.44)	2108	4.43
9	T_9	30.40(33.44)	15.65(23.29)	2543	4.9
10	T_{10} (control)	71.40(57.69)	48.45(44.11)	1876	3.23
SE(treatment mean)		**1.97**	**1.5**	**102.67**	
CD at 5%		**5.72**	**4.3**	**297.95**	
CV		**9.04**	**9.2**	**9.36**	

Angular transformed values are given in Parenthesis.

Borax + Sulphur (basal application) followed by tow spray of carbendazim + mancozeb @ 0.2%, T_6 - Zink sulphate + Borax + sulphar (basal application) followed by Foliar Spray of *P. fluorescens,* T_7- Removal of three leaves followed by Foliar Spray (FS) of Ridomil MZ-72 @ 0.2%, T_8- (ST), Iprodione + carbendazim (1:1) @ 2g/kg seed followed by removal of three lower leaves, T_9-(ST) Propioconazole(Tilt) @ 0.1% followed by foliar spray @ 0.1%, T_{10}- Control.

The different combination of treatment against alternaria blight. Data presented in table 3 revealed that all the treatments were found significantly effective in reducing the disease intensity and increasing the yield over the control.

The data presented in table 3 clearly indicated that amongst the tested treatments $ZnSO_4$ + Borex+Sulphur followed by spray of *Pseudomonas fluorescens* (T_6) were found most effective to reduce the disease intensity 20.40 on leaves and disease intensity 6.34 on pod and

increase the yield 2598 kg/ha. However, the highest thousand grain weight 5.06 g was also recorded with the treatments of $ZnSO_4$+Borex+Sulphur.

Evaluation of different fungicide and micro nutrients with different combination *viz.* ($\mathbf{T_1}$) $ZnSO_4$@15 kg/h ($\mathbf{T_2}$) Borax @ 10kg/h, ($\mathbf{T_3}$) Sulphur as per local recommendation, ($\mathbf{T_4}$) $ZnSO_4$ @ 15kg/h+Borax @ 10kg/h, ($\mathbf{T_5}$) $ZnSO_4$@15kg/h + Sulphur as per recommendation, ($\mathbf{T_6}$) Borax@10kg/h + Sulphur as per recommendation, ($\mathbf{T_7}$) $ZnSO_4$ + Borax+Sulphur, ($\mathbf{T_8}$) spray of slaked lime @ 1% w/v at 50 days of after sowing, ($\mathbf{T_9}$) spray of mancozeb @0.2% and50 days after sowing, ($\mathbf{T_{10}}$) control to find out the efficacy of different combination against alternaria blight. Data presented in Table 4 revealed that all the treatments were found significantly effective in reducing the disease intensity and increasing the yield over the control.

The data presented in table 4 clearly indicated that amongst the tested treatment spray of Mancozeb 50 day after sowing ($\mathbf{T_9}$) were found most effective to reduce the disease intensity 30.40 on leaves, disease intensity 15.65 on pod and increase the yield 2543. However, the highest thousand grain weight 4.9 g was also recorded with the treatment of Spray of mancozeb 50 day after sowing.

A total number of 30 genotypes/cultivars comprising of *Brassica campestis*, *B. rapa*, *B. carinata*, *B. juncea, B. napus* and *Eruca sativa* were screened under artificial conditions and the per cent disease intensity was recorded. UDN 11-05 genotype was found resistant against *Alternaria blight*.

The present study indicates that *B. napus*, *B. juncea* and *B. carinata* were found better source of resistance in comparison to *Brassica campestris*. Similar result was obtain by Bhander and Maini (1965), Rai *et al.* (1977), Degenhardt *et al.* (1974), Kadian and Saharan (1983), Anand *et al.* (1985) and Kolte (1986).

Dang *et al.* (2000) observed that the out of tested 30 genotype, only two genotypes UDN11-05 and UDN11-29 were consistently showing some level of resistence against *Alternaria blight* thorough evalution of different fungicides, nutrient and bio-agent for the *Altenaria blight* on the disease intensity, seed yield and 1000 seed weight.

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