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Screening of Mustard Varieties and Temperature Effect on White Rust and Alternaria Blight

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ABSTRACT

Background: Mustard is one of the most important cruciferous crops which are grown basically for oil. The crop is infected by many diseases prominently fungal diseases which cause limitation in the productivity of the crop. White rust (*Albugo candida*) and Alternaria blight (*Alternaria brassicae*) are the most serious fungal diseases of mustard.

Methods: The study was conducted to find out the resistant response of mustard varieties against these fungal diseases. A field experiment was conducted to screen the response of mustard varieties in *Rabi* season of 2021-22 at Research Farm of Amar Singh (PG) College, Lakhaoti, Bulandshahr (UP), India. In India, yield losses from 23 to 54.5% due to white rust and 17-48% due to Alternaria blight has been reported.

Result: Among the tested sixteen mustard varieties, four mustard varieties like PT-305, PM-44, Kanchan and MYSL-203 were shown resistant against white rust. Whereas, twelve tested mustard varieties like Jagannath, Radhika, Hybrid-805, Dev-142, Nandi bull, Araurali, 45L46 Lohiya, Kranti, Pusa Mahal, PusaVijya, PM-31 and Rh-149 were susceptible to white rust. Infection of Alternaria blight was observed in all tested mustard varieties. Postules of white rust on lower surface of leaves were starting appear after 5th January (Temperature min. 7°C to max. 19°C). The highest incidence of white rust on leaves was observed from 16th January to 08th February (Temperature range min. 8-10°C and max. 20-22°C). Incidence of Alternaria blight was regularly increasing after 28th January.

Key words: Alternaria blight, Mustard, Varieties, White rust.

INTRODUCTION

Mustard [*Brassica juncea* (L.) Czern. and Cosson] is an important oilseed crop which occupies about 80 per cent of the total cropped area under oilseed crops in India. Total global area under rapeseed and mustard is about 26.09 m ha with total output of 571,880 tonnes of mustard at an average yield of 1-1.5 tons ha^{-1} (FAO, 2016). India is the fourth producer of mustard contributing to around 11% of world's total production. It accounted for an estimated production of 32.10 MT with 26.21 thousand hectare of area and 1224 kg/ha in 2016-17 (Anonymous, 2017) and production of edible oils was about 7.05 Mt (Jha, 2017). Rapeseed and mustard yields were lower in India compared to other rapeseed and mustard producing countries such as Germany (3811 kg/ha), France (3240 kg/ha), China (1834 kg/ha) and Canada (1769 kg/ha) as well as the world average (1849 kg/ha) (Kaur and Grover 2020). In India, although rapeseed and mustard is cultivated in 13 states, production in Rajasthan, Uttar Pradesh, Haryana and West-Bengal with their respective share of 45, 13, 11 and 8 per cent accounts for 77 per cent of the total production of rapeseed and mustard in the country (Kaur, 2017). Mustard crop requires about 18-25°C temperature, low humidity, practically no rains especially at the time of flowering.

Many biotic and abiotic stresses are responsible for reducing the production of mustard. White rust caused by *Albugo candida* Kuntze and Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc. have been reported to be most wide spread and destructive fungal diseases of rapeseed mustard throughout the world (Kolte, 1985). In India, both these diseases are quite common, while, combined infection of downy mildew and white rust on mustard have been observed rarely because of dry cool weather in this region. Yield losses from 23 to 54.5% due to both phases (leaf and stag head) of white rust and 17-48% due to Alternaria blight have been reported from India (Saharan *et al.,* 1984 and Saharan, 1991). Hence, the present study was taken up to identify the sources of white rust and Alternaria resistance in different mustard cultivars that can be utilized in the breeding programmers.

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MATERIALS AND METHODS

Sixteen mustard varieties *viz*., Jagannath, Radhika, Hybrid-805, Dev-142, Nandi bull, Araurali, 45L46 Lohiya, Kranti, Pusa Mahal, PusaVijya, PM-31, Rh-149, PT-305, PM-44, Kanchan and MYSL-203 were screened at the Research Farm, Amar Singh (PG) College, Lakhaoti, Bulandshahr during rabi crop season of 2021-22 for check the disease severity of white rust and Alternaria blight disease. All mustard varieties were raised in triplicate in rows. Seeds of mustard varieties were supplied by local markets of Meerut and Bulandshahr. Seeds were sowed on 15th November 2021. Randomly ten plants from each row were selected and tagged for taking observations for initial appearance of disease symptoms and the disease severity. Data collection was started at 35 days after sowing. All the data were collected once in a week.

White rust disease severity

Leaf area infected was observed randomly from each plot. Ten plants per row were randomly selected for the observations. Based on infected area, leaves of each plant were rated as per rating scale (0-9) (Table 1) and the disease severity was calculated by using the following formulae:

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaves examined} \times \text{Maximum grade}} \times 100$$

Alternaria blight disease severity

Leaf area infected was observed randomly from ten plants per row under different varieties by using disease rating scale (0-5) (Table 2) and per cent disease index was calculated on the basis of following formulae:

$$\text{Per cent disease index (PDI)} = \frac{\text{Total sum of individual ratings}}{\text{Total number of leaves examined} \times \text{Maximum grade}} \times 100$$

RESULTS AND DISCUSSION

Symptomology of white rust

One of the most identifiable symptoms of white rust is the white blistering on the undersides of infected leaves (Fig 1). Other disease symptoms include chlorosis, necrosis, defoliation, swelling and distortion of flowers, stunted growth and leaf curling. If the disease becomes systemic, an infected plant may form swollen, twisted floral parts called “stagheads.” If a plant is infected through the soil or seed, stagheads will most likely appear later in the plant’s life (Fig 2). The symptoms of rapeseed-mustard white rust observed in present studies were also reported earlier by Armstrong in 2007.

Symptomology of Alternaria blight

Symptoms of the Alternaria blight were characterized by evolution of spots on leaves, stem and siliquae. It first symptoms are appear on the lower leaves in the form of small light brown to blackish in color, circular or irregular lesions, which later on turns black due to the appearance of spore masses with disease evolution symptoms are show on the upper leaves, stem and siliquae of plant (Fig 3). These spots enlarged and combine forming large sized spots. In some cases, centre of these spots light brown dot surrounded by the number of dark alternating concentric rings. The symptoms of rapeseed-mustard Alternaria blight observed in present studies were also reported earlier by Nayyar *et al.* (2014).

Varietal response against white rust

Among the disease management approaches, the use of resistant varieties is considered to be the best and cheapest method of managing the plant disease. The present study



Fig 1: Blisters on the undersides of infected leaf.



Fig 2: “Stagheads” stage.



Fig 3: Alternaria spot on leaf.

was therefore, carried out for finding out the source of resistance against white blister of mustard caused by *Albugo candida*, under field conditions and results are presented Table 3. It was observed that seven varieties *viz*., Jagannath, Radhika, Hybrid-805, Nandi bull, Kranti, Pusa Mahal and PM-31 were observed to be highly susceptible to the disease. Five mustard varieties *viz*., Dev-142, Arauvali, 45L46 Lohiya, PusaVijya and RH-149 were observed susceptible to be white rust disease. Remaining four varieties *viz*., PT-305, PM-44, Kanchan and MYSL-203 were found as resistant (Immune). It was also observed that appearance of white rust symptoms on the leaves started from 05th January. Temperature on 05th January was range minimum 7°C to maximum 19°C. The highest incidence of white rust on leaves was observed from 16th January to 08thFebruary. Temperature from 16th January to 08th February was ranging minimum 8-10°C and maximum 20-22°C. 'Staghead' stage on floral parts of infected plants was appeared after 10th February. In earlier studies different researchers evaluated different Brassica germplasms and reported few germplasms as a resistant source. Meena *et al*., (2011) reported PBC 9221 and EC 414299 brassica lines as resistant to white rust. Yadav and Sharma (2004) also found that genotypes EC399301 and EC-399299 were resistant to white rust under field conditions. Mukherjee *et al.,* (2011) have reported that most

Table 1: Rating scale used for scoring white rust (AICRP R and M, 2010).

Rating score	Leaf area covered (%)	Disease reaction
0	No symptoms (Postules)	Immune
1	Less than 5% leaf area covered	Highly resistant
3	5 to 10% leaf area covered	Resistant
5	11 to 25% leaf area covered	Moderately Resistant
7	26-50% leaf area covered	Susceptible
9	More than 50 % leaf area covered	Highly susceptible

Table 2: Rating scale used for scoring Alternaria blight (Bal and Kumar, 2013).

Disease rating	Disease severity description	Disease reaction
0	No symptoms on leaf	Immune
1	Small light brown spots scattered covering less than 5% leaf area	Highly resistant
2	Spots small, brown, with concentric rings, covering 5.1 to 10% leaf area	Resistant
3	Spots large, brown, irregular, with concentric rings 10.1 to 25% leaf area	Moderately resistant
4	Large, brown, irregular lesions with typical blight symptoms, covering 25.1 to 50% leaf area	Susceptible
5	Large, brown, irregular lesions with typical blight symptoms, covering more than 50% leaf area	Highly susceptible

Table 3: Reaction of mustard varieties against white rust.

Mustard variety	Initial appearance of symptoms on leaves	Per cent disease index on date 25 January 2022	Disease rating on date 25 January 2022	Reaction	Initial appearance of staghead symptoms
Jagannath	5-Jan-22	1.05	9	Highly susceptible	15-Feb-22
Radhika	5-Jan-22	1.50	9	Highly susceptible	20-Feb-22
Hybrid-805	7-Jan-22	1.45	9	Highly susceptible	15-Feb-22
Dev-142	10-Jan-22	0.73	7	Susceptible	10-Feb-22
Nandi bull	7-Jan-22	1.21	9	Highly susceptible	10-Feb-22
PT-305	Nil	0.00	0	Immune	Nil
Araurali	5-Jan-22	0.72	7	Susceptible	20-Feb-22
45L46 Lohiya	10-Jan-22	0.71	7	Susceptible	20-Feb-22
Kranti	7-Jan-22	1.32	9	Highly susceptible	16-Feb-22
Pusa Mahal	10-Jan-22	1.32	9	Highly susceptible	15-Feb-22
PusaVijya	7-Jan-22	0.77	7	Susceptible	15-Feb-22
PM-31	10-Jan-22	1.38	9	Highly susceptible	20-Feb-22
RH-149	10-Jan-22	0.73	7	Susceptible	15-Feb-22
PM-44	Nil	0.00	0	Immune	Nil
Kanchan	Nil	0.00	0	Immune	Nil
MYSL-203	Nil	0.00	0	Immune	Nil

Table 4: Reaction of mustard varieties against Alternaria blight.

Mustard variety	Initial appearance of symptoms on leaves	Per cent disease index on date 25 January 2022	Disease severity on date 25 February 2022	Reaction
Jagannath	10-Jan-22	0.64	3	Moderately resistant
Radhika	10-Jan-22	1.05	5	Highly susceptible
Hybrid-805	15-Jan-22	0.85	4	Susceptible
Dev-142	10-Jan-22	1.06	5	Highly susceptible
Nandi bull	15-Jan-22	1.06	5	Highly susceptible
PT-305	15-Jan-00	0.66	3	Moderately resistant
Araurali	10-Jan-22	0.87	4	Susceptible
45L46 Lohiya	10-Jan-22	0.87	4	Susceptible
Kranti	15-Jan-22	1.06	5	Highly susceptible
Pusa Mahal	10-Jan-22	0.83	4	Susceptible
PusaVijya	15-Jan-22	0.81	4	Susceptible
PM-31	10-Jan-22	0.82	3	Moderately resistant
Rh-149	15-Jan-22	1.00	5	Highly susceptible
PM-44	15-Jan-22	0.64	3	Moderately resistant
Kanchan	10-Jan-22	0.63	3	Moderately resistant
MYSL-203	15-Jan-22	0.64	3	Moderately resistant

commercial Indian mustard (*B. juncea*) varieties are highly susceptible to white rust.

Varietal response against alternaria blight

The present study was therefore, carried out for finding out the source of resistance against Alternaria blight of rapeseed-mustard caused by *Alternaria brasicae* under field conditions and results are presented in Table 4. The area of the plant part affected was observed visually and the results were expressed in percentage of the plant part affected. It is clear that out of 16 mustard varieties were tested, none was found free to this disease. Appearance of Alternaria blight symptoms on plants was start from 10th January. On the date 25th January disease symptoms was appear in all mustard varieties. Mustard varieties like Radhika and Dev-142 were showed with disease index of 5.6 and 6.4 per cent respectively. Remaining mustard varieties were recorded with below to 5 per cent disease index. On date 25th February, disease symptom of alternaria blight was observed in all mustard varieties. Mustard varieties *viz*., Radhika, Dev-142, Kranti and RH-149 were observed with highly susceptible to the Alternaria blight. Mustard varieties like Jagannath, PT-305, PM-44, Kanchan and MYSL-203 were observed with moderately resistant to the disease. It is well established fact that every pathogen requires specific weather conditions for its occurrence, development and spread. The severity of mustard diseases is highly dependent on different meteorological parameters and different growing environments. Temperature, relative humidity and rainfall have been identified as most significant meteorological parameters in addition to the causal agent and host. Earlier similar work has been reported by many researchers. Meena *et al.* (2011) reported that the incidence of alternaria blight in rapeseed-mustard fields is influenced by air temperature, relative humidity, soil conditions at the time of sowing, splashing rain, wind velocity, leaf wetness and inoculum density available in the soil. Bharti *et al.* (2016) also observed the highest disease intensity of 53.60 per cent from Kalyanpur (Kanpur) and lowest intensity (37.60%) was recorded from Bagha (Kanpur) during their survey of various locations.

CONCLUSION

Sixteen varieties of mustard were screened for their susceptibility against white rust and Alternaria blight. Among the tested sixteen mustard varieties, four mustard varieties like PT-305, PM-44, Kanchan and MYSL-203 were shown resistant against white rust. Whereas, mustard varieties like Jagannath, Radhika, Hybrid-805, Dev-142, Nandi bull, Araurali, 45L46 Lohiya, Kranti, Pusa Mahal, PusaVijya, PM-31 and Rh-149 were susceptible to white rust. Infection of alternaria blight was observed in all tested mustard varieties. Postules of white rust were starting appear after 5th January (Temperature min. 7°C to max. 19°C). The highest incidence of white rust on leaves was observed from 16th January to 08th February (Temperature range min. 8-10°C and max. 20-22°C).Variety, PT-305, PM-44, Kanchan and MYSL-203 were shown resistant against white rust and may be recommended for commercial cultivation and for breeding purpose.

Conflict of interest

All authors declared that there is no conflict of interest.

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