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MANAGEMENT OF BACTERIAL LEAF SPOT DISEASE OF MUSTARD THROUGH RESISTANT GERMPLASM

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ABSTRACT

Canola commonly known as sweet mustard is an important oil seed crop of the world. The successful production of mustard is affected by bacterial leaf spot of crucifers caused by *Xanthomonas campestris* pv. *armoraciae* or pv. *raphani* which is an emerging bacterial disease in Pakistan. The disease management approach through growing resistant germplasm is a cost effective practice. Therefore, the present research was conducted to find the resistant mustard germplasm against bacterial leaf spot disease. Sixteen varieties/lines were evaluated against bacterial leaf spot disease of mustard in field conditions. No variety/line was found immune or highly resistant against bacterial leaf spot disease of mustard. Three varieties/lines viz. KJ-221, KJ-230 and BRJ-1103 exhibited moderately resistant response against the disease. RBJ-13046 and Khanpur Raya were found highly susceptible to the disease. Present research revealed that plant breeders may use these germplasms for their future varietal development trials.

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INTRODUCTION

Mustard belonging to family Brassicaceae (Al-Shehbaz, 2011) is an important oilseed crop of the world. It is the world's third most important source of vegetable oils and their production has witnessed a steady upward rise during the past 25 years (Gunstone, 2004; Gupta and Pratap, 2007).

Leaf spot of crucifers caused by *Xanthomonas campestris* pv. *armoraciae* or pv. *raphani* is an emerging bacterial disease in Pakistan. It was first reported on horseradish in 1929 and on radish and turnip in 1930 (McCulloch, 1929; White, 1930). The disease has been reported in many countries including the United States, Japan (Tamura et al., 1994), Brazil, China (Zeng and Huang, 1994), Turkey, and India (Sherf and MacNab, 1986). Typical symptoms include small, water-soaked, olive green lesions with a yellow halo (Black and Machmud, 1983; McCulloch, 1929; Sherf and MacNab, 1986). Black, sunken, and elongated lesions on stems and petioles may rapidly kill young plants (Sherf and MacNab, 1986). The symptoms of *Xanthomonas* leaf spot closely resemble those of bacterial leaf spot of cauliflower caused by *Pseudomonas syringae* pv. *maculicola (Sahin and Miller, 1997)*.

The disease management approach through growing resistant germplasm is a cost effective practice

biologically and economically (McGee, 1995). The strategy is beneficial for all poly-cyclic, mono-cyclic and polyetic pathogens. The resistant plant interferes with the pathogen's establishment, colonization and multiplication, hence, interferes with the pathogen's life cycle process and results in attrition of pathogen's population pressure. Economically, this approach reduces the inputs of the grower to counter the disease dramatically. The cost for cultural and chemical practices to debacle the disease progression is too high as compared to this approach (Meynard et al., 2003).

Keeping in view the above facts, the present research was conducted to find the resistant mustard germplasm against bacterial leaf spot disease by screening mustard varieties/lines under natural conditions.

MATERIALS AND METHODS

Field trials were conducted at experimental area of Plant Pathology Research Institute, Ayub Agricultural Research Institute (AARI), Faisalabad, Pakistan. Certified seeds of sixteen mustard varieties/lines viz. KJ-221, KJ-230, BRJ-1103, KJ-221, KJ-230, BRJ-1103, BRJ-1104, 13CBJ004, 13CBJ006, ZBJ-06012, ZBJ-08051, RBJ-08015, RBJ-12019, RBJ-13030, RBJ-13046, Khanpur raya were taken from Oilseed Research Institute, AARI, Faisalabad, Pakistan. To prevent soil borne pathogens' attack and to eliminate the seed borne pathogens, seeds were dressed with a systemic fungicide (Topsin-M) and air dried. Seeds were sown using "hand drill" during the 1st week of December at 5 kg seed ha^{-1}, however, a plant population of 15 plants m^{-2} was maintained by thinning the seedlings with 45-cm inter-row and 15-cm intra-row spacing. The augmented design was used with two repeats. All agronomic practices were adopted. Tap water was sprayed in morning and evening times to increase the humidity. Disease severity was recorded to evaluate varieties/lines against bacterial leaf spot disease after the appearance of the disease.

$$\text{Disease severity } \% = \frac{Diseased\ leaf\ area}{Total\ leaf\ area} \times 100$$

RESULTS AND DISCUSSION

Out of sixteen varieties/ lines, none was found immune and highly resistant against bacterial leaf spot disease of mustard. Three varieties/lines viz. KJ-221, KJ-230 and BRJ-1103 exhibited moderately resistant response against the disease. KJ-221, KJ-230, BRJ-1103, BRJ-1104, 13CBJ004, 13CBJ006, ZBJ-06012, ZBJ-08051, RBJ-08015, RBJ-12019 and RBJ-13030 were found moderately susceptible against the pathogen's virulence. RBJ-13046 and Khanpur raya were found highly susceptible to the disease (Table 1 and 2).

Table 1. Disease rating scale used to assess different levels of resistance/susceptibility against bacterial leaf spot disease.

Infection percentage	Level of resistance/susceptibility
No leaf spot on plant leaf	Immune
1-25% infected leaf area	Highly resistant
25-50 % infected leaf area	Moderately resistant
51-75 % infected leaf area	Moderately susceptible
75-100 % infected leaf area	Highly susceptible

Table 2. Evaluation of mustard germplasm against bacterial wilt disease.

Disease %	Reaction	Varieties/line
0	Immune	None
1-25	Highly resistant	None
25-50	Moderately resistant	KJ-221, KJ-230, BRJ-1103
51-75	Moderately susceptible	KJ-221, KJ-230, BRJ-1103, BRJ-1104, 13CBJ004, 13CBJ006, ZBJ-06012, ZBJ-08051, RBJ-08015, RBJ-12019, RBJ-13030
75-100	Highly susceptible	RBJ-13046, Khanpur raya

The disease management approach through growing resistant germplasm is a cost effective practice biologically and economically. Resistance/susceptibility primarily depends on the genome inheritance (Biffen, 1905), mainly controlled by one (vertical resistance) or many genes (horizontal resistance) (Vanderplank, 1984).

Field resistance mainly depends on the genomic properties of the germplasm or by environmental factors (Govindaraj et al., 2015). True resistance phenomenon comes when a plant resists against the pathogen infection in favorable environmental condition by the genomic property (vertical or horizontal resistance). Often, in the presence of susceptible host and virulent pathogen, it happens that infection may not be established due to unfavorable weather condition (Agrios, 2000). In the above-performed experiment, it is clear that infection was established under the pathogen's favorable environmental conditions, which supports the idea that the variation among varieties/lines is due to genomic characterization.

(Atiq et al., 2014) screened fifteen cotton germplasm to govern their genetic response. Results showed that none of variety/advanced line showed immune or highly resistant response although FH- 14, Bt-121 and SLH-336 expressed moderately resistance whereas Kirn, SLH Bt-6, Bt-666, CIM-595, FH-113 and Bt-MK2 showed moderately susceptible and SG-1, Bt-222, Bt-457, Bt-7, SLH-317 and Bt-986 showed highly susceptible response against the bacterial blight disease of cotton.

(Mustafa et al., 2017) screened twenty-three pea varieties against collar rot disease. Out of twenty-three varieties/lines, 4 lines/varieties i.e. No.2001-40, Isprit, 2001-60 and Green arrow were categorized as resistant. Twelve test entries exhibited moderately resistant while remaining germplasm was rated as moderately susceptible.

(Sajid et al., 2017) screened twenty-eight varieties/advanced lines against the disease. Seventeen varieties (BT-Z-33, BT-S-78, BT-786, BT-A-ONE, BT -282, BT-886, BT-3701, BT-SPECIAL, BT-802, Non Bt-FH 901, BT-92, BT-131, BT-905, BT-SUPPER, Non Bt-MNH 496, Non Bt-FH 1000 and BT-121) expressed moderately resistant response. Five varieties viz. Non Bt-FH 207, Non BT-N 112, Non BT-FH 942, Non BT-MNH 6070 and Non Bt-FH941exhibited moderately susceptible response. Non BT-N 814, Non Bt-FH 900, Non BT-ANMOL and Non Bt-FH 2015 were found susceptible against the disease while Non BT-REDACOLA and Non BT-C 26 expressed highly susceptible response against bacterial blight disease of cotton.

CONCLUSION

Present study revealed that the "KJ-221, KJ-230 and BRJ-1103" lines were found moderately resistant against the disease, plant breeders may use these germplasms for their future varietal development trials.

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