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RESEARCH ARTICLE

Host Resistance of Genotypes of Rapeseed and Mustard against *Alternaria* blight Under the Agro-ecological Conditions of Undulating Red and Lateritic Belt of West Bengal

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Abstract

Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc. has been reported to be most wide spread and destructive fungal disease of rapeseed-mustard throughout the world. It has a drastic effect on various yield components of rapeseed and mustard which is reflected in reduction of yield up to the tune of fifty percent. Indiscriminate use of fungicides not only pollute the environment but has an adverse residual effect on soil health and soil fertility. Lack of awareness regarding application of these chemicals, their doses, and timing of spray further aggravated the situation. Experiments were conducted to identify a suitable genotype having enough resistance against the disease under the Undulating Red and Lateritic agro-climatic zone of West Bengal with a view to minimize the use of hazardous chemicals. Nine varieties of rapseed-mustard were grown under natural environmental conditions for evaluating their resistance against *Alternaria* blight. Genotypes Bhagirathi and Kalyan were found to be 'Moderately Resistant' against *Alternaria* blight with percent disease index of 19.52 and 17.64 percent (for leaves) and 13.53 and 11.89 percent (for pods) in 2011-12 which was collinear in the successive year i.e. 2012-13 with percent disease index of 17.42 and 15.54 percent (for leaves) and 12.05 and 11.53 percent (for pods) respectively for the two germplasms. Genotypes namely Varuna, Panchali, Agrani and B-9 came under the 'Highly Susceptible' reaction group with PDI in the range of 58-62% for leaves. Germplasms Seeta and Jhumka were noticed Moderately Susceptible, while, genotype Sarma was reported to be Susceptible in this region. The present study not only validated the resistant sources against *Alternaria* blight based on different morphological parameters but also provided an elementary idea regarding sowing of resistant genotypes to farmers so that the indiscriminate application of various chemicals can be reduced to a great extent on one hand and an increased yield could be obtained on the other.

Introduction

In India, oilseeds follow cereals as the second largest agricultural commodity and like the trend in other countries, rapeseed and mustard form a major section of oilseed crops (Summuna *et al*., 2012). Among the biotic constraints which hamper the enhanced production of rapeseed and mustard, disease namely *Alternaria* blight caused by

Alternaria brassicae (Berk.) Sacc is found to be the most severe disease of rapeseed- mustard with no proven source of transferable resistance in any of the hosts (Meena *et al*., 2010). In extreme cases, yield losses exceeding fifty percent has also been reported (Conn and Tewari, 1990). In West Bengal, the disease has been reported by many workers in different agro climatic zones of West Bengal including undulating red and lateritic zone (Mamgain *et al*., 2014). Indiscriminate application of various chemicals is the major alternative which is being employed by majority of the farmers which even include various progressive farmers. In spite of that, there was unawareness among farmers regarding application of appropriate chemicals, doses and time. Farmers are not adopting proper cultural management practices to combat the disease. The information available on the resistant cultivars suitable for this region is scanty. Keeping in view these constraints and further prospective regarding *Alternaria* blight management, present study was undertaken encompassing screening of various rapeseed and mustard genotypes which were being grown by the farmers of Birbhum district and many locations of other agro climatic zones of West Bengal which could prove fruitful in enhanced yield as well as reducing the indiscriminate application of various chemicals.

Materials and Methods

Screening of rapeseed and mustard germplasms against *Alternaria* blight were done at Agricultural Farm, Palli Siksha Bhavana Agricultural Research farm, Sriniketan, Birbhum , West Bengal for two consecutive years i.e. 2011-12 and 2012-13. The germplasms i.e. Bhagirathi, Kalyan, Varuna, Panchali, Agrani , B-9, Seeta, Sarma and Jhumka were collected from Pulse and Oilseed Research Station (P.O.R.S.), Behrampore, West Bengal and were grown in a Randomized Block Design (RBD). The plot size of 5x3 m^{-2} was used with three replications. To record the initial infection of blight disease in different varieties, plots of different varieties were examined properly after sowing. Incidence of *Alternaria* blight of rapeseed and mustard was recorded at an interval of ten days after appearance of first disease symptoms and it was continued up to the senescence of crop. The interval between the date of sowing and the appearance of first symptoms in different varieties and the interval between first incidence and final incidence of the disease were also recorded. Different pathological aspects like percent disease index (PDI) on leaves, average number of spots per leaf, average number of spots per 10 square cm of leaf area, average size of leaf spot, average number of spots per pod, average size of spot on pods, PDI on pods and area under disease progress curve were also studied. The scale followed was on the basis of percent disease index (PDI) on leaves as well as pods (given in parenthesis) and can be given as:

MR- Moderately resistant (>10-20%), MS- Moderately susceptible (>20-30%), S-Susceptible (>30-50%), HS-Highly susceptible (>50%).

Results and Discussion

The reaction of different germplasms was evaluated on the basis of different pathological parameters as mentioned in Table No.1 and 2 for two consecutive years i.e. 2011-12 and 2012-13. The comparative screening of different germplasms established a validation regarding placement of these germplasms under different reaction groups of susceptibility and resistance against *Alternaria* blight following the scale as mentioned above.

The study revealed that the germplasms namely Varuna, Panchali, Agrani and B-9 came under the 'Highly Susceptible' reaction group with percent disease index in the range of 58-62% for leaves and 51-54 % for pods in the year 2011-12 and correspondingly 56-60% for leaves and 51-52% for pods in the year 2012-13. The results clearly showed that these genotypes are the most susceptible ones and therefore care must be taken with respect to proper cropping as well as plant protection strategies in order to reduce the loss in yield.

Furthermore, it was observed that germplasms Seeta and Jhumka showed percent disease index of 27.12% and 23.45% (for leaves) and 24.23% and 22.61% (for pods) respectively for the year 2011-12 which was again reflected in next year 2012-13 with percent disease index of 25.02% and 27.35% (for leaves) with 22.13% and 21.61% (for pods) respectively. These two germplasms were placed under the reaction group 'Moderately Susceptible'.

Genotype Sarma was the only genotype which was found to be appropriate to be placed in reaction group 'Susceptible' with PDI of 38.68% (leaves) and 33.89% (pods) in 2011-12 which in the next year i.e. 2012-13 was reduced to 36.58% (leaves) and 31.89% (pods) but yet was quite convincing regarding placement of this genotype in the aforesaid reaction group.

As far as the resistant genotypes against *Alternaria* blight were concerned, the only genotypes which showed resistance against *Alternaria* blight were Bhagirathi and Kalyan with percent disease index of 19.52 and

17.64 percent (for leaves) and 13.53 and 11.89 percent (for pods) in 2011-12 which was collinear in the successive year i.e. 2012-13 with percent disease index of 17.42 and 15.54 percent (for leaves) and 12.05 and 11.53 percent (for pods) respectively for the two germplasms. These two germplasms were placed under the reaction group namely 'Moderately Resistant'.

The placing of these genotypes into the above reaction groups was also validated with the help of other pathological aspects like average number of spots per leaf, average number of spots per 10 sq cm leaf area, average size of leaf spot, average number of spots per pod, average size of spots per pod and area under disease progress curve (AUDPC). These pathological aspects are mentioned in the table given below. The comparative analysis of these pathological aspects along with the percent disease index on leaves and pods firmly validated the placement of these genotypes under the mentioned reaction groups.

The conducted study regarding determination of resistance of the grown germplasms in the Birbhum district against *Alternaria* blight not only provided an elementary idea regarding susceptibility and resistance against *Alternaria* blight but it also paved the way regarding following of proper cropping as well as plant protection practices so that an integrated approach leading to sustainable agriculture can also be followed. Measures like encouraging farmers to grow resistant cultivars, avoiding susceptible cultivars and following appropriate plant protection measures keeping in mind the initial appearance of disease with respect to the crop maturation time would prove really fruitful in combating the disease not only in the Birbhum district of West Bengal but also in different zones of the state which would not only help in reducing the dependability on various chemicals with persistent residual effects of them but it would result in an enhanced yield with an eco friendly sustainable agricultural approach (Mamgain et al., 2013).

Table 1: Reaction of rapeseed-mustard varieties against *Alternaria* blight under natural conditions (2011-12)

S.No.	Varieties	Crop Maturation Time (Days)	Initial appearance of disease (DAS)	Average Percent Disease Incidence on leaves (%) **	Average number of spots/ leaf	Average number of spots/10 cm^2 leaf area	Average size of leaf spot (mm)	Average number of spots /pod	Average size (mm)of spot on pods	Average Percentage disease Index on pods (%) **	AUDPC (mm^2)	Reaction Group
1.	Varuna	125-130	40	62.35 (52.150)	42.04	7.45	7.29	12.68	3.56	54.38 (47.513)	1494.50	HS
2.	Sarma	95-105	49	38.68 (38.457)	39.32	5.87	6.95	11.46	2.99	33.89 (35.600)	1258.50	S
3.	Seeta	100	52	27.12 (31.374)	37.31	5.10	6.29	10.35	2.68	24.23 (29.483)	1237.00	MS
4.	Panchali	80-85	43	59.48 (50.465)	44.45	6.92	7.05	12.02	3.45	52.73 (46.565)	1405.50	HS
5.	Agrani	70-75	45	58.39 (49.830)	47.73	7.35	7.15	12.33	3.68	51.63 (45.934)	1428.50	HS
6.	B-9	90-95	42	61.42 (51.602)	46.12	7.52	7.11	12.55	3.72	53.81 (47.185)	1439.00	HS
7.	Jhumka	95-105	51	23.45 (28.957)	38.29	5.02	6.13	10.26	2.59	22.61 (28.390)	1219.00	MS
8.	Bhagirathi	100	57	19.52 (26.218)	29.63	4.87	5.92	8.62	2.19	13.53 (21.575)	1136.00	MR
9.	Kalyan	125-135	58	17.64 (24.833)	26.99	3.25	5.11	8.29	2.05	11.89 (20.169)	1119.50	MR
	SEM(±) CD (at 5%)			0.316 0.949	1.328 3.984	0.431 1.293	0.345 1.035	0.228 0.683	0.161 0.483	0.298 0.893	35.355 105.990	

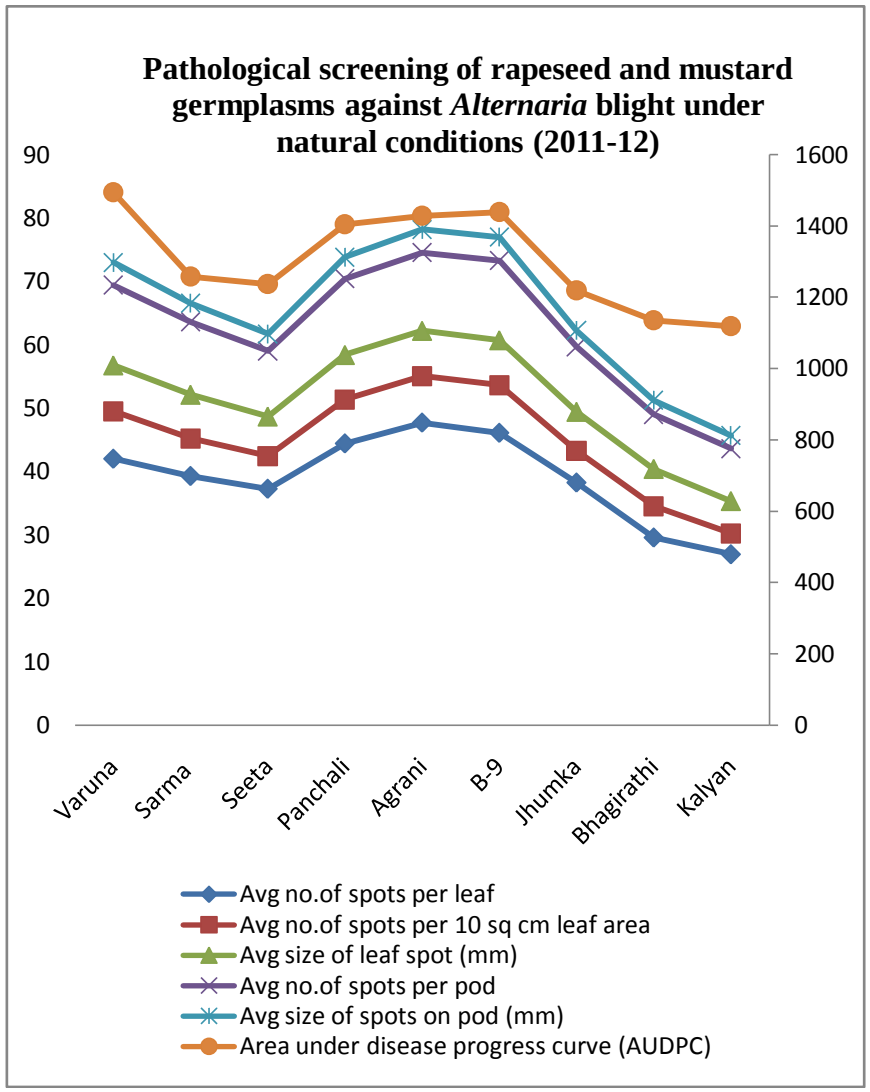
MR- Moderately resistant (>10-20%), MS- Moderately susceptible (>20-30%), S-Susceptible (>30-50%), HS- Highly susceptible (>50%). DAS- Days after Sowing (**values in parenthesis are the angular transformed values)

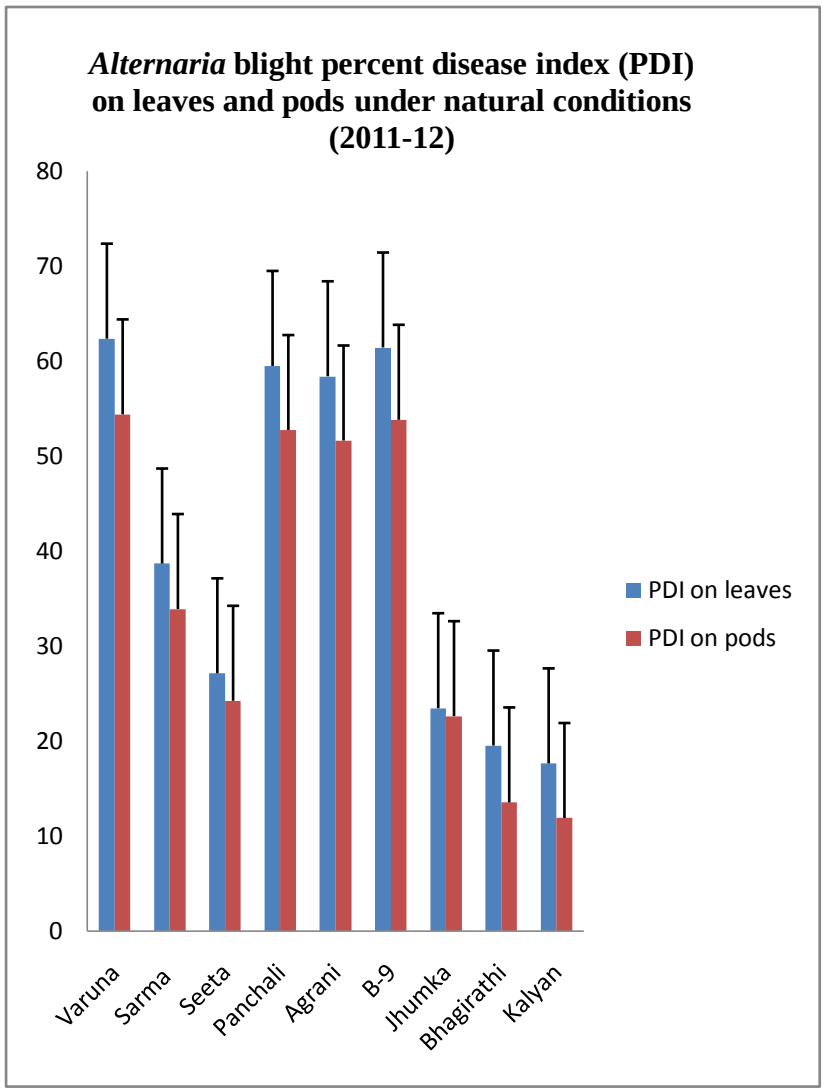
Table 2: Reaction of rapeseed-mustard varieties against *Alternaria* blight under natural conditions (2012-13)

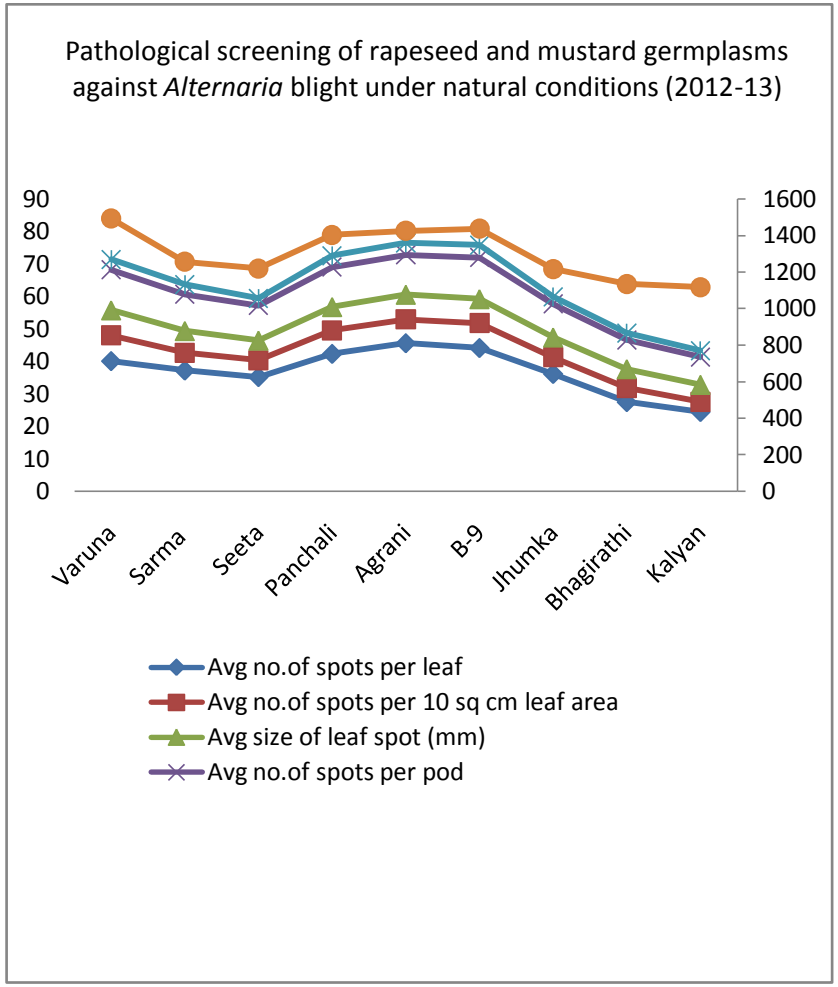
S.No.	Varieties	Crop Maturation Time (Days)	Initial appearance of disease (DAS)	Average Percent Disease Index on leaves (%) **	Average number of spots/ leaf	Average number of spots/10 cm^2 leaf area	Average size of leaf spot (mm)	Average number of spots /pod	Average size (mm)of spot on pods	Average disease Index on pods (%) **	AUDPC (mm^2)	Reaction
1.	Varuna	125-130	39	60.25 (50.916)	40.13	7.97	7.68	12.43	3.21	52.28 (46.306)	1492.50	HS

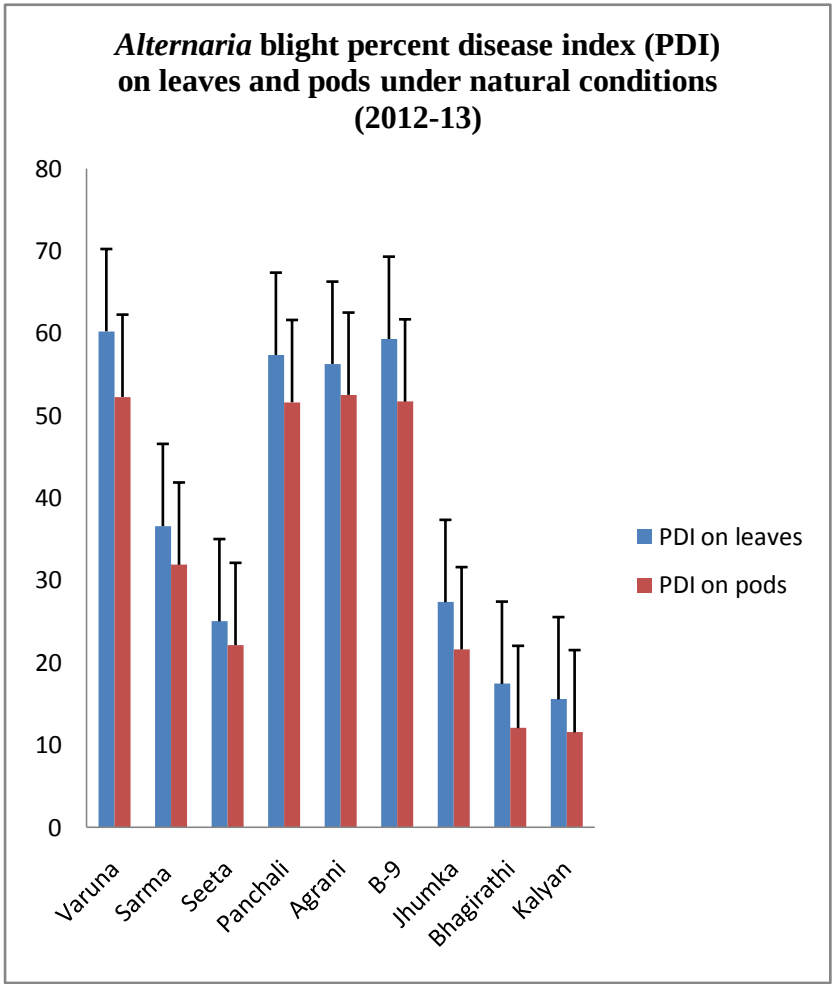
2.	Sarma	95-105	48	36.58 (37.214)	37.22	5.45	6.75	11.26	2.97	31.89 (34.380)	1256.50	S
3.	Seeta	100	53	25.02 (29.994)	35.22	5.15	6.12	10.71	2.15	22.13 (28.056)	1219.00	MS
4.	Panchali	80-85	42	57.38 (49.244)	42.35	7.25	7.19	12.32	3.38	51.63 (45.934)	1403.50	HS
5.	Agrani	70-75	44	56.29 (48.613)	45.63	7.33	7.63	12.23	3.69	52.53 (46.450)	1426.00	HS
6.	B-9	90-95	41	59.32 (50.371)	44.15	7.68	7.39	12.81	3.87	51.71 (45.979)	1437.50	HS
7.	Jhumka	95-105	52	27.35 (31.531)	36.19	5.10	6.15	10.22	2.23	21.61 (27.698)	1217.00	MS
8.	Bhagirathi	100	55	17.42 (24.661)	27.53	4.38	5.78	8.92	2.11	12.05 (20.298)	1134.50	MR
9.	Kalyan	125-135	57	15.54 (23.214)	24.49	3.11	5.26	8.47	1.98	11.53 (19.848)	1117.50	MR
	SEM(±) CD (at 5%)			0.364 1.092	2.189 6.564	0.435 1.305	0.420 1.259	0.191 0.573	0.156 0.469	0.341 1.024	34.515 103.470	

MR- Moderately resistant (>10-20%), MS- Moderately susceptible (>20-30%), S-Susceptible (>30-50%), HS- Highly susceptible (>50%). DAS- Days after Sowing. (**values in parenthesis are the angular transformed values)


Pathological screening of rapeseed and mustard germplasms against *Alternaria* blight under natural conditions (2011-12)
90
80
70
60
50
40
30
20
10
0
1600
1400
1200
1000
800
600
400
200
0
Varuna
Sarma
Seeta
Panchali
Agrani
B-9
Jhumka
Bhagirathi
Kalyan
Avg no.of spots per leaf
Avg no.of spots per 10 sq cm leaf area
Avg size of leaf spot (mm)
Avg no.of spots per pod
Avg size of spots on pod (mm)
Area under disease progress curve (AUDPC)


Alternaria blight percent disease index (PDI) on leaves and pods under natural conditions (2011-12)
80
70
60
50
40
30
20
10
0
Varuna
Sarma
Seeta
Panchali
Agrani
B-9
Jhumka
Bhagirathi
Kalyan
PDI on leaves
PDI on pods


Pathological screening of rapeseed and mustard germplasms against *Alternaria* blight under natural conditions (2012-13)
90
80
70
60
50
40
30
20
10
0
1600
1400
1200
1000
800
600
400
200
0
Varuna
Sarma
Seeta
Panchali
Agrani
B-9
Jhumka
Bhagirathi
Kalyan
Avg no.of spots per leaf
Avg no.of spots per 10 sq cm leaf area
Avg size of leaf spot (mm)
Avg no.of spots per pod


***Alternaria* blight percent disease index (PDI) on leaves and pods under natural conditions (2012-13)**
80
70
60
50
40
30
20
10
0
Varuna
Sarma
Seeta
Panchali
Agrani
B-9
Jhumka
Bhagirathi
Kalyan
PDI on leaves
PDI on pods

Conclusions

From the host resistance study of genotypes it was clear that the genotypes namely, Varuna, Panchali, Agrani and B-9 came under 'Highly Susceptible' reaction group whereas germplasms namely, Seeta and Jhumka came under 'Moderately Susceptible' reaction group. Sarma was the only one which came under the 'Susceptible' reaction group. The genotypes showed enough resistance against *Alternaria* blight were Bhagirathi and Kalyan were categorized under 'Moderately Resistant' group. Apart from the periodical observation of percent disease index on pods and leaves for these germplasms, there were various other pathological parameters which validated the firm placement of these germplasms under the aforesaid reaction groups. Determination of reaction groups for these genotypes would help the farmers to select their appropriate varieties in the region and also help in reducing the disease up to a certain level. This would also help to design a crop sequence model with respect to efficient cropping as well as plant pathological measures to be taken which would result in an efficient, economical and environmental friendly crop yield enhancement strategy.

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