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Research Article

Evaluation of Common Bean Germplasm Lines for Resistance to Angular Leaf Spot (*Phaeoisariopsis griseola* (Scac.) *Ferraris*) Under High Altitude Conditions of Gurez Valley

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ABSTRACT

During kharif season of years 2017 and 2018 field screening of sixteen common bean germplasm lines against angular leaf spot (ALS) under natural disease epidemic conditions could identify for resistance to angular leaf spot (ALS) in common bean have relied on a range of sources of resistance. However, due to occurrences of many different races of the pathogen, sources of resistance may not always be effective in all the regions. The present study was conducted to identify new sources of resistance to ALS. A total of sixteen new germplasm lines were evaluated for resistance. The results observed that the response germplasm lines to ALS during the two years were similar. The results further revealed that under epiphytic conditions only one germplasm viz., SR-1 exhibited resistance reaction.

Keywords: Angular leaf spot; *Pseudocercospora griseola*; Common bean

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) also known as kidney bean, French bean, dry bean or field bean is one of the important pulse crops that has found its place in the daily diet of more than 30 million people worldwide [1]. Beans having originated from South Mexico and Central America are now been cultivated in different parts of the world for its green pods or dry beans (Rajmash). In India, beans occupy an area of 137.54 thousands hectares with a production of 25.42 million MT [2]. Its cultivation is mainly confined to northern and plain tracts of Jammu and Kashmir (J&K), Himachal Pradesh and Uttar Pradesh as a kharif crop and also as winter crop in some parts of Jammu and Kashmir, Maharashtra, Andhra Pradesh, Western and Eastern Ghats and North Eastern plain zone, where winters are mild and frost free. In Jammu and Kashmir, common bean is cultivated over an area of about 2000 hectares with a production of 1600 tones and yield of about 0.8 tons/ha [3]. The biotic and abiotic stresses have been identified as major constraint for low productivity in beans. The bean yields obtained from the farmer's field are only 20% to 30% of the genetic potential of improved varieties [4]. Among the biotic stresses, diseases contribute significantly towards lowering the genetic potential of improved varieties of beans. Yield losses of bean due to diseases are very significant and devastating in bean industry [5]. Among these, angular leaf spot (ALS) disease caused by *Phaseoisariopsis grisola* (Sacc.) *Ferraris* is most widely distributed and damaging disease causing yield losses as high as 80% [6]. This disease mainly infects leaves and pods, inducing premature leaf dropping and consequently reduction in grain quality [7]. Losses in grain yield caused by ALS can reach 80% [8].

The development of cultivars with improved resistance to biotic and abiotic stress has long been the primary goal for plant breeding programes [9]. Breeding for disease resistance is an economic and eco-friendly strategy to fight against this disease. Screening of bean germplasm for identification of sources of resistance is expected to generate basic material to design future breeding programs in beans. The greatest set back to this strategy is the high pathogenic variability occurring *Phaseoisariopsis grisola* that renders bean varieties that are resistant in one location or year susceptible in another and also its incidence and severity has increased in the areas of common bean production [10]. It is considered that the use of resistant cultivars is an efficient, safe and in-expensive technique accessible for bean growers [11]. In fact, this strategy is most effective and sustainable for controlling

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bean disease [12]. Thus it has become imperative and sustainable to screen the available bean germplasm against the prevalent major disease angular leaf spot of the area to identify potential donors to be used for executing future breeding programs.

MATERIALS AND METHODS

Sixteen common bean germplasm lines including three land races and a local susceptible check were screened against the angular leaf spot (ALS) disease at an elevation of 8000 ft masl under natural disease epidemic during years 2017 and 2018 at Mountain Agriculture Research and Extension Station (MAR&ES), Gurez, Bandipora, Jammu and Kashmir, India. The experiment was laid out in a complete randomized block design with three replications each year and recommended organic agronomic practices were followed to raise the crop. From each representative germplasm collection, 10 plants were randomly selected and were tagged for the assessment of the disease. All the leaves of ten plants were counted and then grouped as healthy and disease (Tables 1 and 2).

Table 1: Field reaction of common bean germplasm collection against angular leaf spot disease (%) during 2017 & 2018.

Entry name/No.	Disease Incidence (%)		Pooled
	2017	2018	
WB-112	46.6 (43.0)	43.4 (41.2)	45.0 (42.1)
WB-1446	39.5 (38.9)	34.0 (35.6)	36.7 (37.2)
WB-1492	56.6 (48.8)	49.6 (44.8)	53.1 (46.8)
WB-1639	60.0 (50.7)	53.3 (46.8)	56.6 (48.7)
WB-1443	51.6 (45.9)	45.2 (42.2)	48.4 (44.1)
R-132	40.6 (39.5)	35.5 (36.2)	38.0 (38.1)
WB-222	45.6 (42.5)	41.7 (40.2)	43.6 (41.1)
WB-1643	63.3 (52.7)	55.0 (47.9)	59.1 (50.3)
WB-956	42.6 (40.7)	40.3 (39.4)	41.4 (40.1)
SR-1	37.3 (37.6)	32.4 (34.6)	34.8 (36.1)
WB-83	66.6 (54.6)	59.0 (50.5)	63.0 (52.6)
WB-185	54.4 (47.4)	47.5 (43.6)	50.9 (45.5)
GLC-P	80.3 (63.6)	70.0 (56.8)	75.1 (60.0)
GLY-P	85.6 (67.6)	78.4 (62.3)	82.0 (64.8)
GLM-P	83.5 (66.0)	76.0 (60.7)	79.7 (63.3)
GLS-P	72.8 (58.5)	59.3 (50.3)	66.0 (54.3)
Over all mean	57.9	51.4	54.6
CD (p=0.05)	3	2.7	2.8

Table 2: Disease intensity (%) in common bean germplasm collection against angular leaf spot disease during 2017 & 2018.

Entry name /No.	Disease intensity (%)		Pooled
	2017	2018	

WB-112	22.0 (28.0)	21.5 (27.6)	21.7 (27.8)
WB-1446	13.7 (21.6)	10.7 (19.1)	12.2 (20.4)
WB-1492	28.0 (31.9)	27.3 (31.5)	27.6 (31.7)
WB-1639	29.3 (32.8)	28.5 (32.3)	28.9 (32.5)
WB-1443	25.0 (30.0)	23.3 (28.9)	24.1 (29.4)
R-132	14.7 (22.5)	12.3 (20.5)	13.5 (21.6)
WB-222	19.3 (26.1)	14.8 (22.6)	17.0 (24.4)
WB-1643	30.0 (33.2)	29.3 (32.8)	29.6 (33.0)
WB-956	17.0 (24.4)	13.7 (21.7)	15.3 (23.1)
SR-1	9.5 (18.0)	9.0 (17.5)	9.2 (17.7)
WB-83	32.0 (34.4)	31.7 (34.3)	31.8 (34.4)
WB-185	26.4 (30.9)	25.3 (30.2)	25.8 (30.6)
GLC-P	37.3 (37.6)	35.0 (36.3)	36.1 (37.0)
GLY-P	43.3 (41.1)	40.0 (39.2)	41.6 (40.2)
GLM-P	40.0 (39.2)	38.5 (38.4)	39.2 (38.8)
GLS-P	35.0 (36.3)	34.5 (36.0)	34.7 (36.1)
Over all mean	26.4	24.7	25.5
CD (p=0.05)	2.4	2.3	2.3

Percent disease incidence was worked out as per the formula given by James [13].

Percent disease incidence (%) = No. of diseased leaves/Total number of leaves assessed × 100

For assessment of disease intensity, germplasms of common bean were screened at flowering stage of the crop. Observations were recorded from flowering to maturity of the crop using 1-9 scale as adapted by Centro International de Agricultura Tropical (CIAT) [14].

Scale % leaflet area with lesions

1 = 1-10%

3 = 11-25%

5 = 26-50%

7 = > 50%

9 = Defiolation

Percent disease intensity (PDI) was calculated as per the formula given by FAO:

Percent disease intensity = $\sum (n \times v) / (N \times G) \times 100$

Where, Σ = Summation, n =Number of leaves in each category

V = Numerical value of leaves observed

N = Number of leaves examined

G = Maximum grade value

RESULTS AND DISCUSSION

The observations recorded on screening of sixteen common bean germplasm lines conducted during years 2017 and 2018 under natural epidemic of *Phaeoisariopsis griseola* (Sacc.) Ferr. indicated that the disease occurred in variable proportions on the lines during both years (Tables 1 and 2). However, analysis of the data showed a differential response among the germplasm lines with regard to incidence and intensity.

Disease incidence

The observations recorded revealed that the disease incidence was significantly different for two years and minimum of 51.4 per cent was recorded in the year 2018 and maximum of 57.9 per cent was recorded in the year 2017. The disease incidence among the germplasm lines ranged between 37.3 to 85.6 per cent during the year 2017 and 32.4 to 78.4 per cent in 2018.

The analysis of the pooled data for two years indicated that most of the bean germplasm lines evaluated are susceptible to the disease but there existed a significant difference in the disease incidence among different germplasm lines. Maximum disease incidence 82.0 per cent was recorded in the germplasm (GLY-P) which was significantly at par with GLM- P with average disease incidence 79.7 per cent. Minimum disease incidence was recorded in the genotype SR-1 with average of 34.8 per cent. Rest of the germplasm lines had significant differential response to the maximum and minimum disease incidence. The increase in the disease incidence during year 2017 may be attributed to favourable climate and disease developmental conditions that prevailed during the year. The meteorological data collected from Snow and Avalanche Study Establishment (SASE) Kanzalwan, Gurez (J&K) during the cropping season showed highest precipitation of 428 mm and temperature range of 26.8°C to 4.6°C while during the year 2017, it was 354 mm and 27.3°C to 5.7°C during the year 2018. High precipitations result in higher humidity that is conducive for disease development and might be playing role in the disease dissemination. These results are in agreement with reports by other researchers who reported a negative correlation between disease variables and yield. Angular leaf spot disease incidence of common bean depends upon rainfall quantity and intensity [15,16]. Duration of relative humidity can be used in the prediction of disease events such as incidence and severity [17]. Fluctuating weather conditions, especially relative humidity, temperature, and rainfall have been reported to favour diseases development under fields conditions Scheuemann et al., [18]. The above findings may be attributed to the high rainfall, relative humidity and high altitudes that are more favourable to ALS infection and disease development [19].

Disease intensity

Disease intensity was significantly different for two years and maximum of 26.4 per cent was recorded in the year 2017 and minimum of 24.7 per cent in 2018. The disease intensity among the germplasm lines ranged between 9.5 to 43.3 per cent during the year 2017 as against 9.0 to 40.0 per cent during the year 2018.

The analysis of the pooled data indicated that the germplasm lines evaluated were susceptible to the disease but there existed a significant difference. Maximum disease intensity was recorded in the local germplasm (GLY-P) 41.6 per cent which was statistically at par with GLM-P with average intensity of 39.2 per cent. The disease intensity of 34.7 per cent was recorded in GLS-P which was statistically at par with GLC-P with average intensity of 36.1 per cent. Minimum disease intensity was recorded in SR-1 9.2 per cent which showed statistical difference from other germplasm lines. Among the sixteen germplasm lines screened only SR-1 exhibited resistance reaction to the disease (rating between 1-10%) other entries viz., GLS-P, GLC-P, GLY-P, GLM-P, WB-1492, WB-1639, WB-1643, WB-83 and WB-185 were susceptible (rating between 25.1-50%). Rest of the germplasm lines were moderately susceptible (Table 3).

Table 3: Grouping of common bean germplasm for angular leaf spot reaction based on per cent disease intensity.

Reaction category	Per cent disease Intensity	Germplasms
Resistant	0 - 10	SR-1
Moderately susceptible	10.1 - 25.0	R-132, WB-1443, WB-112, WB-222, WB-956, WB-1446,
Susceptible	25.1 - 50	
		GLC-P, GLS-P, GLM-P, GLY-P, WB-1492, WB-1639, WB-1643, WB-83 and WB-185
Highly susceptible	> 50	-

Plant species have a defence mechanism to avoid and resist pathogens and pests [20]. Identification and utilization of common bean resistant source to *P. griseola* contributes greatly to management of the disease, since resistant varieties are the most practical and easily adaptable strategy. Use of disease resistant cultivars in combination with appropriate cultural practices is essential for the management of bean diseases [11]. Much of genetic improvement in common bean has been achieved through conventional breeding techniques. It has been indicated that resistance to *P. griscola* in common bean is conditioned by major and minor genes, the majority of which are from primary and secondary gene pools. However, breeding for resistant varieties has been made difficult by the variability of *P. griseola*. Use of minor gene based resistance in durable resistance based breeding programme is considered to be highly effective against such fungal diseases. Several common bean lines with good levels of resistance (And-277, Mar-2, Mexico-54, BAT-32 and Cornell-42949) have been identified as potential sources of resistance to certain races of *P. griseola* [21]. Genotype Ouro Negro was reported to have dominant genes that controlled resistance to *P. griseola* races 63-39 and 31-32 [22]. Vidigal, [23] reported only three angular leaf spot resistance genes Phg-1, Phg-2 and Phg-3 have been mapped and used for gene nomenclature as proposed by the Bean Improvement Cooperative (BIC). Kimno et al., [24] reported that out of 34 entries studied; only one showed field resistance to ALS and further revealed that there remains a need to identify further donors of resistance. Razwi et al., [25] has evaluated seventy five accessions of common bean under field conditions and revealed that only five accessions exhibited resistance reaction against angular leaf spot of common beans. Genetic resistance is the most cost effective, easy to use and ecological strategy to manage the disease. However, progress in breeding for resistance to angular leaf spot has been difficult [26].

CONCLUSION

The present study was conducted to identify new sources of resistance to ALS. A total of sixteen new germplasm lines were evaluated for resistance. The results observed that the response germplasm lines to ALS during the two years were similar. The results further revealed that under epiphytic conditions only one germplasm viz., SR-1 exhibited resistance reaction.

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