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Screening for Rust Disease in Soybean [(*Glycine max* L.) Merrill] Across Three Locations

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Abstract The present investigation was carried out to screen over three environments for rust disease in 13 advanced breeding lines (including five parents) of soybean. The experiment was laid out in a randomized complete block design with three replications during *kharif* of 2013. The study revealed that the three lines viz., DSb 21, DSb 23-2 and DSb 28-3 exhibited resistant reaction with respect to number and type of lesions compared to the check JS 335. Rest of all lines exhibited susceptible reaction under natural epiphytotic condition. The rust resistant lines viz., DSb 21, DSb 23-2 and DSb 28-3 may be utilized in further breeding program to develop short duration genotypes suitable for intercropping and sequential cropping system.

Keywords Rust, Sybean, Disease

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Introduction

Oil and fats are essential items in human diet since they provide energy; improve taste and palatability of food. Oilseed crops are next to cereals in production of agricultural commodities in India, which occupy a place of prime importance in Indian economy. Soybean [(*Glycine max* L.) Merrill] designated as the "miracle bean" has established its potential as an industrially vital and viable oil seed crop in many areas of India. Soybean has the highest protein content (40 to 42%) of all other food crops and is second only to groundnut in terms of oil content (18 to 22%). The oil contains 85% unsaturated fatty acids and is free from cholesterol, along with ample mineral elements and is thus highly desirable for human diet. Being legume it also fixes atmospheric nitrogen to available form. As the best source of protein it truly claims the title "the meat that grows on plant". The important constraints for cultivation of soybean in India are outbreak of diseases and insect pests. Diseases play a major role in yield reduction. Among the diseases of soybean, rust caused by *Phakospora pachyrhizi* Syd. is one of the devastating foliar disease of soybean. The severity of disease may range from 10 to 100% depending upon locality, season and cultivar. The disease appeared suddenly in epiphytotic form in recent years (*kharif* 1994/1995) and caused substantial yield losses particularly in parts of Karnataka, Maharashtra and Madhya Pradesh. Now, it has become major constraint for the soybean production system particularly in northern Karnataka and parts of Maharashtra. A key requirement in breeding effort is the screening

Table 1. Pedigree of the genotypes used in the study. *Released by AICSIP, Indore for southern zone during 2014.

Sl. No.	Genotypes	Pedigree\
1	DSb 21*	JS 335 × EC 241778
2	DSb 23-2	JS 335 × EC 241780
3	DSb 28-3	JS 93–05 × EC 241780
4	Line No. 9-1	DSb 12 × EC 241780
5	Line No. 9-2	DSb 12 × EC 241780
6	Line No. 9-3	JS 335 × EC 241780
7	Line No. 30-2	JS 335 × EC 241780
8	Line No. 15-3-2	JS 335 × EC 241780
9	EC 241778 (P)	An exotic germplasm line
10	EX 241780 (P)	An exotic germplasm line
11	DSb 12 (P)	JS 335 × PS 73-7
12	JS 93-05 (P)	Selection from PS 73-22
13	JS 335 (P/C)	JS 78-77 × JS 71-05

of plants for resistance to rust pathogen to identify cultivars that are likely to withstand infection. Though, triazole fungicides have been found effective in control of rust of soybean. The continuous use of these chemical fungicides may pose problem of development of resistance to pathogen. Therefore, the development of high yielding rust resistant varieties is of prime importance. Keeping these in view of above facts, the objectives of the present investigation was to screen the advanced breeding lines of soybean to the rust disease.

Materials and Methods

The materials for the present study comprised of eight advanced breeding lines which are cross derivatives of JS 335 × EC 241778, JS 335 × EC 241780, JS 93-05 × EC 241780, DSb 12 × EC 241780 along with their five parents (Table 1) was laid out in a replicated trial at three locations viz., Main Agricultural Research Station, Dharwad, Agricultural Research Station, Bailhongal and Research and Development Farm, Ugar Sugar Works, Ugarkhurd, during *kharif* of 2013. The trials were conducted in randomized complete block design replicated thrice in each environment each line was sown in 3 rows of 4 meter length, with a spacing of 30 cm between the rows and 10 cm between the plants. And these genotypes were screened for the rust disease under natural epiphytotic condition at all the above three locations. Observations were recorded by using the standard 0 to 9 scale [1].

Table 2. Resistant reaction of advanced breeding lines of soybean under natural epiphytotic conditions. 0–Immune, 1–Highly resistant, 3–Moderately resistant, 5–Moderately susceptible, 7–Susceptible, 9–Highly susceptible.

Genotypes	Resistant reaction (0–9 scale)		
	Dharwad	Bailhongal	Ugarkhurd
DSb 21	1	1	1
DSb 23-2	1	1	1
DSb 28-3	1	1	1
Line No. 9-1	3	3	3
Line No. 9-2	5	3	5
Line No. 9-3	5	3	7
Line No. 30-2	7	5	9
Line No. 15-3-2	9	7	7
EC 241778 (P)	1	1	1
EC 241780 (P)	1	1	1
DSb 12 (P)	7	9	9
JS 93-05 (P)	9	9	9
JS 335 (c)	9	9	9

Disease severity was graded by employing 0 to 9 scale has been followed.

Rating	Description
0	No lesions/spots
1	1% leaf area covered with lesions/spots
3	1.1-10% leaf area covered with lesions

5	10.1-25% of leaf area covered, no defoliation, little damage
7	25.1-50% leaf area covered, some leaves drop, death of few plants, damage conspicuous
9	More than 50% area covered, lesions/spot very common on all plants, defoliation common, death of plants common, damage more than 50%.

On the basis of the disease severity the entry/variety can be classified as follows.

Rating	Resistant category
0%	Absolutely Resistant (AR)
0.01-11.11%	Highly resistant (HR)
12.22-33.33%	Moderately resistant (MR)
34.44-55.55%	Moderately susceptible (MS)
56.66-77.77%	Susceptible
78.88-100.0%	Highly susceptible

Type of lesions may be either reddish brown or tan color. Reddish brown lesions may produce few urediospores, whereas tan lesions may produce numerous urediospores based on color of lesions, these were scored either resistant or susceptible [2, 3].

Results and Discussion

Rust is the major problem in soybean growing areas of the world. So effective management practices need to be evolved for the management of this disease. Among them, the most cheap and effective method of managing rust disease is use of resistant cultivars. Screening of germplasm lines and utilization of resistant germplasm lines in breeding program to develop the cultivars with resistant character is a continuous process. In this study, 13 soylean genotypes were screened for the rust disease. Observations were recorded by using the standard 0 to 9 scale. Reactions of these genotypes are presented in Table 2.

Table 2 shows that in Dharwad out of 13 genotypes screened, five genotypes viz., DSb 21, DSb 23-2, DSb 28-3, EC 242778 and EC 241780 recorded highly resistant reaction to rust (grade 1). None of the en-

Table 3. Resistant reaction of advanced breeding lines of soybean under natural epiphytotic conditions. RB–Reddish brown lesions, TAN–Tan color lesions.

Genotypes	No. of pustules/cm^2				Type of pustule		
	Dharwad	Bailhongal	Ugarkhurd	Average	Dharwad	Bailhongal	Ugarkhurd
DSb 21	22	27	8	19	RB	RB	RB
DSb 23-2	23	5	10	12.67	RB	RB	RB
DSb 28-3	16	4	14	11.33	RB	RB	RB
Line No. 9-1	34	27	30	30.33	TAN	RB	RB
Line No. 9-2	43	35	54	44	TAN	RB	TAN
Line No. 9-3	25	29	48	34	TAN	RB	TAN
Line No. 30-2	25	51	81	52	RB	TAN	TAN
Line No. 15-3-2	66	61	52	59.33	TAN	TAN	TAN
EC 244778 (P)	25	13	8	15.33	RB	RB	RB
EC 241780 (P)	26	22	4	17.33	RB	RB	RB
DSb 12 (P)	52	81	48	60	TAN	TAN	TAN
JS 93-05 (P)	43	80	54	59	TAN	TAN	TAN
JS 335 (c)	48	80	85	71	TAN	TAN	TAN

tries exhibited absolute resistance to rust. Three genotypes viz., Line No. 15-3-2, JS 93-05 and JS 335 recorded disease grade (9) and were found to be highly susceptible.

In Bailhongal five genotypes viz., DSb 21, DSb 23-2, DSb 28-3, EC 241778 and EC 241780 recorded disease grade (1) and were found to be highly resistant. Three genotypes viz., DSb 12, JS 93-05 and JS 335 recorded disease grade (9) and were found to be highly susceptible.

Similarly in Ugarkhurd, five genotypes viz., DSb 21, DSb 23-2, DSb 28-3, EC 241778 and EC 241780 were found to be highly resistant (grade 1). Four genotypes viz., Line No. 30-2, DSb 12, JS 93-05 and JS 335 recorded disease grade (9) and were found to be highly susceptible.

Irrespective of locations, five genotypes viz., DSb 21, DSb 23-2, DSb 28-3, EC 241778 and EC 241780 recorded disease grade (1) and were found to be highly resistant. Four genotype viz., Line No. 30-2, DSb 12, JS 93-05 and JS 335 recorded disease grade (9) and were found to be highly susceptible. These results were conformity with the earlier reports [4—8].

The results on type of pustule and lesion density per cm^2 in 13 genotypes are presented in Table 3. In Dharwad, the resistant lines viz., EC 241778, EC 241780, DSb 21, DSb 23-2, DSb 28-3 and Line No. 30-2 exhibited RB lesions with less postules ranging from 16–26 postules/cm^2. However the remaining lines viz., JS 335, JS 93-05, DSb 12, Line No. 9-1, Line No. 9-2, Line No. 9-3 and Line No. 15-3-2 exhibited TAN color lesions with abundant pustules ranged from 25 to 66 Pustules/cm^2.

Further, in Bailhongal, the resistant lines viz., EC 241778, EC 241780, DSb 21, DSb 23-2, DSb 28-3, Line No. 9-1, Line No. 9-2 and Line No. 9-3 recorded 25,26,27,5,4,27,35,29 lesions per leaf respectively. The lines viz., JS 335, JS 93-05 and DSb 12 recorded more than 80 lesions per leaf.

Similarly in Ugarkhurd, the resistance lines viz., EC 241778, EC 241780, DSb 21, DSb 23-2, DSb 28-3, and Line NO. 9-1 developed RB lesions and had very less postules ranging from 4 to 30 pustules/cm^2. on a susceptible cultivars viz., JS 335, JS 93-05, DSb 12, Line No. 15-3-2, Line No. 30-2, Line No. 9-2 and Line No. 9-3 lesions were TAN color and abundant pustules were observed ranging from 48 to 85 Pustules/cm^2.

Irrespective of locations, five genotypes viz., DSb 21, DSb 23-2, DSb 28-3, EC 241778 and EC 241780 recorded less number of lesions per leaf ranging from 11.33 to 19 pustules/cm^2 with RB lesion type and very less pustules. The eight genotypes viz., JS 335 (71), JS 93-05 (59), DSb 12 (60), Line No. 15-3-2 (59.33), Line No. 30-2 (52), Line No. 9-1 (30.33), Line No. 9-2 (44) and Line No. 9-3 (34) exhibited TAN colored lesions with abundant pustules ranging from 30.33 to 71 pustules/cm^2. Hence, The rust resistant lines viz., DSb 21, DSb 23-2 and DSb 28-3 may be utilized in further breeding program to develop short duration genotypes suitable for intercropping and sequential cropping system.

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