

Original Research Article

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Screening of Genotypes to Identify the Resistance Source against Major Diseases of Soybean under High Disease Pressure Conditions

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ABSTRACT

Charcoal rot and Aerial alight caused by *Macrophomina phaseolina* (Tassi) Goid and *Rhizoctonia solani* Kuhn, respectively are major biotic challenges across the country in soybean cultivation. The problem of disease can be overcome nicely by growing resistant variety and using integrated disease management practices. In this concern, for the identification of resistant source, total sixty genotypes including five check varieties namely Shivalik, JS 335, JS 95-60, JS 93-05 and NRC 7 were evaluated under high disease pressure during kharif 2019. The disease index of Rhizoctonia Aerial Blight (RAB) was varied from 0.75 to 37.50 per cent. Out of sixty, five and sixteen genotypes were exhibited highly and moderately resistant reaction against RAB, respectively. In case of Charcoal rot (CR), severity in nine genotypes were reported more than 50 per cent and sixteen genotypes shown absolute resistance. For both diseases, five namely JS 21-71, JS 20-31, TG x – 849 D-13-4, JS 20-42 and JS 20-75 shown absolute resistance to CR plus highly resistance to RAB. Whereas nine i.e. DS 3109, EC 251358, JS 20-79, JS 21-17, VP 1164, JS 20-69, JS 20-34, JS 20-53, MACS 1620 found to be absolute resistant (CR) plus moderately resistant (RAB).

Keywords

Resistance,
Soybean, Charcoal
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Introduction

Soybean (*Glycine max* (L.) Merrill) is known for its high protein and oil content and grows across the world as most important oilseed crops in world. Soybean is cultivated as a kharif season crop in India and during 2016-17, it has occupied 10.97 million ha area with total production of 10.99 million tons whereas the productivity stand of 1002 kg/ha in the

country. Among states, Madhya Pradesh is still ranked first in area as well as in production and covers of 54.01 lakh ha area with the average productivity of 1020 kg/ha and total production of 55.06 lakh ton during the same year of 2016-17 (Anonymous, 2018). In recent year, soybean production and the area coverage under cultivation in different district of M.P. has declined due regular occurring of abiotic and biotic

stresses. In this concern, fungal causing disease like charcoal rot (CR) and Rhizoctonia aerial blight (RAB) have become major challenges in the production of soybean in the state. Both the diseases usually appear during reproductive stages of crop. Charcoal rot can caused complete plant mortality during reproductive stages of crop and formed black microsclerotia in the vascular tissues and on lower part of plant (Bradley and Rio, 2003). Rhizoctonia Aerial Blight caused light to dark brown spots, web like mycelium on foliage and formed sclerotia on above ground parts (Verma and Thapliyal, 1976). Identification and incorporation of resistance in high yielding genotypes is the best way to minimize the losses caused by disease. In looking to increasing view of incidences of diseases, in this field trial an attempt was made to know the resistance level of different genotypes under high disease pressure or hot spot condition.

Materials and Methods

A field evaluation trial for sixty genotypes including five old varieties (Shivalik, JS 335, JS 95-60, JS 93-05 and NRC 7) of soybean were conducted under AICRP on Soybean at JNKVV, Jabalpur during *kharif* 2019. This AICPR, Jabalpur centre is recognized as hot spot for both the diseases (RAB and CR) due to regular appearance of disease in moderate to severe form. All the genotypes were sown in augmented plot design each in two rows during last week of June, 2019.

No fungicides as seed treatment and foliar application were applied during the entire period of crop growth. Whereas other cultivation practices were followed as per the recommendation for the cultivation of soybean. Disease rating and grouping of genotypes were done as per the rating scale used in AICRP on soybean (Anonymous, 2012).

Observation and Grouping of resistance Rhizoctonia Aerial Blight (RAB)

Each genotype was observed regularly during the period of disease progress critically. Observation for RAB was taken on randomly selected ten plants from each genotype. Each selected plants were approximately divided into three positions as bottom, middle and top. In each position two to four leaves are graded and infected leaves were assigned 0-9 ratings/grades which are given Table 1 based on the percent leaf area infected.

Per cent Disease index (PDI) Calculation:

These grades are then utilized for the calculation of PDI by using the following formula of Wheeler’s (1969)

Per cent Disease Index (PDI) =

$$\frac{\text{Sum of individual rating}}{\text{No. of leaves examined}} \times \frac{100}{\text{Max. Disease}}$$

On the basis of PDI, the genotypes/varieties were classified as follows:

PDI	Categories
0.0	Absolutely resistant
0.1 – 1.0	Highly resistant
1.1-10.0	Moderately resistant
10.1- 25.0	Moderately susceptible
25.1 - 50.0	Susceptible
> 50.0	Highly susceptible

Charcoal rot (CR)

Charcoal rot mortality was observed before the maturity of crop in month of September. On the basis of dead and total plant in the particular line, the per cent mortality was calculated and accordingly the genotypes were classified as given below:

Score	Descriptions	Categories
0	No mortality	Absolutely resistant (AR)
1	1 % mortality	Highly resistant (HR)
3	1.1 to 10 % mortality	Moderately resistant (MR)
5	10.1 to 25 % mortality	Moderately susceptible (MS)
7	25.1 to 50 % mortality	Susceptible (S)
9	More than 50 % mortality	Highly susceptible (HS)

Results and Discussion

Resistance to aerial blight

All the tested genotypes were observed critically during entire crop period. The symptoms of RAB have started appearing after 15th of august and highest severity was noticed in the month of September.

The disease index was varied from 0.75 to 37.50 per cent. Out of sixty, five i.e. JS 21-71, JS 20-31, TG x – 849D-13-4, JS 20-42, JS 20-

75 and sixteen i.e. CAT 1241A, EC 39177, DS 3109, EC 251358, JS 20-79, JS 21-17, VP 1164, JS 20-69, JS 20-34, JS 20-53, MACS 1620, BHATT, VP 1162, EC 241807, EC 114573, JS 95-60(c) were exhibited highly and moderately resistant reaction against RAB, respectively. Whereas remaining thirty two and seven were found to be moderately susceptible to susceptible, respectively.

Resistance to charcoal rot

Plant death in different genotypes due to charcoal rot was observed during reproductive stages especially just before the maturity of crop. Out of sixty, nine genotypes were reported more than 50 per cent mortality and grouped under highly susceptible against CR disease. In resistant entries, sixteen namely JS 21-71, JS 20-31, TG x – 849D-13-4, JS 20-42, JS 20-75, EC 241309, DB 1588, DS 3109, EC 251358, JS 20-79, JS 21-17, VP 1164, JS 20-69, JS 20-34, JS 20-53 and MACS 1620 were found absolute resistant. Likewise eighteen genotypes reacted as moderate resistant and remaining seventeen were exhibited moderate susceptible to susceptible reaction.

Table.1 Ratings/ grades based on the percent leaf area infected

Rating	Descriptions
0	No lesions/spots
1	1 % leaf area covered with lesions/spots
3	1.1 to 10 % leaf area covered with lesions/spots, no spots on stem
5	10.1 to 25% of leaf area covered, no defoliation; little damage
7	25.1 to 50 % leaf area covered; some leaves drop; death of a few plants, damage conspicuous
9	More than 50 % area covered, lesions/spots very common on all plants, defoliation common; death of plants common; damage more than 50 %.

Table.1A Reaction of soybean genotypes against *Rhizoctonia* Aerial Blight (RAB) and Charcoal rot (CR) during Kharif - 2019

S.N.	Genotypes	RAB		CR	
		PDI	Reaction	Score	Reaction
1	DS 3109	4.75	MR	0	AR
2	JS 20-51	27.45	S	3	MR
3	EC 109540	18.20	MS	5	MS
4	NRC 67	14.83	MS	3	MR
5	JS 21-71	0.75	HR	0	AR
6	EC 107407	22.43	MS	5	MS
7	CAT 1241A	4.58	MR	3	MR
8	EC 251358	8.25	MR	0	AR
9	JS 20-37	14.30	MS	5	MS
10	EC 241309	16.26	MS	0	AR
11	DB 1588	23.50	MS	0	AR
12	PS 1347	19.45	MS	3	MR
13	JS 21-08	23.80	MS	3	MR
14	P501	20.15	MS	5	MS
15	JS 20-79	8.56	MR	0	AR
16	EC 245986	33.50	S	5	MS
17	EC 7048	21.35	MS	3	MR
18	JS 20-82	20.30	MS	7	S
19	EC 250591	30.40	S	5	MS
20	JS 20-31	0.87	HR	0	AR
21	AGS 95	18.30	MS	5	MS
22	M 204	16.53	MS	7	S
23	JS 20-67	18.0	MS	9	HS
24	EC 291398	21.43	MS	7	S
25	EC 242104	20.50	MS	3	MR
26	EC 457286	14.33	MS	9	HS
27	EC 39177	4.50	MR	9	HS
28	TG x – 849D-13-4	0.87	HR	0	AR
29	EC 241778	22.3	MS	3	MR
30	JS 21-17	2.57	MR	0	AR
31	BHATT	4.60	MR	9	HS
32	JS 20-42	0.75	HR	0	AR
33	VP 1162	4.20	MR	5	MS
34	VP 1164	3.85	MR	0	AR
35	JS 20-69	8.78	MR	0	AR
36	EC 241807	7.43	MR	5	MS
37	PI 210178	17.30	MS	7	S
38	ANKUR	19.20	MS	9	HS

39	EC 114573	8.55	MR	9	HS
40	NRC 84	18.40	MS	3	MR
41	JS 20-65	37.50	S	3	MR
42	Dsb 21	18.45	MS	9	HS
43	EC 291448	28.60	S	3	MR
44	JS 20-34	7.80	MR	0	AR
45	GP 448	31.50	S	5	MS
46	PLS 057	33.25	S	5	MS
47	EC 241696	21.67	MS	3	MR
48	EC 241771	18.75	MS	3	MR
49	EC 1619	20.45	MS	3	MR
50	NRC 71	23.85	MS	3	MR
51	JS 20-53	7.90	MR	0	AR
52	EC 358002	17.53	MS	3	MR
53	EC 241777	20.40	MS	3	MR
54	JS 20-75	0.85	HR	0	AR
55	MACS 1620	5.60	MR	0	AR
56	SHIVALIK (c)	23.4	MS	5	MS
57	JS 95-60(c)	8.57	MR	9	HS
58	JS 93-05(c)	19.80	MS	9	HS
59	JS 335(c)	22.50	MS	3	MR
60	NRC 7 (c)	19.65	MS	5	S

Table.2 Soybean genotypes showing dual resistance against Charcoal rot (CR) plus Rhizoctonia Aerial Blight (RAB) during Kharif- 2019

Diseases	Genotypes	Total
Charcoal rot (AR) + Aerial blight (HR)	JS 21-71, JS 20-31, TG x – 849D-13-4, JS 20-42, JS 20-75	5
Charcoal rot (AR) + Aerial blight (MR)	DS 3109, EC 251358, JS 20-79, JS 21-17, VP 1164, JS 20-69, JS 20-34, JS 20-53, MACS 1620	9
Charcoal rot (MR) + Aerial blight (MR)	CAT 1241A	1

Photo.1 Showing complete mortality (A) and blackening of infected root due to Charcoal rot (B) and close up of progressing of Aerial blight in susceptible genotypes (C), respectively



A



B



C

Resistant to both diseases

Only few genotypes were reported dual resistance against both the diseases. Of this, five namely JS 21-71, JS 20-31, TG x – 849D-13-4, JS 20-42 and JS 20-75 shown absolute resistance to CR plus highly resistance to RAB. Whereas nine i.e. DS 3109, EC 251358, JS 20-79, JS 21-17, VP 1164, JS 20-69, JS 20-34, JS 20-53, MACS 1620 and one namely CAT 1241A found to be absolute resistant (CR) plus moderately resistant (RAB) and moderately resistant (CR plus RAB), respectively.

In India, several workers have reported different level of resistance against both the disease. Gopal and Jagadeeshwar (1997) found highest incidence of 86.8 per cent of charcoal rot in soybean during screening of different genotypes and these were also grouped accordingly their resistance level. Singh (2009) and Patel (2011) screened resistance against *R. solani* causing Aerial blight of soybean and findings were categorized in to highly resistant to highly susceptible. Amrate *et al.*, (2018) also evaluated one hundred and nineteen genotypes in Madhya Pradesh agro condition and reported twenty nine genotypes as highly resistant against charcoal rot and Aerial blight.

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