Screening of soybean genotypes for resistance against three major insect-pests*

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ABSTRACT

Thirty-five soybean genotypes comprising of advanced breeding lines, germplasm lines, released varieties and farmers' selections were evaluated for resistance against three major insect-pests, viz. stem fly, girdle beetle and green semilooper. Some new parameters that have direct impact on grain yield have been used to categorize the genotypes into resistance groups. Accordingly, breeding lines – $B_{14}P_{58\text{-}59}$, D_2P_{11}, D_2P_{23}, D_2P_{25}, D_3P_6, D_3P_8, D_3P_{23}, D_4P_{20}, D_6P_{18}, D_6P_{22}, released variety - JS 93-05, and farmers' selections - Samart, Sel.-280, Sel.-1040, Sel.120, JS 93-05 and Sel. 2002 were found to possess multiple insect resistance.

Key words: Soybean, insects, resistance

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Soybean, *Glycine max* (L.) Merrill, is attacked by about twenty different major insect pests. Out of these, stem fly (*Melanagromyza sojae*), girdle beetle (*Oberiopsis brevis*) and green semilooper (*Chrysodexcis acuta*) are predominant in central part of the country, which contribute about 70 % of area and production. These insect-pests account for more than 25 % reduction in yield. The most economical way to deal with these insect-pests and avoid yield losses, is to cultivate insect resistant / tolerant varieties. Hybridization, involving identified resistant sources and agronomically suitable genotypes, is in progress at National Research Centre for Soybean (NRCS), Indore (M.P.). Several advanced generation progenies have exhibited good yield potential. But their response against major insect-pests was not deciphered. In order to identify potential resistant genotypes against stem fly, girdle beetle and green semilooper field screening was carried out using more relevant screening criteria.

MATERIALS AND METHODS

Thirty-five soybean genotypes consisting of 21 breeding lines, one germplasm line, six released varieties and seven farmers' selections were planted in randomized block design with three replications at National Research Centre for Soybean (NRCS), Indore (M.P.), India during *kharif* 2002. Each genotype had three rows of five-meter length each sown at 45 cm row spacing. Observations on percent seedling mortality and percent stem tunneling due to stem fly were recorded at 10 DAG and 75 DAG respectively. Number of infested plant by girdle beetle (ring formation) were counted in each plot and converted to 100 square meters. These plants were tagged and observed

till maturity. Number of plant showing typical "cut-off" symptoms were counted and expressed as per cent plant damage. For green semilooper, number of larvae per meter row length (mrl) were counted at three place per plot by using 'Vertical Beat Sampling Trey' (Sharma, 1999). The data were converted to appropriate transformed values and subjected to statistical analysis by using "MSTAT-C " software. Categorization was done following the 'AICRPS' method (Sharma, 1996).

RESULTS AND DISCUSSION

Per cent Seedling mortality: The Percent seedling mortality in different genotypes ranged between 0 and 4.93. It is interesting to note that 11 genotypes viz. breeding lines- $B_{14}P_{58-59}$, C_9P_{17}, D_1P_{15}, D_2P_{11}, germplasm line-L-129, Selection-280, Selection-1040, Selection-120 and released varieties- MAUS-47, JS 93-05 and NRC-41 showed 0.0 per cent seedling mortality. Talekar (1989) described percent seedling mortality as the most important criteria for screening against stem fly as it leads to reduction in plant population at a very early stage. From this point of view the genotypes showing 0 per cent seedling mortality seem to have great importance.

Per cent stem tunneling : Stem tunneling (%) recorded in different genotypes ranged from 6.46 per cent in D_5P_{11} to 32.16 per cent in D_3P_8. Out of thirty-five genotypes, twenty seven genotypes were *at par* with respect to per cent stem tunneling. Out of remaining eight genotypes, only C_9P_{17} (29.21) and D_3P_8 (32.16) recorded stem tunneling higher than the economic injury level, which is reported to be 26 per cent (Kundu and Mehra, 1989). Bhattacharya and Rathore (1980) however, did not find any correlation between percent stem tunneling and grain yield. In earlier studies soybean varieties PK

462, PK 416, PK564 and Shivalik were reported to be highly tolerant to damage by stem fly (Sharma *et al.*, 1994).

Girdle beetle plant infestation: The girdle beetle plant infestation in different genotypes varied between 0.0 (Selection-1040) to 622.02 (D_5P_{23}) plants per 100 sq.m. On the basis of categorization, Selection-1040, Selection-280 and D_2P_{11} were found to be highly resistant (HR), farmers' variety - Samrat, breeding lines-D_2P_{23}, D_2P_{25}, and variety JS 93-05 were resistant (R). Breeding lines-D_6P_{18}, D_6P_{22} and B_2P_{28} were highly susceptible (HS) and farmer selections-Selection-2002 and breeding line-D_5P_{23} were susceptible (S).

Girdle beetle plant damage: The extent of plant damage among different genotypes varied from 0.0 to 75.99 per cent. Categorization according to 'AICRPS' method revealed that breeding line-D_3P_8, farmer selections-Selection-280, Selction-1040 were highly resistant, breeding line-D_3P_6 variety JS93-05 were resistant, breeding line- D_6P_{18} highly susceptible while breeding line- D_4P_{22}, D_6P_{22} were susceptible. It is to be noted that plant infestation alone does not necessarily cause reduction in grain yield. Sharma (1995) reported that percent plant damage (typical "cut-off" symptoms) is more appropriate criterion for screening genotypes against girdle beetle. From this point of view breeding line- D_3P_8, Selection0280, Selection-1040 and cultivar-JS93-05 could be potential sources for resistance against girdle beetle. Breeding lines- D_6P_{18} and D_6P_{22} were found to be susceptible to this insect on the basis of plant infestation as well as plant damage. These lines could serve as infester rows in the screening programmes.

Green semilooper: Larval population of green semilooper per meter row length recorded in the different genotypes ranged from 2.22 in Samrat to 10.44 in D_2P_{11}. Categorization on the basis of 'AICRPS' procedure revealed that germplasm line-L-129, farmer selection- Samrat, Selection-280, Selection-2002, breeding lines-$B_{14}P_{52-53}$, D_3P_{23}, D_4P_7, D_6P_{18}, D_6P_{22}, variety-Bragg were highly resistant (HR), farmer selection – Selection-120, breeding line-D_4P_{20} were resistant (R) and breeding lines -B_2P_{28}, D_1P_8, D_1P_{15}, D_2P_{11}, D_3P_6, D_3P_{25} were highly susceptibly (HS).

Reaction of different genotypes against stem fly, girdle beetle and green semilooper, indicates that genotypes – $B_{14}P_{58-59}$, D_2P_{11}, D_2P_{23}, D_2P_{25}, D_3P_6, D_3P_8, D_3P_{23}, D_4P_{20}, D_6P_{18}, D_6P_{22}, Samart, Sel.-280, Sel.-1040, Sel.120, JS 93-05 and Sel. 2002 posses resistance to one or more insect-pests and could serve as potential donors in breeding programmes after confirming through laboratory screening methods. As the resistance to lepidopterous defoliators is governed by single gene (Killen and Lambert, 1986) the trait should be easily transferable to girdle beetle and/or stem fly resistant but defoliator susceptible genotypes.

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Table 1. Reaction of soybean genotypes against major insect-pests

Genotypes	Stem fly				Girdle beetle				Green semilooper	
	Seedling mortality (%)	Category	Stem tunnelling (%)	Category	Plant Infestation / 100 m^2)	Category	Damage (%)	Category	Larvae /mrl*	Category
1. B_2P_{28}	1.73 (.37)**	LR	16.22 (23.42)**	MR	320.88 (17.57)*	HS	29.13 (32.36)**	LR	09.22 (3.03) **	HS
2. $B_{14}P_{52-53}$	2.88 (5.70)	LR	11.54 (17.29)	MR	157.97 (12.37)	LR	26.88 (31.08)	MR	04.78 (2.18)	MR
3. $B_{14}P_{58-59}$	0.00 (0.00)	MR	10.84 (18.98)	MR	222.15 (14.79)	LR	17.49 (24.67)	MR	03.78 (1.94)	**HR**
4. C_9P_{17}	0.00 (0.00)	MR	29.21 (32.57)	LR	192.53 (13.41)	LR	38.37 (38.25)	LR	05.33 (2.31)	MR
5. D_1P_8	4.79 (7.42)	LR	15.10 (20.73)	MR	088.86 (09.28)	MR	36.48 (37.01)	LR	10.00 (3.16)	HS
6. D_1P_{15}	0.00 (0.00)	MR	17.19 (22.82)	MR	236.96 (13.81)	LR	32.55 (34.68)	LR	07.67 (2.77)	HS
7. D_2P_{11}	0.00 (0.00)	MR	14.86 (22.33)	MR	024.68 (04.91)	**HR**	16.67 (15.00)	MR	10.44 (3.23)	HS
8. D_2P_{23}	0.37 (2.02)	MR	18.37 (24.52)	MR	039.49 (06.07)	**R**	19.44 (21.76)	MR	06.33 (2.51)	LR
9. D_2P_{25}	2.13 (4.89)	LR	18.37 (28.04)	LR	039.49 (06.26)	**R**	11.11 (11.75)	MR	05.90 (2.42)	LR
10. D_3P_6	1.00 (4.46)	LR	22.48 (37.04)	LR	074.05 (08.58)	MR	05.55 (08.03)	**R**	09.90 93.14)	HS
11. D_3P_8	0.31 (1.85)	MR	32.16 (33.52)	LR	044.43 (06.24)	**R**	00.00 (00.00)	**HR**	06.78 (2.60)	LR
12. D_3P_{23}	1.34 (3.85)	LR	25.90 (30.25)	LR	049.37 (06.72)	**R**	15.00 (18.86)	MR	03.56 (1.88)	**HR**
13. D_3P_{25}	1.21 (3.66)	LR	13.18 (19.94)	MR	103.67 (09.96)	MR	17.42 (20.49)	MR	10.11 (3.18)	HS
14. D_4P_7	1.27 (3.75)	LR	0 9.55 (17.81)	MR	222.15 (14.79)	LR	42.77 (40.84)	LR	03.11 (1.76)	HR
15. D_4P_{20}	4.93 (11.35)	S	0 9.34 (17.36)	MR	113.54 (10.55)	MR	45.83 (42.59)	LR	03.90 (1.96)	**R**
16. D_4P_{22}	1.01 (4.62)	LR	14.94 (21.11)	MR	162.91 (12.71)	LR	65.93 (54.56)	S	05.56 (2.35)	LR
17. D_5P_{11}	0.82 (3.01)	LR	06.46 (14.58)	MR	162.91 (12.68)	LR	41.94 (40.35)	LR	06.67 (2.57)	LR
18. D_5P_{23}	0.28 (1.74)	MR	10.42 (18.69)	MR	256.71 (15.98)	S	35.11 (36.10)	LR	06.11 (2.47)	LR
19. D_6P_{18}	0.83 (4.12)	LR	10.41 (18.23)	MR	622.02 (24.81)	HS	75.99 (60.86)	HS	03.11 (1.76)	**HR**
20. D_6P_{22}	0.31 (1.85)	MR	0 8.20 (16.32)	MR	552.91 (23.39)	HS	64.36 (53.39)	S	03.00 (1.73)	**HR**
21. JS 335	0.48 (2.31)	MR	13.75 (20.60)	MR	114.44 (10.55)	MR	40.00 (39.15)	LR	05.67 (2.38)	LR
22. JS 71-05	0.51 (2.36)	MR	17.39 (23.95)	MR	074.05 (08.48)	MR	38.73 (38.46)	LR	05.90 (2.42)	LR
23. JS 80-21	1.47 (4.04)	LR	19.81 (26.34)	LR	207.34 (14.34)	LR	44.46 (41.78)	LR	05.90 (2.42)	LR
24. Bragg	0.33 (1.89)	MR	24.82 (29.86)	LR	098.73 (09.89)	MR	54.05 (47.51)	LR	03.00 (1.73)	**HR**
25. L-129	0.00 (0.00)	MR	15.55 (22.86)	MR	192.53 (13.56)	LR	50.33 (45.49)	LR	07.11 (2.66)	S
26. Samrat	0.34 (1.92)	MR	15.16 (22.69)	MR	034.56 (05.66)	**R**	50.00 (45.00)	LR	02.22 (1.48)	**HR**
27. Sel. 280	0.00 (0.00)	MR	20.21 (26.71)	LR	009.87 (02.57)	**HR**	00.00 (00.00)	**HR**	02.56 (1.62)	**HR**
28. Sel. 1040	0.00 (0.00)	MR	25.78 (29.29)	LR	000.00 (00.00)	**HR**	00.00 (00.00)	**HR**	02.90 (1.69)	**HR**
29. Sel. 120	0.00 (0.00)	MR	10.69 (18.82)	MR	133.29 (11.50)	LR	42.95 (40.80)	LR	06.78 (1.96)	**R**
30. Sel. 200	2.75 (8.86)	LR	14.36 (20.83)	MR	108.61 (10.42)	MR	41.86 (40.11)	LR	07.00 (2.64)	LR
31. Sel. 44	0.29 (1.79)	MR	12.72 (20.46)	MR	059.24 (07.43)	MR	47.01 (43.23)	LR	09.00 (3.00)	HS

32. MAUS-47	0.00 (0.00)	MR	12.35 (20.23)	MR	108.61 (10.39)	MR	40.48 (28.01)	MR	06.44 (2.54)	LR
33. JS 93-05	0.00 (0.00)	MR	17.30 (24.33)	MR	039.49 (06.20)	**R**	08.33 (10.00)	**R**	05.56 (2.35)	LR
34. NRC-41	0.00 (0.00)	MR	17.10 (23.86)	MR	148.10 (12.08)	LR	47.11 (43.33)	LR	04.78 (2.18)	MR
35. Sel. 2002	0.33 (1.89)	MR	22.39 (27.39)	LR	266.58 (16.29)	S	40.58 (39.57)	LR	03.67 (1.90)	**HR**
S.Em. ±	(2.51)		(4.45)		(1.46)		(7.47)		(0.11)	
C.D. at 5%	(7.07)		(12.53)		(4.10)		(22.03)		(0.30)	

* Square root transform values are given in parentheses.

**. Angular transformed values are given in parentheses

HR – Highly Resistant, R – Resistant, MR – Moderately Resistant, LR – Low Resistance, S – Susceptible

HS – Highly Susceptible