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Performance of soybean genotypes against major insect pests of soybean crop

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Abstract
The present study was conducted in the academic year 2016-2017 during *kharif season* at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The screening trial was conducted under two categories, the initial varietal trial (IVT) and advanced varietal trial (AVT). And the entries were screened as per the methodologies explained in the materials and methods. The results on the response of the genotypes in the screening trials are also presented in this paper.
During the present study under the IVT trial, genotype PS-1589 with least number of lepidopterous caterpillars per meter row (1.0 number of larvae per meter row) and genotypes NSO-626 with least number of sucking pests per plant (6.0 numbers of sucking pests per plant) were found to be least susceptible against these insect pests. However, the highest yield was recorded with genotypes NRC-126 (675 gm/plot) which was observed and found to be tolerant against different insect-pests in soybean.
Under the AVT trial, genotype RV S-2010-1 and RVS-2008-24 with minimum larval count (0.7 larvae per meter row) and genotype DSB-28-3 with minimum sucking pests (11.0 per plant) were identified to be least susceptible against lepidopterous defoliators and sucking pests. The highest grain yield was recorded with genotype PS-1572 (0.976 q/ha) which was found tolerant to against different insect-pests in soybean.

Keywords: Soybean, genotype, lepidopterous, caterpillars, defoliators

Introduction
Soybean (*Glycine max* L. Merril) is the world's most important and nutritious seed legume which contributes to about 25 % of the global edible oil and about two-thirds of the world's protein concentrate for livestock feeding. Soybean as a meal is also one of the valuable ingredients in formulated feeds for poultry and fish (Krishnamurthy K, Shivashankar K, 1975) [1]. Soybean is considered as a pulse crop but due to high oil content and greater response to applied nitrogen, now it is placed in oil seed category. Soybean has become an important oilseed crop in India in a very short period with approximately 10 million ha area under its cultivation. Soybean as the miracle golden bean of 20th century has not only revolutionized the agriculture sector but also generated economy of many countries.
The utilization of soybean for food uses in India is still meager and hence, it has enormous scope to be grown at larger scale (Bhatnagar PS and Joshi OP, 2004) [2]. That's why, it needs to be explored more in terms of blending with other foods to make taste acceptable. The high-quality soybean protein should be included in daily diet of Indian masses to mitigate the widespread protein malnutrition.
Despite having made rapid stride for both coverage and total production, soybean still suffers on productivity front. There are number of constraints pertaining to climate, edaphic, production, and technology aspects that really hinder the higher productivity. Similarly, in Chhattisgarh also the soybean crops are suffering from many hindrances including being attacked by many species of insect pests, such as tobacco caterpillar (*Spodoptera litura*), green semilooper (*Chrysodeixis acuta*), white fly (*Bemisia tabaci*), Thrips (*Thrips tabaci*), etc. The most economical way to deal with these insect-pests and avoid yield losses is to cultivate insect resistant or tolerant varieties (Awasthi *et al*., 2005) [3]. The use of the resistant plant is proposed to stabilized the yield and has significant advantages over the use of chemical insecticides. It is also proved to be environmentally friendly, minimizes the production costs, does not involve the transfer of new technologies and is considered compatible with other control methods used in insect management (Pinheiro, 2005, Suharsono and Sulistyowati, 2012) [4, 5].

In the above backdrop, this paper tries to find out the susceptible or resistant variety against major insect pests of soybean crop by screening of germplasm under field conditions.

Materials and Methods

In reference to the finding of performance of soybean genotypes against major insect pests, the performance of soybean genotype was done under two categories, the initial varietal trial (IVT) and advanced varietal trial (AVT). In initial varietal trial thirty-nine entries of soybean were screened against caterpillar and sucking pests of soybean in which each entry was sown in two rows, each of 5-meter length with a row to row spacing of 30 cm. Entries from 1-35 were coded. There were four checks entries - RKS-18, Bragg, JS335, and JS-97-52 and these entries were replicated twice.

In advanced varietal trial, twenty-four entries of soybean were screened against caterpillar and sucking pests of soybean under randomized block design in which each entry was sown in three rows of 3-meter length with a row to row spacing of 30 cm. This trial comprised of 20 test entries and four checks (RKS-18, Bragg, JS 335 and JS-97-52). The entries were sown in two replications.

The crop was shown on 28th June 2016 (IVT) and (AVT) to evaluate the incidence of major insect pests of soybean during *kharif* season. All the recommended packages and practices were followed in establishing the plants except the insect pests control measures. In IVT entry nos. 1-35 were coded and denoted as V1 to V35. The variety name of entry no.36 to39 is listed in the below Table-1.

Table 1: Name of check entries against major insect-pests of soybean

S. No.	Entry No.	Name
1.	V 36	RKS – 18
2.	V 37	Bragg
3.	V 38	JS-335
4.	V 39	JS-97-52

Observations Recorded

The observations were taken during cropping period by counting number of caterpillar pests from five randomly selected places of one-meter row length from each plot at maximum infestation by insect pests. Similarly, for sucking pests, five plants were selected randomly and insect count was recorded from three leaves (upper, middle and bottom part of the plant) from each plot.

Result and Discussions

The results on the response of the genotypes in the screening trials are mentioned as below:

IVT Screening Trial

The data of the insect-pests infestation recorded in entry no. 1 to 35, along with the checks entries viz., RKS-18, Bragg, JS-335, and JS-97-52 have been presented in Table-2 and the results are as follows:

The thirty-nine genotypes were screened for resistance against major caterpillar pests, i.e. tobacco caterpillar (*S. litura*), and semilooper (*C. acuta*). Among the different genotypes, JS-21-05 with the mean value of 0.1 larvae per meter row was least preferred by *S. litura*. It was followed by RSC-10-71 with 0.2 larvae per meter row and also by PS-1589, RVS-2009-9, KDS-921, MAUS-771 and TS-70 each with 0.3 larvae per meter row and DSb-32, MACS-1520, PS-1587, NRC-25, PS-1086, VLS-93, NRC-127, and RSC-10-52, each with 0.4 larvae per meter row. Among the test entries, genotype VLS-92 with mean value 1.10 larvae per meter row was most attacked by tobacco caterpillar, as against 0.5 to 0.9 larvae per meter row in check varieties.

Table 2: Field screening of IVT entries for resistance to major insect pests of Soybean during *Kharif* 2016

S. No.	Name of entries	Incidence per meter row length – Larval Population (mean of two rep.)			No. of sucking pests per three leaves per plant			Grain Yield (gm/plot)
		S.litura	*C.acuta*	Total	*Bemisia tabaci*	*Thripstabaci*	Total	
1	TS-80	0.60	1.0	1.6	4.4	4.2	8.6	215
2	JS21-08	0.80	1.1	1.9	4.2	3.8	8.0	415
3	VLS-92	1.10	1.4	2.5	4.0	4.0	8.0	175
4	PS-1589	0.30	0.7	1.0	2.1	4.2	6.3	225
5	MACS-1543	0.80	1.5	2.3	4.6	4.2	8.8	525
6	DS-3105	0.60	1.4	2.0	4.5	4.2	8.7	475
7	SL-1104	0.60	1.3	1.9	5.1	4.8	9.9	325
8	KDS-1045	0.70	1.2	1.9	4.3	6.0	10.3	490
9	DSb -32	0.40	0.9	1.3	4.7	4.2	8.9	590
10	RVS-2009-9	0.30	0.9	1.2	5.0	4.0	9.0	500
11	MACS-1520	0.4	0.8	1.2	3.9	5.0	8.9	570
12	PS-1587	0.4	0.8	1.2	4.7	3.4	8.1	415
13	NRC-126	0.5	0.8	1.3	3.9	3.2	7.1	675
14	RSC-10-70	0.7	1.5	2.2	4.7	4.2	8.9	490
15	KDS-921	0.3	1.3	1.6	4.1	3.2	7.3	375
16	Himso-1687	0.7	1.5	2.2	4.6	3.4	8.0	475
17	MAUS 711	0.3	0.9	1.2	3.9	3.2	7.1	490
18	NSO-626	0.8	0.8	1.6	3.2	2.8	6.0	550
19	AMS-MB 5-19	0.5	1.1	1.6	3.9	3.6	7.5	375
20	NRC-125	0.4	0.9	1.3	3.7	2.4	6.1	650

S. No.	Name of entries	Incidence per meter row length			No. of sucking pests per three leaves per plant			Grain Yield (gm/plot)
		Larval Population (mean of two rep.)			*Bemisia tabaci*	*Thripstabaci*	Total	
		S.litura	*C.acuta*	Total				
21	RSC-10-71	0.2	0.9	1.1	4.8	4.0	8.8	637
22	PS-1086	0.4	1.0	1.4	5.5	5.60	11.1	175
23	TS-70	0.3	1.0	1.4	5.0	4.6	9.6	165
24	VLS-93	0.4	1.5	1.9	5.5	5.6	11.1	175
25	NRC-127	0.4	1.4	1.8	4.8	4.0	8.8	515
26	SL-1113	0.5	1.8	2.3	5.8	5.8	11.6	450
27	DS-3106	0.9	1.6	2.5	5.1	4.4	9.5	390
28	BAU-100	0.6	1.3	1.9	4.9	3.6	8.5	375
29	RSC-10-52	0.4	1.1	1.5	4.3	4.6	8.9	400
30	NRC-124	0.70	0.9	1.6	4.7	4.6	9.3	525
31	AMS-MB-5-18	0.60	1.1	1.7	5.3	4.8	10.3	500
32	MACS-1505	0.60	0.8	1.4	5.7	5.4	11.1	415
33	KDS-980	0.60	1.1	1.7	5.2	4.8	10.0	560
34	DSb-31	0.70	1.1	1.8	4.6	4.8	9.4	475
35	JS-21-05	0.10	0.6	1.7	4.8	4.8	9.6	440
36	RKS 18 (Check)	0.70	0.9	1.6	5.6	5.6	11.2	350
37	Bragg (Check)	0.50	0.9	1.4	4.9	5.4	10.3	560
38	JS335 (Check)	0.90	1.0	1.9	4.7	5.6	10.3	390
39	JS-97-52 (Check)	0.80	1.0	1.8	4.9	4.8	9.7	365

Similarly, among the different genotypes, JS-21-05 with the mean value of 0.6 larvae per meter row was least preferred by semilooper. It was followed by PS-1589 with 0.7 larvae per meter row and also by MACS-1520, PS-1587, NRC-126, NSO-626, and MACS-1505 each with 0.8 larvae per meter row and DSb-32, RVS-2002-9, MAUS-771, NRC-125, RSC-10-71, and NRC-124 each with 0.9 larvae per meter row. Among the test entries, genotype SL-1113 with 1.8 larvae per meter row was most attacked by semilooper, as against 0.9 to 1 larvae per meter row in check varieties.

Based on total lepidopterous larval infestation, genotype PS-1589 with 1.0 larvae per meter row was least attacked by the lepidopterous pests. It was followed by RVS-2009-9, MACS-1520, PS-1587, HIMSO-1687, and MAUS-771, each with 1.2 larvae per meter row. Whereas, genotype DS-3106 and VLS-92 with 2.5, and SL-1113 with 2.4 larvae per meter row was most attacked by caterpillar pests as against 1.4 to 1.9 larvae per meter row in check entries.

Among the sucking pests, the incidence of whiteflies was mostly equal to that of thrips. The incidence of whiteflies ranged from 2.1 to 5.8 whiteflies per plant. Genotype PS-1589 was least attacked by whiteflies with 2.1 whiteflies per plant followed by genotype NSO-626 with 3.2 whiteflies per plant and MACS-1520, NRC-126, MAUS-711, and AMS-MB 5-19, each with 3.9 whiteflies per plant.

The highest incidence of whiteflies was on genotype SL-1113 with 5.8 whiteflies per plant as against 4.7 to 5.6 whiteflies per plant in check entries.

Based on total sucking pests' population per plant, genotype NSO-626 with 6.0 sucking pests per plant was least preferred by sucking pests. It was followed by genotypes NRC-125 with 6.1 and PS-1589 each with 6.3 sucking pests per plant. Genotype VLS-93 and PS-1086 each with 11.1 sucking pests per plant was most preferred by the sucking pests as against 9.7 to 11.2 sucking pests per plant on the check entries.

Based on overall pests' incidence, genotype PS-1589 with 1.0 larvae per meter row was least attacked by the lepidopterous pests. It was followed by RVS-2009-9, MACS-1520, PS-1587, HIMSO-1687, and MAUS-771, each with 1.2 larvae per meter row, and genotype NSO-126 with 6.0 sucking pests per plant was least preferred by sucking pests. It was followed by genotypes NRC-125 with 6.1 and PS-1589 with 6.3 sucking pests per plant, respectively showed least preference by these insect pests.

The grain yield among different test genotypes ranged from 165 to 675gm/plot as against 350 to 560 gm/plot yield in check varieties. The highest yield was recorded with genotype NRC-126 (675gm/plot) as against 350, 560, 390, and 365 gm/plot grain yields from check varieties.

AVT Screening Trial

Under AVT, twenty-four soybean genotypes including four checks – RKS-18, BRAGG, JS- 335 and JS-97-52 were screened against major insect-pests of soybean during *kharif*, 2016. The results on the response of the genotypes in the screening trials are presented in the following paragraphs and Table-3.

The 24 genotypes were screened for resistance against caterpillar pests, i.e. tobacco caterpillar, and semilooper. Among the different genotypes, JS-20-96 and RVS-2010-1 each with 0.1 larvae per meter row was least preferred by *S. litura*. It was followed by RVS-2006-7, RSC-10-46, and JS-20-87 each with 0.2 larvae per meter row and PS-1572, SL-1074, PS-1569, JS-20-116, JS-20-94, NRS-117, PS-1556, RVS-2008-24, DSB-28-3, and KDS-869 each with 0.3 larvae per meter row. Among the test entries, genotype DS-1301, VLS-89, SL-1028, MACS-1407 and KDS-753 each with 0.4 larvae per meter row was most attacked by tobacco caterpillar, as against 0.2 to 0.3 larvae per meter row in check varieties.

Table 3: Field screening of AVT entries for resistance to major insect pests of Soybean during *Kharif*, 2016

S. No	Name of entries	Incidence per meter row length Larval Population (mean of two rep.)			No. of sucking pests per three leaves per plant			Grain Yield (gm/plot)
		S.litura	*C.acuta*	Total	*Bemisiatabaci*	*Thripstabaci*	Total	
1	PS – 1572	0.30	0.6	0.9	9.40	6.30	15.7	0.976
2	SL – 1074	0.30	0.7	1.0	8.50	5.10	13.6	0.650
3	PS – 1569	0.30	0.5	0.8	8.40	4.80	13.2	0.600
4	JS – 20-116	0.30	0.7	1.0	8.30	4.70	13.0	0.850
5	RVS – 2010-1	0.10	0.6	0.7	7.70	4.60	12.3	0.800
6	JS – 20-94	0.30	0.5	0.8	8.50	4.70	13.2	0.250
7	NRS – 117	0.30	0.8	1.1	9.70	4.70	14.4	0.750
8	PS – 1556	0.30	0.7	1.0	8.30	4.20	12.5	0.425
9	DS – 1301	0.40	0.7	1.1	7.80	4.30	12.1	0.600
10	VLS – 89	0.40	0.4	0.8	7.70	4.40	12.1	0.550
11	SL – 1028	0.40	0.5	0.9	8.90	5.50	14.4	0.250
12	MACS – 1407	0.40	0.6	1.0	9.20	5.20	1.4.4	0.950
13	RSC – 10 –46	0.20	0.8	1.0	9.60	5.30	14.9	0.725
14	KDS – 753	0.40	0.6	1.0	8.50	4.60	13.1	0.325
15	RVS – 2006-7	0.20	0.6	0.8	9.90	5.30	15.2	0.900
16	JS – 20-87	0.20	0.6	0.8	9.30	5.20	14.5	0.250
17	RVS – 2008-24	0.30	0.4	0.7	9.90	5.80	15.7	0.550
18	JS – 20-96	0.10	0.8	0.9	9. 20	4.90	14.1	0.800
19	DSB-28-3	0.30	0.7	1.0	7.10	3.90	11.0	0.350
20	KDS- 869	0.30	0.5	0.8	7.50	4.20	11.7	0.675
21	RKS-18 (Check)	0.30	0.6	0.9	8.90	4.80	13.7	0.475
22	BRAGG (Check)	0.20	0.8	1.0	9.10	5.00	14.1	0.900
23	JS- 335 (Check)	0.20	0.4	0.6	8.60	4.60	13.2	0.275
24	JS - 97-52 (Check)	0.20	0.5	0.7	9.4	4.50	13.9	0.900

Genotypes VLS-89, and RVS-2008-24 each with 0.4 larvae per meter row were least attacked by *C. acuta*, followed by genotype PS-1569, SL-1028 and KDS-869 each with 0.5 larvae per meter row. And also genotype NRS-117, RSC-10-46, and JS-20-96 each with 0.8 larvae per meter row were mostly attacked by the semilooper as against 0.4 to 0.8 larvae per meter row in check varieties.

Based on total lepidopterous larval infestation, genotype RVS-2010-1, and RVS-2008-24 each with 0.7 larvae per meter row was least attacked by the lepidopterous pests. It was followed by PS-1569, JS-20-94, VLS-89, RVS-2006-7, JS-20-87 and KDS-869 each with 0.8 larvae per meter row. Whereas, genotype NRS-117 and DS-1301 each with 1.1 larvae per meter row was most attacked by caterpillar pests as against 0.6 to 0.9 larvae per meter row in check entries.

Among the sucking pests, the incidence of whiteflies was comparatively higher than that of thrips. The incidence of whiteflies ranged from 7.10 to 9.90 whiteflies per plant. Genotype DSB-25-3 was least attacked by whiteflies with 7.10 whiteflies per plant followed by genotype KDS-869 with 7.50 and RVS-2010-1 and VLS-89 each with 7.70 whiteflies per plant and DS-1301 with 7.80 whiteflies per plant. The highest incidence of whiteflies was on genotype RVS-2008-24 and RVS-2006-7 with 9.90 whiteflies per plant as against 8.60 to 9.40 whiteflies per plant in check entries.

Similarly, the thrips incidence ranged from 3.90 to 6.30 thrips per plant on the test entries. Genotype DSB-28-3 with 3.90 thrips per plant was least preferred by the thrips and followed by PS-1556 and KDS-869 with 4.20 thrips per plant and DS-1301 with 4.30 thrips per plant. Whereas, maximum incidence of thrips was observed on genotype PS-1572 with 6.30 thrips per plant; as against 4.60 to 5.0 thrips per plant on the check entries.

Based on total sucking pests (whiteflies and thrips) population per plant, genotype DSB-28-3 with 11.0 sucking pests per plant was least preferred by sucking pests. It was followed by genotypes KDS-869 with 11.7 and DS-1301 and VLS-89 with 12.1 sucking pests per plant. Genotype PS-1572 and RVS-2008-24 with 15.7 sucking pests per plant was most preferred by the sucking pests as against 13.2 to14.1 sucking pests per plant on the check entries.

Based on overall pests' incidence, genotype RVS-2010-1, and RVS-2008-24 each with 0.7 larvae per meter row was least attacked by the lepidopterous pests. It was followed by PS-1569, JS-20-94, VLS-89, RVS-2006-7, JS-20-87 and KDS-869 each with 0.8 larvae per meter row, and genotype DSB-28-3 with 11.0 sucking pests (whiteflies and thrips) per plant and followed by KDS-869 with 11.7 and DS-1301 and VLS-89 with 12.1 sucking pests per plant was least preferred by these insect pests.

The grain yield among different test genotypes ranged from 0.25 to 0.976gm/plot as against 0.27 to 0.900 gm/plot yield in check varieties. The highest yield was recorded with genotypes PS-1572 (0.976 gm/plot) as against 0.27 to 0.976 gm/plot grain yields from check varieties.

The findings of the present study were similar with the findings of Kujur [6] who reported that among the soybean genotypes screened for resistance against major insect pests of soybean, MACS 1039 showed resistance against lepidopterous defoliators whereas, DSb 63 was identified as resistant against both sucking pests and lepidopterous defoliators. He also reported that DSb 63 was recorded as highest grain yield (21.4 q/ha) compared to all the other genotypes with respect to the yield. Similar findings with the present study were also reported by Netam [13] who found that genotype L129 with least number of girdle beetle damaged plants and lepidopterous larvae per meter row and minimum density of sucking pests per plant was most tolerant to these insects which results in the 31.1q/ha grain yield. Haq-ul-Ihsan [8] also reported that Psc-56 suffered minimum infestation percentages of soybean looper. Similarly, Murry [9] reported that the genotype DS 3105 (17.25 ten plants-1) and BAU 100

(5.25 ten plants-1) showed highest and lowest infestation by whitefly, respectively. Some authors namely Gupta [10], Sandhya [11] and Sinha [12] have also reported the similar findings with regard to screening of soybean genotypes but they worked on different major insects of soybean.

Conclusion

On the basis of the incidence of lepidopterous caterpillars and sucking pests, genotype PS-1589 and NSO-626 were respectively found to be least susceptible and the highest yield was observed in genotype NRC-126 under the IVT trial. However under the AVT trial, the incidence of lepidopterous caterpillars was least observed in genotype RVS-2010-1 and RVS-2008-24 and the incidence of sucking pest was least observed in DSB 28-3. And the highest yield was observed in genotype PS-1572.

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