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Response of Soybean Cultivars against major Insect Pests and their Natural Enemies

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ABSTRACT

Present investigation was conducted at Rajmata Vijayaraje Scindia Krishi Vishwa Vidhyalaya-Zonal Agricultural Research Station, Morena (M.P.) to evaluate the ten cultivars of soybean against major insect pests and their natural enemies. The minimum incidence of major insect pest viz, whitefly (0.69/three leaves), stem fly (22.13 % stem tunneling), girdle beetle (24.97 %), green semilooper (1.10 larvae/mrl) and tobacco caterpillar (2.90 larvae/mrl) was observed in soybean cultivar JS-20-34. Cultivar JS-20-34 was found resistant to major insect pest of soybean. Cultivar MACSNRC-1575 was found susceptible against whitefly. Soybean cultivars NRC- 132 was observed susceptible to stem fly and girdle beetle. Cultivars AMS-100-39 and NRC-147 was found susceptible against semilooper and tobacco caterpillar. Maximum population of natural enemy (lady bird beetle) was recorded in cultivars JS-335 followed by AMS-100-39, MACSNRC-1575 and NRC-130. In the present study cultivars JS-20-34 was found tolerant to major insect pest and suitable to cultivation the area.

KEYWORDS

Insect pest, natural enemies, soybean cultivars

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INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is a cash crop and has occupied important place in agriculture and oil economy of the country. Soybean has been occupying first rank among oil crops in India since 2005. The soybean cultivation area has increased from 10.60 million ha to 11.25 million ha in 2017-18 to 2019-20 and production from 10.98 MT to 11.32 MT Anonymous (2019). This indicates an increase of about 6.13% and 2.45% in area and production, respectively. Madhya Pradesh contributes about 67% area and 58%production in the country and is called as "Soya state " Anonymous (2005, 2007). In India, soybean has acquired third position among the oil consumption after groundnut and mustard. In Madhya Pradesh, soybean occupies an area of 5.24 m ha with production of 6.72 MT and productivity of 1286 kg/ha (Anonymous, 2019).

The soybean crop is infested by more than 275 insect pests on different plant parts of soybean throughout its growth stage and about a dozen of them have been reported causing serious damage to soybean from sowing to harvesting (Babu, 1984). This crop suffers lot due to the attack of number of insect pests (Lal *et al*, 1981). It is mainly attacked by gram podborer, *Helicoverpa armigera* Hubner; leaf eating caterpillar, *Spodoptera litura* Fabricious; green semilooper, *Chrysodeixis acuta* Walker; grey semilooper, *Amyna octo* Guenee; leaf miner, *Aproeremamodicella* Deventer; whitefly, *Bemisia tabaci* Gennadius; stem fly, *Ophiomyia phaseoli* Tryon; thrip, *Caliothrips indicus*; aphid, *Aphis glycine* Koch and jassid, *Empoascakerri* Pruthi (Ahirwar *et al*, 2015). Abiotic factors regulate seasonal incidence, population count and development rates of the pests and natural enemies. As the cultivation of soybean has expanded around the world, crops become susceptible to different environmental and biotic stress which has increased the pest infestations. Gangarde (1976) reported over 99 insect species attacking soybean crop at Jabalpur. According to (Bhattacharya and Rathore, 1979) 100 species of insects found to harbour the soybean at different crop stages in Uttar Pradesh. Mundhe (1980) reported 16 species damaging to soybean crop in Maharashtra. In the present studies we evaluated the ten various cultivars against the major insect pest prevalent in the area for selection of cultivars for cultivation and minimize the economic loss.

MATERIALS AND METHODS

The present study was conducted during the kharif season 2018 in the experimental field of RVSKVV-Zonal Agricultural Research Station, Morena (M.P.). The experimental area is having uniform topography, gentle slope and adequate drainage.

Location and climate

Morena is situated in Chambal region at the latitude of 2630′ North and longitude 78 59′ East with an altitude of 195.0 meters from mean sea level, in Madhya Pradesh. This Region comes under semi-arid sub-tropical climate with extreme weather condition having hot and dry summer and cold winter. Generally, monsoon sets in during the last week of June. Annual rainfall up to706 mm, most of which falls during last June to the middle of September. In this area winter rains are

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occasional and uncertain. The maximum temperature goes up to 47°C during summer and minimum as low at 5°C during winter. Meteorological data recorded during the period of experimentation are given in Table 1 .

Table 1: Meteorological data during the crop season 2018

Standard Week no.	Week	Temperature °C Max	Temperature °C Min	Relative Humidity (%)	Rainfall (mm)
22	May-Jun. 28-3	45.07	29.21	51.00	000.00
23	Jun. 4-10	43.21	29.86	55.71	001.43
24	Jun. 11-17	41.57	29.00	58.14	000.00
25	Jun. 18-24	41.79	29.43	52.00	000.00
26	Jun.-Jul. 25-1	38.29	28.07	78.43	008.57
27	Jul. 2-8	36.21	25.86	74.14	000.00
28	Jul. 9-15	37.36	27.57	78.57	003.03
29	Jul. 16-22	35.07	26.00	93.86	013.50
30	Jul. 23-29	31.14	25.50	90.71	010.90
31	Jul.-Aug. 30-5	30.71	24.14	78.86	003.79
32	Aug. 6-12	32.07	25.43	83.29	006.57
33	Aug. 13-19	32.64	25.57	88.43	003.57
34	Aug. 20-26	30.57	25.79	94.43	014.00
35	Aug.-Sep. 27-2	30.93	25.64	95.57	007.79
36	Sep. 3-9	30.00	24.86	93.29	006.86
37	Sep. 10-16	32.43	24.43	83.71	000.00
38	Sep. 17-23	33.64	24.93	79.14	001.57
39	Sep. 24-30	33.79	24.07	76.14	001.29
40	Oct. 1-7	36.71	23.29	58.29	000.00
41	Oct. 8-14	36.79	20.71	51.86	000.00
42	Oct 15-21	34.21	18.93	55.14	000.00
43	Oct 22-28	33.43	18.29	56.43	000.00
44	Oct - Nov 29-4	31.57	16.07	60.57	000.00
45	Nov. 5-11	30.36	15.93	67.43	000.00
46	Nov. 12-18	29.71	14.50	67.86	000.00
47	Nov. 19-25	28.50	12.71	67.43	000.00
48	Nov-Dec. - 26-2	28.43	11.07	59.71	000.00
49	Dec. 3-9	27.36	10.29	50.57	000.00
50	Dec. 10-16	20.93	7.21	53.29	000.00
51	Dec. 17-23	23.36	6.36	49.29	000.00
52	Dec. 24-30	22.29	4.87	51.71	000.00
Mean		**32.91**	**21.15**	**69.52**	**002.67**

Source: Meteorological Observatory, Z.A.R.S., Morena (M.P.)

Experimental details

Ten soybean cultivars namely AMS-100-39, NRC-132, MACSNRC-1575, NRC-130, NRC 131, NRC-147, JS-335, JS-97-52, NRC-86 and JS-20-34 were used in the experiment. The crop was sown in plot size 5.0X3.0 m with row to row distance 40cm. The row length was 3m and eight row per plot, Treatment was replicated four time in Randomized Block Design.

Observations to be recorded

Weekly observations of foliage feeders were recorded from five randomly selected plants one meter row length from each plot. Similarly, for sucking pests; from each plot, five plants were selected randomly and insect counted was recorded on three leaves (upper, middle and bottom part of the plant).

Statistical analysis

The data were subjected to statistical analysis after transformation. The count data were transformed to $\sqrt{x}$ values, while percentages were transformed to $\sqrt{x}$ whose values ranges from 0 to 30 and 70 to 100 and into angular whose values ranges from 0 to 100.

RESULTS AND DISCUSSION

The results obtained with respect to Response of soybean cultivars against major insect pests and their natural enemies are presented in Table 2 .

Aphid (*Aphis gossypii*)

The data of present finding indicated that the incidence of aphid in soybean cultivars ranged from 0.70 to 1.21 aphids/ 3 leaves. The minimum aphid population was recorded in JS-20-34 (0.70 aphid / 3 leaves) and it was at par with cultivars NRC-86 (0.84aphid / 3 leaves). The maximum aphid population was recorded in JS-335 (1.21 aphid /3 leaves) followed by MACSNRC-1575 (1.14aphid / 3 leaves), AMS-100-39 (1.13 aphid / 3 leaves), NRC-132 (1.12 aphid / 3 leaves), NRC-130 (1.10 aphid / 3 leaves), NRC-147 (1.08 aphid / 3 leaves) and JS 97-52 (1.03 aphid / 3 leaves) it was at par with each other and there is no significant difference among cultivars.

Present findings revealed that minimum aphid incidence was recorded in JS 20-34, this cultivars are more tolerance to aphid and the cultivars on which maximum aphid population was recorded in JS-335 cultivar was susceptible, Garewal *et al* (2003) also evaluated ten genotypes of soybean and found JS 71-05 and NRC-25 as resistance variety to aphid. Yoodarimiki et al. (2019) found that the genotypes PS 1613 are found more susceptible to aphid and genotypes NRC-137 had more are resistant to aphid.

Whitefly (*Bemisia tabaci* Gennadius)

The data on whitefly incidence showed that whitefly incidence in different cultivars varied from 0.69 to 1.17 / three leaves. The minimum whitefly incidence was recorded in JS 20-34 (0.69/three leaves), it was significantly differ from all the cultivars except NRC – 86 (0.83/three leaves).

Table 2: Response of soybean cultivars against major insect pest and natural enemies of soybean during kharif 2018

S. No	Cultivars	Mean population of insect pests and natural enemies								
		Aphid (Per Plant per 3 leaves)	Whitefly (Per Plant per 3 leaves)	Jassid (Per Plant per 3 leaves)	Green sting bug(Per mrl)	Stem fly (% Stem tunnel-ing)	Girdle beetle (Infesta-tion (%) / plant)	Semilooper (No. of lar-vae/mrl)	Tobacco caterpil-lar(No. of lar-vae/mrl)	Lady bird beetle (Per plant)
1	AMS-100-39	1.13 (1.28)	1.09 (1.26)	1.35 (1.36)	3.34 (1.96)	30.71 (5.59)	26.60 (5.21)	1.90 (1.55)	3.67 (2.04)	0.82 (1.15)
2	NRC-132	1.14 (1.28)	0.93 (1.2)	1.32 (1.35)	3.35 (1.96)	32.84 (5.77)	28.37 (5.37)	1.72 (1.49)	3.60 (2.02)	0.75 (1.12)
3	MACSNRC-1575	1.14 (1.28)	1.17 (1.29)	1.40 (1.38)	3.47 (1.99)	30.54 (5.57)	26.72 (5.22)	1.85 (1.53)	3.52 (2)	0.82 (1.15)
4	NRC-130	1.10 (1.27)	1.13 (1.28)	1.40 (1.38)	3.07 (1.89)	30.45 (5.56)	24.97 (5.05)	1.77 (1.51)	3.68 (2.04)	0.82 (1.15)
5	NRC-131	1.12 (1.27)	1.00 (1.22)	1.37 (1.37)	3.21 (1.92)	31.73 (5.68)	27.40 (5.28)	1.67 (1.47)	3.54 (2.01)	0.76 (1.12)
6	NRC-147	1.08 (1.26)	1.09 (1.26)	1.32 (1.35)	3.13 (1.91)	31.95 (5.7)	27.35 (5.28)	1.71 (1.49)	3.70 (2.05)	0.75 (1.12)
7	JS-335	1.21 (1.31)	1.12 (1.27)	1.42 (1.38)	3.28 (1.94)	32.14 (5.71)	26.95 (5.24)	1.88 (1.54)	3.48 (1.99)	0.88 (1.17)
8	JS-97-52	1.03 (1.24)	1.04 (1.24)	1.29 (1.34)	3.12 (1.9)	25.84 (5.13)	22.67 (4.81)	1.42 (1.38)	3.18 (1.92)	0.75 (1.12)
9	NRC-86	0.84 (1.16)	0.83 (1.15)	1.05 (1.25)	2.57 (1.75)	24.27 (4.98)	20.32 (4.56)	1.38 (1.37)	3.05 (1.88)	0.63 (1.06)
10	JS-20-34	0.70 (1.09)	0.69 (1.09)	0.92 (1.19)	2.31 (1.68)	22.13 (4.76)	18.21 (4.33)	1.10 (1.26)	2.90 (1.84)	0.52 (1.01)
	SEm (±)	0.074	0.076	0.068	0.079	0.236	0.263	0.072	0.071	0.076
	CD (P=0.05)	0.215	0.222	0.197	0.230	0.689	0.767	0.209	0.206	0.223

The maximum whitefly population was recorded in cultivars MACSNRC- 1575 (1.17/three leaves) followed by JS-335 (1.12/three leaves), NRC-147 (1.09/ three leaves), JS 97-52 (1.04/three leaves), NRC-131(1.0/three leaves) and NRC-132 (0.93/three leaves).

Jassid (*Empoasca kerri* Pruthi)

The data recorded on incidence of jassid in various soybean cultivars varied from 0.92 to 1.42 jassid/3 leaves. The minimum population of jassid (0.92 jassid/3 leaves) was recorded in JS-20-34 and it was at par with NRC-86(1.05 jassid/3 leaves).The maximum jassid population was recorded in JS-335 (1.42 jassid/3 leaves) followed by MACSNRC-1575(1.40 jassid/3 leaves), NRC-130(1.40 jassid/3 leaves).NRC-131(1.37 jassid/3 leaves), AMS-100-39 (1.35 jassid/3 leaves), NRC-132(1.32 jassid/3 leaves), NRC-147 (1.32 jassid/3 leaves) and JS97-52(1.29 jassid/3 leaves), it was significantly similar to each other.

The minimum whitefly and jassid incidence was recorded in JS 20-34, followed by NRC –86, proving that this cultivars are more tolerant to whitefly and jassid. The cultivars on which maximum whitefly and jassid population was recorded are MACSNRC- 1575, JS-335 proving that this cultivar was susceptible to white fly and jassid, Garewal *et al* (2003) also evaluated ten genotypes of soybean and found NRC-18, JS 335, JS 71-05 and JS 80-21 as resistance variety from whitefly and jassid.

Green stink bug (*Nezaraviridula* Linn.)

In the present study incidence of green stink bug varied from 2.31 to 3.47/mrl in various soybean cultivars. The significantly minimum population of green stink bug was observed in cultivars JS-20-34 (2.31/ mrl) among the cultivars. The maximum population of green stink bug was recorded in cultivars MACSNRC-1575 (3.47/ mrl) followed by NRC-132 (3.35/ mrl), AMS 100-39 (3.34/ mrl) and JS -335 (3.28/ mrl), it was at par with each other's except cultivars NRC-131, NRC-147,JS 97-52, NRC-130 and NRC-86.

Stem fly (*Melanagromyza sojae* Zehntner)

The data recorded on percent infestation of stem fly in soybean cultivars varied for 22.13 to 32.84 percent stem tunneling. The significantly minimum stem tunneling was found in soybean cultivars JS 20-34 (22.13 percent) among the cultivars. The significantly maximum stem tunneling due to stem fly was noticed in cultivars NRC-132 (32.84 percent) followed by cultivars JS-335 (32.14 percent), NRC-147 (31.95 percent),NRC-131(31.73 percent), AMS 100-39 (30.71 percent), MACSNRC 1575(30.54 percent), NRC-130 (30.45 percent), JS 97-52 (25.84 percent) and NRC-86 (24.27 percent).

The maximum population of stem fly was noticed in NRC-132 followed by JS-335, this cultivar proved to be susceptible, and JS-20-34 was least preferred by stem fly proved that this cultivar is more resistance to Stem fly. Anon., (1985), also found Himso-58A, Himso-1509, MACS-94, MACS-176, JS-79-295 and PK-327 as resistant against stem fly, and MACS-125 and MACS-32 varieties of soybean as susceptible variety.

Girdle beetle (*Obereopsis brevis* Swed.)

In the present finding infestation of the girdle beetle was recorded in weekly interval. The data on girdle beetle infestation ranged from 18.21 to 28.37 percent/plant. The significantly minimum infestation of girdle beetle was recorded in JS -20-34 (18.2 percent/ plant) followed by NRC– 86 (20.32 percent/ plant), JS 97-52 (22.67percent/ plant),NRC-130(24.97percent/ plant), AMS-100-39 (26.60 percent / plant), MACSNRC-1575 (26.72 percent / plant), JS 335 (26.95 percent / plant), NRC -147(27.35 percent / plant) and NRC -131 (27.40 percent / plant). The significantly maximum percent infestation of girdle beetle was found in NRC-132 (28.37 percent / plant).

Wang *et al* (1992) found that the cultivars JS -335, NRC -2, Punjab -1 are resistant to girdle beetle. Kujur (2011) reported MACS 1336 and MACS 1140, highly resistant against girdle beetle whereas Sinha (2009) observed NRC – 37 less infested variety.

Green semilooper (*Chrysodeixis acuta* Walker)

The present findings indicated that the infestation of green semilooper varied 1.10 to 1.90 larval/mrl in different cultivars of soybean. The minimum population of semilooper was noticed in JS-20-34 (1.10 larvae/mrl.), it was significantly differ among the cultivars. The maximumpopulationof semilooper was found cultivars AMS-100-39 (1.90larvae/mrl). It was at par with cultivars JS-335 (1.88larvae/mrl), MACSNRC-1575 (1.85larvae/mrl), NRC-130 (1.77larvae/mrl), NRC-132 (1.72larvae/mrl) and NRC- 131(1.67 larvae/mrl).

The minimum green Semilooper incidence was recorded in JS 20-34, this cultivars are more resistance to green Semilooper and the cultivars on which maximum green Semilooper population was recorded are AMS-100-39, followed by JS-335 ,this cultivar was susceptible to green Semilooper, Garewal *et al* (2003) found JS 71-05 and NRC-25 as resistance variety to green Semilooper.

Tobacco caterpillar / Leaf eating caterpillar (*Spodoptera litura* Fabricius)

The observations recorded on infestation of s. litura in various cultivars of soybean indicated that population of s. litura varied from 2.90 -3.70 larvae/mrl in different cultivars. The significantly minimum population of s. litura was observed in cultivars JS 20 -34 (2.90 larvae/mrl). The maximum population of s. litura was found in cultivar NRC-147 (3.70 larvae/mrl), it was at par with cultivars NRC-130, AMS 100-39, NRC-132, NRC-131 and MACSNRC -1575 accept cultivars JS-335, JS-52 and NRC-86.

Minimum tobacco caterpillar incidence was recorded in JS 20-34, proving that this cultivars are more resistance to tobacco caterpillar and the cultivars on which maximum tobacco caterpillar population was recorded are NRC-147, followed by NRC-130 proving that this cultivar was susceptible to tobacco caterpillar, Garewal *et al* (2003) also evaluated ten genotypes of soybean and found NRC-18 and NRC-7 as resistance to tobacco caterpillar.

Lady bird beetle (*Coccinella septempunctata* Fabricius)

Present finding indicated that population of natural enemies (Lady bird beetle) varied from 0.52-0.88 per plant in different soybean cultivars. The maximum population of lady bird beetle was recorded in soybean cultivars JS-335(0.88/plant) followed by NRC-130(0.82/plant), MACSNRC-1575 (0.82/plant), AMS-100-39 (0.82/plant), NRC-131 (0.76/plant), NRC-147 (0.75/plant), NRC-132 (0.75/plant) and JS 97-52 (0.75/plant), it was significantly similar to each other. The minimum population of lady bird beetlewas recorded in cultivars JS-20-34 (0.52 /plant) followed by NRC-86 (0.63/plant).

CONCLUSION

In the present study, cultivar JS-20-34 was less preferred by major insect pests of soybean and it was expressed resistant to whitefly, stem fly, girdle beetle, green semilooper and tobacco caterpillar. While cultivars MACSNRC-1575 was found susceptible to whitefly, NRC- 132 to stem fly and girdle beetle and cultivars AMS-100-39 was found susceptible to semilooper and NRC-147 to susceptible tobacco caterpillar. Soybean cultivar JS-20-34 was found tolerant to major insect pest and suitable to cultivation the area.

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