

Screening of Soybean Genotypes/Varieties for Resistant Against Major Insect-Pests and Classification into Resistance Groups Based on Yield Potential and Loss

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ABSTRACT

In search of host plant resistance against defoliators and girdle beetle, thirteen genotypes/varieties of soybean from normal maturity group were screened at Agricultural Research Station, Kota under AICRP on Soybean during kharif 2022. These genotypes/varieties were classified into resistance groups based on their natural yield potential and yield loss due to defoliators and girdle beetle using 'maximin-minimax' method. Accordingly, genotypes NRC 189, NRC 192 and check RVSM 2011-35 as resistant high yielding whereas genotype RSC 11-42 and check AMS 100-39 were tolerant against prevailing insect pest complex. The remaining genotypes/varieties were found susceptible low yielding.

Key words: Resistance groups, screening, soybean varieties, yield potential

Introduction:

Soybean, *Glycine max* (L.) Merrill is native of China and was introduced in India in 1968 from USA. In India it is major oil seed *kharif* crop mainly grown in Madhya Pradesh, Maharashtra and Rajasthan which together contribute 95 per cent of area and production. In Rajasthan, it covers an area of 1.16 million hectare (Anonymous, 2022) over the districts of Kota, Baran, Jhalawar and Bundi which comes under humid south eastern plain Zone (Zone-V). While soybean is an important source of protein and oil (Singh and Mittal, 1970), its rich green foliage with high nutritive value attracts many insect-pests attack throughout its growth (Sharma, 1995). Major defoliators *i.e.* green semilooper (*Chrysodeixis acuta*), semilooper, (*Achea janata*), tobacco caterpillar (*Spodoptera litura*), hairy caterpillar (*Spilosoma obliqua*) etc. and Girdle beetle (*Obereopsis brevis*) cause huge loss of soybean yield (Thakur, 1985).

The most economical way to deal with these insect-pests and avoid yield losses is to cultivate insect resistant/tolerant varieties. Odulaja and Nokoe (1993) suggested 'maximin-minimax' methods for classifying varieties into resistant or tolerant groups, based on the joint consideration of percent yield loss and actual yield potential. In present study, the 'maximin-minimax' procedure was employed to identify soybean genotype either resistant and/or tolerant to the prevailing insect-pest complex, which includes mention above. In order to identify potential resistant genotypes against defoliators and girdle beetle field screening was carried out using more relevant screening criteria.

Materials and Methods

An experiment was conducted in Randomized Block Design with two replications in protected and unprotected set and 30 cm row to row distance with plot size 3-meter length at Agricultural Research Station, Kota under "All India Co-ordinated Research Project on Soybean" during *Kharif*, 2022. There are thirteen genotypes/ varieties were sown on 24th June, 2022. Observation on effect of insect-pest complex on yield of soybean genotypes were recorded and analysis was done as per prescribed screening procedure of 'maximin minimax' method. This method envisages maximizing the yield while minimizing the yield loss. The relative yield (RY) of the *i*th genotype relative to the resistance check is given as:

$RY_i = 100 Y_i / Y_r$, where, Y_i is yield of *i*th genotype, Y_r is yield of the resistant check, both under the unprotected condition.

Similarly, the relative per cent yield loss (RP) of the *i*th genotype relative to a susceptible check was calculated as:

$RP_i = 100 P_i / P_s$, where, P_i is per cent yield loss of the *i*th genotype, P_s is per cent yield loss in the susceptible check.

When resistant and susceptible checks are not known, this approach allows considering the genotype giving highest yield under unprotected condition as a resistant check and the one with highest per cent yield loss as a susceptible check. After setting an acceptable lower limit (L) for RY and an upper limit (U) for RP a 'maximin-minimax' plot with four quadrants is prepared. Each quadrant houses genotypes of a specific category. (Fig. 1).

Table 1: Categorization of soybean genotypes/varieties according to 'maximin-minimax' method

S. No.	Name of Entries	Yield Protected	Yield Unprotected	% Yield Loss	Relative yield (%)	Relative yield loss (%)	Category
1.	AS 24	1011.11	533.33	47.25	31.48	66.26	SLY
2.	KDS 1096	402.78	313.89	22.07	18.52	30.95	SLY
3.	NRC 189	2022.22	1694.45	16.21	100.00	22.73	RHY
4.	NRC 190	1225.00	1011.11	17.46	59.67	24.48	RLY
5.	NRC 192	1877.78	1625.00	13.46	95.90	18.88	RHY
6.	RSC 11-42	2072.22	1305.56	37.00	77.05	51.88	SHY
7.	AMS 100-39 (C)	1638.89	1319.45	19.49	77.87	27.33	SHY
8.	RSC 10-52 (C)	552.78	444.44	19.60	26.23	27.48	SLY
9.	RVSM 2011-35 (C)	2041.67	1680.56	17.69	99.18	24.80	RHY
10.	JS 335 (LC)	1055.56	302.78	71.32	17.87	100.00	SLY
11.	RKS 18 (LC)	1586.11	1283.33	19.09	75.74	26.77	SHY
12.	RKS-24 (LC)	1391.67	561.11	59.68	33.11	83.69	SLY
13.	RKS-113 (LC)	1694.45	1394.45	17.70	82.30	24.83	RHY
			Mean	29.08	59.45	40.77	

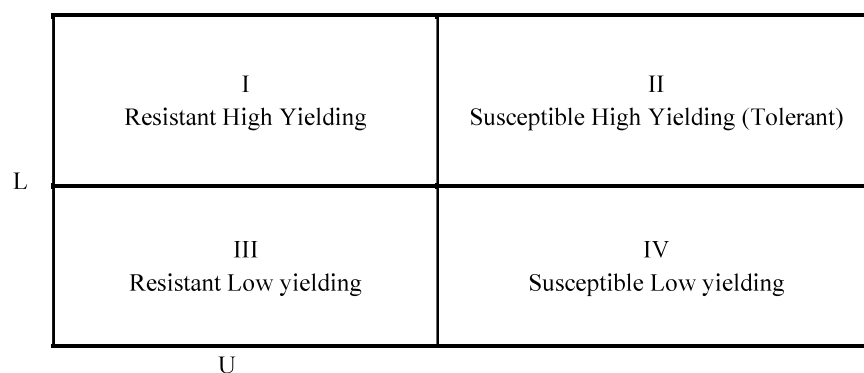


Fig. 1: The maximin-minimax plot

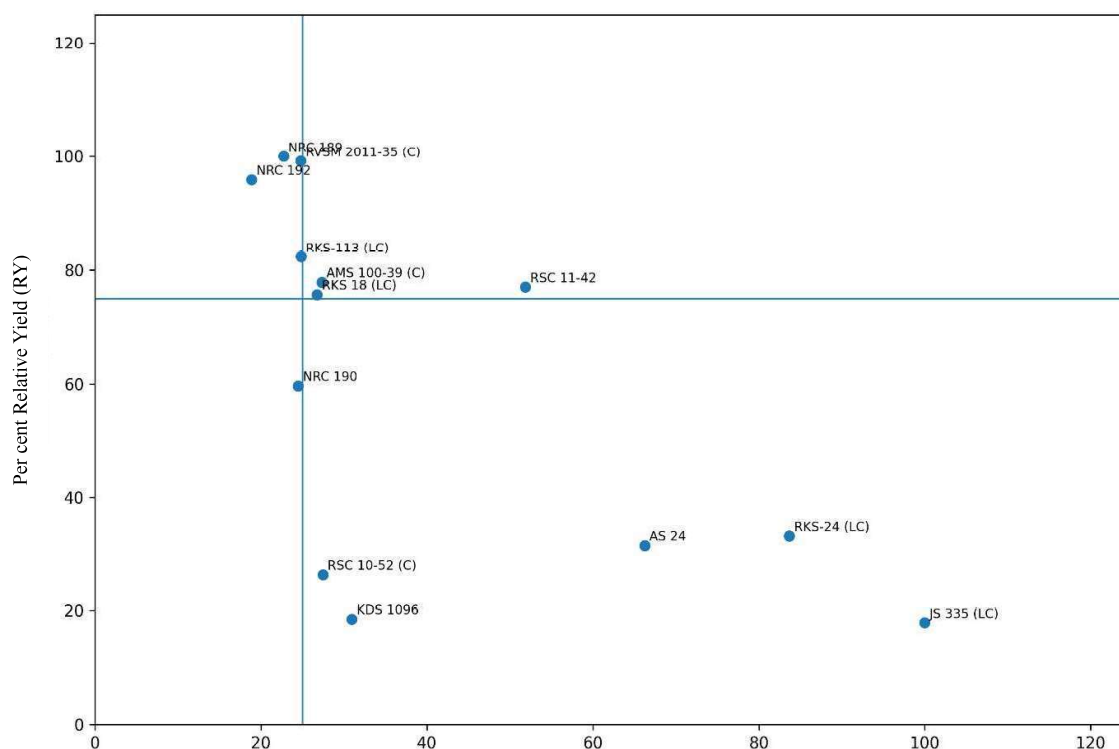


Figure 2: Per cent Relative Yield Loss

RESULTS AND DISCUSSION

Based on the yield obtained, significant variation was observed among the soybean entries/varieties with respect to yield under protected and unprotected conditions. It was found that percent yield loss in different genotypes/varieties ranged from 13.46 in NRC 192 to 71.32 in JS 335 (Table-1). Genotype NRC 189 with the highest yield under unprotected condition (1694.45 kg/ha) was considered as resistant check while JS 335 with the maximum per cent yield loss (71.32) was considered as susceptible check. In relation to these checks, Relative Yield (RY) and Relative Per cent yield loss (RP) were calculated.

Acceptable upper limit for yield losses was taken as 25, which indicated the maximum affordable yield losses that could be avoided by proper insect management practices. Similarly acceptable lower limit for yield was taken as 75, which implied that a genotype under unprotected conditions should be able to produce at least 75% of yield that could be obtained under protected conditions. Genotype NRC 189, having the least per cent of yield loss (13.46) was categorized under resistant high yielding (Fig. 2). It could serve as a donor for resistant character against the pest complex in developing resistant varieties.

In present study, genotypes RSC 11-42 and Check AMS 100-39, RKS 18 were grouped under the susceptible but high yielding (S-HY) *i.e.* tolerant (Fig. 2). In earlier studies also consider AMS 100-39, NR-SL 2, NRC 33, NRC 450 and JS 20-34 were found to be tolerant against prevailing insect-pests complex (Patidar *et al.*, 2022 and Garewal *et al.*, 2005). These tolerant genotypes/varieties should be preferred because they allow some insect-pest population to thrive upon and thereby facilitate build up of natural enemies' population. Cultivation of true insect resistant varieties for along time will tend to deplete the fauna of natural enemies and cause environmental and biotic imbalance.

Among these three tolerant genotypes/varieties, the least per cent yield loss was recorded in RKS 18 (19.09) followed by AMS 100-39 (19.49) and RSC 11-42 (37.00). Genotypes/varieties categorized as susceptible (S) and low yielding (Fig. 2) *i.e.* AS 24, KDS 1096, RSC 10-52, RKS 24 and JS 335 to insect-pests complex are also of significance as they could be used as infester lines in the field screening.

The genotypes categorized a resistant high yielding *i.e.* tolerant to preventing insect-pests complex, could be released for cultivation after completing mandatory

testing procedures. On the other hand, genotypes categorized as resistant but low yielding could serve as potential donors in domestic breeding programmes for developing insect resistant varieties.

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