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Research Article

Screening of Soybean (*Glycine max* L. Merril) Genotypes for Resistance against Major Insect-Pests

Yoodarimiki Shylla*, Pankaj Neog and Imtinaro L.

Dept. of Entomology, School of Agricultural Science & Rural Development, Nagaland University, Medziphema, Nagaland, 797106

*Corresponding Author E-mail: shyllayoodarimiki@gmail.com

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ABSTRACT

A study was conducted in the experimental farm of SASRD, Nagaland University during Kharif 2017 in order to screen soybean genotypes for resistance against major insect pests using two replications. Forty one soybean genotypes along with five check varieties were arranged in RBD. The major insect pests observed at weekly intervals were leaf webber (Anarsia ephippias), aphid (Aphis glycines), leaf hopper (Bothrogonia indistincta), Pod bug (Riptortus pedestris) and blister beetle (Mylabris phalerata). The genotypes NRC 134 (4.20 no/mrl) and JS 20-17 (0.70 no/mrl) showed highest and lowest infestation by leaf webber. Highest infestation of aphid was found on PS 1613 (21.85no/3leaf) and lowest was found on AMS 100-39 (1.50 no/3leaf). In case of leaf hopper, the highest infestation was found on NRC 137 (4.75no/3leaf) and the lowest infestation was found on DSb 34 (1.08 no/3leaf). Genotypes namely NRC 137 (5.88 no/mrl) showed highest infestation and genotype JS 21-15 (1.23 no/mrl) showed lowest infestation by blister beetle. For pod bug, genotype CSB 10112 (5.90 no/mrl) showed highest infestation and NRC 128 (0.12 no/mrl) showed lowest infestation. The highest yield was reported by TS 53 (3155 kg/ha) and lowest was NRC 131 (488.88 kg/ha). Cluster analysis was used to group line based on five major soybean insect pests (leaf webber, aphid, leaf hopper, blister beetle and pod bug) infestation levels within the site and found that Cluster V (TS 53, SL 1123, SKF-SPS-11) was considered the resistant cluster with highest yield, where the best performing genotypes were included.

Keywords: *Soybean, Genotypes, Insect pests and Yield*

INTRODUCTION

Soybean (*Glycine max* L. Merril) is one of the most important leguminous oilseed crops, occupying an important position in the world trade. Even though, Soybean was originated from China but the largest acreage with the highest production is in United States, Brazil and Argentina. Soybean has a prominent place as the world's most important seed legume, which contributes 26.7% to the global vegetables oil production (Anonymous, 2015). In Nagaland, Soybean is locally known as 'Naga dal'. It is grown in Phek, Mokokchung, Zunheboto, Wokha, Peren, Longleng and Dimapur districts of Nagaland.

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It is cultivated in an area of 24,510 hectares, production of 30,680 metric tonnes and productivity of 1.25 metric tons per ha. But, it is mainly grown in Zunheboto district with 7500 ha areas under cultivation, producing about 9620 metric tons. In Dimapur district, soybean is produced in an area of 2040 ha, with a production of 2520 tonnes and productivity of 1.23 tonnes per ha (Anonymous, 2016). The suitable varieties recommended by ICAR for north eastern plain are NRC 2, JS 80-21, PK 472, MAUS 71, JS 335, RKS 18, JS 97-52 (Singh, 2013).

Patil reported that soybean was attacked by 48 phytophagous species, among these the seedling borers (*Melangromyza sojae*), Girdle beetle (*Obereopsis brevi)*, leaf eating caterpillar (*Spodoptera litura*) and pod borer (*Cydia ptychora*) were key pests during *kharif.* Whereas, leaf miner (*Aproaerema modicella*), white fly (*Bemisia tabaci*) and leaf hopper (*Amrasca biguttula*) were the major pests found during summer[7]. For the management of these insect-pests, host plant resistance is a highly useful strategy.

MATERIALS AND METHODS

RBD (Randomized Block Design) was used to layout the field experiment. It was carried out in the field condition during the *Kharif* season (July-Nov) 2017. A total of forty six soybean genotypes which included forty one elite soybean genotypes (NRC 128, RVS 2011-3, DSb 34, MAUS 725, SL 1068, JS 21-15, AUKS 174, NRC 137, VLS 95, CSB 10084, MACS 1493, JS 20-17, NRC 130, TS 53, RVS 2011-4, SL 1123, BAUS 102, MACSNRC 1575, MAUS 731, NRC 132, VLS 94, AMS 2014-1, KDS 1095, NRC 133, DS 3108, AMS 100-39, NRC 136, RVS 2011-1, CSB 10112, PS 1613, NRC 131, KDS 992, RSC 11-07, NRCSL 1, PS 1611, RSC 11-03, NRC 134, NRC 129, RVS 2011-2, SKF-SPS-11 & SKF-1050) with five check varieties (JS 335, JS 97-52, RKS 18, JS 93-05 and PS 1347) were used for the study. The field was replicated two times with each replication having 46 plots of size 3m x 1.4m with 1m distance between the plots. The plant to plant distance was kept at 10cm and the replication at 1m distance.

Observation on major insect pests

Observation on leaf webber, pod bug, blister beetle

Number of larvae, adult pod bug and adult blister beetle per metre row length (mrl) in at least 3 places and means were recorded in number per metre.

Observation on aphids and leaf hopper

Number of insects (nymph and adults) in 3 leaves per plant (upper, middle and lower leaf) in 10 plants each was recorded.

AICRP method of categorization to be followed (Sharma, 1996)

HR – Value < mean – CD at 1%

R – Value between mean – CD at 1% and mean – CD at 5%

MR – Value between mean – CD at 5% and mean

LR – Value between mean and mean + CD at 5%

S – Value between mean + CD at 5% and mean + CD at 1%

HS – Values > mean + CD at 1%

The treatments were compared among themselves by calculating critical difference (CD) and 5% level of significance.

A cluster analysis of the genotypes was evaluated by using SPSS software.

RESULTS AND DISCUSSION

Response of soybean genotypes against leaf webber, *Anarsia ephippias* (Meyrick)

Out of the forty six soybean genotypes screened only one genotype (JS 20-17) with 0.70 larva per mrl was highly resistant, ten genotypes (DSb 34, VLS 95, MACS 1493, RVS 2011-4, BAUS 102, MACS NRC 1575, CSB 10112, KDS 992, JS 335, RKS 18) showed resistant, fourteen genotypes (NRC 128, MAUS 725, NRC 137, NRC 130, NRC 133, DS 3108, AMS 100-39, NRC 136, RVS 2011-1, RSC 11-07, PS 1611, RSC 11-03, SKF-SRS-11, PS 1347) were found to be moderately resistant, eleven genotypes (JS 21-15, AUKS 174, CSB 10084, TS 53, SL 1123, MAUS 731, NRC 132, VLS 94, PS 1613, NRC 131, NRC 129) showed low resistant, eight genotypes (RVS 2011-3, SL 1068, AMS 2014-1, KDS 1095, NRCSL 1, SKF-1050, JS

97-52) were found to be susceptible and two genotypes (NRC 134, RVS 2011-2) were highly susceptible (Table 1). The findings from Manu and Patil who reported to have similar result where JS 335 and RKS 18 were also found to be resistant (Manu, 2015).

Response of soybean genotypes against Aphid, *Aphis glycines* (Matsumura)

Out of the forty six soybean genotypes screened only one genotype (CSB 10084) was susceptible with 17.35 aphids in three leaves per plant. Eight genotypes (NRC 128, TS 53, SL 1123, AMS 2014-1, CSB 10112, PS 1613, NRC 134, SKF-1050) were highly susceptible, four genotypes (RVS 2011-3, AUKS 174, VLS 95, RVS 2011-2) showed low resistant, three genotypes (RVS 2011-4, RVS 2011-1, RKS 18) were moderately resistance, twelve genotypes (DSb 34, NRC 137, JS 20-17, BAUS 102, NRC 132, NRC 136, NRC 131, KDS 992, SKF-SPS-11, JS 335, JS 93-05, PS 1347) showed resistance and eighteen genotypes (MAUS 725, SL 1068, JS 21-15, MACS 1493, NRC 130, MACS NRC 1575, MAUS 731, VLS 94, KDS 1095, NRC 133, DS 3108, AMS 100-39, RSC 11-07, NRC SL 1, PS 1611, RSC 11-03, NRC 129, JS 97-52) were found to be highly resistant (Table 1).

The present study is also similar with Pierson et al. (2010) where they found three genotypes (KS4202, K-1639-2 and K1621) were considered moderately resistant based on the assessed damage ratings.

Response of soybean genotypes against leaf hopper, *Bothrogonia indistincta* (Walker)

On the basis of categorization, seven genotypes (DSb 34, JS 21-15, VLS 95, AMS 100-39, NRC 131, PS 1611, RVS 2011-2) were found to be highly resistant, twenty one genotypes (SL 1068, AUKS 174, MACS 1493, RVS 2011-4, BAUS 102, MACSNRC 1575, MAUS 731, VLS 94, KDS 1095, DS 3108, NRC 136, CSB 10112, PS 1613, RSC 11-07, NRC 129, SKF 1050, JS 335, JS 97-52, RKS 18, NRC 130, TS 53) exhibited resistant, seven genotypes (RVS 2011-3, SL 1123, NRC 132, AMS 2014-1, KDS 992, RSC 11-03 and JS 93-05) showed moderately resistant, seven genotypes (NRC 128, CSB 10084, JS 20-17, NRC 133, NRCSL 1, NRC 134, PS 1347) were low resistant, two genotypes (MAUS 725, SKF-SPS-11) were found to be susceptible and two genotypes (NRC137, RVS 2011-1) showed highly susceptible (Table 1).

Similar finding was reported by Thejaswi et al. (2008) who reported that the leafhopper in field bean appeared during vegetative phases of the crop with the population ranging from 2.00 to 5.50 hoppers per three leaves.

Response of soybean genotypes against blister beetle, *Mylabris phalerata* (Thunb)

The mean of the adult beetles population count ranged from as low as 1.23 to 5.88 beetles per mrl). On the basis of categorization six genotypes (NRC 128, JS 21-15, PS 1611, JS 335, JS 97-52, PS 1347) were found to be highly resistant, twelve genotypes (RVS 2011-3, DSb 34, MAUS 725, SL 1068, VLS 95, JS 20-17, SL 1123, VLS 94, AMS 100-39, CSB 10112, PS 1613, RSC 11-03) showed resistant, seven genotypes (AUKS 174, BAUS 102, KDS 1095, NRC 133, NRC SL 1, SKF-SPS-11, NRC 130) were found to be moderately resistant, twelve genotypes (CSB 731, MACS 1493, RVS 2011-4, MACSNRC 1575, NRC 132, AMS 2014-1, DS 3108, NRC 136, KDS 992, RVS 2011-2, SKF 1050, JS 93-05) were low resistant, seven genotypes (MAUS 731, RVS 2011-1, NRC 131, RSC 11-07, NRC 129, RKS 18, TS 53) were susceptible and two genotypes (NRC 137, NRC 134) were found to be highly susceptible (Table 1).

Anantharaju et al. (2008) screened for resistance to spotted pod borer and blister beetle where LGR 41 recorded the highest grain yield with lowest yield loss followed by ICPL 332. Thus, the above observation is similar with the present findings.

Response of soybean genotypes against pod bug, *Riptortus pedestris* (Fabricius)

Out of the forty six genotypes screened, four genotypes (NRC 128, MACS 1493, KDS 992, SKF-SPS-11) were highly resistant, twelve genotypes (RVS 2011-3, MAUS 725, SL 1068, AUKS 174, BAUS 102, MACSNRC 1575, AMS 2014-1, NRC 129, RVS 2011-2, RKS 18, JS 93-05, NRC 130) showed resistant, thirteen genotypes (DSb 34, JS 21-

15, NRC 137, VLS 137, CSB 10084, JS 20-17, RVS 2011-4, SL 1123, NRC 132, DS 3108, RVS 2011-1, PS 1611, NRC 134) were moderately resistant, ten genotypes (MAUS 731, VLS 94, KDS 1095, NRC 133, AMS 100-39, RSC 11-07, SKF 1050, JS 335, JS 97-52, PS 1347) showed low resistant, four genotypes (NRC 136, PS 1613, RSC 11-03, TS 53) were susceptible and three genotypes (CSB 10112, NRC 131, NRC SL 1) were found to be highly susceptible (Table 1).

Similar research study was conducted by Krisnawati et al. (2017) who screened 10 soybean genotypes against pod sucking bug, *Riptortus linearis*. The results showed that the lowest percentage of pod and seed damage was found on G511H/Anjasmoro/Anjasmoro-2-8 in both no-choice and choice test. This genotype could be used as a resistant donor in the soybean breeding program for resistance to pod sucking bug.

Grain yield (kg/ha) of soybean genotypes under the influence of the major insect pests

The yield obtained (Table 1) from each genotypes was recorded and tabulated. The highest yield was reported by TS 52 (3155 kg/ha), followed by SL 1123 (3000 kg/ha) and SKF-SPS-11 (2911.10 kg/ha). The lowest grain yield was recorded in NRC 131 (488.88 kg/ha), followed by SKF-1050 (688 kg/ha) and AMS 100-39 (800 kg/ha).

Similar findings were also reported by Motaphale et al. (2016) who screened twenty two genotypes for tolerance against major insect pests of soybean. During 2010 Genotypes DSb 16 (2199.1kg/ha) with the highest yield under unprotected conditions was considered as tolerant check. Among the entries tested, two entries *viz.*, SL-799, DSb-16 and three checks JS 93-05, JS-335 and MAUS-158 were categorized as high yielding entries. During 2011, the per cent yield loss in different genotypes ranged from 14.35 (PS 1466) to 61.56 (JS 97-52). Under protected and unprotected conditions yield obtained from JS 93-05 (1621.31 kg/ha) to DS 12-13 (2526.61 kg/ha) and from PS 1466 (1089.65 kg/ha) to DSb 16 (2199.06 kg/ha) (Motaphale et al. 2016).

Table 1: Field screening of soybean genotypes against major insect pests and their yield during *kharif*, 2017

Sl. no	Genotypes	Leaf webber (no/mrl)	Category	Aphid (no/3 leaf)	Category	Leafhopper (no/3 leaf)	Category	Beetles (no/mrl)	Category	Pod bug (no/mrl)	Category	Yield (g/plot)	Yield (Kg/ha)
1.	NRC 128	1.95 (1.57)	MR	21.65 (4.70)	HS	2.98 (1.86)	LR	2.00 (1.58)	HR	0.12 (0.78)	HR	473.33	1133.00
2.	RVS 2011-3	3.68 (2.04)	HS	14.10 (3.82)	LR	2.63 (1.76)	MR	2.65 (1.77)	R	1.43 (1.38)	R	1032.77	2488.88
3.	DSb 34	1.80 (1.52)	R	7.10 (2.76)	R	1.08 (1.25)	HR	2.99 (1.87)	R	2.75 (1.80)	MR	459.375	1088.88
4.	MAUS 725	1.50 (1.41)	MR	3.10 (1.87)	HR	4.08 (2.14)	S	2.75 (1.80)	R	1.30 (1.32)	R	659.66	1555.55
5.	SL 1068	3.25 (1.94)	S	2.70 (1.76)	HR	2.03 (1.59)	R	2.38 (1.68)	R	1.14 (1.28)	R	1151.04	2733.00
6.	JS 21-15	2.90 (1.84)	LR	4.60 (2.25)	HR	1.65 (1.47)	HR	1.23 (1.31)	HR	2.30 (1.67)	MR	584.55	1355.00
7.	AUKS 174	2.60 (1.76)	LR	12.20 (3.56)	LR	1.90 (1.54)	R	3.18 (1.90)	MR	1.56 (1.43)	R	875.29	2022.21
8.	NRC 137	2.00 (1.58)	MR	6.25 (2.59)	R	4.75 (2.29)	HS	5.88 (2.51)	HS	2.75 (1.80)	MR	744.2	1822.00
9.	VLS 95	1.80 (1.51)	R	12.00 (3.32)	LR	1.33 (1.35)	HR	2.73 (1.79)	R	2.40 (1.70)	MR	444.15	1044.45
10.	CSB 10084	2.85 (1.83)	LR	17.35 (4.19)	S	2.93 (1.85)	LR	4.35 (2.19)	LR	2.20 (1.64)	MR	557	1333.33
11.	MACS 1493	1.70 (1.48)	R	4.25 (2.17)	HR	2.25 (1.66)	R	4.07 (2.13)	LR	0.92 (1.18)	HR	872.24	2088.88
12.	JS 20-17	0.70 (1.09)	HR	5.30 (2.40)	R	3.48 (1.99)	LR	2.25 (1.65)	R	2.35 (1.68)	MR	802.69	1911.12
13.	NRC 130	2.00 (1.57)	MR	2.75 (1.80)	HR	1.98 (1.57)	R	3.83 (2.08)	MR	1.90 (1.53)	R	581.09	1333.00
14.	TS 53	2.65 (1.77)	LR	21.05 (4.62)	HS	2.15 (1.63)	R	4.82 (2.30)	S	4.30 (2.18)	S	1322.65	3155.00
15.	RVS 2011-4	1.40 (1.38)	R	11.25 (3.42)	MR	2.15 (1.63)	R	4.58 (2.24)	LR	2.34 (1.68)	MR	584.55	1355.00
16.	SL 1123	2.75 (1.80)	LR	21.60 (4.69)	HS	2.75 (1.80)	MR	2.85 (1.82)	R	0.78 (1.10)	HR	1258.5	3000.00
17.	BAUS 102	1.35 (1.34)	R	5.25 (2.39)	R	1.75 (1.50)	R	3.03 (1.85)	MR	0.72 (1.10)	HR	1117.005	2644.45

18.	MACSN RC 1575	1.60 (1.44)	R	3.50 (2.00)	HR	1.89 (1.54)	R	4.27 (2.16)	LR	1.73 (1.48)	R	487.38	1155.55
19.	MAUS 731	2.55 (1.75)	LR	3.95 (2.09)	HR	1.70 (1.48)	R	5.57 (2.44)	S	3.90 (2.10)	LR	927	2200.00
20.	NRC 132	2.60 (1.76)	LR	6.35 (2.61)	R	2.83 (1.82)	MR	4.16 (2.13)	LR	2.85 (1.83)	MR	690.035	1644.00
21.	VLS 94	2.75 (1.80)	LR	4.10 (2.13)	HR	2.03 (1.59)	R	2.42 (1.71)	R	2.85 (1.82)	LR	431.28	1022.21
22.	AMS 2014-1	3.60 (2.02)	S	21.50 (4.67)	HS	2.55 (1.74)	MR	4.58 (2.25)	LR	1.15 (1.28)	R	586.665	1355.00
23.	KDS 1095	3.30 (1.93)	S	1.75 (1.50)	HR	2.00 (1.58)	R	3.66 (2.03)	MR	1.75 (1.49)	R	458.815	1088.88
24.	NRC 133	1.90 (1.55)	MR	4.25 (2.17)	HR	3.40 (1.97)	LR	3.15 (1.91)	MR	3.85 (2.08)	LR	398.795	933.31
25.	DS 3108	2.30 (1.67)	MR	3.25 (1.93)	HR	1.95 (1.57)	R	4.10 (2.13)	LR	2.35 (1.68)	MR	359.49	844.43
26.	AMS 100-39	2.10 (1.59)	MR	1.50 (1.41)	HR	1.68 (1.47)	HR	2.87 (1.83)	R	3.55 (2.01)	LR	319	800.00
27.	NRC 136	2.15 (1.61)	MR	8.20 (2.95)	R	2.20 (1.64)	R	3.91 (2.08)	LR	4.45 (2.22)	S	662.15	1555.00
28.	RVS 2011-1	2.15 (1.63)	MR	10.00 (3.21)	MR	4.25 (2.17)	HS	5.05 (2.35)	S	2.75 (1.79)	MR	482.33	1111.10
29.	CSB 10112	1.75 (1.50)	R	20.00 (4.52)	HS	1.80 (1.52)	R	3.00 (1.87)	R	5.90 (2.53)	HS	666	1600.00
30.	PS 1613	2.80 (1.81)	LR	21.85 (4.72)	HS	1.73 (1.49)	R	2.50 (1.71)	R	4.10 (2.14)	S	595.5	1400.00
31.	NRC 131	2.40 (1.70)	LR	6.00 (2.52)	R	1.60 (1.45)	HR	4.83 (2.31)	S	5.75 (2.50)	HS	207.78	488.88
32.	KDS 992	1.75 (1.50)	R	5.75 (2.47)	R	2.75 (1.79)	MR	4.20 (2.13)	LR	0.78 (1.10)	HR	415.725	977.79
33.	RSC 11-07	2.40 (1.69)	MR	3.30 (1.95)	HR	1.83 (1.51)	R	4.90 (2.32)	S	3.60 (2.02)	LR	579.995	1333.31
34.	NRCSL 1	3.50 (2.00)	S	3.85 (2.07)	HR	3.08 (1.87)	LR	3.75 (2.06)	MR	5.45 (2.42)	HS	555.195	1377.76
35.	PS 1611	2.45 (1.71)	MR	3.00 (1.87)	HR	1.38 (1.36)	HR	2.10 (1.59)	HR	2.15 (1.63)	MR	458.825	1088.88
36.	RSC 11-03	2.10 (1.59)	MR	1.60 (1.44)	HR	2.80 (1.79)	MR	2.58 (1.75)	R	4.60 (2.25)	S	458.825	1088.88
37.	NRC 134	4.20 (2.16)	HS	19.50 (4.46)	HS	3.15 (1.91)	LR	6.55 (2.65)	HS	2.55 (1.74)	MR	483.995	1111.10
38.	NRC 129	2.55 (1.74)	LR	3.80 (2.06)	HR	2.25 (1.64)	R	5.00 (2.33)	S	1.11 (1.22)	R	410.665	955.55
39.	RVS 2011-2	3.75 (2.06)	HS	14.00 (3.80)	LR	1.30 (1.34)	HR	4.16 (2.16)	LR	1.90 (1.55)	R	471.69	1111.10
40.	SKF-SPS-11	2.35 (1.65)	MR	6.05 (2.53)	R	4.03 (2.10)	S	3.35 (1.96)	MR	0.60 (1.05)	HR	1232.695	2911.10
41.	SKF-1050	3.55 (2.01)	S	20.30 (4.56)	HS	1.85 (1.53)	R	4.33 (2.18)	LR	3.50 (1.98)	LR	279.885	688.00
42.	JS 335	1.70 (1.48)	R	6.25 (2.59)	R	2.25 (1.64)	R	1.28 (1.27)	HR	1.93 (1.54)	R	683.46	1622.21
43.	JS 97-52	3.05 (1.88)	S	4.55 (2.25)	HR	1.75 (1.50)	R	1.92 (1.52)	HR	3.60 (1.98)	LR	649.78	1533.00
44.	RKS 18	1.67 (1.46)	R	11.00 (3.39)	MR	2.18 (1.63)	R	4.91 (2.32)	S	1.79 (1.70)	R	804.175	1911.00
45.	JS 93-05	3.25 (1.93)	S	6.25 (2.59)	R	2.65 (1.77)	MR	3.91 (2.09)	LR	1.60 (1.44)	R	725.68	1711.12
46.	PS 1347	2.25 (1.66)	MR	4.93 (2.31)	R	3.05 (1.87)	LR	1.29 (1.31)	HR	3.85 (2.08)	LR	798.025	1888.88
SEm±		0.12		0.24		0.11		0.17		0.14			
CD (P= 0.05)		0.33		0.69		0.30		0.49		0.40			

Note: Figures in the table are mean values and those in parenthesis are square root transformed values
HR = Highly Resistant R = Resistant MR = Moderately Resistant
LR = Low Resistant S = Susceptible HS = Highly Susceptible

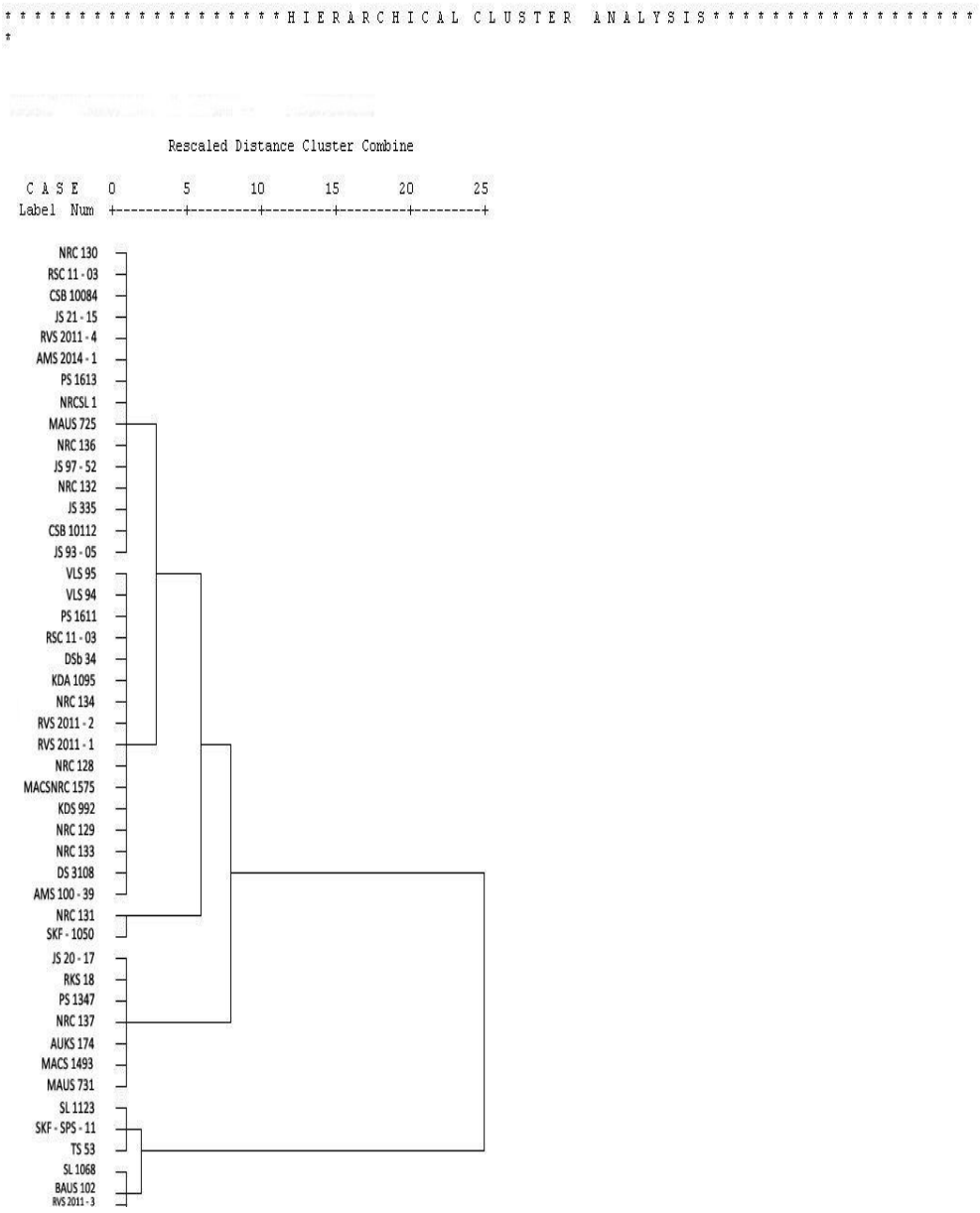

Fig. 1: Dendrogram using Average Linkage (Between Group)

CONCLUSION

It can be concluded that Cluster V (TS 53, SL 1123 and SKF-SPS-11) are considered the resistant cluster with highest yield under the influence of major insect pests that could be helpful in soybean breeding program aimed at developing the varieties against major pests of soybean.

REFERENCES

Anantharaju, P., & Muthiah, A. R. (2008). Screening of pigeonpea spotted pod borer and blister beetle species tolerance techniques under field conditions, *Plant Archives. 8*(1), 189-194.

Anonymous, (2015). Vision 2050, Directorate of Soybean Research, Indian Council of Agricultural Research, pp 1.

Anonymous, (2016). Dimapur District, Inventory of agriculture, ICAR-Agricultural Technology Application Research Institute, Umiam (Barapani), Meghalaya. Pp 32.

Krishnawati, A., Bayu, M. S. Y., & Adie, M. M. (2017). Screening of soybean

genotypes for resistance to pod sucking bug, *Riptortus linearis*, *Nusantara Bioscience*. *9*(2), 181-187.

Manu, N., & Patil, R.H. (2015). Screening of soybean varieties against leaf eating caterpillar and classification into resistance groups based on yield potential and loss, *Soybean Research*. *13*(1), 40-47.

Motaphale, A. A., Bhosle, B. B., & Khan, F. S. (2016), Screening of germplasm for tolerance against major stem pests of soybean, *International Journal of Plant Protection. 9*(2), 387-394.

Patil, R. H. (2002). Evaluation of insect pest management components in soybean ecosystem. *Ph. D. Thesis*, Univ of Agric. Sci. Dharwad, India.

Pierson, L. M., Heng Moss, T.M., & Reese, J. C. (2010). Categorizing the resistance of soybean genotypes to the soybean aphid (Hemiptera: Aphididae) *Journal of Economic Entomology*. *103*(4), 1405-1411.

Sharma, A. N. (1996). Comparison of two screening procedures and classification of soybean genotypes into insect-resistant groups. *International Journal of Pest Management*. *42*(4), 303-310.

Singh, R., & Sharma, A. (2013). Soybean production technology for better yield in Morung Express. 3 Sept, http://morungexpress.com/soybean-production-technology-for-better yield/

Thejaswi, L., Naik, M. I., & Manjunatha, M. (2008). Studies on Population Dynamics of Pest complex of Field Bean (Lab lab purpereus L.) and Natural enemies of Pod borer, *Karnataka J. Agril Sc*. *21*(3), 399-402.