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Screening of germplasm for tolerrance against major stem pests of soybean

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ABSTRACT

Field experiments were conducted during *Kharif* 2010-2011 and 2011-12, at the field of College of Agriculture, Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). Twenty two germplasm were screened 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). Among the entries PS-1466 categorized as resistant high yielding entry.

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INTRODUCTION

Soyabean is considered as pulse crop but due to high oil content and greater response to applied nitrogen, now it is placed in oil seed category. Soybean the miracle golden bean of 20th century has revolutionized the agriculture as well as generated economy of many countries (Balasubramaniam, 1972). Twenty two germplasms were screened for tolerance against stem pests of soybean. The Twenty two germplasm were categorized into susceptible low yield (S-LY), susceptible high yielding tolerant (S-HY-T), resistant high yielding (R-HY) and resistant low yielding (R-LY) categories according to maximin-minimax approach for classifying crop varieties into resistant groups based on yield potential and yield loss. Screening of germplasm under field conditions for categorization according to their tolerance against major insect pests of soybean helps to source of tolerant or resistant sources against insect pests.

MATERIAL AND METHODS

Twenty two germplasm (14+8 checks) within RBD

experimental design in 3 replications with a plot size 1.35 x 3.0 m by keeping 45 x 5 cm spacing were transplanted .The entries were categorized into groups against prevailing pest complex according to the maximin-minimax method (Odulaja and Nokoe, 1993) . One meter row length area was marked at five places and total number of plants and girdled plants/ mrl was recorded. The data was presented in per cent plant infestation. All the infested plants were labeled with date, in earmarked area and number of plants showing typical cut of symptoms were recorded. Per cent damage of plants was calculated. Seedling mortality- Total number of plants and number of plants succumbed to stemfly infestation/ mrl at 3 places per plot on 7 and 10 days after sowing were recorded and expressed in per cent. Stem tunneling- Plant height and length of stem tunneled in 10 plants at physiological maturity was observed and expressed in percentage. Treatment details are given under Table A.

Table A : Treatment details

Sr. No.	Genotype
1.	VLS 75
2.	DS 12-13
3.	SL 794
4.	PS 1466
5.	SL 799
6.	DSb 16
7.	MACS 1140
8.	MACS 1281
9.	MACS 1039
10.	Bragg (check)
11.	JS 93-05 (Check)
12.	JS 335(Check)
13.	JS 97-52 (Check)
14.	MAUS 158(Check)
15.	MAUS 2(Check)
16.	MAUS 71(Check)
17.	MAUS 162(Check)
18.	MACS 1201
19.	MACS 1336
20.	DSb 18
21.	VLS 76
22.	MACS 1311

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

Screening of germplasm for tolerance against girdle beetle soybean:

The data in respect of per cent infestation of girdle beetle on twenty two germplasm of soybean at peak period are presented in Table 1. During 2010, per cent infestation of girdle beetle was recorded from 10.66 to 28.68 per cent. Significantly minimum per cent plants infested by girdle beetle was recorded in DSB18 (10.66%) followed by MAUS2 (11.80 %), MACS1140 (13.90%) and JS335 (15.46%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was VLS76 (17.41%) followed by MAUS71 (17.83%), MACS 1039(18.00%), MAUS158 (18.39%), Bragg (18.96%), JS93-05(19.70%), JS 97-52 (20.36%),VLS75(20.43%), PS 1466 (22.80%) and DS12-13(23.60%) which were found at par with each other. The next best genotypes were in order of SL799 (24.90%) and DSB16 (24.90%) < MACS1281(25.62%)<MACS1201(25.80 %) < MAUS162 (26.33%)<MACS1336(26.56%)< SL794 (26.70%) and MACS1311(28.68%). During 2011, per cent infestation of girdle beetle was recorded from 18.68 to 40.21 per cent. Significantly minimum per cent plants infested by girdle beetle was recorded in JS 93-05 (18.68 %) followed by MACS1281 (20.30%), MAUS2 (20.62%), DSB18(20.88 %), SL799(21.81%), JS97-52 (23.15 %), MACS 1039(23.61%), MACS 1201(23.59%) and DSB16 (24.31%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotype was Bragg (25.94%) followed by MACS1140 (26.56%), MAUS71 (26.58%), MAUS162 (26.63%), DS12-13(27.18%), JS 335 (27.20 %), SL794 (29.87%), MAUS158 (31.52 %) PS 1466 (32.02%) and VLS76 (32.21%) found at par with each other. The next genotypes were in order of VLS75 (35.77%) <MAUS11133 (37.88%) <MACS1336 (40.21%).

Pooled data showed that the per cent infestation of girdle beetle was recorded from 15.77 to 33.38 per cent. Significantly minimum per cent plants tunneled by girdle beetle was recorded in DSB18 (15.77%) followed by MAUS2 (16.25 %) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was JS 93-05 (19.19%) followed by MACS1140 (20.23%), MACS1039 (20.80%) and JS 335 (21.33 %) which were significantly superior over rest of the genotypes and found at par

with each other. The next best genotypess were in order of JS 97-52 (21.75%) < MAUS71 (22.20%). <MACS1281 (22.96%) < SL799(23.35%)< MACS1201 (24.69%) <DSB16 (24.60%) <VLS 76(24.81%) <MAUS 158 (24.95%)< DS12-13(25.39%)< MAUS 162 (26.48 %) <Bragg (27.31 %)<PS 1466 (27.41%) <VLS 75(28.10%) <SL794 (28.28%)< MACS1311 (28.42%) < MACS1336 (29.80%).

The findings of present investigation are similar to those of Salunke (1999) conducted experiment on screening 14 cultivars against girdle beetle *O. brevis* at Marathwada Agricultural University, Parbhani during *Kharif* 1998 and reported that comparatively less girdle beetle damage was observed in the cultivar JS-335. Also Sharma *et al.* (2006) reported that the least per cent plant damage by girdle beetle was observed in L129(61.11%) and maximum in case of NRC 18, NRC 33, NRC 7, JS 71-05 and JS335 (83.33%). The present findings are in line with the above research workers.

Screening of germplasm for tolerance against stem fly of soybean:

The data in respect of per cent infestation of stem fly on twenty two germplasm of soybean at peak period during *Kharif* 2010-11, *Kharif* 2011-12 and pool analyzed are presented below in Table 2. During 2010, per cent infestation of stem fly was recorded from 18.30 to 40.60 per cent. Significantly minimum per cent plants infested by stem fly was recorded in JS 97-52 (18.30%) followed by MAUS 71(19.73%), MACS 1336(20.80%), VLS76(21.00%) and MAUS158(21.13%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was DSB16(21.30%) followed by MAUS2 (21.90%), SL794 (22.60%), MACS1201 (22.80%),VLS75 (23.00%), SL799 (24.10%) and DSB18 (24.50%) which were found at par with each other. The next best genotypes were in order of following PS1466 (24.80%) <DS12-13(25.20%)< MACS1039 (25.20%)<JS93-05(26.60%)<MACS1311 (27.30%) < JS335 (28.10%)

Table 1 : Per cent infestation of girdle beetle at seedling stage

Sr. No.	Genotypes	Per cent infestation of girdle beetle at seedling stage		
		2010-2011	2011-12	Pooled
1.	VLC 75	20.43 (26.70)	35.77 (36.73)	28.10 (31.71)
2.	DS 12-13	23.60 (29.04)	27.18 (31.41)	25.39 (30.22)
3.	SL 794	26.70 (31.12)	29.87 (33.10)	28.28 (32.11)
4.	PS 1466	22.80 (28.51)	32.02 (34.43)	27.41 (31.47)
5.	SL 799	24.90 (29.95)	21.81 (27.82)	23.35 (28.88)
6.	DSB 16	24.90 (29.95)	24.31 (29.20)	24.60 (29.57)
7.	MACS 1140	13.90 (21.88)	26.56 (30.99)	20.23 (26.43)
8.	MACS 1281	25.62 (30.38)	20.30 (26.75)	22.96 (28.56)
9.	MACS 1039	18.00 (25.03)	23.61 (28.93)	20.80 (26.98)
10.	Check- Bragg	28.68 (32.32)	25.94 (30.62)	27.31 (31.47)
11.	Check-JS 93-05	19.70 (26.32)	18.68 (25.58)	19.19 (25.95)
12.	Check-JS 335	15.46 (22.89)	27.2 (31.43)	21.33 (27.16)
13.	Check-JS 97-52	20.36 (26.78)	23.15 (28.75)	21.75 (27.76)
14.	Check-MAUS 158	18.39 (25.21)	31.52 (34.15)	24.95 (29.68)
15.	Check-MAUS 2	11.88 (20.00)	20.62 (26.89)	16.25 (23.44)
16.	Check-MAUS 71	17.83 (24.90)	26.58 (31.00)	22.20 927.95)
17.	Check-MAUS 162	26.33 (30.84)	26.63 (30.96)	26.48 (30.90)
18.	MACS 1201	25.8 (30.39)	23.59 (28.90)	24.69 (29.64)
19.	MACS 1336	26.56 (30.99)	40.21 (39.34)	33.38 (35.16)
20.	DSB 18	10.66 (18.75)	20.88 (27.06)	15.77 (22.90)
21.	VLS 76	17.41 (24.57)	32.21 (34.41)	24.81 (29.49)
22.	MACS 1311	18.96 (25.79)	37.88 (37.98)	28.42 (31.88)
	S.E.±	1.72	1.63	0.41
	C.D. (P=0.05)	4.76	4.50	1.53

< Bragg (29.90%) <MAUS162 (32.40%) <MACS1140 (35.00%) and MACS1281 (40.60%). During 2011, per cent infestation of stem fly was recorded from 18.00 to 39.40 per cent. Significantly minimum per cent plants infested by stem fly was recorded in DS12-13(18.00%) followed by MAUS71 (21.10%) and VLS76(21.20%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was JS 93-05 (21.80%) followed by JS 335 (22.80 %), SL794 (22.96%), PS1466 (23.90%) and MACS 1201 (25.06%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes were in order of JS 97-52 (25.43%) < MAUS162 (25.73%) <DSB16 (26.23%) < Bragg (27.20%) <DSB18(28.23%) <MACS1336 (29.70%) < MAUS2 (30.36%), <VLS75 (30.70%) < SL799 (32.33%) <MACS1311 (32.40%) < MACS1039 (33.90%) < MACS1281 (36.40%)< MAUS158 (36.60%) <MACS1140 (39.40%).

Pooled data showed that the per cent infestation of stem fly was from 21.10 to 38.36 per cent. Significantly minimum per cent plants infested by stem fly was recorded in VLS76(21.10%) followed by DS12-13 (21.60%), JS 97-52 (21.86%) and SL794 (22.78%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was MACS 1201(23.93%) followed by, DSB16 (23.76%) JS 93-05 (24.20 %), PS 1466 (24.35%) and JS 335 (25.45 %) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypess were in order of MACS 1336(25.25%) <MAUS2(26.13%)<DSB18(26.36%) < VLS75(26.85%) < SL799(28.21%)< Bragg(28.55%) < MAUS 158 (28.86%)< MAUS 162 (29.06%) < MAUS71 (29.56%)<MACS1311(29.85%)<MACS1140 (31.79%) < MACS1281 (38.36%). Salunke (1999) conducted experiment on screening 14 cultivars against stem fly *M. sojae* at Marathwada Agricultural University, Parbhani during *Kharif* 1998 evaluated that lowest per cent stem length tunneled by stem fly were observed in

Table 2 : Per cent infestation of stem flies at seedling stage

Sr. No.	Genotypess	Per cent infestation of stem fly at seedling stage		
		2010-2011	2011-12	Pooled
1.	VLC 75	23.00 (28.70)	30.70 (33.68)	26.85 (31.19)
2.	DS 12-13	25.20 (30.12)	18.00 (25.24)	21.60 (27.68)
3.	SL 794	22.60 (28.36)	22.96 (28.61)	22.78 (28.480
4.	PS 1466	24.80 (29.88)	23.90 (29.21)	24.35 (29.54)
5.	SL 799	24.10 (29.39)	32.33 (34.64)	28.21 (32.01)
6.	DSB 16	21.30 (27.46)	26.23 (30.77)	23.76 (29.11)
7.	MACS 1140	35.00 (36.26)	21.10 (27.33)	31.79 (38.50)
8.	MACS 1281	40.60 (39.61)	36.40 (37.12)	38.36 (29.55)
9.	MACS 1039	25.20 (30.17)	33.90 (36.22)	29.55 (33.19)
10.	Check- Bragg	29.90 (33.17)	27.20 (31.43)	28.55 (32.30)
11.	Check-JS 93-05	26.60 (31.08)	21.80 (27.84)	24.20 (29.46)
12.	Check-JS 335	28.10 (32.05)	22.8 (28.47)	25.45 (30.26)
13.	Check-JS 97-52	18.30 (25.32)	25.43 (30.21)	21.86 (27.76)
14.	Check-MAUS 158	21.13 (27.35)	36.60 (37.21)	28.86 (32.28)
15.	Check-MAUS 2	21.90 (27.90)	30.36 (33.43)	26.13 (30.66)
16.	Check-MAUS 71	19.73 (26.36)	39.40 (38.87)	29.56 (32.61)
17.	Check-MAUS 162	32.40 (34.69)	25.73 (30.47)	29.06 (32.58)
18.	MACS 1201	22.80 (28.53)	25.06 (30.02)	23.93 (29.27)
19.	MACS 1336	20.80 (29.64)	29.70 (33.02)	25.25 (31.33)
20.	DSB 18	24.50 (35.50)	28.23 (32.09)	26.36 (33.79)
21.	VLS 76	21.00 (27.28)	21.20 (27.41)	21.10 (27.34)
22.	MACS 1311	27.30 (21.46)	32.40 (34.68)	29.85 (28.07)
	S.E.±	0.76	0.84	0.56
	C.D. (P=0.05)	2.12	2.33	1.57

the cultivars *viz.,* JS-335 and JS-80-21.The present findings are supported by all above workers.

Screening of germplasm for tolerance against per cent length of stem tunneled by girdle beetle of soybean:

The data in respect of per cent length of stem tunneled by girdle beetle on twenty two germplasm of soybean at peak period are presented in Table 3. Twenty two germplasm of soybean were screened for recording per cent length of stem tunneled by girdle beetle of soybean. During 2010, per cent length of stem tunneled was recorded from 9.53 to 27.66 per cent. Significantly minimum per cent plants tunneled by girdle beetle was recorded in MAUS158(9.53%) followed by MAUS2 (9.70 %), MACS1311 (10.04%). VLS75 (10.29%), MACS1140(10.30%), DSB18 (11.03%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes were MAUS71 (11.33%) followed by VLS76 (12.43%) which were found at par with each other. The next best genotypess were in following order JS 97-52 (14.86%) < JS 93-05 (15.06 %) <JS 335 (15.33 %)< PS 1466 (16.03%) <MACS1281 (16.80%) <Bragg (17.70 %) < DSB16 (19.36%) < DS12-13 (19.71%) < MACS1039 (20.26%) <SL794 (21.39%) < MACS 1201 (22.90%) < SL799 (23.53%)< MAUS162 (26.46%)< MACS1336 (27.66%). During 2011, per cent length of stem tunneled was recorded from 11.83 to 30.43 per cent. Significantly minimum per cent plants tunneled by girdle beetle was recorded in MACS1311 (11.83%) followed by MACS1140 (12.63%), MAUS158 (14.16%) and MAUS2 (14.66%), which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was VLS75(15.06%) followed by VLS76 (15.16%) which were found at par with each other. The next best genotypess were in order of following MACS1281 (17.16%) < JS 93-05 (18.90%) < MAUS71 (2013%).<JS 335 (20.16 %)< PS 1466 (20.33%)< DSB18 (20.50%) < JS 97-52 (20.66 %) <

Table 3 : Per cent length of stem tunneled due to girdle beetle

Sr. No.	Genotypess	Per cent length of stem tunneled due to girdle beetle		
		2010-2011	2011-12	Pooled
1.	VLC 75	10.29 (18.71)	15.06 (22.83)	12.67 (20.77)
2.	DS 12-13	19.71 (26.31)	23.10 (28.71)	21.40 (27.51)
3.	SL 794	21.39 (27.55)	24.60 (29.75)	22.99 (28.56)
4.	PS 1466	16.03 (23.60)	20.33 (26.80)	18.18 (25.20)
5.	SL 799	23.53 (29.02)	21.63 (27.71)	22.58 (28.36)
6.	DSB 16	19.36 (26.10)	21.26 (27.45)	21.31 (26.77)
7.	MACS 1140	10.30 (18.70)	12.63 (20.81)	11.46 (19.75)
8.	MACS 1281	16.8 (24.19)	17.16 (24.45)	16.98 (24.32)
9.	MACS 1039	20.26 (26.75)	22.43 (28.26)	21.34 (27.50)
10.	Check- Bragg	17.70 (24.87)	20.80 (27.12)	19.25 (25.99)
11.	Check-JS 93-05	15.06 (22.83)	18.90 (25.75)	16.98 (24.29)
12.	Check-JS 335	15.33 (23.04)	20.16 (26.68)	17.74 (24.86)
13.	Check-JS 97-52	14.86 (22.67)	20.66 (26.89)	17.76 (24.78)
14.	Check-MAUS 158	9.53 (17.95)	14.16 (22.18)	11.84 (20.06)
15.	Check-MAUS 2	9.70 (18.14)	14.66 (22.50)	15.18 (20.32)
16.	Check-MAUS 71	11.33 (19.65)	20.13 (26.64)	15.73 (23.14)
17.	Check-MAUS 162	26.46 (30.94)	30.43(33.47)	28.44 (32.20)
18.	MACS 1201	22.90 (28.58)	28.46 (32.28)	25.68 (30.43)
19.	MACS 1336	27.66 (31.73)	29.80 (33.08)	28.73 (32.40)
20.	DSB 18	11.03 (19.39)	20.5 (26.92)	15.76 (23.15)
21.	VLS 76	12.43 (20.62)	15.16 (22.89)	13.79 (21.75)
22.	MACS 1311	10.04 (18.44)	11.83 (20.09)	10.93 (19.26)
	S.E.±	0.56	0.58	0.41
	C.D. (P=0.05)	1.56	1.60	1.15

Bragg (20.80 %) < DSB16 (21.26%) < SL799 (21.63%) < MACS1039(22.43%)<<DS12-13(23.10%)< SL794 (24.90%) < MACS1201 (28.46%) < MACS1336 (29.80%) < MAUS162(30.43%).

Pooled data showed that the per cent length of stem tunneled by girdle beetle was recorded from 10.93 to 28.73 per cent. Significantly minimum per cent plants tunneled by girdle beetle was recorded in MACS1311 (10.93%) followed by MACS1140 (11.46%), MAUS 158 (24.95%) DSB18 (15.77%) followed by MAUS2 (16.25%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was JS 93-05 (19.19%) followed by MACS1140 (20.23%), MACS1039 (20.80%) and JS 335 (21.33 %) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes were in order of following JS 97-52 (21.75%) < MAUS71 (22.20%).<MACS1281 (22.96%)<SL799(23.35%)<MACS1201(24.69%) < DSB16(24.60%)< VLS76 (24.81%) < MAUS158 (24.95%) < DS1213 (25.39%) < MAUS162 (26.48%) < Bragg (27.31%) < PS1466 (27.41%) < VLS75 (28.10%) < SL794 (28.28%) < MACS1311 (28.42%) < MACS1336 (29.80%).

Screening of germplasm for tolerance against per cent length of stem tunneled by stem fly of soybean:

The data in respect of per cent length of stem tunneled by stem fly on twenty two germplasm of soybean at peak period are presented in Table 5. Twenty two germplasm of soybean were screened for recording per cent length of stem tunneled by stem fly of soybean. During 2010, per cent length of stem tunneled was recorded from 17.90 to 36.73 per cent. Significantly minimum per cent plants tunneled by stem fly was recorded in MACS 1336(17.90%) followed by DSB16(18.56%), MACS1201(18.50%), SL799 (18.95%), VLS75 (19.56%), MAUS2 (20.26%), which were significantly superior over rest of the genotypes and found at par with each other. The next best

Table 4 : Per cent length of stem tunneled due to stem fly

Sr. No.	Genotypess	Per cent length of stem tunneled due to stem fly		
		2010-2011	2011-12	Pooled
1.	VLC 75	19.56 (26.23)	21.33 (27.50)	20.44 (26.86)
2.	DS 12-13	24.50 (29.65)	22.33 (28.11)	23.41 (28.88)
3.	SL 794	20.70 (27.06)	19.30 (26.04)	20.00 (26.55)
4.	PS 1466	22.60 (28.38)	20.26 (26.74)	21.43 (27.56)
5.	SL 799	18.96 (25.81)	20.06 (26.56)	19.51 (26.18)
6.	DSB 16	18.56 (25.51)	18.96 (25.80)	18.76 (25.65)
7.	MACS 1140	35.00 (36.26)	30.70 (33.64)	32.85 (34.95)
8.	MACS 1281	36.73 (37.30)	30.53 (33.66)	33.63 (35.48)
9.	MACS 1039	27.16 (31.41)	22.30 (28.18)	24.73 (29.79)
10.	Check- Bragg	29.86 (33.12)	24.40 (29.53)	27.13 (31.32)
11.	Check-JS 93-05	21.50 (27.61)	17.36 (24.58)	19.43 (26.09)
12.	Check-JS 335	22.86 (28.56)	24.30 (29.53)	23.58 (29.04)
13.	Check-JS 97-52	20.63 (27.00)	22.03 (27.98)	21.33 (27.49)
14.	Check-MAUS 158	21.33 (27.50)	20.83 (27.13)	21.08 (27.31)
15.	Check-MAUS 2	20.26 (26.74)	18.56 (25.25)	19.41 (25.99)
16.	Check-MAUS 71	22.83 (28.53)	21.16 (27.33)	21.99 (27.93)
17.	Check-MAUS 162	33.10 (35.13)	29.00 (32.58)	31.05 (33.85)
18.	MACS 1201	18.50 (25.47)	20.23 (26.72)	19.36 (26.09)
19.	MACS 1336	17.90 (25.00)	19.63 (26.27)	18.76 (25.63)
20.	DSB 18	35.93 (36.82)	33.23 (35.19)	34.58 (36.00)
21.	VLS 76	29.53 (32.91)	31.50 (34.13)	30.51 (33.52)
22.	MACS 1311	30.76 (33.68)	27.70 (31.75)	29.23 (32.71)
	S.E.±	0.64	0.83	0.52
	C.D. (P=0.05)	1.78	2.29	1.44

genotypes was in JS 97-52 (20.63%) followed by SL 794 (20.70%), MAUS158(21.33%), JS 93-05 (21.50 %), PS 1466 (22.60%), MAUS71 (22.83%) and JS 335 (22.86 %) found at par with each other. The next best genotypes were in order of following DS12-13(24.50%) < MACS 1039 (27.16%) < VLS76 (29.53%)< Bragg (29.86 %) <MACS1311 (30.76%)< MAUS162 (33.10 %) < MACS1140 (35.00%) < DSB18 (35.93%) <MACS1281 (36.73%).During 2011, per cent length of stem tunneled was recorded from 17.36to 33.23 per cent. Significantly minimum per cent plants tunneled by stem fly was recorded in JS 93-05 (17.36%) followed by MAUS2 (18.56%), DSB16 (18.96%), SL 794 (19.30%), MACS 1336 (19.63%) SL799(20.06%), MACS1201 (20.23%) and PS 1466 (20.26%) which were significantly superior over rest of the genotypes and found at par with each other. The next best genotypes was MAUS 158 (20.83%) followed by MAUS71 (21.16%), VLS 75 (21.33%), JS 97-52 (22.03 %) MACS 1039 (22.30%), DS12-13 (22.33%), JS 335 (24.30 %), Bragg (24.40 %) found at par with each other. The next best genotypes were in following order MACS1311 (27.70%) < MAUS162 (29.00%) < MACS1281 (30.53%) <MACS1140 (30.70%) <VLS76 (31.50%) < DSB18 (33.23%).

Categorization of entries according to maximin-minimax method :

The data on grain yield of protected and unprotected set of this experiment was analysed as per maximin-minimax method. The Twenty two germplasm were categorized into susceptible low yield (S-LY), susceptible high yielding tolerant (S-HY-T), resistant high yielding (R-HY) and resistant low yielding (R-LY) categories according to maximin-minimax approach for classifying crop varieties into resistant groups based on yield potential and yield loss.

The results depicted in Table 5 during 2010 indicate that the per cent yield loss obtained in different genotypes was ranged from 4.84 (DSb 16) to 52.96 (DS 12-13 . Under protected and unprotected conditions yield obtained from DS 12-13 (2573.16 kg/ha) to MACS 1336 (4144.28 kg/ha) and from PS 1466 (284.64 kg/ha) to VLS 76 (273.24 kg/ha).Genotypes DSb 16 (2199.1kg/

Table 5 : Categorization of entries according to maximin-minimax method 2011-12

Sr. No.	Genotype	Seed yield (kg/ha)		Yield loss (%)	Relative yield (RY)	Per cent yield loss (%) (RP)	Category
		Protected	Unprotected				
1.	VLC 75	3301.3	2076.2	37.11	75.99	59.33	S-HY-Y
2.	DS 12-13	2573.2	1672.8	34.99	61.22	55.94	S-LY
3.	SL 794	2901.2	2080.3	28.29	76.14	45.23	S-HY-T
4.	PS 1466	3017.6	284.64	14.35	94.59	22.94	R-HY-T
5.	SL 799	3846.6	2379.6	38.14	87.09	60.97	S-HY-T
6.	DSB 16	3337.4	2519.4	24.52	75.47	39.2	S-HY-T
7.	MACS 1140	3639.2	2464.9	32.27	90.21	51.59	S-HY-T
8.	MACS 1281	3555.5	2432.1	31.6	89.01	50.51	S-HY-T
9.	MACS 1039	3732.6	2440.3	34.63	65.37	56.25	S-LY
10.	Bragg	3816.3	2423.9	36.48	88.71	58.33	S-HY-T
11.	JS 93-05	3529.3	2043.4	42.1	74.78	68.38	S-LY
12.	JS 335	3990.1	2504.3	37.24	91.65	59.53	S-HY-T
13.	JS 97-52	3839.2	1476	61.56	54.02	100	S-LY
14.	MAUS 158	4090.2	2399.3	41.34	87.81	67.15	S-HY-T
15.	MAUS 2	3215.7	2420.7	24.73	88.59	40.11	S-HY-T
16.	MAUS 71	3015.5	1992.9	33.92	72.93	55.1	S-HY-T
17.	MAUS 162	2978.9	2174.3	27.01	79.57	43.87	S-LY
18.	MACS 1201	2954.5	1730.2	41.44	63.32	67.31	S-LY
19.	MACS 1336	4144.3	2219.1	46.46	81.21	71.49	S-HY-T
20.	DSB 18	3206.2	1761.4	45.07	64.46	72.04	S-LY
21.	VLS 76	3714.6	2732.2	26.45	100	94.07	S-HY-T
22.	MACS 1311	3560.4	2123.8	40.36	77.73	65.56	S-LY

ha) with the highest yield under unprotected conditions, was considered as resistant 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 resistant high yielding entries. Genotypes JS 97-52, MAUS 2, MAUS 71 and VLS 76 were grouped under susceptible but high yielding *i.e.* tolerant category. Rest of all genotypes were come under Susceptible low yield category.

The results depicted in Table 5 during 2011 indicate that the per cent yield loss obtained 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).Among the entries PS-1466 categorized as resistant high yielding entry. Genotypes VLC 75, SL 794,PS 1466,SL 799, DSB 16, MACS1140, MACS 1281, Bragg, JS 335, MAUS 158, MAUS 2, MAUS 71, MAUS 162, VLS 76 and MACS 1311 were grouped under susceptible but high yielding *i.e*. tolerant category. Rest of all genotype was under susceptible low yield category.

The findings of present investigation are more or less similar to those of Sharma *et al*. (2006) reported that the per cent yield loss in different genotypes ranged from 1.15 in NRC to 49.38 per cent in JS 71-05. Accordingly, genotype NRC 18 was categorized under resistant but low yielding (R-LY). On the other hand genotypes NRC 33, JS 335, L129 and MACS 450 were grouped under susceptible but high yielding (S-HY) *i.e.* tolerant.

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