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Estimation of Avoidable Losses in Mungbean Genotypes Evaluated under field conditions during summer against *Maruca Vitrata*

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Abstract

Hundred and ten greengram genotypes screened against M. vitrata during summer, 2009-10 and 2010-11. Among the hundred and ten screened greengram genotypes, avoidable loss was ranged from 1.4 to 83.5 percent and the lowest avoidable losses were recorded in 18 genotypes, which grouped under resistant category and highest avoidable losses in 20 highly susceptible genotypes, where as the remaining 72 genotypes were grouped under moderate category. The genotypes KM-8-666 (83.5%), KM-8-656 (76.9%), KM-9-121 (76%), LGG-497 (75.5%) and LGG-514 (75%) recorded the highest percent avoidable losses, while genotypes MGG-336 (1.4%), KM-8-655 (2.4%), MGG-335 (3.2%), Madhira Mung (7.9%), KARS-165 (8.3%), KM-9-122 (9.0%), Pusa Vishal (9.1%), MGG-295 (10.6%), GG-9 (10.8%) and MGG-353 (11.9%) recorded the lowest avoidable losses. The low yielding greengram genotypes, KARS-22 (25.5), KARS-166 (26.5), Asha (29.0), KM-2241 (41.5), MGG-330 (45.5), MGG-359 (48.0), Line -76 (49.0), BAR-02/22 (49.5), KM-9-136 (51.0), MGG-367 (51.5) under unprotected conditions, became moderate yielders (KARS-22 (56.5), KARS-166 (82.5), Asha (95.5), KM-2241 (110.5), MGG-330 (110), MGG-359 (137.5), Line -76 (185), BAR-02/22 (60.0), KM-9-136 (139), MGG-367 (73.0)) under protected conditions. Similarly, the moderate yielding genotypes, viz., KM-8-666 (70.5) and KM-8-656 (109.5) under unprotected conditions, became high yielders (KM-8-666 (427) and KM-8-656 (473.5)) under protected conditions, this significant yield improvement, might be due to Maruca management. It is concluding that we can avoid 83.5 percent yield losses by choosing resistant varieties and adopting management practices against Maruca.

Keywords: Greengram, field screening *maruca vitrata,* avoidable losses, summer.

Introduction

Pulses are grown in the semi arid regions under a wide range of agro climatic conditions of India. Among the pulses, mung bean or greengram (*Vigna radiata* L. Wilczek) is the important pulse crop of India and it occupies an area of about 3 m ha with a production of 0.25 m t and 425 kg ha^{-1} productivity[1]. Andhra Pradesh is the 4th major state of India contributing 15.5% of the national production of greengram with 351 kg ha^{-1} average productivity. Greengram is cultivated throughout the year in all cropping seasons due to its short duration and suitability to crop rotation and crop mixtures. As *kharif* season is becoming uncertain to get the greengram crop due to climatic changes, it is grown as sole crop in water retentive heavy soils during *rabi* (September to December) and cultivated as relay crop in *Kharif* rice fallows during late *rabi* (December -February). During summer, it is cultivating with the availability of irrigation facilities. Most of the farmers are preferring greengram after completion of cotton crop (February - April) due to its short duration with drought tolerance nature. The low productivity in greengram may be attributed to factors like limited varietal improvement, low resilience to soil moisture stress, pest infestation etc., among them, ravage of insect pests is important.

Among the borers, legume pod borer, *Maruca vitrata* Geyer is the devastating pest of greengram, which cause damage mainly at reproductive phase of the crop, as it is available throughout the year. It is known to cause economic loss of 20 - 25 % and yield loss of 2 - 84% in greengram[2] accounting to US $ 30 million. It is reported that 20–30% pod damage in mungbean[3]. As all the existing greengram cultivars are susceptible to *Maruca*, it has become imperative to identify the resistance sources for breeding programmes. Hence, present study conducted to estimate the avoidable losses due to *M. vitrata* in greengram.

Material and Methods

Investigation was carried out to screen the possible resistance source against *Maruca* with Hundred and ten greengram genotypes procured from different institutions were used as source material for the screening study (table-1). The experiment was laid out in the farm of Agricultural Research Station, Madhira in RBD with 2 replications and hundred and ten genotypes including ten check varieties as treatments. The experiment was sowed on 10.02.2010 and 04.02.2011 in summer. Each plot size is 2.4 m^2 with 30 X 10 cm. Observations recorded from 5 randomly selected plants from each plot at weekly intervals from bud initiation stage to pod maturity stage on no. of infested buds, flowers, webs per plant and damaged pods were collected from randomly selected 100 pods at the time of harvest to calculate pod damage (%).

Table-1
Evaluation of greengram genotypes against *M. vitrata* (Pooled data 2009-10 and 2010-11)

S. No.	Genotype	Mean Yield (g / plot)			No. of Larvae/ plant		Pod damage (%)	
		UP	P	Avoidable Losses (%)	UP	P	UP	P
1	Asha	29	95.5	69.6	1.9	0.9	17.86	7.0
2	BAR-02/22	49.5	60	17.5	0	0	28.90	0.0
3	BDYR	84	177.5	52.7	1.1	0.5	34.35	6.5
4	COGG912	84	105.5	20.4	1.3	0.7	25.73	4.5
5	EC-19515	153.5	188.5	18.6	1.9	0.55	24.24	4.5
6	GG-9	182	204	10.8	1.7	0.3	32.37	5.9
7	GG-10	111.5	174.5	36.1	1.9	0.5	24.85	5.5
8	GG-16	118.5	167.5	29.3	1.6	0.65	22.69	8.6
9	GG-17	123	175	29.7	1.6	0.7	35.77	4.3
10	IPM-02-03	81	113.5	28.6	1.75	0.5	20.00	4.9
11	IPM-02-14	106	168	36.9	1.7	0.5	51.49	8.6
12	KARS- 22	25.5	56.5	54.9	0.9	0.3	63.38	5.5
13	KARS- 27	20	34	41.2	1	0.7	0.00	0.0
14	KARS-165	27.5	30	8.3	0.65	0.3	0.00	0.0
15	KARS-166	26.5	82.5	67.9	0.5	0.15	6.21	0.0
16	KM-173	115	159	27.7	2.05	0.7	68.39	8.3
17	KM-195	81.5	135.5	39.9	2.3	0.9	19.90	9.5
18	KM-200	107	152	29.6	1.9	0.9	30.89	5.9
19	KM-203	75	122	38.5	1.9	0.7	28.13	4.9
20	KM-2241	41.5	110.5	62.4	2.1	0.5	40.0	5.5
21	KM-8-651	115.5	148.5	22.2	1.3	0.7	35.43	10.9
22	KM-8-652	134	173	22.5	2.1	0.5	25.77	6.9
23	KM-8-653	99.5	182	45.3	2.3	0.7	34.43	6.6
24	KM-8-654	103	148.5	30.6	1.7	0.5	48.87	12.6
25	KM-8-655	123.5	126.5	2.4	1.9	0.7	22.60	14.3
26	KM-8-656	109.5	473.5	76.9	1.9	0.7	16.80	10.9
27	KM-8-657	167.5	228.5	26.7	1.7	0.9	38.45	6.3
28	KM-8-658	172	239.5	28.2	1.45	0.9	43.94	12.3
29	KM-8-659	108.5	241	55.0	1.3	0.5	22.26	13.9
30	KM-8-660	111.5	210	46.9	1.5	0.6	58.04	10.3
31	KM-8-661	130	189	31.2	1.65	0.7	45.61	8.6
32	KM-8-662	114.5	169	32.2	1.7	0.5	43.25	4.3
33	KM-8-664	120	219	45.2	1.9	0.7	15.44	8.9
34	KM-8-666	70.5	427	83.5	1.9	0.9	27.04	8.5
35	KM-8-667	118	197.5	40.3	2.5	0.9	30.51	9.1
36	KM-8-668	337	1000	66.3	2.75	0.9	34.14	6.5
37	KM-9-121	64.5	268.5	76.0	2.7	0.7	43.87	9.9
38	KM-9-122	116.5	128	9.0	2.6	0.5	22.99	8.5
39	KM-9-123	213.5	327	34.7	2.35	0.8	32.37	9.4
40	KM-9-126	146	183.5	20.4	2.75	0.9	29.94	5.5
41	KM-9-128	57	222	74.3	2.7	0.9	3.5	8.5
42	KM-9-134	88.5	143.5	38.3	0.8	0.5	36.87	6.3
43	KM-9-136	51	139	63.3	1.2	0.3	5.8	10.3
44	KSAS-06/44	0	0	0.0	0	0	0.00	0.0
45	KSAS-06/245	0	0	0.0	0	0	0.00	0.0
46	KSAS-06/378	0	0	0.0	0	0	0.00	0.0
47	KSAS-06/407	0	0	0.0	0	0	0.00	0.0
48	LGG-477	173	214	19.2	2.25	0.5	18.25	7.5
49	LGG-491	73.5	273.5	73.1	1.9	0.6	23.80	8.5
50	LGG-497	71	289.5	75.5	1.1	0.6	17.90	8.9

S. No.	Genotype	Mean Yield (g / plot)			No. of Larvae/ plant		Pod damage (%)	
		UP	P	Avoidable Losses (%)	UP	P	UP	P
51	LGG-502	167	225.5	25.9	1.75	0.7	21.35	7.5
52	LGG-521	222.5	272	18.2	2.3	0.7	18.59	5.9
53	LGG-522	170	260.5	34.7	2.1	0.5	20.00	8.3
54	LGG-527	182	235	22.6	2.1	0.5	9.50	7.9
55	LGG-528	209	301.5	30.7	2.3	0.7	62.29	10.3
56	LGG-538	305.5	527.5	42.1	1.9	0.5	10.00	8.3
57	LGG-540	257	1028	75.0	3.1	0.7	37.20	8.9
58	LGG-541	180	258	30.2	2.9	0.9	22.54	6.5
59	LGG-542	198.5	288	31.1	3.15	0.7	35.80	10.3
60	LGG-543	205.5	234.5	12.4	3.55	0.9	24.65	8.5
61	LGG-544	204.5	368	44.4	3.1	0.5	47.43	8.8
62	LGG-545	200	242.5	17.5	2.2	0.6	26.00	6.3
63	LGG-547	92	232	60.3	2.5	0.7	26.00	5.5
64	LGG-549	116.5	184.5	36.9	2.1	0.5	31.00	10.3
65	LGG-551	224.5	578.5	61.2	2.05	0.5	34.54	8.5
66	Line - 76	49	185	73.5	1.8	0.8	53.04	1.9
67	M.MUNG	75.5	82	7.9	2	0.9	26.05	8.5
68	MGG- 295	210	235	10.6	2.1	0.7	62.72	15.9
69	MGG-330	45.5	110	58.6	1.1	0.7	24.72	4.3
70	MGG-332	105	163	35.6	2.3	0.5	12.59	6.9
71	MGG-335	106.5	110	3.2	2.25	0.6	30.51	7.5
72	MGG-336	143	145	1.4	1.2	0.7	34.09	5.5
73	MGG-341	124	211	41.2	2.1	0.7	24.80	8.5
74	MGG-347	215	265	18.9	2.2	0.65	23.63	18.5
75	MGG-348	237.5	370	35.8	2.4	0.75	28.77	19.9
76	MGG-349	125.5	148	15.2	2.1	0.7	14.10	6.3
77	MGG-350	75.5	146	48.3	0.9	0.5	30.36	5.9
78	MGG-351	140.5	274	48.7	2.1	0.5	38.43	7.5
79	MGG-353	155	176	11.9	2.2	0.7	26.65	4.9
80	MGG-356	106	168.5	37.1	2.3	0.9	22.10	6.3
81	MGG-359	48	137.5	65.1	2.5	0.65	23.10	9.5
82	MGG-360	142.5	196	27.3	1.2	0.5	24.30	8.1
83	MGG-361	139	197.5	29.6	2.9	0.7	35.25	6.8
84	MGG-367	51.5	73	29.5	2.3	0.5	23.00	6.4
85	ML-1299	80	110	27.3	1.5	0.5	18.43	8.3
86	NDS-391	0	0	0	0	0	0.00	0.0
87	NM-1	69.5	158	56.0	1.7	0.9	39.93	9.8
88	NS-04-112	0	0	0	0	0	0.00	0.0
89	NSKMS 72	0	0	0	0	0	0.00	0.0
90	NSKMS 174	0	0	0	0	0	0.00	0.0
91	PANT-M-5	93.5	172	45.6	2.6	0.7	17.75	10.6
92	PDM-54	103	172	40.1	2.75	0.5	22.00	9.3
93	PUSA-9531	115.5	178.5	35.3	2.45	0.7	31.09	10.8
94	P.VISHAL	114.5	126	9.1	1.8	0.5	15.00	4.3
95	RMG-492	30.5	51.5	40.8	2.1	0.5	8.34	6.3
96	SM-131	150.5	209.5	28.2	1.9	0.5	22.03	7.5
97	SML-668	103	168.5	38.9	1.8	0.3	34.52	6.3
98	TRRM-1	64	107.5	40.5	1.9	0.5	28.07	8.3
99	UPM-84-178	146.5	290.5	49.6	2.2	0.3	26.77	9.9
100	UPM-99-3	98	167.5	41.5	2.2	0.5	20.21	6.5
101	V-90	144	321.5	55.2	2.5	0.3	24.19	8.0

S. No.	Genotype	Mean Yield (g / plot)			No. of Larvae/ plant		Pod damage (%)	
		UP	P	Avoidable Losses (%)	UP	P	UP	P
102	WGG-2	142	327	56.6	2.5	0.65	19.31	8.1
103	WGG-42	130.5	171.5	23.9	1.8	0.5	24.94	9.9
104	WGG-43	112	164	31.7	1.9	0.5	21.47	7.5
105	WGG-44	155.5	277.5	44.0	1.9	0.65	19.04	8.5
106	WGG-45	124	220.5	43.8	1.9	0.65	17.60	9.5
107	WGG-46	192.5	296.5	35.1	1.5	0.4	16.68	9.5
108	WGG-47	121	313.5	61.4	2.1	0.5	16.24	10.3
109	WGG-48	68	196.5	65.4	1.9	0.4	18.63	8.9
110	WGG-49	113	235.5	52.0	1.8	0.5	21.96	8.9
	G. Mean	116.5	200.2	36.61	1.84		26.09	
	SEM±	7.24	8.01	4.92	0.12		3.48	
	C.D 0.05% *	20.28	22.44	13.77	0.34		9.76	
	C.V %	8.78	5.66	18.98	9.43		18.88	

UP= Unprotected P= Protected * = Significant

The same set of experimentation was repeated and maintained under protected (Sprayed) conditions for comparison of infestation, yield and calculating available losses. Classification of genotypes was done by considering the Mean (X) and Standard Deviation (SD) of mean larval population and per cent pod damage[4].

Resistant genotypes with larval population / pod damage less than $\overline{X}$ – SD, Susceptible genotypes with larval population/ pod damage between $\overline{X}$ – SD, Highly susceptible genotypes with larva population / pod damage > $\overline{X}$ + SD, Plot yields were collected from both unprotected and protected conditions and calculated Avoidable Losses by using the given formula[5].

$$\text{Avoidable Losses (\%)} = \frac{\text{Yield in protected Plot} - \text{Yield in unprotected Plot}}{\text{Yield in protected plots}} \times 100$$

Results and Discussion

The two years cumulative data is presented in table-1 and results revealed that, there was a highly significant difference between the genotypes and mean larval population ranged from 0-3.55 larvae per plant. The highest population was recorded in the genotypes LGG-543 (3.55), LGG-542 (3.15), LGG-544 and LGG-540 (3.1), MGG-361 and LGG-541(2.9), PDM-54, KM-9-126, KM-8-668 (2.75), where as the lowest population was recorded in the genotypes, KARS-166(0.5),KARS-165(0.65), KM-9-134(0.8), KARS-22 and MGG-350(0.9).

The mean per cent pod damage ranged from 0.00 to 52.38 per cent. The highest pod damage was observed in the genotypes, GG-9 (52.38%) followed by KM-9-121 (47.07%), KM-8-658 and LGG 528 (47.0 %), KM-8-660 (46.60%) and KARS-22 (44.99%), whereas the lowest pod damage was recorded in LGG 551 (4.33%), MGG 351 (5.67 %) and LGG 541 (5.78 %) which was on par with MGG-330 (5.92%), LGG-497 (6.31%), LGG-545 (6.01%), WGG-45 (6.12%), LGG 497 (6.31%) and MGG-335 (6.54%).

The mean and standard deviation values were calculated for mean larval population per plant, Per cent pod damage, yields from unprotected and protected conditions and avoidable losses (table-2). The greengram genotypes, NS-04-112 (1.5), KARS-166 (6.21), KARS-27 (6.5), RMG-492 (8.34), and LGG-538 (10.0) were found resistant among the screened genotypes whereas, the genotypes, KM-8-62 (43.25), KM-9-21 (43.86), KM-8-58 (43.93), KM-8-61(45.60), LGG-44 (47.43), KM-8-54 (48.86), IPM-02-14 (51.49), Line-76 (53.04), KM-8-60 (58.04), LGG-28 (62.29), MGG-295 (62.72), KARS-22 (63.38) and KM-173 (68.38) were grouped as highly susceptible among the screened genotypes (table-3).

Table-2
Mean ± S D values of greengram genotypes based on their reaction against *M. vitrata* and Yield both under protected and unprotected conditions

	Mean value	SD	Mean – SD	Mean + SD
Mean larval Population / Pl	1.84	0.72	1.12	2.56
Mean per cent Pod damage	26.09	14.36	11.73	40.45
Yield (g/Plot) under Protected condition	205.5	149.7	55.8	355.2
Yield (g/Plot) under Unprotected condition	116.5	64.5	52.0	180.9
Avoidable Losses (%)	36.21	21.75	14.46	57.96

Table-3
Grouping of greengram genotypes based on the pod damage caused by *M. vitrata*

Resistant genotypes (14) (< Mean– S.D) (<11.73)	**Susceptible genotypes (83) (Values between < Mean –SD to > Mean + SD (11.73 to 40.45)**	**Highly susceptible genotypes (13) (> Mean + S.D) (> 40.45)**
KARS-165(0), KM-9-128(0), KM-9-136(0), KSAS-06/44(0), KSAS-06/245 (0), KSAS-06/378(0), KSAS-06/407(0), LGG-527(0), NDS-391(0), NS-04-112(1.5), KARS-166(6.21), KARS- 27(6.5), RMG-492(8.34), and LGG-538(10.0).	MGG-332(12.59), MGG-349(14.1), PUSA VISHAL (15), KM-8-664(15.44), WGG-47 (16.235),WGG-46 (16.68), KM-8-656(16.8), WGG-45 (17.59), PANT-M-5 (17.75), Asha(17.86), LGG497(17.9), LGG-477(18.25), ML-1299(18.43), LGG-521(18.585),WGG-48 (18.63), WGG-44(19.035),WGG-2 (19.305), KM-195 (19.9), LGG-522 (20.1), UPM-99-3 (20.21), IPM-02-03 (20.985), LGG502(21.35), WGG43(21.46), WGG-49 (21.96), PDM-54 (21.99), SM-131(22.03),MGG-356(22.1), KM-8-659(22.26), LGG-541(22.54), KM-8-655(22.59), GG-16 (22.69), KM-9-22(22.99), MGG-367(23),MGG-359(23.1), MGG-347 (23.62), LGG-491(23.8), V-90 (24.18), EC-19515 (24.23), MGG360(24.3), LGG543(24.65), MGG-330 (24.72), MGG-341(24.8),GG-10 (24.85), WGG-42 (24.94), COGG912(25.73), KM-8-652 (25.76), LGG-545(26), LGG-547(26), M.MUNG (26.05), MGG-353 (26.65), UPM-84-178 (26.7), KM-8-666 (27.04), TARM-1(28.06), KM-203 (28.12), MGG-348(28.77), BAR-02/22 (28.9), KM-9-126 (29.94), MGG-350(30.36), KM-8-667 (30.5), MGG-335 (30.51), KM-200 (30.89), LGG-549 (31.0), PUSA-9531(31.08), GG-9 (32.36), KM-9-123 (32.36), MGG-336 (34.09), KM-8-668(34.14), BDYR (34.35), KM-8-653 (34.43), SML-668 (34.52), LGG-551 (34.54), MGG-361(35.25), KM-8-651 (35.43), GG-17 (35.76), LGG-542(35.79), KM-9-134 (36.87), LGG-540 (37.2), MGG-351(38.43), KM-8-657(38.45) NM-1(39.93) and KM-241(40.44).	KM-8-662 (43.25), KM-9-121 (43.86), KM-8-658 (43.93), KM-8-661(45.60), LGG-544(47.43), KM-8-654(48.87), IPM-02-14 (51.49), Line –76(53.04), KM-8-660(58.04), LGG-528(62.29), MGG-295(62.72), KARS-22(63.38) and KM-173(68.38)

Grouping of genotypes based on their Plot Yield and Avoidable Losses: The plot yields were recorded both under protected and unprotected conditions and the data revealed that there is a significance difference between the plot yields between unprotected and protected conditions. The plot yields were ranged from 0 to 337g and 0 to 1028 g per plot under unprotected and protected conditions respectively.

Under unprotected conditions, green gram genotypes were grouped as low yielders, moderate yielders and high yielders based on their Mean and Standard Deviation values. The results showed that there were twenty one greengram genotypes as low yielders, seventeen were as high yielders and the remaining seventy two were grouped as moderate yielders (table-4). The highest plot yields were recorded in the genotypes, KM-8-668 (337g), LGG-538(305.5g), LGG-540(257g), MGG-3487 (237.5g), LGG-551(224.5g), LGG-521(222.5g), and MGG-347(215g), where as the lowest plot yields were recorded in the genotypes, KARS-27(20g), KARS-22(25.5g), KARS-166 (26.5g), KARS-165 (27.5g), Asha (29.0g), RMG-492 (30.5g), KM-2241 (41.5g), MGG-330 (45.5g), MGG-359(48g), Line-76 (49g) and BAR-02/229 (60g).

Under protected conditions, 8 greengram genotypes were found to be high yielders, 11 low yielders, and the remaining 91 were moderate yielders (table-5). The highest plot yields were recorded in the genotypes, LGG-540 (1028 g), KM-8-668 (100 g), LGG-551 (578.5 g), LGG-538 (523 g), KM-8-656 (474 g), KM-8-666 (427 g), MGG-348 (370 g), LGG-544 (368 g), WGG-24, KM-9-123 (327 g), V-90 (322 g), WGG-47 (314 g) and LGG-528 (302 g). The genotypes, KARS-165 (30g), KARS-27 (34g), NS-04-112 (45.5 g), RMG-492 (51.5g), KARS-22 (56.5g), BAR-02/229 (60g), MGG-367 (73 g), Madhira Mung (82 g), KARS-166 (82.5 g) and Asha (95.5 g) recorded the lowest yields.

Avoidable Losses (%): Among the hundred and ten screened greengram genotypes, avoidable loss was ranged from 1.4 to 83.5 percent and the lowest avoidable losses were recorded in 17 genotypes, which grouped under resistant category. Highest avoidable losses were recorded in 18 highly susceptible genotypes where as the remaining 75 genotypes were grouped under moderate category.

Table-4
Grouping of greengram genotypes based on their Mean + SD values for plot yield under unprotected conditions

Low Yielders **(21 genotypes)** **< Mean –SD** **(< 52.0)**	**Moderate Yielders (72 genotypes)** **Values between** **(< Mean –SD to > Mean + SD)** **(52.0 to 180.9)**	**High Yielders** **(17 genotypes)** **> Mean +S.D** **(> 180.9)**
KSAS-06/44, KSAS-06/245, KSAS-06/378, KSAS-06/407 NDS-391 NSKMS-72 NSKMS- 174 NS-04-112 (0), KARS- 27 (20.0) KARS- 22 (25.5) KARS-166 (26.5) KARS-165 (27.5) Asha (29 .0) RMG-492 (30.5) KM-2241 (41.5) MGG-330 (45.5) MGG-359 (48.0) Line -76 (49 .0) BAR-02/22 (49.5) KM-9-136 (51 .0) MGG-367 (51.5)	KM-9-128 (57.0), TARM-1(64.0), KM-9-121(64.5), WGG-48 (68.0), NM-1 (69.5), KM-8-666 (70.5), LGG-497 (71.0), LGG-491(73.5), KM-203 (75.0), MADHIRA MUNG (75.5), MGG-350 (75.5), ML-1299 (80), IPM-02-03(81), KM-195 (81.5), BDYR (84.0), COGG912 (84), KM-9-134 (88.5), LGG-547 (92), PANT-M-5 (93.5), UPM-99-3 (98.0), KM-8-653 (99.5), KM-8-654 (103), PDM-54 (103), SML-668 (103), MGG-332 (105), IPM-02-14 (106), MGG-356 (106), MGG-335 (106.5), KM-200 (107), KM-8-659 (108.5), KM-8-656 (109.5), GG-10 (111.5), KM-8-660 (111.5), WGG-43 (112), WGG-49 (113), KM-8-662 (114.5), PUSA VISHAL (114.5), KM-173 (115), KM-8-651 (115.5), PUSA-9531 (115.5), KM-9-122 (116.5), LGG-549 (116.5), KM-8-667 (118), GG-16 (118.5), KM-8-664 (120), WGG-47 (121), GG-17 (123), KM-8-655 (123.5), MGG-341 (124), WGG-45 (124), MGG-349 (125.5), KM-8-661 (130), WGG-42 (130.5), KM-8-652 (134), MGG-361 (139), MGG-351(140.5), WGG-2 (142), MGG-360 (142.5), MGG-336 (143.0), V-90 (144), KM-9-126 (146), UPM-84-178 (146.5), SM-131 (150.5), EC-19515 (153.5), MGG-353 (155), WGG-44 (155.5), LGG-502 (167), KM-8-657 (167.5), LGG-522 (170), KM-8-658 (172), LGG-477(173) and LGG-541 (180)	KM-8-668 (337) LGG-538 (305.5) LGG-540 (257) MGG-348 (237.5) LGG-551 (224.5) LGG-521 (222.5) MGG-347 (215) KM-9-123 (213.5) MGG- 295 (210) LGG-528 (209) LGG-543 (205.5) LGG-544 (204.5) LGG-545 (200) LGG-542 (198.5) WGG-46 (192.5) GG-9 (182) LGG-527 (182)

The highest percent Avoidable losses were recorded in the genotypes KM-8-666 (83.5%), KM-8-656 (76.9%), KM-9-121 (76%), LGG-497 (75.5%) and LGG-514 (75%). The lowest avoidable losses were recorded in the genotypes MGG-336 (1.4%), KM-8-655 (2.4%), MGG-335 (3.2%), Madhira Mung (7.9%), KARS-165 (8.3%), KM-9-122 (9.0%), Pusa Vishal (9.1%), MGG-295 (10.6%), GG-9 (10.8%) and MGG-353 (11.9%) (table-6).

Conclusion

The low yielding greengram genotypes, KARS-22 (25.5), KARS-166 (26.5), Asha (29.0), KM-2241 (41.5), MGG-330 (45.5), MGG-359 (48.0), Line -76 (49.0), BAR-02/22 (49.5), KM-9-136 (51.0), MGG-367 (51.5) under unprotected conditions, became moderate yielders (KARS-22 (56.5), KARS-166 (82.5), Asha (95.5), KM-2241 (110.5), MGG-330 (110), MGG-359 (137.5), Line -76 (185), BAR-02/22 (60.0), KM-9-136 (139), MGG-367 (73.0)) under protected conditions. Similarly, the moderate yielding genotypes, viz., KM-8-666 (70.5) and KM-8-656 (109.5) under unprotected conditions, became high yielders (KM-8-666 (427) and KM-8-656 (473.5)) under protected conditions, this significant yield improvement, might be due to *Maruca* management.

Management provides protection from initial floral damage due to Maruca and after initial damage in the resistant lines, the *Maruca* larvae required time to cause significant damage to the new flowers and young pods developing through second flush of flowers. Tolerance is clearly indicated by the high level of recovery from *Maruca* damage in the resistant selections by yield compensation mechanism by a second flush of flowers. The resistant lines show clear non-preference for oviposition and antibiosis, both under multi and no choice conditions. Hence, it is concluding that we can avoid 83.5 percent yield losses by choosing resistant varieties and adopting management practices against *Maruca*.

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Table-5
Grouping of greengram genotypes based on their Mean ± SD values for plot yield under protected conditions

Poor Yielders (11 genotypes) < Mean –SD (< 55.8)	**Moderate Yielders (91 genotypes) Values between (< Mean –SD to > Mean + SD) (55.8 to 355.2)**	**High Yielders (8 genotypes) (> Mean + SD) (> 355.2)**
KSAS-06/44, KSAS-06/245, KSAS-06/378, KSAS-06/407 NSKMS-174 (0), NDS-391(0), NSKMS-72 (0), KARS-165 (30.0), KARS-27 (34.0), NS-04-112 (0), RMG 492 (51.5)	KARS-22 (56.5), BAR-02/22 (60.0),MGG-367 (73.0), MADHIRA MUNG (82.0),KARS-166 (82.5), Asha (95.5), COGG912 (105.5), TARM-1 (107.5), MGG-330 (110), MGG-335 (110), ML-1299 (110), KM-2241 (110.5), IPM-02-03 (113.5), KM-203 (122),PUSA VISHAL (126), KM-8-655 (126.5),KM-9-122 (128), KM-195 (135.5), MGG-359 (137.5), KM-9-136 (139),KM-9-134 (143.5), MGG-336 (145),MGG-350 (146), MGG-349 (148), KM-8-651(148.5), KM-8-654 (148.5),KM-200 (152), NM-1(158), KM-173 (159),MGG-332(163), WGG-43 (164), GG-16 (167.5),UPM-99-3 (167.5), IPM-02-14 (168), MGG-356 (168.5), SML-668 (168.5),KM-8-662 (169), WGG-42 (171.5),PANT-M-5 (172), PDM-54 (172), KM-8-652 (173), GG-10 (174.5), GG-17 (175), MGG-353 (176), BDYR (177.5), PUSA-9531(178.5), KM-8-653 (182), KM-9-126 (183.5), LGG-549 (184.5), Line -76 (185), EC-19515 (188.5), KM-8-661(189), MGG-360 (196), WGG-48 (196.5), KM-8-667 (197.5), MGG-361 (197.5), GG-9 (204), SM 131 (209.5), KM-8-660 (210), MGG-341 (211), LGG-477 (214), KM-8-664 (219), WGG-45 (221), KM-9-128 (222), LGG-502 (225.5), KM-8-657 (228.5), LGG-547 (232), LGG-543 (234.5), LGG-527(235), MGG-295 (235), WGG-49 (235.5), KM-8-658 (239.5), KM-8-659 (241), LGG-545 (242.5), LGG-541 (258), LGG-522 (260.5), MGG-347 (265), KM-9-121(268.5), LGG-521 (272), LGG-491 (273.5), MGG-351 (274),WGG-44 (277.5), LGG-542 (288), LGG-497 (289.5), UPM-84-178 (290.5), WGG-46 (296.5), LGG-528 (301.5),WGG-47 (313.5), V-90 (321.5), KM-9-123 (327) and WGG-2 (327)	LGG-544 (368) MGG-348 (370) KM-8-666 (427) KM-8-656 (473.5) LGG-538 (527.5) LGG-551 (578.5) KM-8-668 (1000) LGG-540 (1028)

Table-6
Grouping of greengram genotypes based on their Mean + S D values for Avoidable Losses for *M. vitrata*

Resistant genotypes (18) < Mean–SD(14.46)	**Susceptible genotypes (72) Values between < Mean –SD to > Mean + SD(14.46 to 57.96)**	**Highly susceptible genotypes (20) >Mean+ SD(> 57.96)**
KSAS-06/44 (0), KSAS-06/245 (0), KSAS-06/378 (0), KSAS-06/407 (0), NDS-391 (0), NSKMS-72 (0), NSKMS-174 (0), MGG-336 (1.4), KM-8-655 (2.4), MGG-335 (3.2), MADHIRA MUNG (7.9), KARS-165 (8.3), KM-9-122 (9.0), PUSA VISHAL (9.1), MGG-295 (10.6), GG-9 (10.8), MGG-353 (11.9) and LGG-543 (12.4).	MGG-349 (15.2), BAR-02/22 (17.5),LGG-545 (17.5), LGG-521 (18.2), EC-19515 (18.6), MGG-347 (18.9), LGG-477 (19.2), COGG912 (20.4), KM-9-126 (20.4), KM-8-651 (22.2), KM-8-652 (22.5), LGG-527 (22.6), WGG-42 (23.9), LGG-502 (25.9), KM-8-657 (26.7), MGG-360 (27.3), ML-1299 (27.3), KM-173 (27.7), KM-8-658 (28.2), SM-131(28.2), IPM-02-03 (28.6), GG-16 (29.3), MGG-367 (29.5), KM-200 (29.6), MGG-361 (29.6), GG-17 (29.7), LGG-541(30.2), KM-8-654 (30.6), LGG-528 (30.7), LGG-542(31.1), KM-8-661(31.2),WGG 43(31.7), KM-8-662 (32.2), KM-9-123(34.7), LGG-522 (34.7), WGG-46 (35.1), PUSA-9531(35.3), MGG-332 (35.6), MGG-348 (35.8), GG-10 (36.1), IPM-02-14 (36.9), LGG-549 (36.9), MGG-356 (37.1), KM-9-134 (38.3), KM-203 (38.5), SML-668 (38.9), KM-195 (39.9), PDM-54 (40.1), KM-8-667 (40.3), TARM-1 (40.5), RMG-492 (40.8), KARS- 27 (41.2), MGG-341(41.2), UPM-99-3 (41.5), LGG-538 (42.1), WGG-45 (43.8), WGG-44 (44.0), LGG-544 (44.4), KM-8-664 (45.2), KM-8-653(45.3), PANT-M-5 (45.6), KM-8-660 (46.9), MGG-350 (48.3), MGG-351 (48.7), UPM-84-178 (49.6), WGG-49 (52.0), BDYR (52.7), KARS- 22 (54.9), KM-8-659 (55.0), V-90 (55.2), NM-1 (56.0) and WGG-2 (56.6).	MGG-330 (58.6), LGG-547 (60.3), LGG-551(61.2), WGG-47 (61.4), KM-2241 (62.4), KM-9-136 (63.3), MGG-359 (65.1), WGG-48 (65.4), KM-8-668(66.3), KARS-166 (67.9), Asha (69.6), LGG-491(73.1), Line-76 (73.5), KM-9-128 (74.3), LGG-540 (75.0), LGG-497 (75.5), KM-9-121 (76.0), KM-8-656 (76.9), KM-8-666 (83.5) and NS-04-112 (100.0)

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