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SUSCEPTIBILITY OF DIFFERENT GREEN GRAM VARIETIES / GENOTYPES AGAINST PULSE BEETLE, *CALLOSOBRUCHUS MACULATUS* (F.) IN STORAGE CONDITION

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ABSTRACT

The present investigation was carried out on screening of different green gram varieties /genotypes for their susceptibility to pulse beetle, *Callosobruchus maculatus* (F.) infesting green gram seeds under storage conditions at the Post Graduate Laboratory, Department of Entomology, Junagadh Agricultural University, Junagadh during 2021-22 and was evaluated based on population growth after three and six months of storage. The varieties /genotypes GM 4, K 851 and Virat demonstrated significant resistance in terms of adult development, showed the lowest population growth of *C. maculatus*. GAM-5, Pant M 3 and GJM-2015 followed as next best in effectiveness. GJM-2016, GJM-2015 and NKM 15-12 were of mediocre effectiveness, while Vamban-2 and Meha were the least effective. Based on population growth after 3 and 6 months, GM 4, K 851 and Virat were categorized as resistant (R) to *C. maculatus*, while Pant M 3 was categorized as moderately resistant (MR). GAM-5, GJM-2015 and GJM-2016 were moderately susceptible (MS) and NKM 15-12, Vamban-2 and Meha were classified as susceptible (S).

Key words : *C. maculatus*, Genotypes, Green gram seeds, Pulse beetle, Varieties.

Introduction

Mung bean is an excellent source of high-quality protein as ascorbic acid (Vitamin C), which is synthesized in sprouted seeds of mung bean with increment in riboflavin and thiamine. It contains 24 percent protein, 56.7 percent carbohydrates, 3.5 percent fibre and 1.3 percent fat. In Gujarat, green gram is grown in about 98.80 thousand hectares with the total production of 43.87 thousand tonnes with a productivity of 444 kg/ha in 2021-22. (Anon., 2022). Due to unsure rain and uneven season in our country, food grains are required to be stored for a longer period of about 6 to 12 months. The farmers retain certain percentage of produce for their domestic consumption as grains, seed purpose and animal feeds. The seeds retained by the farmers in rural areas are kept in various storage structures where they are prone to damages and hence losses. According to a recent estimate by Ministry of Food and Civil Supplies, Government of India, the total preventable post-harvest losses of food grains is 10 per cent of total production or about 20 million tones. Accordingly, significant losses occur in green gram, during storage quantitatively as well as qualitatively. Apart from quantity, the quality and nutritional value of pulses get deteriorate during storage. Pulse beetles, *Callosobruchus maculatus* (F.) are severe pests of stored pulses which damage them to become unfit for human consumption if their attack is not prohibited. Pulse beetles may cause the total loss of stored grain legumes within a few months of storage. It is reported that 55-60 % loss occurs in seed weight and 45.5-66.3 % in protein (Ghosh and Durbey, 2003).

Materials and Methods

Ten gren gram varieties /genotypes (GJM-2015, GJM-2016, Pant M-3, Meha, Vamban-2, Virat, K 851, NKM

15-12, GAM-5 and GM 4) were evaluated for their susceptibility to *C. maculatus* based on population growth during storage. For initiation of culture, adults of *C. maculatus* were collected from the culture maintained at Department of Entomology, J.A.U., Junagadh. They were reared in glass jars (20 cm x 15 cm) for two generations in the storage laboratory of Department of Entomology, J.A.U., Junagadh on green gram seeds (variety GM-4) at room temperature (32-35ºC) during year 2021-22. From the stock culture, samples of adult insects were drawn for further studies. Twenty-five pairs of one or two days old adults were released per rearing jar containing 250 g of green gram seeds, keeping in 6 repetitions. Open end of a jar was covered with muslin cloth fastened with elastic bands. Before releasing the insects, the green gram seeds were cleaned by removing broken/damaged seeds, weeds seeds, dirt and other extraneous material. The cleaned seeds were kept in oven (50 ºC) for four hours to eliminate both apparent and hidden infestation, if any, as suggested by Patil (2007). Such jars were placed in an incubator kept at 30 ± 2 ºC and 65 ± 5% relative humidity to maintain uniform moisture level in the samples.

The experiment was conducted during 2021-22 in Completely Randomized Design (CRD) with 3 repetitions. For each variety/genotype, 3 samples of green gram of 50 g each (one sample for one repetition) were filled in the glass jar (Diameter: 7 cm and Height: 8 cm) individually. Ten pairs of *C. maculatus* were released in each jar for egg laying and each jar was covered with two fold muslin cloth kept in position by means of a rubber band to prevent the adults from escaping. After 7 days of oviposition, the adults were removed from each jar. The observations on the number of adults (live + dead) developed in each repetition were recorded after 3 and 6 months of storage. The data on the number of adults developed after 3 and 6 months of storage were subjected to ANOVA after transforming them to square root.

The green gram varieties/genotypes were grouped into six categories of susceptibility to *C. maculatus viz.*, highly resistant, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible based on population growth (number of adults emerged during 6 months of storage). For the purpose, mean value of individual variety/genotype $\left(\overline{X}_i\right)$ was compared with the mean value of all varieties/genotypes $\left(\overline{X}\right)$ and standard deviation (SD) following the scale according to the variability observed in green gram seed. The transformed data was used for computation of $\overline{X}_i$, $\overline{X}$ and SD. The scale was used for categorizing different varieties/ genotypes are as under.

Table 1 : Categorization scale of green gram varieties/ genotypes.

Category of resistance	Scale for resistance
Highly Resistant	$\overline{X}_i \leq \left(\overline{X} - 2SD\right)$
Resistant	$\overline{X}_i > \left(\overline{X} - 2SD\right) < \left(\overline{X} - SD\right)$
Moderately Resistant	$\overline{X}_i > \left(\overline{X} - SD\right) < \overline{X}$
Moderately Susceptible	$\overline{X}_i > \overline{X} < \left(\overline{X} + SD\right)$
Susceptible	$\overline{X}_i > \left(\overline{X} + SD\right) < \left(\overline{X} + 2SD\right)$
Highly Susceptible	$\overline{X}_i \geq \left(\overline{X} + 2SD\right)$

Results and Discussion

Among all the varieties /genotypes of green gram, GM 4 (194.67) and K 851 (209.33) were found at par with each other and significantly superior as less number of adults were developed after 3 months of storage (Table 2). Comparatively lower number of beetles were emerged in Virat (226.00) which was found at par with K 851 at one side while on the other side it was at par with Pant M-3 (241.00). GAM-5 (312.33) and GJM-2015 (315.00) were found at par with each other and found mediocre in their effectiveness as more number of adult were developed in this treatments. GJM-2016 (356.33) and

Table 2 : Susceptibility of green gram varieties/ genotypes to *C. maculatus* based on population growth.

Varieties/ genotypes	No. of adults developed after months of storage	
	3 Months	6 Months
GJM-2015	17.76^{d} (315.00)	21.47^{bc} (460.67)
GJM-2016	18.89^{e} (356.33)	21.94^{cd} (481.00)
Pant M-3	15.54^{c} (241.00)	21.13^{b} (446.00)
Meha	20.13^{f} (404.67)	23.92^{e} (571.67)
Vamban-2	19.77^{f} (390.33)	23.44^{e} (549.00)
Virat	15.04^{bc} (226.00)	19.96^{a} (398.33)
K 851	14.48^{ab} (209.33)	19.81^{a} (392.00)
NKM 15-12	19.53^{ef} (381.00)	22.60^{d} (510.33)
GAM-5	17.68^{d} (312.33)	21.04^{b} (442.33)
GM 4	13.97^{a} (194.67)	19.44^{a} (377.67)
S. Em. ±	0.26	0.23
C. D. @ 5%	0.76	0.67
C. V.%	2.57	1.82

Note: Means within the parentheses are retransformed values, those outside are √X transformed values.

Table 3 : Categorization of green gram varieties/genotypes for their susceptibility to *C. maculatus* based on population growth.

Category of resistance 1	Scale 2	Varieties/genotypes (X_i) 3
Based on the number of adults emerged after 3 months of storage: $\overline{X}$ = 303.07; SD = 75.77		
Highly Resistant (HR)	$\overline{X}_i \leq 151.53$	—
Resistant (R)	$\overline{X}_i > 151.53 < 227.30$	GM 4 (194.67), K 851 (209.33) and Virat (226.00)
Moderately Resistant (MR)	$\overline{X}_i > 227.30 < 303.07$	Pant M 3 (241.00)
Moderately Susceptible (MS)	$\overline{X}_i > 303.07 < 378.84$	GAM-5 (312.33), GJM- 2015 (315.00) and GJM- 2016 (356.33)
Susceptible (S)	$\overline{X}_i > 378.84 < 454.61$	NKM 15-12 (381.00), Vamban-2 (390.33) and Meha (404.67)
Highly Susceptible (HS)	$\overline{X}_i \geq 454.61$	—
Based on the number of adults emerged after 6 months of storage: $\overline{X}$ = 462.90; SD = 57.91		
Highly Resistant (HR)	$\overline{X}_i \leq 347.08$	—
Resistant (R)	$\overline{X}_i > 347.08 < 404.99$	GM 4 (377.67), K 851 (392.00) and Virat (398.33)
Moderately Resistant (MR)	$\overline{X}_i > 404.99 < 462.90$	Pant M 3 (446.00) and GAM-5 (442.33)
Moderately Susceptible (MS)	$\overline{X}_i > 462.90 < 520.81$	GJM- 2015 (460.67), GJM- 2016 (481.00) and NKM 15-12 (510.33)
Susceptible (S)	$\overline{X}_i > 520.81 < 578.72$	Vamban-2 (549.00) and Meha (571.67)
Highly Susceptible (HS)	$\overline{X}_i \geq 578.72$	—

NKM 15-12(381.00) were found less effective which were more preferred by beetles. The least effective varieties were Vamban-2 (390.33) and Meha (404.67) as highest number of adults were observed after 3 months of storage.

Based on number of adults developed after 6 months of storage, GM 4 (377.67), K 851 (392.00) and Virat (398.33) were found at par with each other and significantly superior as less number of adults were developed. GAM-5 (442.33), Pant M 3 (446.00) and GJM-2015 (460.67) were found at par with each other and found mediocre in their effectiveness as more number of adult were developed in these treatments. GJM-2016 (481.00) was found at par with GJM-2015 at one side while on the other side it was at par with NKM 15-12 (510.33), which were more preferred by beetles. The least effective varieties were Vamban-2 (549.00) and Meha (571.67) as highest number of adults were observed.

Details of categorization based on population growth are presented in Table 3. Based on the population growth (number of adults emerged) after 3 months of storage period, GM 4 (194.67), K 851 (209.33) and Virat (226.00) were recorded the adults which was within the range of 151.53 - 227.30 and thus they were categorized as resistant (R). The adults emerged from Pant M 3 (241.00) was between 227.30 to 303.07 and so it was graded as moderately resistant (MR). Further, higher number of adults were emerged from GAM-5 (312.33), GJM- 2015 (315.00) and GJM- 2016 (356.33), which was in the range of 303.07 to 378.84 and thus they were graded as moderately susceptible (MS). While, NKM 15-12 (381.00), Vamban-2 (390.33) and Meha (404.67) recorded more than 378.84 but less than 454.61 adults and hence categorized as susceptible (S). None of the varieties/ genotypes were fall under highly susceptible (HS) and highly resistant (HR) category as none of the varieties/ genotypes recorded more than 454.61 and less than 151.53 adult emergence due to the infestation of *C. maculatus* in green gram.

Based on the number of adults emerged after 6 months of storage period, GM 4 (377.67), K 851 (392.00) and Virat (398.33) were recorded the adults which was within the range of 347.08 to 404.99 and thus they were

categorized as resistant (R). The adults emerged from Pant M 3 (446.00) and GAM-5 (442.33) was between 404.99 to 462.90 and so it was graded as moderately resistant (MR). Further, higher number of adults were emerged from GJM- 2015 (460.67), GJM- 2016 (481.00) and NKM 15-12 (510.33), which was in the range of 462.90 to 520.81 and thus they were graded as moderately susceptible (MS). While, number of adults were emerged from Vamban-2 (549.00) and Meha (571.67) which was in the range of 520.81 to 578.72 adults and hence categorized as susceptible (S). None of the varieties/ genotypes were fall under highly susceptible (HS) and highly resistant (HR) category as none of the varieties/ genotypes recorded more than 578.72 and less than 347.08 adult emergence due to the infestation of *C. maculatus* in green gram.

Conclusion

Green gram varieties/genotypes GM 4, K 851 and Virat was found least preferred by *C. maculatus* in which lowest number of adults develop and they were categorized as resistant (R). Vamban-2 and Meha was found susceptible towards *C. maculatus*. None of the green gram varieties /genotypes were observed to be highly susceptible and highly resistant against *C. maculatus*. The results are in close proximity with the results of Parmar and Patel (2015) as variety Meha was found moderately susceptible among all tested varieties and GM 4 and K851 were categorized as resistant based on number of eggs laid /20 grains, number of adult emerged, per cent weight loss and per cent loss in germination.

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