# Influence of plant resistance in certain genotypes of Green gram on insecticide tolerance on Spotted Pod Borer, *Maruca vitrata* (Geyer)


## Abstract

Ten genotypes of green gram *viz*., WGG-42, LGG-407, PM-115, MGG-360, PM-110, LGG-410, PM-112, TM-962, LGG-450 and LGG-460 were screened for their susceptibility to Spotted pod borer, *Maruca vitrata* (Geyer) infestation at wetland farm, S.V.Agricultural College, Tirupati in a randomized block design (RBD) during the late *Kharif* season of 2014. Two crops were raised one at during last week of August- and second 2014was raised durin second week of September-2014. Readings on the number of *Maruca* webbings per plant, total number of caterpillars per plant and per cent infestation were taken at weekly intervals. Field screening experiments which were conducted on green gram genotypes against *M. vitrata* infestation revealed that WGG-42, TM-962 and MGG-360 were observed resistant, moderately resistant and susceptible reaction based on number of webbings per plant and number of caterpillars per plant. Further investigation on feeding preference of *Maruca* by free-choice and no-choice techniques on selected genotypes of green gram in the laboratory to confirm the resistance ranking observed in the field screening have yielded similar resistance reaction to *Maruca* infestation. Larvae of the first instar were allowed to feed on the susceptible and resistant genotypes of green gram upto third instar. At the third instar stage, they were allowed for topical bioassay application with Chlorpyriphos insecticide after taking the larval weights. The larvae which fed on the WGG-42 (resistant) gave $LC_{50}$ (Lethal Concentration) and $LD_{50}$ (Lethal Dose) values of 1.39 µL/ml and 36.98 µg/g and the larvae which fed on the MGG-360 (susceptible) gave $LC_{50}$ and $LD_{50}$ values of 1.63 µL/ml and 36.85 µg/g.



**Key words**: *Maruca vitrata*, Green gram, Chlorpyriphos, $LC_{50}$ and $LD_{50,}$


## 1.Introduction

"Pulses, the food legumes, have been grown by farmers since millennia providing nutritionally balanced food to the people of India and many other countries in the world" [16]. Pulses, such as chickpea, pigeonpea, green gram, urdbean, cowpea, lentil, and many more, are a major source of protein in our diet and are often referred to as "poor man's meat" [3]. "Green gram [*Vigna radiata* (L.)Wilczek] is also known as mungbean or moong, is a leguminous plant species belonging to the Fabaceae family. It is an excellent source of high-quality protein (25%) having high digestibility. It is consumed as whole grains as well as "Dal" in a variety of ways in Indian food" [13]. "Mungbean is the third most important pulse crop farmed in India among the major pulse crop accounting for roughly 16% of the country's total pulse area" [8]. "Green gram is also used as a green manuring crop. It is a leguminous crop that has the capacity to fix atmospheric nitrogen (30-40 kg N/ha). It also helps in preventing soil erosion. These crops grow quickly, generate good profit for farmers and contribute to agricultural and environmental sustainability" [1]. "India is the major producer of green gram in the world and grown in almost all the states. It is grown in about 4.5 million ha with the total production of 2.5 million tonnes with a productivity of 548 kg/ha and contributing 10% to the total pulse production. Andhra Pradesh ranks sixth in green gram production with 0.08 million tonnes under an area of 0.12 million ha with productivity of 735 kg/ha" [21]. "The insect pests exercising heavy toll of green gram crop include pod borer complex *viz*, gram pod borer, *Helicoverpa armigera* (Hubner), blue butter fly, *Lampides boeticus* L., spotted pod borer, *Maruca vitrata* (Geyer), pod bug, *Riptortus spp*. are major pests of green gram" [19].

"Spotted pod borer, *Maruca vitrata* (Geyer) (Lepidoptera: Crambidae) is most formidable and potential pest that causes extensive damage to green gram under field conditions. The low yield of green gram is attributed to the regular outbreaks of spotted pod borer. It is considered one of the voracious legume pests because of its broad host range, high degree of damage and worldwide distribution" [12,17]. "Because of its extensive host range and destructiveness, it became a persistent pest in green gram. It is known to cause an economic loss of 20 - 25%, yield loss of 2 - 84% and pod damage of 20 - 60% in green gram" [9]. "The webbing behaviour protects the *Maruca* larvae from both biotic and abiotic conditions and also makes it difficult to manage the insect by synthetic chemicals. The repeated use of older class chemicals such as chlorpyriphos, acephate, dichlorovos etc., have resulted in development of resistance to insecticides. It has long been recognized that host plant resistance holds a great promise for exploitation in integrated pest management programmes because the use of resistant varieties provide crop protection that is biologically, ecologically, economically and socially acceptable"[17]. "Host Plant Resistance (HPR) offers one of the best insect pest management strategy which is environmentally safe and no additional cost was incurred to the farmers" [14]. Much research has been conducted on the susceptibility of various genotypes, wild relatives, and germplasm of different pulses to insect pests that feed on them. A substantial amount of research has also been conducted to determine the mechanism of resistance involved as well as the role of secondary metabolites in plant resistance to insects. Quite few numbers of insect resistant genotypes has also been released by state, national and international institutes. However not much work has been done on host plant resistance to spotted pod borer in green gram and its interaction with insecticide tolerance. The present study was carried out to understand the role of host plant resistance on usage of chemical pesticides against damage by *M. vitrata*.

## 2. Materials and Methods

Field screening of certain genotypes of green gram for observing susceptibility against *M.vitrata* infestation; effect of plant resistance in popular genotypes of green gram to *M.vitrata* and its role in insecticide tolerance during 2014-2015 were conducted in Department of Entomology, S.V. Agricultural College and Regional Agricultural Research Station (RARS), Tirupati.

### 2.1 Screening of certain genotypes of green gram for the incidence of *M.vitrata*:

A screening trial was conducted with ten genotypes of green gram *viz*., WGG-42, LGG-407, PM-115, MGG-360, PM-110, LGG-410, PM-112, TM-962, LGG-450, LGG-460 against *M.vitrata* in the wetland farm, S.V. Agricultural College, Tirupati in a randomized block design (RBD). Two crops were raised one at during last week of August-2014 and second was raised during second week of September-2014. Five randomly selected plants were tagged in each genotype for long term sampling to record the infestation of the *M.vitrata*. During the period of study, incidence of the *M.vitrata* across different genotypes was recorded from vegetative parts, flower buds and pods at different dates of sowing of each crop. During first crop, data was observed at 71, 78, 85 and 92 DAS (Days After Sowing) and during second crop, data was observed at 57, 64, 71, 78, 85 and 92 DAS. Based on the observations, the genotypes were grouped into resistant, moderate resistant and susceptible to their reaction to *Maruca* infestation and were used for further investigations.

### 2.2 Scrutinising mechanisms of resistance in selected genotypes of green gram:

"The genotypes of green gram were grouped into resistant, moderate resistant and susceptible to *Maruca* damage based on field observations those were used in the present study to confirm their resistant rankings in feeding preference by free-choice and no-choice (biology) techniques"[14].

"In free-choice technique, the leaves, flowers, and developed pods of resistant, moderate resistant and susceptible genotypes of green gram were placed in a radical fashion in separate petriplates of size 18cm diameter, at equal distance. Six larvae of same instar were released in the middle of the petriplate and after 24 hours, larvae on each test genotype was recorded to test feeding preference" [14].

"In no-choice technique**,** six first instar larvae were released separately for each test genotype of green gram in six loculed cell wells and observations were recorded on biological parameters such as duration of egg stage, instar durations, pre-pupal duration, pupal duration, adult longevity of the spotted pod borer. From the day of hatching of the egg, the first and second instar larvae of spotted pod borer were provided with sufficient amount of flower buds of resistant, moderate resistant and susceptible genotypes for feeding. For third, fourth and fifth instar larvae, flower buds and developed pods were provided for feeding. The time from hatching of first instar to the final pre-pupal stage were considered as the total larval duration. Duration of each instars of larvae was recorded by observing the moulted skins of the next larval stages on test genotypes of green gram. The duration of pupation to the adult emergence was considered as the duration of pupal stage of the moth and was expressed in days. From the day of adult emergence till the death was considered as the adult longevity" [14].

### 2.3 Effect of plant resistance in selected genotypes of green gram to *M.vitrata* and its role in insecticide tolerance:

"Based on field screening and biological studies of pest species in the laboratory, resistant and susceptible genotypes of green gram were selected and were grown in plastic pots of size 15 cm diameter and 15 cm depth in greenhouse with staggered sowing. For the insecticide bioassay study, the first instar larvae from nucleus culture were separated carefully with camel hair brush and were kept in separate trays having flower buds of resistant and susceptible genotypes separately in each tray and were allowed to feed upto ten days. Just before conducting the bio-assay test, larval weights were taken" [14].

For topical bioassay, a serial dilution of chlorpyriphos with 5 concentrations (10, 5, 2.5, 1.25 and 0.625 mL/lit of water) were prepared and with microapplicator, 2.0 µl of each concentration of chlorpyriphos was applied to the mid dorsum of early third instar larvae. For topical application, ten larvae were taken for each concentration. After topical application, the larvae were placed in rearing boxes containing green gram flowers and pods for feeding. A group of ten larvae were kept as control with no insecticide treatment. The number of dead larvae were recorded after 24, 48 and 72 hours. The data was subjected to probit analysis by using a Statistical Package for Social Sciences (SPSS) [20] to calculate lethal concentration ($LC_{50}$) values for *M.vitrata* against insecticide on various green gram genotypes having various levels of plant resistance to *M.vitrata.* From the $LC_{50}$ values, lethal dose ($LD_{50}$) values were calculated by the following equation [3,4,5,14]

$$LD_{50} = \frac{\text{Volume of insecticide applied (µL)}}{\text{Mean larval weight (µg)}} \times LC_{50}$$

## 3. Results and Discussion

### 3.1 Field screening of different genotypes of green gram for the incidence of *M.vitrata* :

For the first crop, the observations were recorded at 71DAS as all the genotypes have attained 50% flowering at this age and for the second crop, observations were recorded from 57 DAS.

### 3.1.1 Screening for number of webbings per plant

From the mean data (Table 1) of first crop, lowest number of webbings per plant were observed in WGG-42(2.28 ± 0.50). Highest number of webbings per plant were found in MGG-360(5.83 ± 0.54) followed by LGG-410(4.56 ± 1.04) (significantly different) and the remaining (LGG-450, PM-115, LGG-460, LGG-407, PM-110, TM-962 and PM-112) genotypes were on par with each other. Number of webbings of *M. vitrata* in the present investigation varied from 1.07/plant to 7.80/plant between 71 DAS to 92 DAS. From the mean data of second crop (Table 2), lowest number of webbings per plant were observed in WGG-42(2.38 ± 0.63). In MGG-360(5.33 ± 0.67) highest number of webbings per plant were observed and the remaining (PM-112, LGG-450, PM-110, LGG-460, TM-962, LGG-410 PM-115 and LGG-407) genotypes were on par with each other. Number of webbings of *M. vitrata* in the present investigation varied from 1.07/plant to 7.80/plant between 57 DAS to 92 DAS. These results were in close resemblance with that of Reddy and Hariprasad [14] who observed that lowest number of webbings per plant were observed in LBG-645(2.02 ± 0.50) and highest number of webbings per plant were found in LBG-790 (4.60 ± 1.00) for one crop. Revathi and Selvanarayanan [15] reported that the active webbing by *Maruca* was least on genotype IC-39301-1 followed by IC-311451 and the highest in the genotype IC-39317 during *Rabi*, 2020 and *Kharif*, 2021 respectively.

**Table 1. Number of webbings of *M.vitrata* larva per plant in different genotypes of green gram during first crop**

| DAS / Genotypes | 71 DAS | 78 DAS | 85 DAS | 92 DAS | Mean |
|---|---|---|---|---|---|
| **WGG-42** | $1.07^{a}$±0.25 (1.03) | $2.53^{a}$±0.83 (1.57) | $2.60^{a}$±0.73 (1.60) | $2.93^{a}$±0.88 (1.70) | $2.28^{a}$±0.50 (1.47) |
| **LGG-407** | $1.40^{ab}$±0.63 (1.16) | $4.20^{b}$±1.01 (2.04) | $4.60^{bc}$±0.98 (2.13) | $5.00^{b}$±1.64 (2.21) | $3.80^{b}$±0.77 (1.88) |
| **PM-115** | $1.47^{ab}$±0.74 (1.18) | $3.87^{b}$±0.99 (1.95) | $3.93^{b}$±1.03 (1.97) | $4.47^{b}$±1.40 (2.09) | $3.43^{b}$±0.72 (1.80) |
| **MGG-360** | $2.73^{c}$±0.88 (1.63) | $5.87^{c}$±1.18 (2.41) | $6.93^{d}$±1.10 (2.63) | $7.80^{d}$±1.14 (2.79) | $5.83^{d}$±0.54 (2.36) |
| **PM-110** | $1.27^{ab}$±0.45 (1.11) | $4.27^{b}$±1.58 (2.03) | $4.73^{bc}$±1.03 (2.16) | $5.00^{b}$±1.25 (2.22) | $3.81^{b}$±0.75 (1.88) |
| **LGG-410** | $1.33^{ab}$±0.48 (1.14) | $5.67^{c}$±1.87 (2.35) | $5.07^{c}$±1.22 (2.23) | $6.20^{c}$±1.42 (2.47) | $4.56^{c}$±1.04 (2.05) |
| **PM-112** | $1.53^{ab}$±0.64 (1.21) | $4.27^{b}$±1.90 (2.01) | $4.73^{bc}$±1.57 (2.14) | $5.33^{bc}$±1.49 (2.29) | $3.96^{b}$±1.21 (1.92) |
| **TM-962** | $1.67^{b}$±0.81 (1.26) | $4.07^{b}$±1.10 (2.00) | $4.47^{bc}$±0.90 (2.15) | $5.00^{b}$±1.60 (2.21) | $3.85^{b}$±0.68 (1.90) |
| **LGG-450** | $1.33^{ab}$±0.48 (1.14) | $3.47^{ab}$±1.06 (1.84) | $4.00^{b}$±1.06 (1.98) | $4.60^{b}$±1.40 (2.12) | $3.35^{b}$±0.73 (1.77) |
| **LGG-460** | $1.40^{ab}$±0.63 (1.16) | $3.87^{b}$±1.56 (1.93) | $4.60^{bc}$±6.91 (2.13) | $4.93^{b}$±1.22 (2.20) | $3.70^{b}$±0.78 (1.86) |
| **Grand Mean** | 1.52±0.74 (1.20) | 4.21±1.60 (2.01) | 4.59±1.46 (2.11) | 5.13±1.77 (2.23) | 3.86±1.16 (1.89) |

Values in parenthesis are square root transformed

Values having the same alphabet are not significantly different as per Duncan Multiple Range Test (DMRT)

**Table 2. Number of webbings of *M.vitrata* larva per plant in different genotypes of green gram during second crop**

| DAS / Genotypes | 57 DAS | 64 DAS | 71 DAS | 78 DAS | 85 DAS | 92 DAS | Mean |
|---|---|---|---|---|---|---|---|
| **WGG-42** | $1.07^{a}\pm0.25$ (1.03) | $1.93^{a}\pm0.79$ (1.36) | $2.67^{a}\pm0.97$ (1.61) | $2.80^{a}\pm0.94$ (1.65) | $2.93^{a}\pm1.22$ (1.68) | $2.87^{a}\pm0.91$ (1.67) | $2.38^{a}\pm0.63$ (1.50) |
| **LGG-407** | $1.47^{a}\pm0.74$ (1.18) | $2.33^{abc}\pm1.29$ (1.47) | $3.73^{b}\pm1.33$ (1.9) | $4.67^{d}\pm1.49$ (2.13) | $5.33^{c}\pm1.39$ (2.29) | $5.73^{b}\pm1.28$ (2.38) | $3.86^{b}\pm0.97$ (1.89) |
| **PM-115** | $1.47^{a}\pm0.64$ (1.19) | $2.67^{abc}\pm1.11$ (1.60) | $3.80^{b}\pm0.94$ (1.93) | $4.40^{cd}\pm0.91$ (2.09) | $4.93^{bc}\pm1.03$ (2.21) | $4.87^{b}\pm1.45$ (2.18) | $3.70^{b}\pm0.69$ (1.87) |
| **MGG-360** | $2.27^{b}\pm0.88$ (1.48) | $3.20^{c}\pm1.52$ (1.74) | $5.20^{c}\pm1.20$ (2.27) | $6.20^{e}\pm0.86$ (2.48) | $7.47^{d}\pm0.91$ (2.73) | $7.80^{c}\pm1.01$ (2.79) | $5.33^{c}\pm0.67$ (2.25) |
| **PM-110** | $1.27^{a}\pm0.59$ (1.10) | $2.27^{ab}\pm0.88$ (1.48) | $3.60^{b}\pm0.98$ (1.88) | $4.27^{cd}\pm1.10$ (2.05) | $4.53^{bc}\pm1.40$ (2.10) | $4.93^{b}\pm1.28$ (2.20) | $3.47^{b}\pm0.65$ (1.80) |
| **LGG-410** | $1.40^{a}\pm0.63$ (1.16) | $2.60^{abc}\pm1.18$ (1.57) | $3.73^{b}\pm1.16$ (1.91) | $3.93^{bcd}\pm1.22$ (1.96) | $4.93^{bc}\pm1.33$ (2.20) | $5.20^{b}\pm1.01$ (2.27) | $3.62^{b}\pm0.84$ (1.84) |
| **PM-112** | $1.27^{a}\pm0.45$ (1.11) | $2.93^{bc}\pm1.16$ (1.68) | $3.27^{ab}\pm1.48$ (1.77) | $3.07^{ab}\pm0.79$ (1.74) | $4.27^{b}\pm1.22$ (2.04) | $4.80^{b}\pm1.01$ (2.18) | $3.27^{b}\pm0.71$ (1.75) |
| **TM-962** | $1.20^{a}\pm0.41$ (1.08) | $2.27^{ab}\pm1.03$ (1.47) | $3.40^{ab}\pm0.98$ (1.83) | $4.00^{cd}\pm1.30$ (1.97) | $5.13^{bc}\pm1.30$ (2.25) | $5.27^{b}\pm1.53$ (2.27) | $3.53^{b}\pm0.84$ (1.81) |
| **LGG-450** | $1.47^{a}\pm0.74$ (1.18) | $2.07^{ab}\pm1.03$ (1.40) | $3.27^{ab}\pm1.10$ (1.79) | $3.60^{ab}\pm1.18$ (1.87) | $4.73^{bc}\pm1.38$ (2.15) | $5.47^{b}\pm1.18$ (2.33) | $3.42^{b}\pm0.77$ (1.78) |
| **LGG-460** | $1.40^{a}\pm0.63$ (1.16) | $2.13^{ab}\pm0.91$ (1.43) | $3.27^{ab}\pm1.03$ (1.76) | $3.93b^{cd}\pm1.03$ (1.97) | $5.20^{bc}\pm0.94$ (2.27) | $4.93^{b}\pm1.38$ (2.20) | $3.52^{b}\pm0.75$ (1.80) |
| **Grand Mean** | 1.43±0.67 (1.17) | 2.44±1.14 (1.52) | 3.59±1.26 (1.87) | 4.09±1.39 (1.99) | 4.95±1.60 (2.19) | 5.19±1.64 (2.25) | 3.61±1.01 (1.83) |

Values in parenthesis are square root transformed values
Values having the same alphabet are not significantly different as per DMRT.

### 3.1.2 Screening for number of caterpillars per plant

From the mean data of first crop, lowest number of caterpillars per plant were found in WGG-42(1.73 ± 0.52). Highest number of caterpillars per plant were observed in MGG-360(6.08 ± 0.87) and the remaining (LGG-50, LGG-407, LGG-460, TM-962, PM-110, PM-115, PM-112 and LGG-410) genotypes were on par with each other (Table 3). From the mean data of second crop (Table 4), highest number of caterpillars per plant were obtained in MGG-360(5.02 ± 0.84). Lowest number of caterpillars per plant were observed in WGG-42(1.84 ± 0.54) and the remaining (LGG-450, PM-112, LGG-460, PM-110, TM-962, LGG-410, LGG-407 and PM-115) genotypes were on par with each other. The obtained observations were similar to the findings of Reddy and Hariprasad [14] who reported that lowest number of caterpillars per plant were found in LBG-645 (1.62 ± 0.59) followed by LBG-709 (2.48 ± 0.66) (significantly different) and the highest number of caterpillars per plant were found in LBG-790 (4.07 ± 0.74) followed by LBG-752 (3.13 ± 0.70) (significantly different) and the remaining (LBG-792, LBG-791, LBG-123, LBG-20 and PU-31) genotypes were on par with each other. Singh *et al*, [16] reported that overall mean population of pod borer was highest in genotype Pusa 1671(2.84 larvae/3 plants) while the overall least mean population was recorded in genotype PM 11-26 (1.79 larvae/3 plants). Revathi and Selvanarayanan [15] observed the least larval population of *Maruca* on IC-39301-1 genotype followed by IC-311451 and highest in the genotype IC-39317 during *Rabi*, 2020 and *Kharif* ,2021 respectively.

**Table 3. Total number of *M.vitrata* caterpillars per plant in different genotypes of green gram during first crop**

| DAS / Genotype | 71 DAS | 78 DAS | 85 DAS | 92 DAS | Mean |
|---|---|---|---|---|---|
| **WGG-42** | 1.00$^{a}$±0.00 (1.41) | 1.07$^{a}$±0.88 (1.41) | 3.67$^{a}$±1.11 (1.89) | 1.20$^{a}$±0.94 (1.45) | 1.73$^{a}$±0.52 (1.54) |
| **LGG-407** | 1.07$^{a}$±0.70 (1.42) | 2.13$^{b}$±0.99 (1.75) | 6.07$^{b}$±1.28 (2.45) | 2.93$^{b}$±1.90 (1.93) | 3.05$^{b}$±0.94 (1.89) |
| **PM-115** | 1.27$^{a}$±0.59 (1.50) | 2.27$^{bc}$±0.88 (1.79) | 5.60$^{b}$±1.24 (2.35) | 3.73$^{b}$±1.71 (2.13) | 3.21$^{b}$±0.65 (1.94) |
| **MGG-360** | 3.20$^{b}$±0.86 (2.04) | 6.53$^{d}$±2.47 (2.71) | 7.87$^{c}$±1.12 (2.80) | 6.73$^{c}$±2.52 (2.75) | 6.08$^{c}$±0.87 (2.57) |
| **PM-110** | 0.87$^{a}$±0.74 (1.34) | 2.47$^{bc}$±1.40 (1.83) | 5.80$^{b}$±1.74 (2.38) | 3.33$^{b}$±1.54 (2.05) | 3.11$^{b}$±0.90 (1.90) |
| **LGG-410** | 0.87$^{a}$±0.64 (1.35) | 3.33$^{c}$±1.71 (2.05) | 6.13$^{b}$±1.64 (2.46) | 3.33$^{b}$±1.17 (2.06) | 3.41$^{b}$±1.01 (1.98) |
| **PM-112** | 1.20$^{a}$±0.77 (1.46) | 2.73$^{bc}$±1.28 (1.91) | 5.33$^{b}$±1.11 (2.30) | 4.13$^{b}$±1.88 (2.23) | 3.35$^{b}$±0.91 (1.97) |
| **TM-962** | 1.33$^{a}$±1.04 (1.50) | 1.73$^{ab}$±1.16 (1.62) | 5.80$^{b}$±1.14 (2.40) | 3.60$^{b}$±1.92 (2.10) | 3.11$^{b}$±0.82 (1.90) |
| **LGG-450** | 1.00$^{a}$±0.65 (1.39) | 2.00$^{ab}$±0.92 (1.71) | 5.67$^{b}$±1.39 (2.36) | 3.27$^{b}$±1.90 (2.02) | 2.98$^{b}$±0.83 (1.87) |
| **LGG-460** | 1.33$^{a}$±0.72 (1.51) | 2.27$^{bc}$±0.88 (1.79) | 5.67$^{b}$±1.44 (2.36) | 3.07$^{b}$±1.90 (1.96) | 3.08$^{b}$±0.80 (1.91) |
| **Grand Mean** | 1.31±0.95 (1.49) | 2.65±1.92 (1.86) | 5.76±1.62 (2.38) | 3.53±2.17 (2.07) | 3.31±1.31 (1.95) |

Values in parenthesis are square root transformed

Values having the same alphabet are not significantly different as per DMRT.

**Table 4. Total number of *M.vitrata* caterpillars per plant in different genotypes of green gram**

| DAS / Genotypes | 57 DAS | 64 DAS | 71 DAS | 78 DAS | 85 DAS | 92 DAS | Mean |
|---|---|---|---|---|---|---|---|
| **WGG-42** | $0.73^{ab}$±0.59 (1.30) | $0.93^{a}$±0.88 (1.36) | $3.27^{a}$±1.16 (1.78) | $2.07^{a}$±1.48 (1.69) | $2.27^{a}$±1.62 (1.75) | $1.87^{a}$±0.83 (1.34) | $1.84^{a}$±0.54 (1.54) |
| **LGG-407** | $0.93^{ab}$±0.70 (1.37) | $2.00^{ab}$±1.51 (1.68) | $4.67^{b}$±1.58 (2.13) | $3.80^{b}$±1.97 (2.14) | $6.20^{c}$±1.89 (2.66) | $2.60^{ab}$±1.05 (1.58) | $3.36^{b}$±0.68 (1.93) |
| **PM-115** | $0.87^{ab}$±0.74 (3.14) | $2.40^{b}$±1.50 (1.8) | $4.80^{b}$±1.20 (2.17) | $5.13^{b}$±1.59 (2.45) | $5.40^{bc}$±1.63 (2.51) | $2.47^{ab}$±1.12 (1.53) | $3.45^{b}$±0.81 (1.97) |
| **MGG-360** | $1.80^{c}$±0.67 (1.66) | $2.20^{b}$±1.61 (1.74) | $6.40^{c}$±2.06 (2.48) | $6.60^{c}$±2.02 (2.73) | $8.20^{d}$±2.67 (3.01) | $4.93^{c}$±1.28 (2.20) | $5.02^{c}$±0.84 (2.30) |
| **PM-110** | $0.53^{a}$±0.51 (1.22) | $2.20^{b}$±1.01 (1.77) | $4.40^{ab}$±1.45 (2.07) | $4.27^{b}$±1.83 (2.26) | $4.87^{bc}$±1.84 (2.39) | $3.07^{b}$±1.33 (1.71) | $3.20^{b}$±0.58 (1.90) |
| **LGG-410** | $1.07^{b}$±0.70 (1.42) | $2.27^{b}$±1.83 (1.74) | $4.73^{b}$±1.66 (2.14) | $3.87^{b}$±1.80 (2.16) | $5.27^{bc}$±1.66 (2.48) | $2.60^{ab}$±0.98 (1.58) | $3.30^{b}$±0.74 (1.92) |
| **PM-112** | $0.73^{ab}$±0.45 (1.30) | $2.80^{b}$±1.37 (1.92) | $4.40^{ab}$±1.72 (2.06) | $3.80^{b}$±1.52 (2.16) | $4.20^{b}$±1.74 (2.25) | $3.07^{b}$±1.16 (1.72) | $3.14^{b}$±0.63 (1.90) |
| **TM-962** | $0.67^{ab}$±0.48 (1.28) | $2.27^{b}$±1.38 (1.71) | $4.27^{ab}$±1.03 (2.05) | $3.93^{b}$±1.33 (2.23) | $5.40^{bc}$±1.40 (2.51) | $3.07^{b}$±1.33 (0.71) | $3.23^{b}$±0.69 (1.91) |
| **LGG-450** | $1.13^{b}$±0.64 (1.44) | $1.93^{ab}$±1.16 (1.68) | $4.40^{ab}$±1.50 (2.07) | $2.47^{a}$±1.12 (1.83) | $5.40^{bc}$±3.26 (2.45) | $2.33^{ab}$±0.81 (1.50) | $2.94^{b}$±0.80 (1.83) |
| **LGG-460** | $0.80^{ab}$±0.56 (1.32) | $2.00^{ab}$±1.25 (1.69) | $4.20^{ab}$±1.58 (2.01) | $4.53^{b}$±1.64 (2.33) | $4.73^{bc}$±1.94 (2.36) | $2.60^{ab}$±1.29 (1.57) | $3.14^{b}$±0.83 (1.88) |
| **Grand Mean** | 0.93±0.68 (1.37) | 2.08±1.41 (1.71) | 4.55±1.65 (2.10) | 4.05±2.01 (2.20) | 5.19±2.43 (2.44) | 2.86±1.35 (1.65) | 3.26±1.01 (1.91) |

Values in parenthesis are square root transformed values

Values having the same alphabet are not significantly different as per DMRT.

### 3.1.3 Screening for percentage infestation of *Maruca*

The mean data depicted in the table 5 implied that the lowest percentage infestation of *M.vitrata* was observed in LGG-410(34.04 ± 6.05) followed by WGG-42(36.36 ± 1.96) (not significantly different). Highest percentage infestation was found in MGG-360(52.78 ± 0.69) followed by PM-112(47.34 ± 2.36) (not significantly different) and the remaining (LGG-460, PM-110, LGG-407, TM-962, LGG-450 and PM-115) genotypes were on par with each other (Table 5). From the mean data, lowest percentage infestation was found in PM-112(36.51 ± 2.75), TM-962(36.84 ± 3.16), LGG-450(37.61 ± 6.63), PM-115(38.52 ± 2.65), LGG-407(38.97 ± 3.57) (not significantly different). Highest percentage infestation was observed in MGG-360(46.79 ± 3.43) and the remaining (LGG-460, PM-110, WGG-42, LGG-410) genotypes were on par with each other (Table 6). These results were supported by the findings of the Reddy and Hariprasad [14] who reported that percentage infestation was found lowest in LBG-645 (33.33 ± 0.83) followed by LBG-791(33.73 ± 3.42) and highest percentage infestation was found in LBG-790 (44.60 ± 5.50) followed by LBG-709 (41.11 ± 6.08), LBG-752 (39.09 ± 2.93) and LBG-123 (38.41±3.27). Singh and Srivastava [17] observed minimum per cent pod damage in VGG 10-008 (7.27 %) genotype while maximum pod damage was observed in genotype, KM 2348 (19.26 %). Revathi and Selvanarayanan [15] observed that the per cent pod damage by *Maruca* was least on IC-39301-1 genotype and the highest was reported in the genotype IC-39317, followed by IC-103981 during *Rabi*, 2020 and *Kharif*, 2021 respectively.

**Table 5. Percentage infestation of *M.vitrata* in different genotypes of green gram**

| DAS / Genotypes | Total no. of plants | 71 DAS | 78 DAS | 85 DAS | 92 DAS | Mean |
|---|---|---|---|---|---|---|
| **WGG-42** | 18.67$^{a}$±3.05 (4.31) | 32.70$^{a}$±5.14 (34.85) | 37.58$^{a}$±1.26 (37.83) | 37.58$^{a}$±1.26 (37.83) | 37.58$^{a}$±1.26 (37.83) | 36.36$^{a}$±1.96 (37.08) |
| **LGG-407** | 20.67$^{ab}$±3.51 (4.53) | 26.07$^{a}$±2.95 (30.70) | 46.39$^{abc}$±11.09 (42.93) | 44.80$^{ab}$±12.14 (42.01) | 44.80$^{ab}$±12.14 (42.01) | 40.52$^{ab}$±9.50 (39.41) |
| **PM-115** | 20.33$^{ab}$±0.57 (4.51) | 27.93$^{a}$±6.14 (31.84) | 44.20$^{ab}$±3.87 (41.69) | 45.79$^{ab}$±6.22 (42.60) | 50.79$^{bc}$±5.18 (45.48) | 42.18$^{ab}$±4.08 (40.40) |
| **MGG-360** | 21.00$^{ab}$±1.00 (4.58) | 25.51$^{a}$±3.92 (30.31) | 57.07$^{c}$±2.04 (49.10) | 63.43$^{c}$±3.33 (52.83) | 65.10$^{d}$±1.51 (53.82) | 52.78$^{c}$±0.69 (46.52) |
| **PM-110** | 22.33$^{ab}$±2.88 (4.72) | 25.80$^{a}$±5.41 (30.46) | 41.15$^{ab}$±10.15 (39.86) | 43.93$^{ab}$±7.81 (41.51) | 45.32$^{abc}$±6.33 (42.33) | 39.05$^{ab}$±7.21 (38.54) |
| **LGG-410** | 22.67$^{ab}$±1.52 (4.76) | 25.30$^{a}$±6.97 (30.09) | 36.91$^{a}$±7.22 (37.37) | 35.46$^{a}$±5.47 (36.53) | 38.510$^{ab}$±8.08 (38.30) | 34.04$^{a}$±6.05 (35.57) |
| **PM-112** | 20.67$^{ab}$±2.30 (4.54) | 25.92$^{a}$±2.78 (30.60) | 53.36$^{bc}$±2.95 (46.96) | 53.36$^{bc}$±2.95 (46.96) | 56.73$^{cd}$±3.79 (48.90) | 47.34$^{bc}$±2.36 (43.35) |
| **TM-962** | 22.67$^{ab}$±0.57 (4.76) | 25.03$^{a}$±2.91 (30.01) | 44.07$^{ab}$±3.49 (41.6) | 47.03$^{ab}$±8.80 (43.31) | 47.03$^{abc}$±8.80 (43.31) | 40.79$^{ab}$±5.50 (39.56) |
| **LGG-450** | 22.33$^{ab}$±2.88 (4.72) | 24.41$^{a}$±6.20 (29.52) | 45.68$^{abc}$±10.77 (42.52) | 48.46$^{ab}$±8.42 (44.14) | 48.46$^{abc}$±8.48 (44.14) | 41.75$^{ab}$±8.42 (40.08) |
| **LGG-460** | 21.47$^{b}$±2.08 (4.83) | 25.85$^{a}$±2.40 (30.56) | 38.73$^{a}$±4.88 (38.48) | 41.45$^{ab}$±3.47 (40.09) | 41.45$^{ab}$±3.47 (40.09) | 36.87$^{ab}$±3.13 (37.31) |
| **Grand Mean** | 21.47±2.34 (4.63) | 26.45±4.57 (30.90) | 44.51±8.50 (41.84) | 46.13±9.53 (42.78) | 47.57±9.86 (43.62) | 41.17±7.06 (39.78) |

Values in parenthesis are arc sine transformed values

Values having the same alphabet are not significantly different as per DMRT

**Table 6. Percentage infestation of *M.vitrata* in different genotypes of green gram**

| DAS / Genotypes | Total no. of plants | 57 DAS | 64 DAS | 71 DAS | 78 DAS | 85 DAS | 92 DAS | Mean |
|---|---|---|---|---|---|---|---|---|
| **WGG-42** | $17.33^{a}\pm1.15$ (4.28) | $28.94^{ab}\pm2.00$ (32.55) | $42.36^{b}\pm3.02$ (40.62) | $42.36^{bc}\pm3.02$ (40.62) | $42.36^{ab}\pm3.02$ (40.62) | $42.36^{a}\pm3.02$ (40.62) | $44.21^{a}\pm0.40$ (41.70) | $40.43^{ab}\pm2.13$ (39.46) |
| **LGG-407** | $20.00^{ab}\pm1.00$ (4.58) | $30.05^{b}\pm1.50$ (33.25) | $31.72^{ab}\pm3.21$ (34.28) | $38.48^{abc}\pm4.57$ (38.34) | $41.73^{ab}\pm3.46$ (40.25) | $43.40^{a}\pm6.05$ (41.21) | $48.50^{a}\pm5.05$ (44.16) | $38.97^{a}\pm3.57$ (38.58) |
| **PM-115** | $20.00^{ab}\pm1.00$ (4.58) | $28.30^{ab}\pm1.85$ (32.14) | $31.56^{ab}\pm6.54$ (34.12) | $38.23^{abc}\pm4.10$ (38.20) | $39.90^{ab}\pm3.01$ (39.19) | $44.91^{a}\pm2.75$ (42.10) | $48.24^{a}\pm6.47$ (44.01) | $38.52^{a}\pm2.65$ (38.29) |
| **MGG-360** | $20.33^{b}\pm1.15$ (4.62) | $24.64^{a}\pm1.44$ (29.77) | $41.19^{b}\pm5.35$ (39.93) | $45.95^{c}\pm2.68$ (42.70) | $47.54^{b}\pm4.76$ (43.61) | $57.39^{b}\pm4.78$ (49.29) | $64.08^{b}\pm6.06$ (53.24) | $46.79^{b}\pm3.43$ (43.09) |
| **PM-110** | $18.00^{ab}\pm1.00$ (4.36) | $31.53^{b}\pm1.68$ (34.17) | $35.88^{ab}\pm9.73$ (36.68) | $39.21^{abc}\pm4.38$ (38.77) | $39.21^{ab}\pm4.38$ (38.77) | $46.48^{a}\pm3.06$ (43.00) | $46.48^{a}\pm3.06$ (43.00) | $39.79^{ab}\pm3.95$ (39.07) |
| **LGG-410** | $19.33^{ab}\pm0.57$ (4.51) | $29.05^{ab}\pm4.83$ (32.58) | $37.49^{ab}\pm8.30$ (37.69) | $40.93^{abc}\pm6.58$ (39.76) | $42.51^{ab}\pm3.83$ (40.71) | $47.62^{a}\pm4.12$ (43.65) | $51.06^{a}\pm4.07$ (45.63) | $41.44^{ab}\pm4.96$ (40.00) |
| **PM-112** | $20.67^{b}\pm2.51$ (4.65) | $27.84^{ab}\pm1.54$ (31.85) | $31.44^{ab}\pm1.96$ (34.12) | $35.25^{ab}\pm3.65$ (36.42) | $35.25^{a}\pm3.65$ (36.42) | $42.78^{a}\pm5.30$ (40.85) | $46.50^{a}\pm5.70$ (43.01) | $36.51^{a}\pm2.75$ (37.11) |
| **TM-962** | $19.33^{ab}\pm1.15$ (4.51) | $27.54^{ab}\pm2.12$ (31.66) | $27.63^{a}\pm3.48$ (31.70) | $32.81^{a}\pm3.58$ (34.94) | $36.32^{a}\pm6.07$ (37.03) | $44.91^{a}\pm4.25$ (42.09) | $51.84^{a}\pm6.48$ (46.08) | $36.84^{a}\pm3.16$ (37.25) |
| **LGG-450** | $20.67^{b}\pm2.51$ (4.65) | $29.33^{ab}\pm3.68$ (32.78) | $30.92^{ab}\pm4.18$ (33.76) | $34.36^{ab}\pm7.17$ (35.82) | $37.80^{a}\pm10.17$ (37.83) | $42.55^{a}\pm7.61$ (40.70) | $50.74^{a}\pm9.22$ (45.46) | $37.61^{a}\pm6.63$ (37.72) |
| **LGG-460** | $19.33^{ab}\pm1.15$ (4.51) | $31.11^{b}\pm1.92$ (33.91) | $36.48^{ab}\pm7.33$ (37.12) | $39.81^{abc}\pm4.72$ (39.12) | $39.63^{ab}\pm0.64$ (39.03) | $41.48^{a}\pm2.56$ (40.11) | $48.52^{a}\pm6.09$ (44.17) | $39.50^{ab}\pm3.57$ (38.91) |
| **Grand Mean** | 19.27±1.59 (4.50) | 28.83±2.80 (32.47) | 34.67±6.70 (36.00) | 38.74±5.41 (38.47) | 40.23±5.31 (39.35) | 45.39±5.89 (42.36) | 50.02±7.09 (45.05) | 39.64±4.30 (38.95) |

Values in parenthesis are arc sine transformed values

Values having the same alphabet are not significantly different as per DMRT.

Based on observations on number of webbings; number of caterpillars; per cent infestation of two crops, different green gram genotypes were arranged into plant resistant groups (Table 7)

**Table 7: Categorization of green gram genotypes into resistant, moderate resistant and susceptible groups**

| | 1st crop | | | 2nd crop | | |
|---|---|---|---|---|---|---|
| **Characters** | **Resistant** | **Moderate resistant** | **Susceptible** | **Resistant** | **Moderate Resistant** | **Susceptible** |
| Number of webbings | WGG-42<br>LGG-450<br>PM-115 | LGG-460<br>LGG-407<br>PM-110<br>TM-962 | PM-112<br>LGG-410<br>MGG-360 | WGG-42<br>PM-112<br>LGG-450 | PM-110<br>LGG-460<br>TM-962<br>LGG-410 | PM-115<br>LGG-407<br>MGG-360 |
| Number of caterpillars | WGG-42<br>LGG-450<br>LGG-407 | LGG-460<br>TM-962<br>PM-110<br>PM-115 | PM-112<br>LGG-410<br>MGG-360 | WGG-42<br>LGG-450<br>PM-112<br>LGG-460 | PM-110<br>TM-962<br>LGG-410 | LGG-407<br>PM-115<br>MGG-360 |
| Per cent infestation | LGG-410<br>WGG-42<br>LGG-460 | PM-110<br>LGG-407<br>TM-962<br>LGG-450 | PM-115<br>PM-112<br>MGG-360 | PM-112<br>TM-962<br>LGG-450 | PM-115<br>LGG-407<br>LGG-460<br>PM-110 | WGG-42<br>LGG-410<br>MGG-360 |

From the different categories of green gram genotypes (Table 7), the genotypes WGG-42, TM-962 and MGG-360 that were consistent in their rankings were classified as resistant, moderate resistant and susceptible genotypes based on number of webbings per plant and number of caterpillars per plant. The observed classification was in accordance with the work done by Reddy and Hariprasad [14] who classified the blackgram genotypes *viz.*, LBG-645, LBG-791 and LBG-790 as resistant, moderate resistant and susceptible genotypes based on number of webbings per plant and total number of caterpillars per plant. These genotypes were taken for further investigation in the laboratory for confirmation of resistance that has been observed in the field condition.

## 3.2 Mechanisms of resistance in selected genotypes of green gram

It was observed that more number of *Maruca* larvae preferred the genotype MGG-360 (2.57 ± 0.79) (susceptible) which were significantly different from WGG-42 (resistant) which were preferred by few number of *Maruca* larvae (1.57 ± 0.53) (Table 8). Larval preference of genotype TM-962 (1.86 ± 0.69) (moderate resistant) were in between MGG-360 and WGG-42. The present results were in close agreement with the findings of Reddy and Hariprasad [14] who reported that the highest larval orientation of *Maruca* larvae observed in LBG-790 (susceptible genotype of blackgram) both in pods and flowers than the tolerant genotype (LBG-645).

**Table 8. Larval preference of *Maruca vitrata* on different genotypes of green gram in free- choice experiment**

| Genotypes | No. of larvae after 24 hrs |
|---|---|
| WGG-42 (Resistant) | $1.43^{a}$ ± 0.53<br>(1.18) |
| TM-962 (Moderate resistant) | $1.71^{a}$ ± 0.75<br>(1.28) |
| MGG-360 (Susceptible) | $2.57^{b}$ ± 0.83<br>(1.58) |
| Total mean | 1.90 ± 0.83<br>(1.34) |

| | |
|---|---|
| LSD | 0.77 |

Values in parenthesis are square root transformed
Values having the same alphabet are not significantly different

In case of green gram genotypes (Table 9), it was observed that more number of larvae preferred the genotype MGG-360 (2.57 ± 0.79) (susceptible) which were significantly different from WGG-42 (resistant) which were preferred by few number of *Maruca* larvae (1.57 ± 0.53). Larval preference of genotype TM-962 (1.86 ± 0.69) (moderate resistant) were in between MGG-360 and WGG-42. The study of biology on green gram genotypes revealed that the duration of the second instar larva of spotted pod borer is 3.00 ± 0.00 days, when reared on MGG-360 (susceptible) followed by 3.14 ± 0.38 days on WGG-42 (resistant) and 3.57 ± 0.53 days in TM-962 (moderate resistant) genotypes. The duration of third instar larva was 3.29 ± 0.49 days on TM-962 (moderate resistant) followed by 3.43 ± 0.53 days in MGG-360 (susceptible) and 3.71 ± 0.49 days in WGG-42 (resistant). The duration of the fourth instar larva was 2.14 ± 0.38 days on MGG-360 (susceptible) followed by 2.71 ± 0.49 days in TM-962 (moderate resistant) and 2.86 ± 0.38 days on WGG-42 (resistant). The duration of the fifth instar larva was 2.57 ± 0.53 days on MGG-360 (susceptible) (significantly different) followed by 3.43 ± 0.53 days on TM-962 (moderate resistant) and 3.71 ± 0.49 days on WGG-42 (resistant). The total duration of the larvae was 11.14 ± 1.21 days on MGG-360 (susceptible) followed by 13.00 ± 1.15 days on TM-962 (moderate resistant) and 13.43 ± 0.53 days on WGG-42 (resistant). The lowest larval weight of the third instar (0.0342 ± 0.0018 gms) was observed, when larvae were reared on WGG-42 (resistant) followed by 0.0380 ± 0.0035 gms on TM-962 (moderate resistant). Highest larval weights (0.0440 ± 0.0021 gms), were observed, when larvae were reared on MGG-360 (susceptible). The lowest larval weight of the third instar (0.0444 ± 0.0026 gms) was observed, when larvae were reared on WGG-42 (resistant) followed by 0.0459 ± 0.0031 gms on TM-962 (moderate resistant). Highest larval weights (0.0525 ± 0.0016 gms) were observed when larvae were reared on MGG-360 (susceptible). Lowest pupal weight (0.0397 ± 0.0020) were observed, when insects were reared on WGG-42 (resistant) followed by TM-962 (moderate resistant) (0.0425 ± 0.0019) and (0.0468 ± 0.0012) gms, when insects were reared on MGG-360 (susceptible). The duration of the pupa was 4.52 ± 0.5 days on MGG-360 (susceptible) followed by 5.21 ± 0.47 days in TM-962 (moderate resistant) and 5.55 ± 0.55 days on WGG-42 (resistant) genotypes. The longivity of the adults was 5.21 ± 0.52 days on MGG-360 (susceptible) followed by 5.79 ± 0.64 days on TM-962 (moderate resistant) and 6.45 ± 0.6 days on WGG-42 (resistant). The results of the findings were supported by the observations of Sonune *et al* [18] who reported that the second, third, fourth, fifth instar and mean larval durations were 2.80 ± 0.70, 2.80 ± 0.66 , 2.76 ± 0.72 , 3.60 ± 0.64 and 14.04 ± 0.97 days on green gram. The pupal weight was 0.04 ± 0.01 g according to the observations of Long *et al* [10]. Sonune *et al* [18] reported that the pupal duration was 10.84 ± 1.79 days in green gram. The results of the findings were strongly supported by the observations of Chaitanya *et al* [2] who reported that the mean longevity of the *Maruca* adult was 8.83 ± 0.82 days. Mahankuda and Tiwari [11] recorded that the total time duration required to complete larval stage of *Maruca* was 2.85±0.39 days and the pre pupation, pupation and the mean adult longevity period continued up to 2.39±0.39, 3.31±0.51 and 7.67±0.91days respectively.

**Table 9. Biology of *M.vitrata* in resistant, moderate resistant and susceptible genotypes of green gram in no-choice technique**

| Genotype | 2$^{nd}$ instar larva duration (days) | 3$^{rd}$ instar larva duration (days) | 4$^{th}$ instar larva duration (days) | 5$^{th}$ instar larva duration (days) | Larval duration (days) | 3$^{rd}$ instar larval weight (gms) | 4$^{th}$ instar larval weight (gms) | Pupal weight (gms) | Pupal duration (days) | Adult longevity (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| **WGG-42 (Resistant)** | 3.14$^{a}$ ± 0.38 | 3.71$^{a}$ ± 0.49 | 2.86$^{b}$ ±0.38 | 3.71$^{b}$ ± 0.49 | 13.43$^{b}$ ± 0.53 | 0.0342$^{a}$ ± 0.0018 | 0.0444$^{a}$ ± 0.0026 | 0.0397$^{a}$ ± 0.0020 | 5.55$^{c}$± 0.55 | 6.45$^{c}$ ± 0.6 |
| **TM-962 (Moderate resistant)** | 3.57$^{b}$± 0.53 | 3.29$^{a}$ ± 0.49 | 2.71$^{b}$ ±0.49 | 3.43$^{b}$ ± 0.53 | 13.00$^{b}$ ± 1.15 | 0.0380$^{b}$ ± 0.0035 | 0.0459$^{a}$ ± 0.0031 | 0.0425$^{b}$ ± 0.0019 | 5.21$^{b}$ ± 0.47 | 5.79$^{b}$± 0.64 |
| **MGG-360 (Susceptible)** | 3.00$^{a}$± 0.00 | 3.43$^{a}$ ± 0.53 | 2.14$^{a}$ ± 0.38 | 2.57$^{a}$ ± 0.53 | 11.14$^{a}$ ± 1.21 | 0.0440$^{c}$ ± 0.0021 | 0.0525$^{b}$ ± 0.0016 | 0.0468$^{c}$ ± 0.0012 | 4.52$^{a}$± 0.5 | 5.21$^{a}$± 0.52 |
| **Grand mean** | 3.24 ± 0.44 | 3.48 ± 0.51 | 2.57 ± 0.51 | 3.24 ± 0.7 | 12.52 ± 1.4 | 0.0387 ± 0.0048 | 0.0476 ± 0.0043 | 0.0430 ± 0.0034 | 5.1 ± 0.66 | 5.82± 0.77 |
| **LSD** | 0.42 | 0.56 | 0.47 | 0.58 | 1.14 | 0.002 | 0.002 | 0.002 | 0.12 | 0.21 |

Values having the same alphabet are not significantly different

## 3.3 Effect of plant resistance in selected genotypes of green gram to *M.vitrata* and its role in insecticide tolerance

From the table 10, it was clear that $LC_{50}$ (µl/ml) of Chlorpyriphos was less 1.39 µl/ml on *Maruca* larvae reared on resistant green gram genotype, WGG- 42 as compared to susceptible genotype, MGG-360 (1.62 µl/ml). No significant differences were observed in $LD_{50}$ values of Chlorpyriphos to *M.vitrata* larvae reared on resistant and susceptible genotypes. This probably is due to the fact on resistant genotype WGG-42, the larvae were much smaller and weighed less (Table 10 ) due to the stress imposed on them by plant resistance factor present in WGG-42. As the insects were much smaller, low amount of insecticide is needed to get 50 per cent mortality and hence low $LC_{50}$ values were recorded. The results of the observations were strongly supported by the observations of Reddy and Hariprasad [14] who reported that *M.vitrata* which is a insect pest on Blackgram shows lower $LC_{50}$ and $LD_{50}$ values for insects reared on resistant (LBG-645) than on the susceptible (LBG-790) genotype against Chlorpyriphos. Garlet *et al* [4] reported that the $LD_{50}$ values of chlorpyrifos for the resistant (Clorp-R) and susceptible (Sus) Fall Army Worm genotypes were 24.26 and 0.023 µg per larva, respectively.

**Table 10. Tolerance of larvae of *Maruca* to chlorpyriphos on resistant and susceptible genotypes of green gram**

| Genotypes | $LC_{50}$ (µL/ml) | Lower Fiducial limits | Higher Fiducial limits | $LD_{50}$ (µg/g) |
|---|---|---|---|---|
| **WGG-42 (Resistant)** | 1.39 | 1.05 | 1.78 | 36.98 |
| **MGG-360 (Susceptible)** | 1.63 | 1.07 | 1.85 | 36.85 |
| **LSD** | 0.07 | - | - | 2.32 |

## 4.Conclusion

The findings of this study confirm the significance of insect resistance genotypes in controlling the population of insect pests. Green gram genotypes WGG 42, TM 960 and MGG 360 showed resistant, moderately resistant and susceptible reaction to *Maruca* infestation. Further research on Maruca biology on selected genotypes of greengram in the laboratory to confirm the resistance ranking discovered in the field screening resulted in a similar resistance reaction to Maruca infestation. In topical bioassays with chlorpyriphos, larvae reared on resistant genotypes had lower $LC_{50}$ and $LD_{50}$ values than larvae reared on susceptible genotypes.

## 5.Abbreviations

DAS -Days After Sowing
DMRT -Duncan Multiple Range Test
HPR -Host Plant Resistance)
$LC_{50}$ - Lethal Concentation
$LD_{50}$ -Letahl Dose
RBD -Randomized Block Design
SPSS - Statistical Package for Social Sciences

## 6. Acknowledgment

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