

Screening of greengram (*Vigna radiata*) cultivars to three species of pulse beetle (*Callosobruchus* sp.)*

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Pulses (grain legumes) constitute the main source of protein in developing countries like India. Among pulse crops greengram (*Vigna radiata* (L.) Wilczek) is important and valuable food legume used in our daily diet as dietary protein. Greengram is an excellent source of carbohydrates, proteins and minerals and its protein quality is similar to or better than other legumes, such as chickpea, blackgram, peas, pigeonpea (Anisha and Prema 2008). During storage of different pulses they are liable to infestation by bruchids. Out of five known species of *Callosobruchus* from India, three are commonly infest source in stored pulses being their most important insect pests (Yadav *et al.* 2000, Jha 2002 and Khanna *et al.* 2003). Various authors reported the host suitability of chickpea cultivars to *C. chinensis* and *C. analis*. Recently Srinivasan (2008) found that 15 accessions of greengram for their resistance to *C. maculatus* under no choice condition. Hence, a study was conducted to know the relative susceptibility of eight promising cultivars of greengram to *C. maculatus*, *C. chinensis* and *C. analis* under free and force choice condition.

Eight promising cultivars of greengram (200 g each) were procured from the Pulse Laboratory, Division of Genetics, Indian Agricultural Research Institute, New Delhi and the experiment was conducted in 2008. Each cultivar was kept separately in a muslin cloth tightened with rubber band and kept in desiccator maintaining 60% relative humidity by potassium hydroxide. Insect cultures of *Callosobruchus maculatus*, *C. chinensis* and *C. analis* were maintained separately as a stock culture in a glass jar (15.5 cm × 10.5 cm) having greengram as a host. Glass jar covered with markin cloth tightened with rubber band and kept at 27±1.5°C and 60% relative humidity.

Free choice test was carried out in olfactory chamber and 10 grains were kept in a single hole and each cultivar

*Short note

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randomly replicated thrice in the chamber. Five pairs of 3–4-days-old adult insect were transferred in a central hole and fixed with lid. Like this three chambers were used which comprised nine replications. Forced choice test was carried in small Petri-dish (7.5 cm dia) where 90 grains of each cultivar were kept in separate Petri-dish and 5 pairs of adult insects (3–4-days-old) were transferred. Insects were separated after 24 hr in both (free and forced) tests. Ten grains of each cultivar in both condition were kept in a homeopathic vials plugged with cotton. These vials were kept in BOD chamber at 27±1.5 °C and 60% relative humidity. The number of eggs laid on the surface were counted and after a week number of hatched eggs were also recorded. Similar procedures were repeated in case of *C. chinensis* and *C. analis*. The adult emergence was recorded up to complete emergence. From the recorded data, growth index value was calculated from per cent emergence of adult beetle and mean development period.

Through free choice test method maximum number of eggs (4.1)/10 grains of *C. maculatus* were observed on 'PS 16' and 'Pusa 9531' and minimum on 'Pusa Baisakhi' (Table 1). All the remaining cultivars ranged between 2.2 ('PS 10') and 3.1 ('Pusa Vishal'). Maximum (61.66%) adult emergence was recorded in 'PS 10', followed by 'PS 16' (48.67). Per cent emergence of adults of other cultivars ranged between 9.25 ('Pusa Baisakhi') and 48.67 ('PS 16'). Maximum mean development period (MDP) was recorded in 'PS 10' and 'Pusa 9531' while the minimum 25 MDP were recorded in 'Pusa 9072' and 'Pusa Ratna'. Maximum growth index of 'PS 10' (0.164) was proved as highly susceptible, whereas 'Pusa Baisakhi' was found least susceptible with 0.088.

With force choice test method, maximum 8.78 eggs were laid /10 grain on 'Pusa 9531' while the minimum 2.78 eggs were laid on 'Pusa Vishal'. Other cultivars showed 3.1 ('Pusa Baisakhi') to 8.56 ('Pusa Ratna'). However, maximum (92.77%) emergence was observed in 'PS 16' (Table 1), followed by 85.2 and 85.07% in case of 'Pusa Vishal' and 'Pusa 9072'

Table 1 Mean number of eggs, emergence, per cent emergence, mean development period (MDP) and growth index (GI) of *C. maculatus* under free and forced choice condition on different cultivars of greengram

| Cultivar | No. of eggs*/ 10 grains# | | No. of emergence# | | Per cent emergence** | | MDP (days) | | Growth index | |
|-----------------|-----------------------------|---------------------|----------------------|------------------|-------------------------|------------------|-----------------|------------------|-----------------|------------------|
| | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice |
| 'PS 10' | 2.22 (1.48±0.74) | 6.56 (2.65±0.21) | 1.89 (1.41) | 4.56 (2.22) | 61.66 (53.74) | 75.97 (62.38) | 25.08 ±0.16 | 25.23 ±0.34 | 0.16 | 0.17 |
| 'PS 16' | 4.11 (2.05±0.65) | 7.11 (2.75±0.26) | 2.44 (1.58) | 6.22 (2.59) | 48.67 (29.25) | 70.01 (60.58) | 25.02 ±0.06 | 24.56 ±0.42 | 0.15 | 0.18 |
| 'Pusa 105' | 2.44 (1.58±0.68) | 6.67 (2.66±0.33) | 1.44 (1.30) | 5.11 (2.34) | 42.45 (38.81) | 92.77 (81.06) | 25.06 ±0.16 | 24.71 ±0.81 | 0.15 | 0.17 |
| 'Pusa 9072' | 2.89 (1.679±0.78) | 4.56 (2.23±0.31) | 1.67 (1.34) | 3.89 (2.07) | 42.22 (37.08) | 85.07 (73.00) | 25.00 ±0.00 | 25.00 ±0.74 | 0.15 | 0.18 |
| 'Pusa 9531' | 4.11 (1.98±0.83) | 8.78 (3.02±0.40) | 2.11 (1.47) | 6.78 (2.66) | 43.70 (37.94) | 77.64 (66.85) | 25.08 ±0.16 | 24.63 ±0.39 | 0.15 | 0.18 |
| 'Pusa Baisakhi' | 1.67 (1.44±0.34) | 3.11 (1.83±0.52) | 0.33 (0.86) | 3.44 (1.96) | 9.25 (8.922) | 52.05 (47.95) | 25.06 ±0.16 | 24.56 ±0.42 | 0.09 | 0.16 |
| 'Pusa Ratna' | 2.67 (1.66±0.64) | 8.56 (3.00±0.22) | 1.11 (1.18) | 0.33 (0.86) | 27.77 (26.78) | 77.50 (66.73) | 25.00 ±0.00 | 24.67 ±0.28 | 0.13 | 0.17 |
| 'Pusa Vishal' | 3.11 (1.77±0.69) | 2.78 (1.79±0.27) | 2.11 (1.48) | 2.44 (1.68) | 46.29 (41.26) | 85.20 (76.09) | 25.02 ±0.063 | 24.58 ±0.64 | 0.15 | 0.18 |
| SEm± | 0.23 | 0.12 | 0.20 | 0.13 | 11.09 | 7.00 | 0.04 | 1.28 | | |
| CD (P=0.05) | 0.70 | 0.36 | 0.59 | 0.38 | 33.25 | 21.00 | 0.13 | 3.85 | | |

*Average of nine replication number of 10 grains; # Data in parentheses /n+0.5; **Data in parantheses are arcsin transformed values

respectively. Minimum emergence of 52.05 % was recorded in 'Pusa Baisakhi'. Similarly, minimum mean development period of 24.56 was recorded in 'Pusa Baisakhi' showed the minimum GI of 0.161. In this condition also 'Pusa Baisakhi' was found least susceptible, while the 'PS 16' was found highly susceptible with 0-0.184 GI value *C. chinensis* with free choice test method, registered maximum 2.89 eggs/10 g on 'Pusa Vishal' while the minimum remained 0.667 eggs on 'Pusa 105'. Maximum per cent emergence (48.33 adults were recorded in 'Pusa Vishal' while minimum (5.55%) in 'Pusa 9531' (Table 2). Minimum mean development period (21.3) was recorded in 'Pusa 105' while the maximum MDP was observed in 'Pusa Ratna'. Minimum GI 0.077 was observed in 'Pusa 9531' showed least susceptible variety for *C. chinensis*, followed by 0.137 ('PS 16') with the maximum GI 0.175 in 'Pusa Vishal' which was noted as the highly susceptible cultivar.

It was recorded that *C. chinensis* with force choice test method showed maximum (5.4) eggs laid on 'Pusa Vishal' as against minimum (2.2 eggs) on 'Pusa 105' (Table 2). The maximum per cent emergence (86.01) occurred on 'Pusa 9072', followed by 'Pusa Ratna' (84.44), whereas minimum (44.25) was with 'PS 16'. Only minimum MDP (22.0) were recorded in 'Pusa 105' and 'Pusa 9531' whereas lowest growth index (0.17) could be observed with 'Pusa 16' followed by 'Pusa 9531' (0.192). Thus 'Pusa 9072' with maximum GI (0.20) emerged highly susceptible cultivar for *C. chinensis* under force choice condition.

For *C. analis* minimum eggs were recorded on 'Pusa Baisakhi' (3.22), while the maximum were on 'Pusa Vishal' (6.56) (Table 3) through free choice test method. Number of eggs laid on other cultivars ranged between 3.33 ('Pusa 9072') and 6.44 ('PS 10'). Maximum (97.77 %) emergence was in 'PS 16', followed by 'Pusa 105' (96.19) and minimum (61.66 %) was recorded on 'Pusa Baisakhi'. Cultivar 'PS 16' and 'Pusa 105' showed similar minimum mean development period (25.00 days), while the maximum (25.11) was with 'Pusa 9072' and 'Pusa Vishal'. Thus based on growth index (GI) 'Pusa Baisakhi' (0.164) showed the least susceptible cultivar of *C. analis* like *C. maculatus*. In this case 'PS 16' was showed highly susceptible cultivar of *C. analis*.

Under force choice test minimum and maximum eggs were registered on 'Pusa 9531' (6.33) and 'PS 16' (12.22) respectively. Eggs laid on other cultivars ranged between 7.78 ('Pusa 9072') and 11.22 ('Pusa Ratna'). Maximum emergence was recorded in 'Pusa 9072' (90.67%), while the minimum on 'PS 10' (68.99%). The maximum MDP was registered with 'Pusa 9531' (27.44), while the minimum was with 'Pusa 9072' (26.46). According to growth index 'PS 10' (0.155) was the least susceptible variety for *C. analis* under force choice condition, while 'Pusa 9072' (0.170) was found to be highly susceptible cultivar. This variety was highly susceptible with force choice condition of *C. chinensis*.

'Pusa Baisakhi' was found to be least susceptible out of eight cultivar for *C. maculatus* based on eggs laid, emergence

Table 2 Mean number of eggs, emergence, per cent emergence, mean development period (MDP) and growth index (GI) of *C. chinensis* under free and forced condition on different cultivars of greengram

| Cultivar | No. of eggs*/ 10 grains# | | No. of emergence# | | Per cent emergence** | | MDP (days) | | Growth index | |
|-----------------|-----------------------------|---------------------|----------------------|------------------|-------------------------|------------------|----------------|------------------|-----------------|------------------|
| | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice |
| 'PS 10' | 0.78 (1.04±0.45) | 5.11 (2.34±0.37) | 0.67 (0.98) | 4.33 (2.13) | 33.33 (30.00) | 83.70 (75.28) | 21.56 ±0.50 | 22.21 ±0.25 | 0.163 | 0.199 |
| 'PS 16' | 0.78 (1.04±0.45) | 3.67 (2.02±0.31) | 0.44 (0.89) | 1.78 (1.44) | 19.44 (16.67) | 44.25 (38.28) | 21.67 ±0.67 | 22.07 ±0.19 | 0.137 | 0.172 |
| 'Pusa 105' | 0.67 (1.04±0.31) | 2.22 (1.61±0.35) | 0.33 (0.88) | 1.89 (1.46) | 33.33 (30.00) | 74.06 (66.08) | 21.33 ±0.94 | 22.00 ±0.00 | 0.164 | 0.196 |
| 'Pusa 9072' | 1.44 (1.33±0.41) | 4.56 (2.23±0.31) | 0.78 (1.05) | 2.89 (1.80) | 31.44 (28.90) | 86.01 (75.07) | 22.00 ±0.94 | 22.07 ±0.19 | 0.157 | 0.202 |
| 'Pusa 9531' | 1.33 (1.34±0.17) | 3.33 (1.92±0.39) | 0.11 (0.76) | 2.11 (1.59) | 5.55 (5.00) | 68.31 (59.19) | 22.11 ±0.31 | 22.00 ±0.00 | 0.077 | 0.192 |
| 'Pusa Baisakhi' | 1.44 (1.32±0.47) | 2.67 (1.75±0.27) | 0.56 (0.95) | 1.56 (1.36) | 25.00 (21.67) | 77.77 (70.00) | 22.11 ±0.87 | 22.06 ±0.17 | 0.146 | 0.197 |
| 'Pusa Ratna' | 1.11 (1.22±0.36) | 5.11 (2.30±0.57) | 0.56 (0.95) | 4.33 (2.10) | 22.22 (20.00) | 84.44 (74.26) | 22.37 ±0.85 | 22.24 ±0.62 | 0.139 | 0.199 |
| 'Pusa Vishal' | 2.89 (1.65±0.744) | 5.44 (2.39±0.46) | 2.11 (1.44) | 4.89 (2.27) | 48.33 (42.31) | 77.40 (76.74) | 22.20 ±0.70 | 22.13 ±0.20 | 0.175 | 0.196 |
| SEm± | 0.16 | 0.14 | 0.15 | 0.17 | 12.70 | 8.21 | 0.26 | 0.09 | | |
| CD (P=0.05) | 0.480 | 0.42 | 0.46 | 0.51 | 38.06 | 24.62 | 0.79 | 0.28 | | |

*Average of nine replication number of 10 grains; # Data in parentheses /n+0.5; **Data in parantheses are arcsin transformed values

Table 3 Mean number of eggs, emergence, per cent emergence, mean development period (MDP) and growth index (GI) of *C. analis* under free and forced choice condition on different cultivars of greengram

| Cultivar | No. of eggs*/ 10 grains# | | No. of emergence# | | Per cent emergence** | | MDP (days) | | Growth index | |
|-----------------|-----------------------------|----------------------|----------------------|------------------|-------------------------|------------------|----------------|------------------|-----------------|------------------|
| | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice | Free choice | Forced choice |
| 'PS 10' | 6.44 (2.43±1.01) | 10.44 (3.30±0.24) | 4.33 (2.16) | 7.11 (2.72) | 90.07 (80.79) | 68.99 (59.06) | 25.10 ±0.11 | 27.39 ±0.45 | 0.179 | 0.155 |
| 'PS 16' | 3.56 (1.96±0.46) | 12.22 (3.55±0.31) | 3.44 (1.94) | 8.67 (3.02) | 97.77 (87.05) | 72.94 (60.65) | 25.00 ±0.00 | 26.63 ±0.24 | 0.183 | 0.161 |
| 'Pusa 105' | 3.78 (2.04±0.366) | 8.89 (3.06±0.18) | 3.67 (2.01) | 8.00 (2.91) | 96.19 (84.59) | 90.72 (73.03) | 25.00 ±0.00 | 26.67 ±0.29 | 0.182 | 0.169 |
| 'Pusa 072' | 3.33 (1.90±0.48) | 7.78 (2.86±0.30) | 3.11 (1.84) | 7.00 (2.72) | 74.07 (73.14) | 90.67 (78.11) | 25.11 ±0.31 | 26.46 ±0.47 | 0.171 | 0.170 |
| 'Pusa 531' | 6.11 (2.45±0.77) | 6.33 (2.59±0.37) | 5.00 (2.29) | 5.11 (2.35) | 92.22 (82.05) | 81.95 (70.41) | 25.04 ±0.13 | 27.44 ±0.25 | 0.181 | 0.160 |
| 'Pusa Baisakhi' | 3.22 (1.76±0.78) | 10.78 (3.35±0.21) | 3.00 (1.71) | 7.77 (2.87) | 61.66 (53.72) | 72.36 (59.37) | 26.70 ±0.25 | 27.00 ±0.25 | 0.164 | 0.159 |
| 'Pusa Ratna' | 4.22 (2.08±0.63) | 11.22 (3.41±0.33) | 3.89 (2.01) | 7.78 (2.87) | 83.59 (72.19) | 72.25 (61.59) | 25.10 ±0.17 | 27.10 ±0.30 | 0.176 | 0.158 |
| 'Pusa Vishal' | 6.56 (2.64±0.26) | 10.11 (3.25±0.17) | 5.56 (2.45) | 8.22 (2.95) | 86.85 (74.17) | 81.90 (67.65) | 25.11 ±0.18 | 27.17 ±0.41 | 0.178 | 0.162 |
| SEm± | 0.23 | 0.10 | 0.17 | 0.10 | 8.53 | 4.60 | 0.98 | 0.12 | | |
| CD (P=0.05) | 0.68 | 0.30 | 0.51 | 0.29 | 25.58 | 13.80 | 2.94 | 0.36 | | |

*Average of nine replication number of 10 grains; # Data in parentheses /n+0.5; **Data in parantheses are arcsin transformed values

(9.25%) and GI (0.088). Srinivasan (2008) evaluated 15 accessions of greengram under laboratory condition for their resistance to *C. maculatus* under no choice condition and he found EC 98674 and 'PLM 209' were resistant. In case of *C. chinensis* 'Pusa 9531' was least susceptible according to minimum per cent emergence (5.55) and GI (0.077) under free choice condition. But with force choice condition 'PS 16' found to be least susceptible cultivar with minimum emergence (44.25) and GI (0.171).

Similar to *C. maculatus* Pusa Baisakhi' was least susceptible according to eggs laid, adult emergence and GI values against *C. analis* with free choice condition. However, 'PS 10' was found to be least susceptible cultivar with force choice test based on emergence 68.99 and GI (0.153) value Srinivasan (2008) who tested the 15 accession of greengram for the resistant against *C. maculatus*. But these accession were different than the above mentioned cultivar, whereas in this experiment two more species of bruchid were used to identify the best cultivar amongst 8 varieties. 'Pusa Baisakhi', 'PS 10' and 'PS 16' were found to be resistant against *C. maculatus*, *C. chinensis* and *C. analis*. Therefore, these varieties should be incorporated for future pulse storage programme.

SUMMARY

A study was conducted for the eight genotypes of greengram for their susceptibility to pulse beetle, i.e. *Callosobruchus maculatus*, *C. chinensis* and *C. analis* under storage condition.

To assess the host suitability, different parameters, viz

number of eggs on grain surface, per cent emergence, mean development period (MDP) and growth index of all the three species under free and forced choice condition were studied. Out of eight cultivars, 'Pusa Baisakhi' was found least susceptible for *C. maculatus* under both condition and *C. analis* under free choice condition. Under force choice condition 'PS 10' variety registered least susceptible to *C. analis*. However, in case of *C. chinensis* 'Pusa 9531' was found least susceptible followed by 'Pusa Ratna' in free choice condition and 'PS 16' was showed least susceptible, followed by 'Pusa 9531' in force choice condition.

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