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Research Article

TO ASSESS THE RELATIVE DAMAGE/PREFERENCE OF SOME CHICKPEA VARIETIES (*Cicer arietinum*) FOR MANAGEMENT OF PULSE BEETLE *Callosobruchus chinensis* (Coleoptera: Bruchidae) IN STORED CONDITION

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Abstract: The pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) is a one of the major pests infesting stored pulses and is distributed worldwide. Experiments were conducted to study the assess the relative damage/preference of varietal preference of *C. chinensis* L. to six different varieties of chickpea seeds *i.e*., JG-16, JG-63, JG-5, JGG-1, JGK-2 and JGK-3. In each replication, 100 healthy seeds of each variety of gram was kept separately in small plastic dishes, which was kept equidistant from one another in the peripheral part of the big circular glass trough. The results indicated that among all 6 varieties of gram differed significantly for ovipositional preference by *C. chinensis*. The number of eggs laid per 100 seeds of gram varied from 1.00 to 82.00. The JG-16 (1.00), JG-5 (1.33) and JG-63 (1.33) recorded significantly lowest number of eggs, were on par with each other and were significantly superior over all other varieties indicating that these varieties were least preferred by the pulse beetle for oviposition. On the other hand, more number of eggs was laid on JGK-2 (82.00) which was significantly different from other varieties JGK-3 (79.67) and JGG-1 (75.33) indicating that these varieties were mostly preferred for oviposition.

Keywords: *Callosobruchus chinensis*, Preference ,oviposition, Chickpea varieties

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Introduction

Pulses play a pivotal role in the diet of common people of India. These are also called “poor man’s meat” since they are rich source of protein (20-40%) and are fairly good sources of thiamin, niacin, calcium and iron for the under privileged people who cannot afford animal proteins. Pulses in developing countries suffer high qualitative and quantitative losses from the attack of pulse beetle, *Callosobruchus chinensis* L., a major pest of pulses in storage. They cause damage to pulses both inthe field and storage, but infestation is more crucial in stored condition. The adult beetles do not cause damage to the pulse grains by feeding but they mate and oviposite on grains and contaminate by excreta. Adult *Callosobruchus* beetles do not feed on stored produce, and are very short-lived, usually no more than 12 days under optimum conditions. During this time the females lay many eggs (*C. chinensis* up to 70), although oviposition may be reduced in the presence of previously infested seeds [1]. The optimum temperature for oviposition is high in C. maculatus, about 30-35°C and low in *C. chinensis*, 23°C. The eggs are domed structures with oval, flat bases. When newly laid they are small, translucent grey and inconspicuous. Eggs hatch within 5-6 days of oviposition. The pulse beetle showed a definite intra-varietal response for oviposition. Seeds with rough surface were less preferred for oviposition, where the percentage of grains infested with eggs and the number of eggs laid per grain were minimum compared to the grains with smooth surface. Fumigation beingthe most effective method cannot be practiced in ourvillages because the storage structures are not airtight and these are mostly built inside the residential areas [2-5].

Materials and Methods

The present study ‘to assess the relative damage/preference of some Chickpea varieties (*Cicer arietinum*) for management of pulse beetle *Callosobruchus chinensis* (Coleoptera: Bruchidae) in stored condition; was conducted under laboratory conditions at Department of Zoology, Sri Satya Sai University of Technology and Medical Sciences, Sehore, 466 001, M.P., India during 2015-16 and 2016-17. The varietal preference of *C. chinensis* L. to six different varieties of chickpea seeds *i.e*., JG-16, JG-63, JG-5, JGG-1, JGK-2 and JGK-3. In each replication, 100 healthy seeds of each variety of gram was kept separately in small plastic dishes, which was kept equidistant from one another in the peripheral part of the big circular glass trough. Ten pairs of test insects were used for each replication and released centrally in to each glass trough. The open end of the troughs was then covered with muslin cloth, secured with rubber bands. The troughs then kept in the wire – gauge cages to avoid rat nuisance. The experiment was conducted under room conditions having an average temperature of 33.35"c and relative humidity 77.70 percent in the first year and 32.60"C and 78.80 percent relative humidity in the second-year experiment. The moisture percentages ranged from 9.76 to 11.22 percent in different varieties before the release of freshly emerged adult beetles were released. Each treatment was replicated four times. Different varieties taken under study were as [Table-1].[6-10] The experiment was repeated next year also for confirmation. Observations were recorded in each treatment for the following parameters

Mean oviposition: Three days after release of adult insects, the number of eggs laid on the surface of the seeds were counted with the help of hand lens and the mean number of eggs laid was calculated.

Mean percentage of survival: The F1 progeny emerged from each treatment at 60 days after release (DAR) were counted and adult beetles were discarded daily to avoid further mating and egg laying. The process was continued till they completely cease to emerge. The mean adult emergence was worked out by pooling the data.

Mean seed damage: The number of damaged seeds in each replication was counted at 60 DAR and converted to percent insect infestation by using the following formula.

$$Per\ cent\ insect\ infestation = \frac{Number\ of\ seeds\ with\ bored\ holes}{Total\ number\ of\ seeds\ observed} \times 100$$

Table-1 Phenotypic characters of different varieties of Chickpea

SN	Varieties	Categories	Colour	Size
1	JG-16	Desi	Brown	22-25 g
2	JG-63	Desi	Brown	17 g
3	JG-5	Gulabi	Gulabi	14 g
4	JGG-1	Gulabi	Gulabi	13-15 g
5	JGK-2	Kabuli	White	45 g
6	JGK-3	Kabuli	White	46 g

Result and Discussion

To study the relative preference of *C. chinensis* on 6 varieties of gram *viz.*, JG-16, JG-63, JG-5, JGG-1, JGK-2 and JGK-3 were selected. Ten pairs of newly emerged adults were released on every 100 seed of each variety. The observations were recorded for the extent of mean oviposition, percentage survival and seed damage on per 10 randomly selected seeds from each treatment and replications. The experiment was conducted under controlled temperature and humidity conditions in both the year. By this method it was easy to find out the host preferred under different varieties of gram.

Fecundity (no.)

The results revealed that 6 varieties of gram differed significantly for ovipositional preference by *C. chinensis*. The number of eggs laid per 100 seeds of gram varied from 1.00 to 82.00. The JG-16 (1.00), JG-5 (1.33) and JG-63 (1.33) recorded significantly lowest number of eggs, were on par with each other and were significantly superior over all other varieties indicating that these varieties were least preferred by the pulse beetle for oviposition. On the other hand, more number of eggs was laid on JGK-2 (82.00) which was significantly different from other varieties JGK-3 (79.67) and JGG-1 (75.33) indicating that these varieties were mostly preferred for oviposition.

There is appreciable variation in ovipositional preference on different varieties of gram which could be attributed to several factors. The results are in agreement with the findings of Salunkhe and Jadhav, (1982) reported that variety Sel-436 was the least preferred (1.00 egg/50 g) for oviposition while the kabuli gram variety L-550 was the most preferred (825 eggs/50 g) [11]. The least adult emergence recorded in the varieties, Palem-2, NS/04/124, SKN-88, KSAS/06/391, NSB-10, NS/05/103 and NS/05/93 could be due to less ovipositional preference by the bruchids on these varieties.

Adult emergence (no.)

The mean number of adults emerged from 100 seeds of gram varieties varied from 1.00 (JG-16) to 35.67 (JGG-1). The varieties JG-16, JG-63 and JG-5 recorded the least adult emergence *i.e.*, 1.00, 1.33, and 1.33, respectively (Fig. 4.2). These varieties were found to be on par with each other and were significantly superior over all other varieties. Highest adult emergence was observed in the variety, JGG-1 (35.67) and is significantly different from JGG-3 (30.33) and JGG-2 (13.00). The least adult emergence recorded due to less ovipositional preference by the bruchids on these varieties. As seen from the present investigation, the seed infestation by the pulse beetle varied significantly and ranged from 0.00% in non-preferred varieties *i.e.*, Palem-1, AK-21 and NSB-27 to 52.67% in preferred accession, NS/05/42. Low fecundity and adult emergence with zero index of susceptibility might be the contributory factors for low seed infestation in non-preferred varieties. Salunkhe and Jadhav, (1982) screened twenty varieties of gram, *Cicer arietinum* against *C. maculates* and reported that the variety Sel-436 was the least preferred (1.00 egg/50 g) for oviposition while the kabuli gram variety L-550 was the most preferred (825 eggs/50 g). On the basis of percent grain infestation, as well as percent loss in weight, the variety Sel-436 was found to be resistant (0.76% infestation and 0.28% loss) while L-550 was the most susceptible.

Insect damage (%)

Seeds of six gram varieties damaged by the C. chinensis varied from 0.00 to 52.67% (Table 2). There was no insect damage in JG-63. Further these varieties recorded low fecundity and adult emergence. Lowest damage was recorded in JG-16 (6.33%), was statistically on par with each other and significantly superior over other varieties. Low progeny production on the varieties, JG-63 might have led to negligible insect damage. The variety JGG-1 recorded significantly highest damaged seeds (52.67%) followed by JGK-3 (47.33%).

The other varieties with high % insect damage are JGK-2 (35.33%) and JG-5 (23.33%) which was found to be on par with each other (Fig. 4.3). As seen from the present investigation, the seed infestation by the pulse beetle varied significantly and ranged from 0.00% in non-preferred varieties JG-63 to 52.67% in preferred variety, JGG-1. Low fecundity and adult emergence with zero index of susceptibility might be the contributory factors for low seed infestation in non-preferred varieties. Coefficients of phenotypic and genotypic variations were highly positively correlated with damaged seeds and emergence holes. So, resistance to post-harvest insect attacks like *C. Chinensis* is therefore attributed to the interrelated component factors of antibiosis and non-preference. From the foregoing discussion, it could be concluded that the food consumed by the larva varied with grain host, perhaps owing to the differences in the chemical constitution of the genotypes. Many authors reported differences in susceptibility to bruchid attack among genotypes of chickpea, suggesting the use of resistant cultivars as a method to avoid infestation during storage. The tests conducted by Kashiwaba, *et al.*, (2003) revealed that chemical compound contained in the cotyledon of bean had an inhibitory effect on the growth of the bruchid species [12]. The results also indicated that the chemical in bean cotyledon was most effective against *C. chinensis*. The variation in different parameters may be due to genetic factors, possible presence of biochemical content of seeds such as antibiotics, tannin content, trypsin inhibitor, phenol content *etc.* Based on the present investigation, chickpea genotypes CH-52/02 and B-8/03 deserve special consideration and may be recommended for relatively longer storage as these were found resistant against pulse beetle. In the past, a reasonable number of germplasm varieties have been collected, but still more explorations are needed to achieve the goal of long-term and sustainable pest management strategies with minimal environmental impacts. Resistance is a heritable trait of a plant that lessens insect damage and some traits that are absent in germplasm collections need to be created either through induced mutation or through interspecific hybridization [13-25].

Table-2 Biological parameters of the pulse beetle, *C. chinensis* in Chickpea varieties

Variety	Eggs laid/100 Seeds(no.)**	Adult Emergence (no.)**	Insect Damage(%)*
JG-16	1.00(1.22)	1.00(1.25)	6.33(14.51)
JG-63	1.33(1.34)	1.00(1.22)	0.00(4.05)
JG-5	1.33(1.34)	1.33(1.34)	23.33(30.34)
JGG-1	75.33(8.70)	35.67(5.97)	52.67(56.04)
JGK-2	82.00(9.07)	13.00(3.73)	31.33(39.52)
JGK-3	79.67(8.94)	30.33(5.51)	47.33(43.40)
SEm±	0.22	0.15	1.55
CD (5%)	0.63	0.44	4.36

** Values in the parentheses are angular transformed values*

*** Values in the parentheses are square root transformed values*

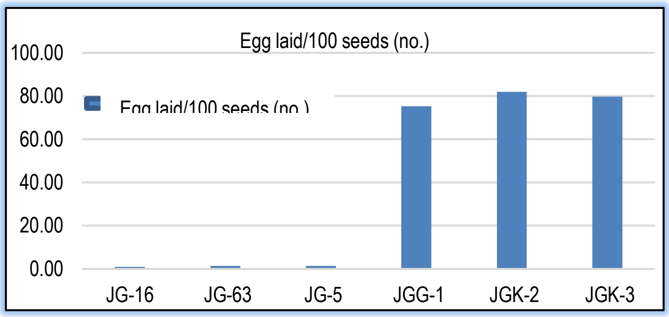

Fig-1 Egg laying of *C. chinensis* on selected gram varieties.

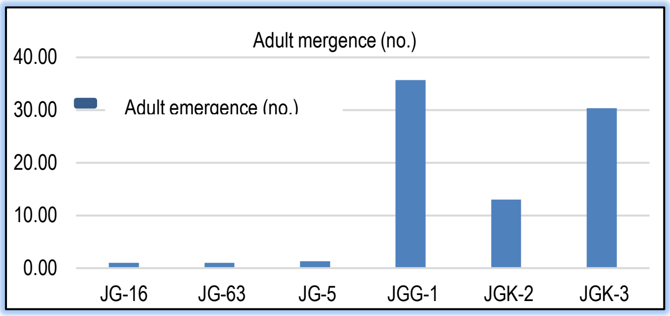

Fig-2 Adult emergence of *C. chinensis* on selected gram varieties.

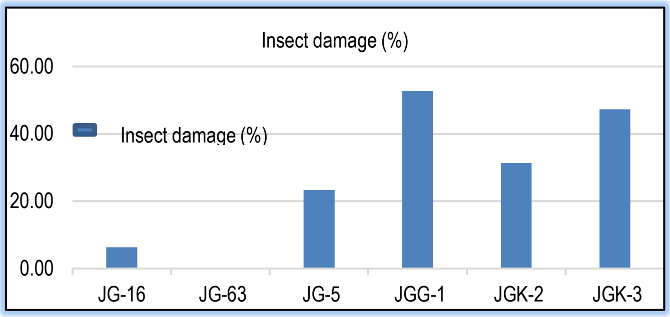

Fig-3 Percent damage of *C. chinensis* on selected gram varieties.

Conclusion

The varietal preference of *C. chinensis* L. to six different varieties of chickpea seeds *i.e*., JG-16, JG-63, JG-5, JGG-1, JGK-2 and JGK-3. The number of eggs laid per 100 seeds of gram varied from 1.00 to 82.00. The JG-16 (1.00), JG-5 (1.33) and JG-63 (1.33) recorded significantly lowest number of eggs, were on par with each other and were significantly superior over all other varieties indicating that these varieties were least preferred by the pulse beetle for oviposition. The varieties JG-16, JG-63 and JG-5 recorded the least adult emergence *i.e*., 1.00, 1.33, and 1.33, respectively. There was no insect damage in JG-63. Further these varieties recorded low fecundity and adult emergence. Lowest damage was recorded in JG-16 (6.33%), was statistically on par with each other and significantly superior over other varieties. Low progeny production on the varieties, JG-63 might have led to negligible insect damage. The variety JGG-1 recorded significantly highest damaged seeds (52.67%) followed by JGK-3 (47.33%). The other varieties with high % insect damage are JGK-2 (35.33%) and JG-5 (23.33%) which was found to be on par with each other.

Application of research: Research is applicable for farmers of the state for minimizing pulse beetle damage in storage condition and also applicable for understanding the preference of chickpea varieties.

Research Category: Oviposition preference of chickpea varieties.

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References

[1] Chavan P. D., Yeshbir Singh and Sing, S. P. (1997) *Indian Journal of Entomology*, 59(3),295-303.
[2] Howe R. W. and Currie J. E.(1964) *Bulletin of Entomological Research*, 55(3),437-477.
[3] Deshpande V.K. Makanur B., Deshpande S.K., Adiger S., Salimath P.M. (2011) *Plant Archives*, 11(2), 723-731
[4] Ahmed K., Khalique F., Afzal M., Tahir M and Malik B.A. (1989) *Journal of Stored Products Research*, 25 (2), 97-99.
[5] Ahmed K., Khalique F., Khan I.A and Malik, B.A. (1993) *Pakistan Journal of Scientific and Industrial Research*, 36, 96-98.
[6] Ali A., Aftab M. and Tufail M.(1991) *Pak. J. Agric. Res*., 12(4), 90-94.
[7] Anandhi P., Varma S. and Sarvanan L. (2008) *J. of Insect Science (Ludhiana)*, 21, 1, 40-43.
[8] Ashraf M., Sohail A., Akhtar M. and Ali A. (1991) *J. Agric. Res*., 29(1), 81-86.
[9] Bellows T.S. (1982) *J. Anim. Ecol*., 51, 597-623.
[10] Biswas N. P. and Biswas A. K. (2005) *Journal of Interacademicia*, 9(3), 448-450.
[11] Salunkhe D.K., Jadhav S.J., Kadam S.S., Chavan J.K. (1982) *Crit Rev Food Sci Nutr*.,17(3),277-305.
[12] Kashiwaba, et al., (2003) *Journal of Economic Entomology*, 96(1),207-13.
[13] Chakraborthy S., Chaudhari N and Senapti S.K. (2004) *Annuals of Plant Protection Science*, 12 (1), 48-50.
[14] Choudhury B.S and Pathak S.C. (1989) *Indian Journal of Plant Protection*, 17, 47-51.
[15] Edward Y.S.J.T. and Gunathilagaraj K. (1994) *J. Entomol. Res*.,18(3), 241-247.
[16] Giga D.P. and Smith R. H. (1981) *App. Ecol*., 18,755-776.
[17] Girish G. K. (l974) *Bull. Grain Technology*,12 (2), 113-116.
[18] Girish G.K.(l974) *Bull. Grain Technology*, 12(2), 113-116.
[19] Gupta D.S and Mishra R.C. (1970) *Bulletin of Grain Technology*, 8, 14-17.
[20] Jha A.N. (2002) *Ind. J. Entomol*.,64(4): 434-437.
[21] Manohar S. S. and Yadava S. R. S. (1990) *Indian Ent*., 52(2), 180-186.
[22] Parsai S.K., Shaw S.S., Despande R.R., Verma R.S., Badaya A.K. and Mandloy K.C. (1990) *Indian J. pulse Res*., 3(1), 61-65.
[23] Rani, C.S and Lakshmi, K.V. (2004) *Pest Management and Economic Zoology*, 12 (2), 123-129.
[24] Singal S.K. (1987) *Bulletin of Grain Technology*, 25 (3), 235-239.
[25] Singh V.N., Pandey N. D. and Singh Y. P.(1995) *Ind. J. Entomol*., 57(2),77-82.