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ELUCIDATING THE HOST PREFERENCE BY THE PULSE BEETLE *CALLOSOBRUCHUS CHINENSIS* (L)

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ABSTRACT

***Callosobruchus chinensis* (Bruchidae: Coleoptera) known as pulse beetle is a serious pest of pulses causing economic losses. The present work reports the effect of pulses on life cycle parameters (oviposition, emergence, longevity, total development period) of *Callosobruchus chinensis* (L.), and also on the nutritional loss incurred by it. Grains of seven pulses viz. *Vigna radiata* (green gram), *Vigna aconitifolia* (moth bean), *Cicer arietinum* (desi chickpea), *Vigna unguiculata* (cowpea), *Cajanus cajan* (pigeon pea), *Vigna mungo* (black gram) and *Pisum sativum* (yellow pea) were used as host with three replications. The results exhibit alterations in the developmental period as it was recorded least in green gram (23± 0.58 days) and maximum in peas (42± 1 days). The number of eggs were maximum on pea (310± 2) and least in moth (180± 2). Maximum longevity was recorded on green grams (16 days) and least on pea (9± 1 days). A significant correlation between weight loss and adult emergence was observed. Loss of nutritional content like protein and carbohydrate was significant.**

Key words: *Callosobruchus chinensis, Vigna radiata, Vigna aconitifolia, Cicer arietinum, Vigna unguiculata, Cajanus cajan, Vigna mungo, Pisum sativum,* oviposition, developmental period, emergence, longevity, nutrition, protein, carbohydrate

Agriculture contributes about 14% to the GDP of India and about 11% of its total exports (Jha et al., 2015). A large-scale loss is occurring in agriculture at post-harvest such as storage transport, retailing and processing. A study measuring crop losses has revealed a loss of cereals (3.9% - 6%), pulses (4.3%-6.1%), oilseeds (2.8%-10.1%), Fruits (5.8%-18.1%) and vegetables (6.9%-13%) during harvesting, post-harvest activities, handling and storage (Jha et al., 2015). Insects are accountable for the deterioration of stored grains, and have been reported for about a yearly loss of 30% (Adu et al., 2014; Kumar and Kalita, 2017). *Callosobruchus chinensis* i.e., pulse beetle is a cosmopolitan and a serious pest of green gram, black gram, cowpea, red gram and chickpea and 32-64% loss in cowpea is due to *C. chinensis* (Duan et al. 2014). Jaiswal et al. (2018 and 2019) reported around 60% loss in weight of the pulses due to pulse beetle. Till date the biology of *C. chinensis* has been explored on chick pea (Chandel and Bhaudaria, 2015; Rana et al., 2020), green gram (Devi and Devi, 2014; Kumari et al., 2020; Gopi and Singh 2020), black gram (Dalal et al., 2020), cowpea (Augustine and Balikai, 2018), moth bean (Meghwal and Singh 2005) and multiple hosts (Patel et al., 2005; Hosamani et al., 2018; Jaiswal et al., 2018 & 2019; Mehta and Negi, 2020). Due to differences in the physical characteristics of the host, the type of host has a considerable impact on the insect's development. The present study aims to decipher some hosts on the development preference by *C. chinensis* under laboratory conditions.

MATERIALS AND METHODS

Pulse beetle, *C. chinensis* for its biology was studied under laboratory conditions at the Zoology Department, The Maharaja Sayajirao University of Baroda. The stock cultures of *C. chinensis* was collected from the warehouses of Vadodara, and culture was acclimatized in the laboratory conditions. Identity of species was confirmed using standard taxonomic keys (Raina, 1970; Harde, 1984). From the stock, 50 pairs of adults of length 3-4 mm were introduced into 250 g of different pulses in plastic jars covered with mesh lids and were allowed to mate, and oviposit. The cultures were kept under 26^0-28^0C and 60-70% RH, and 12-hour photo period. Cultures were observed daily until new progenies emerged. The pure culture from the fifth generation was removed and was used in all further

experiments. Ten pairs freshly emerged (up to 24 hrs) adults were introduced in 50 g pulses viz. green gram, moth bean, desi chickpea, cowpea, pigeon pea, black gram and yellow pea kept in plastic jars covered with mesh lids. These were compared with the control group having only grains for each group. These jars were maintained at 26^0-28^0C, 60-70% RH and 12-hour photo period, and the adults were allowed to mate till the ten pairs died, whole set up was replicated three times (Jaiswal et al., 2018; 2019; Nisar et al., 2021). Cultures were monitored and the developmental period i.e., from eggs to adults was recorded with the overall emergence period of the adults and their longevity. Difference between the loss in weight and nutritional content of the grains exposed to pulse beetle and its control group was calculated. Total carbohydrates estimation was determined by DNSA method, while the total protein content was estimated by Bradford method (1976). The data was analysed using one-way ANOVA (α=0.05 and *p<0.05) using Graph Pad Prism software version 6.

RESULTS AND DISCUSSION

Life cycle of insects in general and pest in particular depends on the type of food (Singh et al., 2013; Mason et al., 2016). In the present study the life cycle was found to vary according to the host. However, the life cycle was found to be in the range of 25-32 days. Numbers of eggs were maximum on pea 310± 2 (p<0.01) and least on moth bean 180± 2 (p<0.05), Mebarkia et al. (2009) and Padmasri et al. (2017) reported that egg laying depends on softness or hardness of the grain. Adebayo and Ogunleke (2016) reported that increase in the length and width leads to high oviposition activity as observed in the present study (Fig. 1); maximum egg laying activity was observed on pea which have more hardness and surface area. The minimum egg laying activity was recorded on moth bean followed by green gram, as these both grains are almost similar in size so much difference was not observed. Total development period (p<0.01) was in the range of 23 to 32 days; minimum development period was reported in green gram followed by cow pea. Similar finding was reported by Radha and Sushila (2014), Hosamani et al., (2018) and Jaiswal et al. (2019). Development period in chick pea was in a range of 28± 0.35 days and this was almost in the range given by Swella and Mushobozy (2009) Kamble et al. (2016) and Ahmad et al. (2017). Maximum adult emergence was observed in green gram 120± 2 followed by cow pea and least in pea 60± 1, and those finding are in accordance with those of Deeba et al. (2006) and Chandel and Bhaudaria (2015). The drop

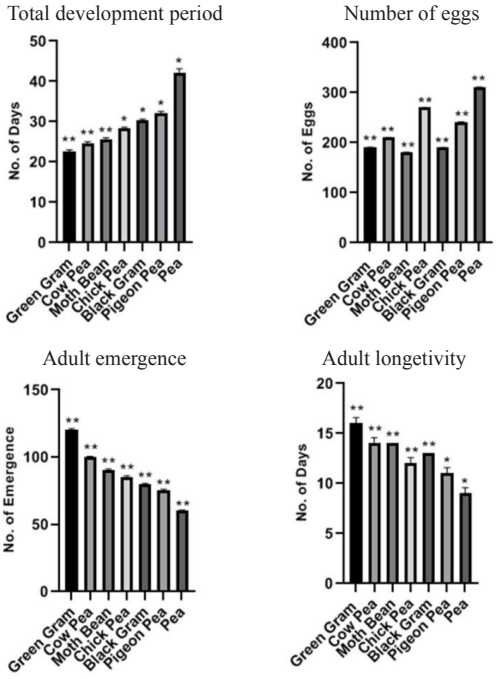

Fig. 1. Lifecycle *C. chinensis*

in adult emergence in pea could be because of the low hatchability of eggs due to hard seed coat (Padmasri et al., 2017). The significant difference (p<0.01) was recorded in the longevity of adult *C. chinensis* reared on different host where maximum longevity was recorded in green grams (Fig. 1). The present findings are in agreement with Hosamani et al., (2018) and Mehta and Negi (2020).

Additionally, loss in weight of grains also altered significantly (Fig. 2); where the highest was seen in green gram 11.4± 0.5g (p<0.01), and least with pea 6.5± 0.5g (p<0.05). Gupta and Apte (2016) and Bharathi et al. (2017) reported maximum weight loss due to *C. maculatus* also Jaiswal et al. (2019) reported maximum loss in chick pea and green gram by *C. chinensis*. The nutrition content was also analyzed and the results obtained revealed that there was a significant (p<0.01)

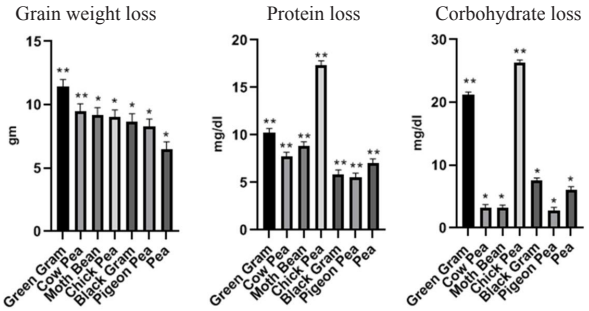

Fig. 2. Losses by *C. chinensis*
Significant level *(p<0.05); **(p<0.01)

decrease of carbohydrates and protein in infested grain. The loss of carbohydrates was highest in chickpea 27.29± 0.82 mg/ dl and least 3.3± 0.4 mg/ dl in pigeon pea ($p<0.05$). The reduction in carbohydrates observed in the chickpea followed by green gram and least in pigeon pea, is almost parallel with the rate of infestation. It was observed that protein content also got reduced, where maximum loss was observed in chick pea (17.48 ± 0.8 mg/dl) and least loss in pigeon pea (4.84± 0.5 mg/dl) ($p<0.05$). Losses in nutritional values, such as protein content, are mainly attributed to storage insect pests, which preferentially feed on grain embryos (Taddese et al., 2020). These observations are in agreement of previous studies by Thakkar and Parikh (2018) who reported nutritional loss by *Sitophilus oryzae* when exposed to different stored grains.

The present study on elucidating the host preference by *C. chinensis* reports that total egg count, total development period, adult emergence, adult longevity, weight loss was maximum in green gram also a good amount of nutritional loss was recorded in green grams. Thus, from the present study it can be concluded that for laboratory, green grams are the suitable host for mass rearing of pulse beetle.

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AUTHOR CONTRIBUTION STATEMENT

PS, PP and PP* designed and conceptualized the study. PS performed the experimental work. PS and PP analyzed the data. PS and PP wrote the draft manuscript. PS, PP and PP* reviewed and revised the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

REFERENCES

Abass A B, Ndunguru G, Mamiro P, Alenkhe B, Mlingi N, Bekunda M. 2014. Post-harvest food losses in a maize-based farming system of semi-arid savannah area of Tanzania. Journal of Stored Products Research 57: 49-57.

Adebayo R A, Ogunleke O M. 2016. Influence of seed size on the performance of *Callosobruchus maculatus* in four cowpea varieties. International Journal of Agricultural Science and Food Technology 2: 164-168.

Adu G B, Abdulai M S, Alidu H, Nustugah S K, Buah S S, Kombiok J M, Etwire, P M. 2014. Recommended production practices for maize in Ghana. CSIR-AGRA Maize production guide. pp. 1-18.

Ahmad M A, Khan M S, Agnihotri M. 2017. Evaluation of resistance in different chickpea varieties to *Callosobruchus chinensis* Linnaeus (Coleoptera: Bruchidae) under Linnaeus conditions. The Bioscan 12: 1897-1901.

Augustine N, Balikai R A, Deshpande S K. 2018. Varietal screening and biochemical basis of resistance in cowpea against pulse beetle, *Callosobruchus chinensis* (L.) in storage. Journal of Experimental Zoology India 21(2): 1151-1154.

Bharathi T D, Krishnayya P V, Madhumathi T. 2017. Comparative studies on the susceptibility of different grains to pulse beetle, *Callosobruchus maculatus*. International Journal of Environmental Science and Technology 6: 308-318.

Bradford M M. 1976. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. Analytical biochemistry 72(1-2): 248-254.

Campbell J F. 2012. Influence of seed size on exploitation by the rice weevil, *Sitophilus oryzae*. Journal of Insect Behaviour 15: 429-445.

Chandel B S, Bhadauria D S. 2015. Assessment of resistance to the attack of pulse beetle, *Callosobruchus chinensis* (Fabricius) in chickpea genotypes on the basis of various physical parameters during storage. Journal of Entomology and Zoology Studies 3(2): 160-165.

Dalal P L, Dangi N L, Mahla M K, Ahir K C, Jat R. 2020. Biology of pulse beetle, *Callosobruchus chinensis* (L.) on stored black gram, *Vigna mungo* (L.). Journal of Entomology and Zoology Studies 8(5): 1798-1800.

Deeba F, Sarwar M, Khuhro R D. 2006. Varietal susceptibility of mungbean genotypes to pulse beetle, *Callosobruchus analis* (Fabricius) (Coleoptera: Bruchidae). Pakistan Journal of Zoology 38: 265-268.

Devi M B, Devi N V. 2014. Biology and morphometric measurement of cowpea weevil, *Callosobruchus maculatus* Fabr. (Coleoptera: Chrysomelidae) in green gram. Journal of Entomology and Zoology Studies 2(3): 74-76.

Duan C X, Li D D, Sun S L, Wang X M, Zhu Z D. 2014. Rapid development of microsatellite markers for *Callosobruchus chinensis* using Illumina paired-end sequencing. PLoS One 9(5): e95458.

Gopi N, Singh K I. 2020. Biology and varietal preference of pulse beetle, *Callosobruchus chinensis* L. on stored green gram. Journal of Entomology and Zoology Studies 8(5): 582-584.

Gupta S, Apte S D 2016. Relative varietal preference of *Callosobruchus maculatus* (Fab.) in different green gram varieties (free choice test). Annals of Biological Research 7: 1-3.

Harde, K W. 1984. A field guide in colour to beetles, Octopus Books, London, 334 pp.

Hosamani G B, Jagginavar S B, Karabhantanal, S S. 2018. Biology of pulse beetle *Callosobruchus chinensis* on different grains. Journal of Entomology and Zoology Studies 6(4): 1898-1900.

Jaiswal D K, Raju SVS, Kumar D, Vani V M 2018. Studies on biology of pulse beetle, *Callosobruchus chinensis* (L.) on stored chickpea under laboratory conditions. Journal of Pharmacognosy and Phytochemistry 7(6): 464-467.

Jaiswal D K, Raju S V S, Vani V M, Sharma K R. 2019. Studies on life history and host preference of pulse beetle, *Callosobruchus*

chinensis (L.) on different grains. Journal of Entomological Research 43(2): 159-164.

Jha S N, Vishwakarma R K, Ahmad T, Rai A, Dixit A K. 2015. Assessment of quantitative harvest and post-harvest losses of major crops and commodities in India. Ministry of Food Processing Industries (Govt. of India), ICAR-CIPHET, Ludhiana. pp. 64-67.

Kamble S M, Bagde A S, Patil R R. 2016. Growth and development of *C. chinensis* L. on different varieties of chickpea. Advancements in Life Sciences 5:4472-4476.

Kumar D, Kalita P. 2017. Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries. Foods 6(1) 8: 1-22.

Kumari, S, Yadav S S, Rolania K, Dhanda S. 2020. The biology of pulse beetle, *C. chinensis* on stored mungbean. Journal of Entomology and Zoology Studies 8(3): 1200-1203.

Mason-D'Croz D, Vervoort J, Palazzo A, Islam S, Lord S, Helfgott A, Lipper L. 2016. Multi-factor, multi-state, multi-model scenarios: exploring food and climate futures for Southeast Asia. Environmental Modelling and Software 83: 255-270.

Mebarkia A, Guechi A, Mekhalif S, Makhlouf M. 2009. Biochemical composition effect of some cereal species on the behaviour of *Sitophilus granarius* L. and *Rhyzopertha dominica* F. species in semi-arid zone of Setif, Algeria. Journal of Agronomy 8: 60-66.

Meghwal H P Singh V. 2005. A study of the biology of pulse beetle, *Callosobruchus chinensis* (Linn.) on moth bean, *Vigna aconitifolia* (Jacq.) Marechal. Indian Journal of Entomology 67: 334-335.

Mehta V, Negi N. 2020. Biology of pulse beetle *Callosobruchus chinensis* (L.) on three grains. Indian Journal of Entomology 82(4): 631-632.

Nisar M S, Haq I U, Ramzan H, Aljedani D M, Qasim M, Islam W, Khan K A. 2021 Screening of different legumes for the developmental preference of *Callosobruchus maculatus* (Bruchidae: Coleoptera). International Journal of Tropical Insect Science 41(4): 3129-3136.

Padmasri A, Srinivas C, Vijaya Lakshmi K, Pradeep T, Rameash K, Anuradha Ch. Anil B. 2017. Management of rice weevil (*Sitophilus oryzae* L.) in maize by botanical seed treatments. International Journal of Current Microbiology and Applied Sciences 6(12): 3543-3555.

Patel V K, Chaudhuri N, Senapati S K. 2005 Biology of pulse beetle (*Callosobruchus chinensis* Linn.) as influenced by feeding of different grain pulses. Agricultural Science Digest 25: 254-256.

Radha R, Susheela P. 2014. Studies on the life history and ovipositional preference of *Callosobruchus maculatus* reared on different pulses. Research Journal of Animal, Veterinary and Fishery Sciences 2: 1-5.

Raina, A. K. 1970. *Callosobruchus* spp. infesting stored pulses (grain legumes) in India and comparative study of their biology. Indian Journal of Entomology 32(4): 303-310.

Rana D K, Mishra S P, Vishal A, Katlam B P, Jaba J, Sathish, K. 2020. Biology and Morphometrics of Pulse Beetle, *Callosobruchus chinensis* (L.) on Chickpea. International Research Journal of Pure and Applied Chemistry 21(23): 161-165.

Singh R P, Prasad P V, Reddy K R. 2013. Impacts of changing climate and climate variability on seed production and seed industry. Advances in Agronomy 118: 49-110.

Swella G B, Mushobozy D M K. 2009. Comparative susceptibility of different legume seeds to infestation by cowpea bruchid *Callosobruchus maculatus* (F.) (Coleoptera: Chrysomelidae). Plant Protection Science 45: 19-24.

Taddese M, Dibaba K, Bayissa W, Hunde D, Mendesil E, Kassie M, Tefera T. 2020. Assessment of quantitative and qualitative losses of stored grains due to insect infestation in Ethiopia. Journal of Stored Products Research 89: 101689.

Thakkar B, Parikh P. 2018. Effects of host grains on the rice weevil *Sitophilus oryzae* (L.). Indian Journal of Entomology 80(4): 1427-1430.

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