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Host influenced Preference of *Callosobruchus chinensis* (L.) and *C. maculatus* (F.) towards Selected Pulses under Storage Ecosystem

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***Abstract*:** Pulse beetle, *Callosobruchus* sp. (Coleoptera: Bruchidae) has got great economic importance and is the most destructive pest on stored pulses. The host preference of pulse beetles towards selected pulses *viz*., black gram (*Vigna mungo* L.), green gram (*Vigna radiata* L.), Cowpea (*Vigna unguiculata* L.), lablab (*Lablab purpureus* L.), red gram (*Cajanus cajan* L.), broad bean (*Vicia faba* L.), bengal gram (*Cicer arietinum* L.) Kabuli and desi was studied under laboratory conditions. Egg laying, number of adults emerged, per cent adult emergence, developmental period and per cent weight loss on selected pulses were recorded. Among the various hosts tested for preference by *Callosobruchus chinensis* (L.) and *C. maculatus* (F.), the minimum egg laying and least number of adult emergence was observed on broad bean as against the maximum on green gram. The lowest adult emergence was noted for red gram as against the highest in Bengal gram. The lowest developmental period was observed for the beetles fed on red gram whereas it was the highest on Lablab. The lowest percent weight loss was observed in broad bean as against the highest in green gram.

***Keywords*:** Pulse beetle, Egg laying, Developmental period, Per cent weight loss

Many pulses such as black gram, green gram, bengal gram, red gram and play a significant role in our dietaries (Sreelekshmi et al 2011). Among all the pests of stored products, the insects act as the chief source of food grain damage (Negamo et al 2007). Mainly bruchids of the genus *Callosobruchus* are well known to inflict post-harvest loss to stored legumes primarily through consumption of the resource and secondarily through the qualitative deterioration of the commodity or reduced seed stock viability. The genus *Callosobruchus* is cosmopolitan in distribution, sometimes it causes 100% damage within 3-4 months of storage (Swamy and Wesley, 2017). Chauhan and Ghaffar (2002) reported 55-65% loss in seed weight and 45.50-66.30% loss in protein content due to its damage and the infested seeds became unfit for human consumption. Considering the damage caused by *Callosobruchus,* it is imperative to evaluate its preference towards various pulses, when stored together. Hence, host preference was evaluated by recording fecundity, percent adult emergence, mean developmental period and percent weight loss by *C. chinensis* and *C. maculatus* on certain pulses.

MATERIAL AND METHODS

Mass culturing of *Callosobruchus chinensis* and *C. maculatus*: Pulse beetles required for this study were mass reared on respective hosts *viz*., black gram, green gram, cowpea, lablab, bengal gram (Kabuli and Desi), red gram and broad bean. The mass culture was initiated by collecting the grains which are infested by the pulse beetle, from domestic storage structures. The culture was maintained in the plastic containers (6 cm dia x 11 cm high) covered with lid and such containers were staked in shelves. The adult beetles obtained from the culture were released into the plastic containers having respective seeds without any prior infestation and they are untreated. Before opening the container for transfer of adults to the new seeds, the container was tapped on the floor for preventing the escape of adults. The adults were allowed to mate and oviposit on the fresh seeds. The seeds were changed in the interval of 40 days for avoiding the fungal growth and also for reducing the competition for egg laying by the freshly emerged adults. The seeds with the eggs were maintained in separate containers for obtaining the freshly emerged adults. Sub-culturing of this beetle was done at regular intervals so as to maintain a continuous supply of insects for the experiments. The freshly emerged adults from the culture were utilized for all the following experiments.

Evaluation of preference of pulse beetle towards selected hosts: Eight legumes *viz*., black gram, green gram, cowpea, lablab, bengal gram (Kabuli and Desi), red gram and broad bean were provided to the beetles under no choice condition. One pair of freshly emerged male and female pulse beetle was released on 40 numbers of seeds (40 numbers) kept in a petri dish. Adults are separated by the most distinguishing characteristics namely the sex specific coloration of the post abdominal plate referred as “Pygidium” in female (Fatima *et al*. 2016). The preference of pulse beetle towards various hosts was evaluated based on fecundity, per cent adult emergence, mean development period and percent weight loss.

Evaluation based on fecundity: To study the fecundity of pulse beetle, each treatment was replicated three times. Eggs laid on

seeds were counted till the death of both male and female bruchids.

Evaluation based on per cent adult emergence: Per cent adult emergence was calculated (Howe 1971).

$$\text{Per cent adult emergence} = \frac{\text{Number of adults emerged}}{\text{Number of eggs laid}} \times 100$$

Evaluation based on mean developmental period: Mean developmental period (MDP) is the time taken for 50 per cent of adults to emerge (Tripathi et al 2015).

$$\text{Mean developmental period} = \frac{D_1A_1 + D_2A_2 + D_3A_3 + \ldots\ldots D_nA_n}{\text{Total number of adults emerged}}$$

Where, D_1- Day at which the adults started emerging (First day), N_1- Number of adults emerged on D_1th day.

Evaluation based on per cent weight loss: Per cent weight loss was calculated (Jat et al 2013).

Statistical analysis: The data thus obtained from evaluation of host preference were analyzed used OPSTAT software.

RESULTS AND DISCUSSION

The fecundity of *Callosobruchus* sp. differed significantly among the selected pulses. Under no choice condition, the mean number of eggs laid on the test pulses ranged from 20.33 to 49 eggs per 40 seeds (Table 1). Significantly the lowest number of eggs was recorded on broad bean which was on par with lablab indicating that these hosts were the least preferred for oviposition by the adult females. The highest numbers of eggs were on green gram indicating that this host was highly preferred for oviposition. Based on the fecundity, green gram was the most preferred host and broad bean was the least preferred host by pulse beetle. Tiwari et al (2012) also reported that green gram and cowpea as the most preferred hosts by pulse beetle. In the present study, pulse beetles laid more eggs on smooth surfaced hosts like green gram and cowpea and laid lesser number of eggs on the host having hard and wrinkled seed coat like bengal gram (Kabuli type). Shivana et al (2011) reported that the preference was high in cowpea and green gram that possess smooth skinned seed texture. Among the different hosts, the percent adult emergence ranged from 71.43 to 87.43. Red gram recorded the significantly least adult emergence which was followed by broad bean. The mean developmental period (days) of *Callosobruchus* sp. grubs on different pulses ranged from 21.66 to 37.31 days (Table 1). Red gram recorded the least developmental period which was on par with black gram whereas pulse beetle that fed on lablab recorded the highest number of days to complete their development Chakraborty et al (2015) observed that mean developmental period ranged from 26.70 to 32.20 days in different pulses. Shivanna et al (2011) reported that cowpea, green gram, bengal gram and horse gram recorded significantly the lowest developmental period. Tiwari et al (2012) revealed that the lowest developmental period (29.00 days) was recorded on cowpea. The weight loss caused due to feeding in different pulses ranged from 7.26 to 40.66 %. The per cent weight loss was the lowest in broad bean which was statistically on par with Bengal gram, weight loss was high in green gram which was on par with black gram and cowpea (Fig. 1). Hosamani et al (2016) reported that red gram variety TS-3R recorded significantly the lowest weight loss as against the highest on cowpea followed by green gram. Chakraborty et al (2014) reported that black gram recorded

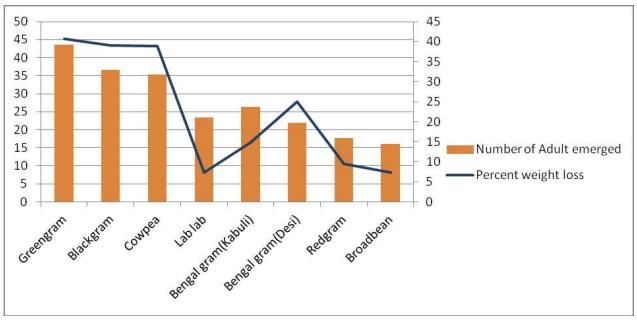

Fig. 1. Preference of pulse beetle towards selected hosts based on number of adults emerged and Percent weight loss

Table 1. Preference of pulse beetle towards selected hosts

Host	No. of. eggs laid/ 40 seeds*#	Adult emergence (%) **#	Developmental period (Days) *#	Weight loss (%) **#
Green gram	49.00 (7.07)^{e}	84.96 (67.19)^{c}	32.36 (5.77)^{d}	40.66 (39.6)^{e}
Black gram	42.33 (6.58)^{d}	86.46 (68.43)^{a}	23.75 (4.97)^{b}	39.06 (38.66)^{e}
Cowpea	41.33 (6.53)^{d}	85.20 (67.55)^{c}	26.23 (5.22)^{c}	38.86 (38.54)^{e}
Bengal gram (Kabuli)	29.00 (4.72)^{a}	81.70 (64.66)^{c}	36.41 (6.18)^{e}	7.40 (15.77)^{a}
Bengal gram (Desi)	30.66 (5.44)^{b}	87.43 (69.25)^{d}	27.24 (6.11)^{e}	14.80 (22.61)^{c}
Red gram	29.66 (5.62)^{c}	71.43 (57.70)^{a}	21.66 (5.31)^{c}	25.00 (29.98)^{d}
Lablab	21.33 (5.50)^{bc}	80.40 (63.75)^{b}	37.31 (4.75)^{a}	9.49 (17.93)^{b}
Broad bean	20.33 (4.65)^{a}	75.10 (60.06)^{a}	30.81 (5.63)^{d}	7.26 (15.62)^{a}

*,**Figures in the parentheses are square root transformed and are arc sine transformed

significantly lowest weight loss while the maximum weight loss was recorded in cowpea. Shivana et al (2011) recorded that the loss in grain weight among different pulses ranged from 1.82 to 4.02 per cent and red gram recorded significantly the lowest weight loss as against the highest weight loss recorded in cowpea.

CONCLUSIONS

The female pulse beetle's host selection behaviour and oviposition preference are influenced by a variety of factors, including host seed size, seed coat characteristics, seed morphology, seed infestation, photoperiod, and the number of copulating males, but not by the length of host deprivation period. The beetle exhibited some level of host size discrimination. Which was accompanied by other factors as stated above. The pulse beetles not only preferred larger seeds with smooth coating, but also preferred fresh healthy seeds under normal photoperiod.

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