Damage Potential Between South Indian Bruchid Strains of *Callosobruchus maculatus* and *Callosobruchus chinensis*

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Abstract

Pulses serve as an important food component in many developing countries including India. Due to high protein content, these crops are constantly faced with different abiotic and biotic stresses such as drought, insects and diseases which ultimately lead to decreased productivity. Among the biotic stresses, seed beetles in the genus *Callosobruchus* constitute a major constraint in pulse production causing high grain losses both in quantity and quality during storage, and are distributed all over the country. In this context, an experiment was conducted to assess the seed damaging potential of two most common *Callosobruchus* species, *Callosobruchus chinensis* and *C. maculatus*, on an important Indian pulse crop, mung bean (variety - CO-8) through artificial infestation under laboratory conditions. Results showed that ovipositional response by the two species differed significantly on 50 mung bean (*Vigna radiata*) seeds. Damage potential of the two bruchid species was evaluated by assessing and comparing seed damage percentage. Seed infestation was significantly higher for *C. maculatus* (91.33 %) than *C. chinensis* (70.67 %). Although mung bean seeds were highly susceptible to both the bruchid species, however, mean developmental period (MDP in days) was found to be significantly different which recorded 29.96 and 24.99 days for *C. chinensis* and *C. maculatus* respectively. Therefore, it can be concluded that *C. maculatus* is more dominant and damaging than *C. chinensis* and hence, can be recommended for use in bruchid host plant resistance study.

***Keywords*:** damage potential, *Callosobruchus*, artificial infestation, susceptible, pulse crop

Introduction

Seed beetles in the genus *Callosobruchus* are tropical and sub-tropical agricultural insect pests (Southgate, 1979) causing severe damage in different legumes mostly during storage conditions. Under

natural conditions, edible legumes are infested by both *Callosobruchus maculatus* (Fabricius) and *C. chinensis* (Linnaeus) either individually or in complex. A reliable bioassay to be conducted for bruchid resistance evaluation must always employ a known species, identified strain or biotype of the insect (Credland, 1994). Moreover, for varietal development in insect host plant resistance studies, utilization of the more destructive species is recommended, which provides reliable results in the long run. Hence, the present investigation was carried out with an aim to determine the damage potential between these two most common bruchid species in Southern India and identify the superior species to be employed in further resistance evaluation and pulse breeding programmes.

Materials and methods

Callosobruchus species under study were obtained from infested soybean (*C. chinensis*) and mung bean seeds (*C. maculatus*) procured from Toxicology lab., Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore and Indian Institute of Crop Processing Technology (IICPT), Thanjavur, Tamil Nadu, respectively. Prior to the study, both the bruchid species were reared on susceptible greengram cv. 'Co-8' (Seram *et al*., 2015) for one generation each (inside incubator maintained at 30ºC temperature and 70% relative huidity) following the procedure of Strong *et al*. (1968), in order to eliminate any short-term changes in behaviour associated with the change of host variety from that used for culturing to that being tested (Dobie, 1974).

The experiment was conducted under "no-choice" condition through artificial bruchid infestation with three replications each. One pair each of the two bruchid species was released per fifty pesticide-free seeds of mung bean and damage potential was assessed by comparing percentage seed damage calculated according to Khattak *et al*. (1987) *i.e.* [(number of seeds damaged / number of seeds taken) x 100]. Other bruchid biological parameters *viz*. oviposition, eclosion from eggs, adult emergence separate for both male and female, mean developmental periods (MDP) and index of suitabilities (IS) were recorded and calculated according to Seram *et al*. (2016a) and Seram *et al*. (2016b). The number of adults emerged were recorded daily to determine the duration of development from egg to adult. Sex ratio was determined by the formula given by Soares *et al*. (2014): RS = number of females / (number of males + females). Data pertaining to various bruchid parameters were subjected to analysis of variance (ANOVA) to determine any significant differences between the means at 5% by LSD.

Results and discussion

Experiment conducted in order to find out the superior bruchid species capable of causing more damage and infestation during grain storage conditions, growth and development of *Callosobruchus maculatus* and *C. chinensis* were separately studied on a susceptible mung bean variety (Co-8) and different developmental parameters were recorded and worked out. Ovipositional response by the two species on 50 seeds differed significantly with 63.33 ± 1.53 eggs laid by *C. chinensis* and 111.67 ± 4.73 eggs by *C. maculatus* respectively (Table.1). Egg hatchability was also higher for *C. maculatus* (87.12 ± 1.86 %) than *C. chinensis* (68.43 ± 1.23 %) which differed significantly. One adult emergence per seed was recorded for *C. maculatus* with a total 45.67 ± 1.53 adults emerged from 50 seeds evaluated, whereas more than one adult emergence from a single seed was observed in case of *C. chinensis* with 38.33 ± 1.15 adults emerged randomly from 50 seeds (Table.2). Mitchell (1991) described one adult emergence per seed for South Indian *C. maculatus* strain which was evident in the present study. In terms of sex ratio, the mean emergence of female bruchids was slightly higher than males (21.84♀ over 20.17♂), but was significantly at par which is also supported by the non-significant result of sex ratio (Table.2).

Damage potential between these two *Callosobruchus* species was determined by assessing the damage caused on seeds, which was manifested by presence of round exit hole(s) on seeds with the 'flap' of seed coat made by the emerging bruchid adults. Seed damage was significantly higher for *C. maculatus* (91.33 ± 3.06 %) than *C. chinensis* (70.67 ± 3.06 %). Although mung bean seeds used for assessing damage were highly susceptible (Highly Susceptible, HS with score 7 based on Seram *et al*., 2016a) to both bruchid species, mean developmental period (MDP in days) were found to be significantly different, with *C. chinensis* and *C. maculatus* taking 29.96 ± 0.39 and 24.99 ± 0.07 days respectively for adult emergence. Significant difference was also observed in index of suitability, 0.059 (*C. chinensis*) and 0.064 (*C. maculatus*) (Table.1). These findings were in corroboration with Raina (1970) who reported that *C. maculatus* is the most damaging among all the *Callosobruchus* species found in India. Moreover, *C. maculatus* has been found to be infesting almost all the legume seeds in Southern states of India like Tamil Nadu (Srinivasan and Durairaj, 2007), where the present study was conducted.

Conclusion

Based on the present findings, it can be concluded that *C. maculatus* is more dominant, superior and destructive than *C. chinensis* since it can complete several generations within a particular period of

time due to its comparatively shorter mean developmental period (MDP) and high seed damage potential. Moreover, *C. maculatus* species is recommended to be employed for host plant resistance determination (germplasm or varietal screening) in pulse breeding or improvement programmes.

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Table 1: Damage potential of two *Callosobruchus* species on *Vigna radiata* seeds

Callosobruchus Species	Eggs/ 50seeds	Eggs Hatched	% Hatch	Damage %	% Survival	MDP (Days)	IS (GI)
C. chinensis	63.33 ±1.53[a]	43.33 ±1.15[a]	68.43 ±1.23[a]	70.67 ±3.06[a]	60.58 ±3.20[a]	29.96 ±0.39[a]	0.059[a]
C. maculatus	111.67 ±4.73[b]	97.33 ±6.11[b]	87.12 ±1.86[b]	91.33 ±3.06[b]	40.92 ±1.45[b]	24.99 ±0.07[b]	0.064[b]
Mean	**87.5**	**70.33**	**77.77**	**81.00**	**50.75**	**27.48**	**0.062**
SEd	2.87	3.59	1.28	2.49	2.03	0.23	0.001
CD (0.05)	7.96	9.97	3.57	6.93	5.64	0.65	0.003

Values are mean of 3 replications (mean ± SD); Letters a and b within a column are significantly different at 5 per cent level by LSD; Damage % - seed damage caused by bruchid, MDP – Mean developmental period, IS – Howe's Index of Suitability (GI-Growth Index)

Table.2. Adults emergence of *Callosobruchus chinensis* and *C. maculatus* from *Vigna radiata* seeds

Callosobruchus Species	Adults emerged	Male adults	Female adults	Sex Ratio	Damaged seeds
C. chinensis	38.33* ±1.15[a]	18.33 ±0.58[a]	20.00 ±1.00[a]	0.522 ±0.06	35.33* ±1.53[a]
C. maculatus	45.67** ±1.53[b]	22.00 ±1.00[b]	23.67 ±1.15[b]	0.518 ±0.07	45.67** ±1.53[b]
Mean	**42.00**	**20.17**	**21.84**	**0.520**	**40.50**
SEd	1.11	0.67	0.88	0.45	1.25
CD (0.05)	3.07	1.85	2.44	1.25	3.46

Values are mean of 3 replications (mean ± SD); Letters a and b within a column are significantly different at 5 per cent level by LSD;

*More than one *C. chinensis* adults emerged from few individual seeds;

**Only one adult emergence per seed for South Indian *C. maculatus* strain (Mitchell, 1991 and Seram *et al*., 2016b)

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Callosobruchus chinensis ***Callosobruchus maculatus***