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Evaluation of selected blackgram accessions for resistance to pulse beetle *Callosobruchus chinensis* l

Pavithradevi P, Muthukumaran N
Department of Entomology, Annamalai University, Annamalai Nagar, Tamil Nadu, India

Abstract
Seven Blackgram accessions were screened for their resistance against *C. chinensis* during 2020-21 in the Department of Entomology, Annamalai University. The selected accessions Kuthirai Saanthal, Kuthalam Local, Sivapuri Local, Thiruvarur Local, Dindigul Local, Sonai Ulunthu and Sivanmalai Local were evaluated for resistance to pulse beetle through choice tests. In multi choice condition, the number of eggs deposition on seeds was lowest in Sivapuri Local (2.0) and highest in Sivanmalai Local (9.67) per 30 seeds. The lowest adult emergence (1.0) was recorded on Sivapuri Local both in 40 and 80 days after release. In no choice condition, number of eggs laid on seeds ranged from 4.33 to 27.33 per 100 grains. Lowest adult emergence was recorded in Sivapuri Local (1.99) and highest in Sivanmalai Local (152.67). Maximum grain damage and weight loss were recorded in Sivanmalai Local, 81.67 per cent and 50 per cent respectively. Lowest grain damage and weight loss were recorded in Sivapuri Local 4 per cent and 5.25 per cent respectively.

Keywords: blackgram, pulse beetle, choice tests, grain damage, weight loss

Introduction
Blackgram is a leguminous crop which contributes in protein and fibre composition of human diet. The productivity of blackgram was reduced due to many biotic and abiotic factors one of which insect pests, damage the crop in over the period of its growth and as well in storage. It was stored for consumption and milling by farmers and millers where pulse beetle *Callosobruchus chinensis* L. (Bruchidae; Coleoptera) is one of the important pest, infest the pods in field as well contaminate the grains in storage [1]. The adults lay the eggs on pods surface which is glued to the seed surface. The larvae of this species feed and develop exclusively on the seed, while the adults do not require food or water and spend their limited lifespan in mating and laying eggs on seeds [2]. Adults emerge within 3-4 weeks under favorable conditions. The young ones feed on internal content of the seed leaving circular holes in seeds which reduce the marketability of the grains. At present, management of insect pests of storage rely on the use of insecticides. Indiscriminate usage of insecticides led to insect resistance, residues in stored grains and pollution. Various control measures have been adopted against *C. chinensis*, one common method being the use of resistant varieties. Resistance varieties were not suitable for feeding, for favorable and quick development of life stages and delayed development due to strong antibiosis factors, adult emergence was low in resistant varieties as the seeds were not suitable for complete development of immature stage [3]. Genetic resistance is a better method than chemical methods to reduce bruchid damage in storage [4]. Considering above points the experiments have been undertaken, to evaluate the resistance potentials of the selected blackgram accessions against *C. chinensis*.

Materials and Methods
The experiment was conducted during 2020-2021 in the Department of Entomology, Faculty of Agriculture, Annamalai University. Six blackgram accessions, Kuthirai Saanthal, Kuthalam Local, Sivapuri Local, Thiruvarur Local, Dindigul Local and Sonai Ulunthu identified earlier as resistant to *Maruca vitrata* (Fab.). For comparison a susceptible check, Sivanmalai Local also selected. Selected blackgram accessions were sown in completely randomized block design with three replications. The mature pods of each accession were picked and the seeds were utilized for both free choice and no choice tests. Insect culture of pulse beetle maintained in laboratory was utilized for the experiments. The procedure followed was given below, [5]

Multi choice test
Grains of all the selected accessions were taken at equal number (30 grains) in individual petriplates and randomly arranged in a circle in a plastic container. Ten pairs of freshly emerged bruchids were released in the middle of the circle giving a choice to adults to settle and oviposition on their preferred grain. The experiment was replicated thrice under normal room temperature. After five days, data on number of eggs deposition on seeds was recorded. At 40 and 80 days after release of insects, data on progeny emergence was recorded from each accession.

No choice test
Blackgram grain (20g) of selected accessions was taken in a separate petriplates into which two pairs of freshly emerged bruchids were released. After introducing the bruchids secure the petriplates with rubber band. The experiment was replicated thrice under normal room temperature. After five days, the adults were removed and data on oviposition was recorded. Later, they were allowed for the progeny development and data on number of adults emerged, per cent grain damage and per cent weight loss at 40 and 80 days after release of adults were recorded.

Per cent grain damage [6]
The grain damage per cent was calculated by using total number of seeds and damaged seeds recorded on 40 & 80

days after release (DAR).

$$\text{Per cent grain damage} = \frac{\text{Number of damaged seeds}}{\text{Total number of seeds}} \times 100$$

Per cent weight loss

The final weight of grain was taken on 40th & 80th day and per cent weight loss was calculated.

$$\text{Per cent gain weight loss} = \frac{(\text{Initial weight of grains} - \text{final weight of grains})}{\text{Initial weight of grains}} \times 100$$

Results and Discussion

The results of choice tests were given and the performance of bruchid, *C. chinensis* was discussed with both mutli and no choice conditions.

In multi choice test, egg count on 30 grains revealed that it ranged from 2.0 to 9.67 numbers. Among the accessions, Sivapuri Local recorded minimum number of eggs on seeds and Sivanmalai Local recorded highest eggs deposition on seeds. The adult emergence ranged between 1.0 to 5.0 and 1.0 to 7.33 in 40 and 80 days after releases respectively. The lowest adult emergence was recorded on Sivapuri Local both in 40 and 80 days after release. The adult emergence was on par with respect to Kuthirai Saanthal and Sonai Ulunthu, both recorded to be 2.67 numbers in 40 days after release and 2.63 in 80 days after release (Table.1).

Table 1: Screening of selected blackgram accessions for resistance to *C. chinensis* under multi choice conditions

Accession	No. of eggs/ 30 grains	Number of adult emergence		
		40 DAR	80 DAR	Total
Kuthirai Saanthal	3.67 (2.13)	2.67 (1.90)	2.33 (1.72)	3.66 (1.81)
Kuthalam Local	8.67 (3.07)	3.67 (2.13)	4.33 (2.29)	8.0 (2.21)
Sivapuri Local	2.0 (1.67)	1.0 (1.38)	1.0 (1.38)	1.67 (1.38)
Tiruvarur Local	4.33 (2.27)	1.67 (1.60)	4.33 (2.26)	5.66 (1.93)
Dindugal Local	5.33 (2.50)	2.33 (1.82)	5.0 (2.42)	7.33 (2.12)
Sonai Ulunthu	3.0 (1.95)	2.67 (1.88)	2.33 (1.79)	3.66 (1.83)
Sivanmalai Local	9.67 (3.25)	5.0 (2.44)	7.33 (2.84)	10.33 (2.64)
SE(m)	0.26	0.18	0.29	0.17
C.D. at 5 %	0.81	0.56	0.89	0.51
C.V.	19.18	16.96	24.02	21.66

DAR – Days after Release; the values in parentheses are square root transformed values

In no choice condition, oviposition ranged from 4.33 to 27.33 eggs per 100 grains.

The lowest egg deposition was recorded on Sivapuri Local and maximum egg deposition on Sivanmalai Local. After Sivapuri Local, Kuthirai Saanthal and Sonai Ulunthu also received less number of eggs on par with each other 8.0 and 8.33 respectively. Adult emergence was ranged from 1.33 to 29.0 after 40 days of release, whereas 0.66 to 123.67 in 80 days after release. Lowest adult emergence was recorded on Sivapuri Local.

The percentage of grain damage was recorded and the results show that it was range from 4.0 to 81.67. The lowest grain damage and weight loss was recorded in Sivapuri Local (Table.2).

The accessions Kuthirai Saanthal (13.5 per cent) and Sonai Ulunthu (11.75 per cent) also recorded less grain damage compared to other accessions (Fig.1).

Table 2: Screening of selected blackgram accessions for resistance to *C. chinensis* under no choice conditions

Accession	No. of eggs/100 grains	Number of adult emergence			Grain damage (%) *	Weight loss (%) *
		40 DAR	80 DAR	Total		
Kuthirai Saanthal	8.0 (2.97)	12.33 (3.63)	87.67 (9.41)	100.0 (6.52)	19.33 (26.03)	13.5 (21.42)
Kuthalam Local	12.33 (3.64)	14.67 (3.95)	97.33 (9.91)	112.0 (6.93)	27.0 (31.25)	32.17 (34.50)
Sivapuri Local	4.33 (2.30)	1.33 (1.48)	0.66 (1.27)	1.99 (1.38)	4.0 (11.47)	5.25 (13.16)
Tiruvarur Local	11.0 (3.45)	12.0 (3.60)	61.0 (7.86)	73.0 (5.73)	68.33 (55.73)	25.75 (30.46)
Dindugal Local	14.0 (3.86)	14.33 (3.90)	66.33 (8.20)	80.66 (6.05)	37.67 (37.83)	28.75 (32.38)
Sonai Ulunthu	8.33 (3.02)	14.33 (3.91)	87.0 (9.37)	101.33 (6.64)	18.33 (25.30)	11.75 (19.64)
Sivanmalai Local	27.33 (5.31)	29.0 (5.47)	123.67 (11.16)	152.67 (8.31)	81.67 (64.65)	50.0 (44.98)
SE(m)	0.20	0.18	0.16	1.10	0.99	1.73
CD at 5%	0.62	0.56	0.50	3.17	3.04	5.31
C.V.	10.03	8.59	3.48	45.38	4.77	10.71

DAR – Days after Release; the values in parentheses are square root transformed values; * values are angular transformed

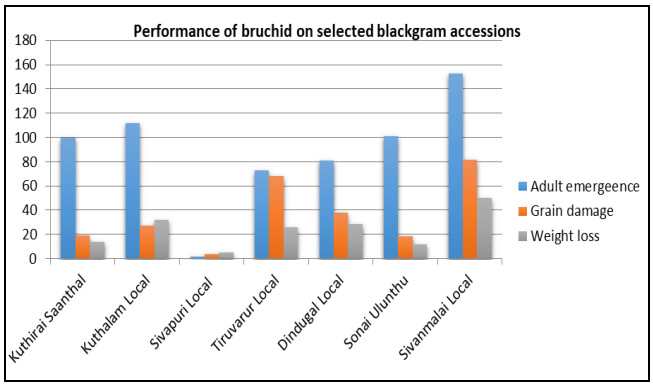

Fig 1: No choice test performance of pulse beetle on selected black gram accessions

In both choice tests Sivapuri Local was performed well compared to other accessions. Highest egg deposition occurred on the accession Sivanmalai Local and the lowest deposition was found on the accession Sivapuri Local. The results are in agreement with the findings of Lambrides and Imrie [7] who reported that the variation of egg deposition on different accessions associated with the morphological characteristics of the seeds. Moreover, large surface area of seed received maximum number of eggs deposition by pulse beetle [8]. Further, oviposition rate of *C. chinensis* depended on the size and quality of seeds with seed coat. The fully filled grains also encouraged the beetle to deposition of eggs. [9]

The selected accessions were collected from hilly and different rural regions of Tamilnadu where cultivating the black gram traditionally. Wild relatives or traditional accessions have been reported to possess resistance against insect pests. Among them, Sivapuri Local recorded as resistant to *C. chinensis* in terms of less grain damage and weight loss. Several wild species were screened earlier and few of them found promising towards bruchids with less grain damage. Wild accessions delayed the development of bruchid in the seeds [10]. Resistant varieties were not suitable for feeding and quick development of the life stages of the bruchids [11]. Seed characteristics like size, colour and lustre

are known to affect resistance or preference of bruchids. Seed size may also affect oviposition preference of bruchids and a strong correlation has been observed between bruchid Resistance and small or medium sized seeds [12]. The thickness of seed coat had greater impact on the damage and weight loss of grain which can be correlated with the findings of [13]. In addition, smooth seed coat minimizes the damage caused by pulse beetle [14].

Conclusion

It can be concluded that, the accession Sivapuri Local found resistant to *C. chinensis* compared to other accessions tested. On the basis of this findings, it could be concluded that resistant accession Sivapuri Local may be exploited in breeding program to develop resistant varieties.

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