

## Effects of Leguminous Hosts on Oviposition, Development and Damage Potential of the Pulse Beetle (*Callosobruchus chinensis* L.) (Bruchidae : Coleoptera)

By

N. RAJAMOCHAN<sup>1</sup>, T. KUMARASWAMY<sup>2</sup> and S. JAYARAJ<sup>3</sup>

### ABSTRACT

A study of the influence of six leguminous hosts on the pulse beetle, *Callosobruchus chinensis* L., revealed that ovipositional preference was in the order of cowpea, field bean, bengal gram, red gram, green gram and black gram. Fecundity was higher when bred on green gram and black gram than bred on green gram and black gram. Best growth was noticed on cowpea, green gram and black gram. Ovipositional preference of the beetle was not related to the suitability of the seed for development. In the infested seeds, the percentage of loss in weight had a negative correlation with the germination percentage in all pulses tested.

### INTRODUCTION

Though reports exist regarding the influences of host on *Callosobruchus* spp., for oviposition (El-sawaf, 1954), development (Arorar and Pajni, 1960) and infestation (Gundurao and Majumdar, 1964) informations are lacking particularly on *C. chinensis* in detail. A study has been made to test the effect of certain pulse seeds on oviposition, development and damage potential of the pulse beetle, *C. chinensis* and the results are reported.

### MATERIALS AND METHODS

A multiple choice test was conducted to assay the ovipositional preference of the beetle on seeds of six pulses viz., bengal gram (*Cicer arietinum* L.) local, black gram (*Phaseolus mungo* L.)

CO 1. Cowpea, (*Vigna sinensis* Savi.)  
CO 2. field bean (*Dolichos lab-lab* var *typicus* L.) local, green gram (*Phaseolus aureus* Roxb.) local and red gram (*Canjanus cajan* Millsp.) S A 1. Sound insect free seeds with moisture content below 5 per cent were used in all tests.

A pair of beetles on emergence was allowed inside a glass cage over petri-dishes containing separately 2 g of seeds of each pulse. The number of eggs laid on each host was recorded at 2, 4, 6 and 8th day after caging. In another test, 250 seeds of each pulse were provided with a pair of beetle bred separately on the concerned hosts for egg laying. Fecundity, development period, egg to adult survival and seed damage were recorded on each host at appropriate intervals. One hundred

1, 2 and 3. Department of Entomology, Agricultural College and Research Institute, Madurai-625 104.



sound and infested seeds of each category were weighed separately and the percentage of loss in weight due to damage was worked out. The germinability of both sound and damaged seeds of 100 each was tested as per the international rules for seed testing, (Anon, 1959). Seeds with one exit hole were taken for the estimation of weight loss and germination since the number of larvae per seed varied in relation to the size of seed and severity of infestation. The data were either transformed into "arc sine" or "square root" values and statistically analysed for "F" test. Correlation coefficient was worked out wherever possible.

## RESULTS AND DISCUSSION

The data on the preference of different pulses for oviposition by *C. chinensis* are presented in Table 1. During the entire period, the egg count was maximum on cowpea to the extent of 36.64 per cent followed by field bean with 26.40 per cent of the eggs. Bengal gram and red gram had 17.15 and 10.28 per cent of the eggs. Egg laying was minimum on green gram and black gram, the percentage being 4.94 and 4.61. Irrespective of the hosts, the number of eggs laid was less with the passage of time and it was 40.92 per cent on the second day, 29.38 on the fourth, 18.81 on the sixth and 10.88 on the eighth day.

TABLE 1. Ovipositional preference of *C. chinensis* on different pulses

	Period of oviposition (Days)				Total
	2	4	6	8	
Cowpea	14.66 (35.48)	11.33 (38.19)	7.00 (36.86)	4.00 (36.39)	36.99 (36.64)
Field bean	10.33 (25.00)	8.00 (26.97)	5.33 (28.06)	3.00 (27.29)	26.66 (26.40)
Bengal gram	6.66 (16.12)	4.33 (14.59)	4.00 (21.06)	2.33 (21.20)	17.32 (17.15)
Red gram	5.00 (12.10)	2.00 (6.74)	2.00 (10.53)	1.33 (12.10)	10.33 (10.23)
Green gram	2.00 (4.84)	2.00 (6.74)	0.66 (3.47)	0.33 (3.00)	4.99 (4.94)
Black gram	2.66 (6.43)	2.00 (6.74)	—	—	4.66 (4.61)
Total	41.31 (40.92)	29.66 (29.38)	18.99 (18.81)	10.99 (10.88)	100.95
		Significance (P=0.05)	SEd	CD (P=0.05)	
Between periods		Yes	0.56	1.25	
Between pulses		Yes	0.51	1.21	
Interaction		Yes	0.74	1.56	

Figures in parentheses are percentage of eggs laid on each host



Table 2 presents the data on the effect of host seeds on the fecundity of the beetle preconditioned on each host for one generation. In all hosts, egg laying was seen up to 8 to 9 days, the maximum being observed with 24 hr of oviposition and there after there was

a gradual reduction. The females reared on cowpea laid maximum number of eggs (94.33/female). Next in order came bengal gram, red gram, black gram and field bean where the fecundity was 81.66, 66.66, 64.00, 61.33 and 48.66 eggs/female.

TABLE 2. Effect of different pulses on the ovipositional pattern of the beetle *C. chinensis*

	Period of oviposition (Days)									Mean
	1	2	3	4	5	6	7	8	9	
Cowpea	33.00 (5.78)	24.00 (4.94)	17.66 (4.25)	7.66 (2.85)	4.66 (2.27)	3.66 (2.03)	2.66 (1.77)	0.66 (1.07)	0.33 (0.91)	10.48
Bengal gram	30.00 (5.52)	19.00 (4.41)	16.00 (4.09)	7.33 (2.79)	3.66 (2.03)	3.33 (1.97)	1.66 (1.47)	0.33 (0.91)	0.33 (0.91)	9.07
Red gram	33.00 (5.78)	12.00 (3.53)	10.66 (3.34)	5.33 (2.41)	1.66 (1.47)	2.33 (1.68)	0.66 (1.07)	1.00 (1.22)	— (0.70)	7.40
Black gram	26.00 (5.14)	15.33 (3.97)	13.00 (3.67)	6.33 (2.61)	2.00 (1.58)	0.66 (1.07)	0.33 (0.91)	0.33 (0.91)	— (0.70)	7.10
Green gram	25.33 (5.08)	14.66 (3.89)	12.66 (3.61)	5.66 (2.48)	1.66 (1.47)	0.66 (1.07)	0.66 (1.07)	— (0.70)	— (0.70)	6.81
Field bean	20.00 (4.47)	12.00 (3.53)	9.33 (3.13)	4.33 (2.19)	1.33 (1.35)	1.00 (1.22)	0.33 (0.91)	0.33 (0.91)	— (0.70)	5.40
Mean	27.88	16.16	13.21	6.10	2.49	1.94	1.05	0.44	0.14	
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	Significance		SED		C.D. (0.05)					
Between pulses	Yes		1.05		2.15					
Between periods	Yes		0.88		1.25					
Interaction	Yes		1.55		2.23					

Figures in parentheses represent transformed values

Table 3 provides data relating the effect of different pulses on fecundity, developmental period, adult survival, extent of damage to seeds and germination of infested seeds. The total developmental period was 32.5 days on cowpea which was shorter by 1.8, 2.3, 2.4, 4.0 and 4.0 days than that on green gram, red gram, black gram, bengal gram and field bean respectively. The egg to adult survival percentage was highest in cowpea (62.04) followed by

bengal gram (45.75) and field bean (41.83). It was much less on black gram (34.01), green gram (29.47) and red gram (27.79).

The percentage of loss in weight of infested seeds was maximum in black gram (42.31) and green gram (41.89). It was 27.79 per cent in red gram, 20.88 per cent in cowpea and 12.96 per cent in bengal gram. The field bean recorded the lowest value of 7.46 per cent. The



TABLE 3. Effect of different pulses on the biology of *C. chinensis* and loss in weight and germination of seeds due to beetle damage

	Fecundity per female	Total deve- lopmental period (Days)	Per cent adult survival	Per cent seed damaged per female	Wt. of 100 seeds (gm)		% of germination		% decrea- se in ger- mination
					Healthy	Damaged	Healthy	Damaged	
Cowpea	94.66 ± 4.92	32.5 ± 1.84	62.04 ± 9.33 (52.08)	30.80 ± 4.87 (33.66)	9.740	7.706	85.00 (67.57)	26.00 (30.57)	-69.41
Bengal gram	81.66 ± 1.91	36.5 ± 3.17	45.75 ± 9.75 (42.53)	21.05 ± 6.07 (27.17)	15.530	13.516	86.33 (68.49)	46.66 (43.08)	-45.95
Red gram	66.66 ± 8.32	34.8 ± 2.97	27.79 ± 3.26 (31.77)	7.46 ± 1.00 (15.83)	7.210	5.206	83.33 (65.69)	15.33 (22.96)	-61.60
Black gram	64.00 ± 3.46	34.9 ± 3.16	34.01 ± 5.41 (35.64)	12.93 ± 2.34 (21.02)	4.733	2.730	86.66 (68.67)	5.66 (13.72)	-93.46
Green gram	61.00 ± 2.64	34.3 ± 2.75	29.47 ± 2.37 (32.89)	11.20 ± 1.60 (19.52)	4.803	2.791	85.00 (67.58)	8.00 (16.36)	-90.53
Field bean	48.66 ± 1.52	36.5 ± 3.17	41.83 ± 6.05 (40.30)	16.93 ± 2.20 (24.24)	29.093	26.920	90.66 (72.24)	66.66 (54.75)	-26.47
Significance (P=0.05)	Yes	Yes	Yes	Between pulses	Significance Yes	SED 0.14	Significance Yes	SE 3.08	C.D 6.38
SED	3.43	0.82	1.47	Between Healthy vs. Damaged	Yes	0.06	Yes	1.37	2.83
C.D(P=0.05)	7.65	1.65	3.47	Interaction	Yes	0.08	Yes	1.93	4.01

Figures in parentheses are transformed values



loss in weight per seed was from 20.03 to 21.73 mg in different pulses but the differences were not significant.

The damaged seeds of black gram, green gram, red gram, cowpea, bengal gram and field bean, recorded 5.66, 8.00, 15.33, 26.00, 46.66 and 66.66 per cent of germination, respectively. The reduction in germination in the above six pulses was 93.46, 90.58, 81.60, 69.41, 45.95 and 26.47 per cent when compared to that of healthy seeds. There was a negative correlation ( $r' = -0.926^*$ ) between the percentage of loss in weight and germination of infested seeds in all pulses tested.

The oviposition of *C. chinensis* was higher on cowpea than on field bean, bengal gram and red gram while green gram and black gram were the least preferred hosts for oviposition. This is in accordance with the observations of El-sawaf (1954) who had reported that *Callosobruchus maculatus* F., preferred cowpea for oviposition to chickpeas, beans and peas. Zaazou (1965) noticed that *Bruchus maculatus* F., and *B. chinensis* L., preferred cowpea for oviposition when offered together with broad beans, string beans and peas.

In the present investigations, the egg production was reduced to three-fourth when reared on red gram, black gram and green gram and to half on field bean. Ishii (1952) reported that *C. chinensis* did not develop in seeds of kidney beans and he indicated specific pentosans as the inhibitory factor responsible for it. Best growth of *C. chinensis* was obtained on cowpea

than on chick peas, french beans and field peas as observed by Teotia and Singh (1960). Applebaum *et al.* (1965) attributed the developmental incompatibility of soybeans for *C. chinensis* to the presence of soybean saponins.

Ovipositional preference of the beetle did not seem to have any relation to the suitability of seeds for the development of *C. chinensis* since black gram and green gram though not much preferred for oviposition recorded best growth and more egg to adult ratio for oviposition than bengal gram and field bean on which oviposition was better than the former hosts.

In all the different pulses, the loss in weight per seed due to damage was a little more than 20 mg and the differences between pulses were not significant. Again, the bigger sized seeds *viz.*, field bean, bengal gram and cowpea recorded lesser percentage of loss in weight than the small sized red gram, green gram and black gram. The percentage of loss in weight had a negative correlative with the percentage of germination of infested seeds in all pulses. Green gram and black gram which noted maximum percentage of loss in weight, recorded lesser germination while bengal gram and field bean registered more germination of seeds with less percentage of loss in weight.

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