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SCREENING OF BENGAL GRAM ACCESSIONS FOR RESISTANCE TO PULSE BEETLE

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ABSTRACT

Two hundred bengal gram accessions (Cicer arietinum L.) were screened for their resistance to Callosobruchus maculatus(F) by Free Choice Test. The number of eggs laid varied from 4 to 60. The adult emergence ranged between one in 11 and 27 in 5 accessions. Hundred per cent survival was observed in four accessions (Shahkot- 2, P-1675, RFG 30 and NEC-1592) as against only five per cent survival in RBH 99 and RC 109. Ovipositional preference was found not related with the suitability of the accession for further development. C. maculatus took 25 to 41 days for development. Based on the suitability index, 22 accessions were categorised as resistant, 40 as moderately resistant, 109 as susceptible and 29 as highly susceptible to C. maculatus.

Any reduction in losses between harvest and consumption helps increase the availability of food protein. The bruchids are the most destructive to stored pulses, of which *Callosobruchus maculatus*(F) is the dominant species (Gangrade, 1974). Storage scientists throughout the world are reporting with increasing frequency, that newly introduced varieties have exacerbated storage problems and increased the need to resort to the use of pesticides to prevent serious losses. In the present study, 200 bengal gram (*Cicer arietinum* L.) accessions were evaluated for their resistance to *C. maculatus* in the laboratory at the Agricultural College and Research Institute, Madurai, Tamil Nadu.

MATERIALS AND METHODS

Two hundred bengal gram accessions received from the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) were screened by Free Choice Test for their resistance to *C. maculatus* in the laboratory employing the method of Gibson and Raina (1972), with slight modifications. Fifteen circular disks of 3 cm diameter were arranged along the circumference of desiccators (15 cm diameter). In each disk, 10 seeds per accession were taken. Fifteen pairs of 0-12 h old *C. maculatus* adults were released at the bottom of the desiccator and were allowed for free choice oviposition in the seed. The desiccator was covered with the lid. Paper

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Table 1. Reaction of bengal gram accessions found to be resistant to C.maculatus

Accession	Eggs laid (No)	Adult emerged (No)	Survival (%)	Mean development period (days)	Suitability index
RBH 99	20	1	5.00	39.00	0.0179
RC 109	20	1	5.00	38.00	0.0184
RFG 29	16	1	6.25	41.00	0.0194
RC 4	17	1	5.88	38.00	0.0202
P-1679-2	13	1	7.69	39.00	0.0227
L 1869	12	1	8.33	38.00	0.0242
RPSP 6	9	1	11.11	38.00	0.0272
NEC 427	11	1	9.09	34.00	0.0299
SITM 16	9	1	11.11	35.00	0.0304
ICC - 6668 DRR	7	1	14.29	38.00	0.0306
P-841-2	21	2	9.52	32.00	0.0308
LRT 1	45	5	11.11	34.00	0.0308
RC 54 -1	36	4	11.11	34.00	0.0308
RBH 83	8	1	12.50	35.00	0.0313
RBH 73	48	7	14.58	37.00	0.0315
RBH 102	11	2	18.18	40.00	0.0315
NEC-442	27	4	14.81	35.00	0.0334
RBH 71	52	8	15.38	35.00	0.0339
P-1829	7	1	14.29	34.00	0.0340
L-1467	37	5	13.51	33.00	0.0343
RBH 88	36	5	13.89	33.00	0.0346
RFA 199	28	4	14.29	33.00	0.0350

strips were provided between the lid and the rim for aeration. After five days, seeds with eggs were transferred to polythene bags and observed daily for adult emergence.

$$\text{Percentage survival} = \frac{\text{Number of adults}}{\text{Number of eggs laid}} \times 100$$

Development period = Time taken for 50 per cent of the adults to emerge

$$\text{Index of suitability} = \frac{\text{Logarithmof per cent survival}}{\text{Mean development period}}$$

were calcutated (Howe, 1971).

RESULTS AND DISCUSSION

The number of eggs laid by *C. maculatus* ranged from 4 to 60 in various accessions at the end of the fifth day. The number of eggs laid was less than ten in 20 accessions. It was 15 times more in Shahkot-5 than in REG-30. Salunkhe and Jadhav(1982) recorded 827.67 times more egg in L-550 bengal gram than in Sel-436 in which only one egg was laid per 50 g seed. The differential egg laying by *C. maculatus* might be due to the difference in seed coat surface of the bengal gram accessions.

Only one adult emerged from accessions RBH 99, RC 109, RFG 29, RC 4, P-1679-2, L-1869, RPSP-6, NEC-427, SITM 16, ICC-6668 DRR RBH 83 and P-1829 (Table 1). The maximum emergence (27) was recorded from LRT7, Shahkot-8, Shahkot-10, LRT 69 and NEC-1567 (Table 1 and 2). Schalk *et al.* (1979) observed 68.5 fold increase in adult emergence in susceptible bengal gram 12-071-10013 than in resistant 12-071-05451.

Table 2. Reaction of bengal gram accessions found to be highly susceptible to C. maculatus

Accession	Eggs laid (No)	Adult emerged (No)	Survival (%)	Mean development period (days)	Suitability Index
RFG 32	9	7	77.78	31.00	0.0610
P-834	31	24	77.42	31.00	0.0609
NEC-1571	33	15	45.45	27.00	0.0614
LRT 74	24	11	45.83	27.00	0.0615
PI 211722	8	5	62.50	29.00	0.0619
RFG 48-1	11	8	72.73	30.00	0.0621
P-1818	11	7	63.64	29.00	0.0622
NEC-1594	25	9	36.00	25.00	0.0623
RFA-201	37	24	64.86	29.00	0.0625
SHAHKOT-2	8	8	100.00	32.00	0.0625
NEC-1531	21	16	76.19	30.00	0.0627
P-1679	17	13	76.47	30.00	0.0628
NEC-1512	13	12	92.31	31.00	0.0634
RBH 89	35	21	60.00	28.00	0.0635
LRT 12	29	21	72.41	29.00	0.0641
P-1814	15	11	73.33	29.00	0.0643
P-1675	8	8	100.00	31.00	0.0645
NEC-1589	12	7	58.33	27.00	0.0654
P-1819	19	13	68.42	28.00	0.0655
RFG 49-1	8	5	62.50	27.00	0.0665
NEC-1595	16	12	75.00	28.00	0.0670
P-1681	9	5	55.56	26.00	0.0671
NEC-1591	17	16	94.12	29.00	0.0681
RFG 30	4	4	100.00	29.00	0.0690
NEC-1590	15	13	86.67	28.00	0.0692
PI-215702	8	7	87.50	27.00	0.0719
NEC-1593	9	8	88.89	27.00	0.0722
LRT 3	21	16	76.19	26.00	0.0724
NEC 1592	13	13	100.00	27.00	0.0741

The possible reason for the lower adult emergence may be due to the difficulty encountered by first instar lavae entering through thick seed coats, the arrest of larval development by hard and tough layers of albumen inside seed coat, presence of antibiotic compounds like alkaloids, saponins, pentose sugars, L-dopa, free amino acids or phytoagglutinins, low nutritive content of cotyledons or presence of endopeptidase inhibitors making digestion difficult (Bridwell, 1918; Ishii and Urushibara, 1951; Applebaum, 1964; Howe and Currie, 1964).

In five accessions, NEC 2711, NEC 2713, NEC 2720, NEC 2722 and P- 1675-1, the larva was unable to develop inside and came out for pupation. This behaviour has not been reported so far in *C. maculatus*, even though it is a normal behaviour in bruchids belonging to the subfamily Pachymerinae. For example, *Caryedon pallidus* (Olivier) spins a cocoon on the outside of the seed head of *Lisea heterocarpa* L., *Caryedon serratus* (Olivier) which comes out of seed for pupation in tamarind and out of seed but within pod in groundnut and some old world Bruchinae such as *Bruchidius strangulatus* (Jek) on

Table 3. Reactioin of bengal gram accessions to C.malculatus

Reaction	Accessions
Resistant	
Suitability Index : 0.0350 Number of eggs laid : 22.27 ± 3.04 Number of adults emerged : 2.64 ± 0.47 Survival(%) : 11.22 ± 0.79 Mean development period : 36.05 ± 0.56	RBH-99, RC-109, RFG-29, RC-4, P-1679-2, RPSP-6, NEC-427, SITM-16, ICC-6668 DRR, P-841-2, LRT-1, RC-54-1, RBH-83, RBH-73, NEC-442, RBH-102, RBH-71, P-1829, L-1467, RBH-88 and RFA-199
Moderately resistant	
Suitability Index : 0.0350 - 0.0450 No.of eggs laid : 34.28 ± 2.19 No.of adults emerged : 7.90 ± 0.58 Survival (%) : 23.65 ± 1.15 Mean development period : 34 ± 0.47	RBU-101, ICCC-32, RBH-70, NEC-1573, P-1821, RPSP-449-1, RBH-87, P- 842, NEC-1566, PI-212595, Shahkot-5, ICC-1587, P-1814-1, NEC-437, Sample-15, NEC-1533, RPSP-139, 74 TA 1740, RPSP-14, PI-220776, NEC- 1568, RBH-76, Shahkot 6, NEC-438, P-1682, P-890, NEC-1528, NEC- 1527, NEC-1536, Apasco 2, ICC-554 WR, RFA-156, Shahkot 14, Shahkot 4, RBH-85, NEC-1526 and RFG-87.
Susceptible	
Suitability index : 0.0450-0.0600 No.of eggs laid : 26.19 ± 1.18 No.of adults emerged : 11.66 ± 0.58 Survival (%) : 47.09 ± 1.41 Mean development period : 31.33 ± 0.18	NEC-1523, P-846, NEC-1518, Shahkot-3, Shahkot 11, NEC-1516, RFA- 201-3, NEC-1514, RFA-184-2, NEC-439, P-831, NEC-1524, P-886, RBH- 184, P-1683-1, LRT-7, NEC-1598, NEC-451, NEC-1535, RFA-200-2, NEC- 2719, ICC-6772 DRR, P-1684, NEC-1515, RBH-80, NEC-426, P-1679-1 NEC-2714, NEC-2716, RFG-11-2, RFA-152-1, NEC-2720, REG-62-2, Shahkot 9, RFG-20-1, PI-220649, LRT-10, P-1678, NEC-1530, NEC-2722, NEC-2711, NEC-2713, NEC-1519, ICC-4716 DRR, P-840, NEC-2721, RFA- 199-2, RPSP-133, NEC-2717, RPSP-148, P-1686, RPSP-30, RC-54, RFG-11-1, LRT-5, LRT-70, NEC-432, P-1830, Shahkot 7, Shahkot 13, P- 1683, NEC-1588, RBH-90, RBH-92, Shakkot 12, P-1837, L-1852, P-843- 1, NEC-1522, RFA-144, P-1675-1, P-841, NEC-2715, P-1831, RFG-36-1, RC-6, P-892-1, P-1683-2, RBH-93, Shahkot 10, L-1776, NEC-2712, NEC- 1509, NEC-1510, P-892, P-1830-1, Shahkot 8, PI-212092, NEC-1513, P- 1677, P-1677, P-1815, 783C. NEC-431, PI-212091, NEC-1569, P-894, LRT-69, NEC-1572, NEC-2718, Phule G-3, NEC 1596, NEC-1597 and P- 844.
Highly susceptible	
Suitability Index : >0.0600 No.of eggs emerged : 11.69 ± 1.0 Survival : 74.14 ± 3.21 Mean development period : 27.50 ± 0.97)	RFG-32, P-834, NEC-1571, LRT-74, PI-211622, RFG-48-1, P-1818, NEC- 1594, RFA-201, Shahkot 2, NEC-1531, P-1679, NEC-1512, RBH-89, LRT- 12, P-1814, P-1675, NEC-1589, P-1819, RFG-49-1, NEC-1595, P-1681, NEC-1591, RFG-30. NEC-1590, PI-215702, NEC-1593, LRT-3 and NEC- 1592.

Crotalaria (Southgate, 1979). The minimum survival (5.00%) was observed in RBH 99 and RC109. There was 100 per cent survival in four accessions viz., Shahkot-2, P-1675, RFG 30 and NEC-1592 (Table 2) Sixty six accessions permitted more than 80 per cent survival. The accession RFG-30 which was the least preferred accession for oviposition supported 100 per cent survival whereas the most preferred accession, Shahkot-4 supported only 18.3 per cent survival. Singal and Singh (1985) reported minimum adult emergence in H-75/35 bengalgram inspite of receiving maximum eggs. The ovipositional preference was not related to the susceptibility of a particular variety for further development (Sachdeva and Sehgal, 1985; Sehgal and Sachdeva, 1985). The secondary plant substances, often quite unrelated to the nutritive value of the plant fot the larva may provide the necessary token stimuli might be toxic to developing larve (Hinton, 1981). The saponin fraction as ovipositional attractant of *Callosobruchus* and deterimental effect of soybean saponin of *Callosobruchus* larvae was attributed mainly to saponin fraction c (Applebaum *et al.*, 1965).

The period of development was extended upto 41 days in RFG 29, P 843 and P-1814-1 (Table 1). The shortest development period of 25 days was observed on NEC-1594. *C. maculatus* was able to complete its development below the average in 102 accessions and above the average in 98 accessions. The development period can be extended by the hard textured variety that are difficult to ingest or digest; varieties that are partially toxic to the insect pests; varieties that are nutritionally inadequate for the development of the pest (Dobie, 1984). Dick and Credland (1986) oberved that the mean development period of *C. maculatus* was extended upto 48.1 days in TVu 2027 cowpea which contains trypsin inhibitor that make digestion difficult as against 27.4 days in Californian black-eyed cowpea.

The index of suitability which is a combined criteria of both survival percentage and development period was found to vary much in different accessions. It ranged from 0.0170 (RBH99) to 0.0741 (NEC 1592). Based on the suitability of different accessions, they were categorised into resistant (0.0350), moderately resistant (0.0351-0.0450), susceptible (0.0451-0.0600) and highly susceptible (0.0600). Twenty two accessions were found resistant, 40 moderately resistant 109 susceptible and 29 highly susceptible to *C. maculatus* (Table 3).

The observations indicate the operation of antibiosis factor in resistant accessions as reflected well in the varied levels of adults emergence and prolonged developmental period in them. Only five per cent survival was recorded in the resistant accessions. However, the oviposition behaviour was not found to be associated with the level of resistance in the seeds.

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GROWTH ATTRIBUTES ON YIELDING ABILITY IN BLACKGARM

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ABSTRACT

Twelve blackgram genotypes with an arbitrary grouping as 'high' 'medium' and 'low' yielders were studied in terms of assimilate partition. The phenotypic variability was wide. Growth in blackgram is significant between 'peak flowering' and 'harvest' phases. Yielding ability is conditioned by the twin criteria of growth attained on the 45th day and number of folds this value is increased by harvest. Accordingly, CO2 rates itself 'high' among high yielders, No.55 among 'medium' yielders and CM and T9 among 'low' yielders. Growth with the parameter of plant dry weight was phenomenal between 45 days and harvest. This velocity of growth and growth already obtained were yield determinants. This is amply demonstrated by the influence on the typical sigmoid growth curve.

The adaptability of grain legumes to ecological conditions is wide in range. Significance has to be attached to their capacity for survival in rigours of drought. They offer scope for exploitation for extensive cultivation in the tropical belt. Only a small fraction of the legumes is short day plants wheras others day neutral. They suffer badly only under water logged conditions. Except for this trait, grain legumes are eminently suited to extensive cultivation in the tropics. In their negligible demand for water supply a capacity to thrive on poor soils and a number of them being adapted to acid soils as well, eliciting basic information on physiological characteristics of the available genotypes will indeed be gainful. Chosen genotypes representing a wide genetic variability have been studied and observations presented in this contribution. Physiological characteristics will be of added utility in breeding programmes.

MATERIALS AND METHODS:

Twelve genotypes representing 'high', 'medium' and 'low' yield groups are employed in this study. The genotypes were raised at Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore. Bunds were formed with a randomised block design. The soil analysed for PH 7.8; E.C. 0.65 (m.mhos/cm) and NPK status was 219, 16 and 426 Kg/ha respectively. A spacing of 15 x 20 cm was adopted. A total of five irrigations was provided at ten day intervals till flowering.

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