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# STUDIES ON RELATIVE RESISTANCE OF COWPEA GENOTYPES TO *CALLOSOBRUCHUS MACULATUS (*F.) (COLEOPTERA: BRUCHIDAE) BOTH UNDER FIELD AND LABORATORY CONDITION

Nalini, R., R.Usha Kumari, D.S.Rajavel and R.K.Murali Baskaran
Department of Agricultural Entomology, Agricultural College and Research institute, Madurai 625 104

**ABSTRACT**

Seventy three cowpea genotypes collected from different states of India were evaluated for their relative resistance to pulse beetle, *Callosobruchus maculatus* under field condition in the Agricultural College and Research Institute, Madurai. Thirty five genotypes were found to be infested under field condition and seed damage ranged from 3.03 to 3.57 per cent. In no choice confinement test under laboratory condition, fourteen genotypes had high seed damage (6.33 to 100%) as well as the seed weight loss (59.13 to 100 %) and were rated as highly susceptible genotypes. Nineteen genotypes recorded seed damage ranging from 11.18 and 40.00 per cent and percentage seed weight loss between 10.98 and 44.35 and were graded as least susceptible genotypes. Five genotypes namely ACM 0502, PGCP 3, NBC 13, CP 235 and PGCP 5 were absolutely free from pulse beetle damage and rated as resistant genotypes. Thus these five genotypes rated as resistant can be used as resistant donors in the future breeding programmes.

**KEYWORDS:** *Callosobruchus maculatus*, relative resistance, seed damage, seed weight loss.

## INTRODUCTION

India is one of the largest producer and consumers of pulses, accounting for 33 per cent of world area and 24 per cent of world production. At present in India, the total area under pulses is 21.12 million ha with a total production of 11.31 million tonnes with a productivity of 536 kg per ha (Anon., 2005). Cowpea is mainly grown in tropical and sub tropical regions in the world for vegetable and seed purpose and to lesser extent as a fodder crop. It is a most versatile pulse crop because of its smothering nature, drought tolerant characters, soil restoring properties and multi-purpose uses. As a pulse crop, cowpea fits well into most of the cropping systems. In India, cowpea is grown in an area of about 3.9 million hectares with the productivity of 567 kg per ha. The productivity of the crop in Karnataka is low (420 kg/ha) as compared to the national productivity. Besides low productivity, other production constraints are post- harvest technology of pulses, the insect pest problems, improper sanitation and storing methods inflicting both qualitative and quantitative loss to pulses. Totally, 25 species of insects attack pulses (Prabhakar, 1979). Of these, coleopteran insect pests cause major damage to stored grain and grain products worldwide. Among them, *Callosobruchus* spp. belonging to the family Bruchidae, are very serious pests of legumes in storage. It is estimated that about 8.5 per cent of the total damage to stored grains is inflicted by insect pests amounting to great loss. Pulse beetles assume greater importance as they damage both in the field and storage (Anon., 1970). Gene based resistance is one of the most satisfactory and sustainable methods of pest control, particularly as a basic element in integrated pest management approach. Keeping these aspects in view, the present study was taken up to evaluate the cowpea genotypes for resistance to *C. maculatus*.

## MATERIALS AND METHODS

***Field screening for carry-over of population***

Seventy three cowpea genotypes collected from different states of India were screened for their relative resistance to pulse beetle, *C. maculatus* under field condition in the Agricultural College and Research Institute, Madurai during 2009-2010. The experiment was repeated during 2010-11 to confirm the resistance. Each genotype was raised in a plot of size one meter square with spacing 30 x 10 cm in Randomized Block Design. Three replications were maintained. After harvest, the seeds were collected separately from each genotype in cloth bags and observed for adult pulse beetle emergence to record the carry over population from field. In the infested genotypes, total number of seeds and the damaged seeds were counted from each genotype to work out the percent seed damage.

***Laboratory screening***

In no choice confinement test, 20g of cowpea seeds (12% moisture content) from each genotype were taken in a glass bottle separately and five pairs of newly emerged pulse beetle was confined for a week. The mouth of glass bottles was covered with kada cloth firmly. Three replications were maintained. Observations on the number of damaged and undamaged seeds were taken on 45$^{th}$ day after the confinement and percentage damage was worked out. The weight of the damaged and undamaged seeds was also

taken on 45th day after confinement and seed weight loss percentage was worked out.

$$\text{Seed weight loss (\%)} = \frac{UNd - DNu}{U(Nd + Nu)} \times 100$$

Where, U – Weight of undamaged seeds
D – Weight of damaged seeds
Nd – Number of damaged seeds
Nu – Number of undamaged seeds

The data were subjected to statistical analysis following the methods of Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

### *Field screening for carry-over of population*

Of the seventy three cowpea genotypes screened under field condition for carry-over of pulse beetle population, thirty five genotypes were found to be infested under field condition and seed damage ranged from 3.03 to 35.71 per cent (Table 1). Of the field infested genotypes CP 164 (3.03%), GC 3 (3.57%) and Kanagamani (3.57%) had the minimum per cent seed damage. The two genotypes *viz*., V. Jyothika and CP 6 recorded the maximum per cent seed damage of 25.00 and 35.71 respectively.

**TABLE 1.** Relative resistance of cowpea genotypes to pulse beetle (in terms of seed damage) under natural field condition

| Sl.No | Genotypes | Seed damage (%) |
|---|---|---|
| 1. | CP 150 | 10.00 (18.39)$^{f-h}$ |
| 2. | P 491 | 9.09 (17.50)$^{d-h}$ |
| 3. | Lola | 18.52 (25.48)$^{kl}$ |
| 4. | CP 10 | 7.14 (15.42)$^{c-e}$ |
| 5. | CP 196 | 9.09 (17.50)$^{d-h}$ |
| 6. | IVT 19 | 6.67 (14.88)$^{cd}$ |
| 7. | CP 128 | 20.00 (26.55)$^{kl}$ |
| 8. | NBC 30 | 20.00 (26.55)$^{kl}$ |
| 9. | IVT 21 | 17.39 (24.63)$^{kl}$ |
| 10. | NBC 43 | 20.83 (27.14)$^{i}$ |
| 11. | V 240 | 8.33 (16.72)$^{d-g}$ |
| 12. | RC 2 | 5.26 (13.14)$^{bc}$ |
| 13. | GC 3 | 3.57 (10.65)$^{ab}$ |
| 14. | CO 6 | 10.00 (18.40)$^{f-h}$ |
| 15. | CP 338 | 13.33 (21.39)$^{ij}$ |
| 16. | CP 186 | 16.67 (24.08)$^{jk}$ |
| 17. | CP 224 | 20.00 (26.55)$^{kl}$ |
| 18. | PGCP 4 | 12.00 (20.24)$^{hi}$ |
| 19. | NBC 8 | 9.09 (17.50)$^{d-h}$ |
| 20. | CP 164 | 3.03 (9.67)$^{a}$ |
| 21. | NBC 28 | 9.52 (17.93)$^{e-h}$ |
| 22. | Kanagamani | 3.57 (10.65)$^{ab}$ |
| 23. | V. Jyothika | 25.00 (29.99)$^{m}$ |
| 24. | CP 6 | 35.71 (36.69)$^{n}$ |
| 25. | EC 1 | 19.44 (26.15)$^{kl}$ |
| 26. | CP 276 | 11.11 (19.34)$^{g-i}$ |
| 27. | CO 7 | 7.41 (15.73)$^{c-f}$ |
| 28. | V 585 | 11.11 (19.43)$^{g-i}$ |
| 29. | EC 1 | 19.44 (26.15)$^{kl}$ |
| 30. | CP 8 | 8.33 (16.72)$^{d-g}$ |
| 31. | CP9 | 13.64 (2.65)$^{ij}$ |
| 32. | CP 89 | 8.00 (16.37)$^{def}$ |
| 33. | CO 4 | 8.33 (16.72)$^{d-g}$ |
| 34. | P 152 (Check) | 7.69 (16.03)$^{d-f}$ |
| 35. | Vellayani Local | 17.65 (24.83)$^{kl}$ |

Mean of three replications.
Figure in the parentheses are arcsine transformed value.
In the column, means followed by same letters are not significantly different (P=0.05) by DMRT.

### *Laboratory screening*

The relative resistance of the 38 uninfested field genotypes against pulse beetle was studied under laboratory condition. There existed significant difference in the reaction of these genotypes in terms of per cent seed damage and seed weight loss. Fourteen genotypes had high seed damage (6.33 to 100%) as well as the seed weight loss (59.13 to 100 %) and were rated as highly susceptible (HS) genotypes (Table 2). Nineteen genotypes recorded seed damage ranging from 11.18 and 40.00 per cent and percentage seed weight loss between 10.98 and 44.35 and were graded as least susceptible (LS) genotypes (Table 2). Of the least susceptible genotypes, NBC 42, ACM 0508 and CP 274

has the minimum seed damage (11.18 – 14.29 %) and seed weight loss (10.98 – 12.67 %). Five genotypes namely ACM 0502, PGCP 3, NBC 13, CP 235 and PGCP 5 were absolutely free from pulse beetle damage and rated as resistant (R) genotypes (Table 2).

**TABLE 2.** Relative resistance of cowpea genotypes to pulse beetle under laboratory condition

| S. No | Genotypes | Seed damage (%) | Seed weight loss (%) |
|---|---|---|---|
| Group 1 –Highly susceptible | | | |
| 1 | CP 191 | 100.00 (89.26)$^{u}$ | 100.00 (89.26)$^{s}$ |
| 2 | CP 338 | 72.22 (58.20)$^{no}$ | 68.15 (55.65)$^{i}$ |
| 3 | NBC 41 | 100.00 (89.26)$^{u}$ | 100.00 (89.26)$^{s}$ |
| 4 | VBN 1 | 91.30 (72.86)$^{t}$ | 90.12 (71.69)$^{r}$ |
| 5 | NBC 49 | 83.33 (65.91)$^{q}$ | 81.98 (64.89)$^{o}$ |
| 6 | EC 2 | 86.96 (68.84)$^{r}$ | 86.27 (68.26)$^{p}$ |
| 7 | NBC 7 | 84.18 (66.57)$^{q}$ | 88.57 (70.25)$^{q}$ |
| 8. | IVT 25 | 80.00 (63.44)$^{p}$ | 81.48 (64.51)$^{o}$ |
| 9. | PGCP 1 | 100.00 (89.26)$^{u}$ | 100.00 (89.26)$^{s}$ |
| 10. | IVT 16 | 87.50 (69.30)$^{r}$ | 86.13 (68.14)$^{p}$ |
| 11. | CP 129 | 88.89 (70.54)$^{s}$ | 86.94 (68.82)$^{p}$ |
| 12. | NBC 33 | 73.33 (58.91)$^{o}$ | 72.92 (58.64)$^{n}$ |
| 13. | NBC 32 | 70.83 (57.31)$^{n}$ | 70.05 (56.82)$^{m}$ |
| 14. | CP 228 | 63.33 (52.73)$^{m}$ | 59.13 (50.26)$^{k}$ |
| Group 2 Least susceptible | | | |
| 15. | PGCP 2 | 33.24 (35.21)$^{j}$ | 31.75 (34.30)$^{h}$ |
| 16. | CP 43 | 22.10 (28.04)$^{f}$ | 21.54 (27.65)$^{e}$ |
| 17. | Sarika | 24.33 (29.55)$^{g}$ | 25.16 (30.10)$^{f}$ |
| 18. | NBC 20 | 31.86 (34.86)$^{ij}$ | 29.33 (32.79)$^{g}$ |
| 19. | NBC 42 | 11.18 (19.53)$^{a}$ | 10.98 (19.35)$^{a}$ |
| 20. | Subatra | 20.59 (26.91)$^{e}$ | 19.88 (26.48)$^{d}$ |
| 21 | NBC 37 | 30.85 (33.74)$^{hi}$ | 29.56 (32.93)$^{g}$ |
| 22 | RC3 | 25.32 (30.21)$^{g}$ | 24.96 (29.97)$^{f}$ |
| 23 | ACM 0507 | 29.43 (32.86)$^{h}$ | 28.28 (32.12)$^{g}$ |
| 24 | CP 221 | 29.86 (33.09)$^{h}$ | 29.18 (32.70)$^{g}$ |
| 25 | CP 79 | 36.47 (37.15)$^{k}$ | 35.87 (36.79)$^{i}$ |
| 26 | ACM 0508 | 13.66 (21.69)$^{b}$ | 12.43 (20.64)$^{b}$ |
| 27 | CP 18 | 21.22 (27.43)$^{ef}$ | 20.67 (27.04)$^{de}$ |
| 28 | NBC 19 | 15.67 (23.31)$^{d}$ | 15.02 (22.80)$^{c}$ |
| 29 | NBC 9 | 15.28 (23.01)$^{cd}$ | 14.54 (22.41)$^{c}$ |
| 30 | RC 1 | 20.54 (26.95)$^{e}$ | 19.64 (26.30)$^{d}$ |
| 31 | IVT 23 | 40.00 (39.23)$^{i}$ | 44.35 (41.76)$^{j}$ |
| 32 | CP 137 | 29.63 (32.98)$^{h}$ | 29.32 (32.79)$^{g}$ |
| 33 | CP 274 | 14.29 (22.20)$^{bc}$ | 12.67 (20.85)$^{b}$ |
| Group 3 Resistant | | | |
| 34 | PGCP 5 | 0.00 | 0.00 |
| 35 | NBC 13 | 0.00 | 0.00 |
| 36 | CP 235 | 0.00 | 0.00 |
| 37 | PGCP 3 | 0.00 | 0.00 |
| 38 | ACM 0502 | 0.00 | 0.00 |

Mean of three replications.

Figure in the parentheses are arcsine transformed value.

In the column, means followed by same letters are not significantly different (P=0.05) by DMRT.

Satyavir (1983) screened twenty four promising varieties of cowpea for their relative resistance to *C. maculatus*. Among these genotypes, VC 5, 25/8/2/2, RS 9, CG 28 and Sel 1476 proved to be relatively resistant, whereas Copusa 1, V 7, Copusa 2, 26/4/1, culture 2, 5262 and P.T.B.I. were found to be most susceptible varieties. Shivanna *et al.,* 2011 reported that CP 17, IT 38956, KBC 2 and KBC 1 are less susceptible to pulse beetle. Thus these five genotypes *viz*., ACM 0502, PGCP 3, NBC 13, CP 235 and PGCP 5 rated as resistant can be used as resistant donors in the future breeding programmes. Further investigations on the seed characteristics like seed colour, texture, size, hardness and its biochemistry related to seed protein types, amino acid profiles and antinutritional factors content which confers the resistance are to be explored.

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