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Identification of sources of resistance in cowpea germplasm against Aphids, *Aphis craccivora* (Koch) and Legume pod borer, *Maruca vitrata* (Fabricius)

Aarthi S, Selvanarayanan V
Department of Entomology, Annamalai University, Chidambaram, Tamil Nadu, India

Abstract
Cowpea cultivation is hampered by various insect pests, among which the aphids, *Aphis craccivora* (Koch) and legume pod borer, *Maruca vitrata* (Fabricius) are most predominant and also cause significant yield loss. Among the various management strategies, exploring and exploiting the resistance available in cowpea germplasm is an eco-friendly and effective approach to manage such insect pests. Considering the above, to identify the resistant sources in cowpea germplasm against *A. craccivora* and *M. vitrata*, ten genotypes selected from preliminary evaluations were screened under field condition in the Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar, Chidambaram, India. The results obtained from this study showed that, the mean infestation index of aphids was the lowest on EC-724316 followed by EC-107183 and the highest on EC-98442-II. Percent pod damage caused by legume pod borer was the least on IC-39870 which was followed by IC-52118, in contrast to the highest pod damage noted on EC-161916. The genotypes EC-724316 and IC-39870 were selected respectively for further evaluation against aphids and legume pod borer to develop desirable varieties.

Keywords: cowpea, genotypes, aphids, legume pod borer, resistance

Introduction
Legumes are multipurpose crops in any cropping system and among the legumes Cowpea, *Vigna unguiculata* [L.] Walp. is a key dietary staple legume in many developing countries (Dhaliwal, 2008) [3] In all the growth stages of the crop, incidence of insect pests are encountered. Dugje *et al*. (2009) [4] reported that *Aphis craccivora* (Koch.) and *Maruca vitrata* (Fabricius) are the major field pests causing significant yield loss in cowpea.
Aphids attack all vegetative parts especially the growing tip and cause leaf curling, loss of vitality and reduction in growth. In severe cases, plants fail to bear flowers and pods resulting in yield loss of more than 50% (Obopile, 2006) [10]. Next to the aphids, legume pod borer, *M. vitrata* infests the young growing plant tips, flower buds, flowers, pods and seeds and pose a significant constraint to the productivity of cowpea and causes 30 to 85% yield loss (Jackai and Daoust, 1986) [7] in different parts of the world.
The use of insecticides has been the recommended control practice for both the pests, but it is expensive, also destroys natural enemies and causes toxic hazards in the environment. Hence, the utilization of host plant resistance is one of the most effective approaches to minimize the damage caused by aphids and pod borer on cowpea (Huynh *et al*., 2015) [5]. With the above background, an experiment was conducted under field condition to assess the resistance level of 10 cowpea genotypes of which five were found promising against aphids, *A. craccivora* whereas other five against *M. vitrata.*

Materials and Methods
For this study, ten genotypes selected based on preliminary screening (Aarthi and Selvanarayanan, 2022) [1] were sown in 2 X 2 m micro plots in randomized block design with four replications at the screening yard, Department of Entomology, Faculty of Agriculture, Annamalainagar, Chidambaram, India. The seeds were sown by adopting 45 cm between rows and 15 cm between plants. For each replication, five plants were randomly selected for recording the population and damage caused by aphids and legume pod borer.
The intensity of infestation by aphids was recorded for each genotype at weekly intervals from the first infestation. Genotypes were categorized based on visual grading by adopting the 0-4 scale proposed by Jayappa (1984) [8] and Anusha *et al*. (2013) [2] (Table 1).

Table 1: Grading of intensity of infestation of aphids (Jayappa, 1984 and Anusha, 2013) [8, 2]

Grade	Intensity of infestation
0	Free from aphids
1	Less than 25 per cent of the plant area covered by aphids
2	25-50 per cent of the plant area covered by aphids

3	50-75 per cent of the plant area covered by aphids
4	75-100 per cent of the plant area covered by aphids

The number of plants falling under each category was multiplied with each grade value and the sum of the products was divided by the number of plants observed to obtain the mean aphid infestation index.

$$\text{Mean infestation index} = \frac{\text{Sum of (All numerical ratings x Grade value)}}{\text{Number of plants}}$$

Baesd on the infestation index, the genotypes were categorized based on the resistance rating proposed by Jayappa (1984) [8] (Table 2).

Table 2: Aphid infestation index rating (Jayappa, 1984) [8]

Aphid infestation index	Rating
0.0-1.0	Resistant
1.0-2.0	Moderately Resistant
2.0-3.0	Susceptible
3.0-4.0	Highly Susceptible

For assessing the pod borer damage, five plants were randomly selected from each replication and on each plant, five peduncles were randomly observed for damage by *M. vitrata*. Pod damage in each peduncle was observed on each genotype from the first infestation at weekly interval. The pod damage percentage was calculated by using the following formula:

$$\text{Per cent pod damage} = \frac{\text{Number of infested pods}}{\text{Total number of pods}} \text{ X } 100$$

These values were converted into scores by following 1 to 5 scale as per the resistance rating proposed by Jackai (1982) [6]. (Table 3).

Table 3: Resistance rating for percent pod damage by legume pod borer

% damage per peduncle	Score	Resistant rating
0-20	1	Highly resistant
21-40	2	Moderately resistant
41-60	3	Intermediate
61-80	4	Susceptible
81-100	5	Highly susceptible

Results and Discussion

A huge germplasm of cowpea comprising 280 genotypes was evaluated for resistance against aphids and legume pod borer during *rabi* season of the year of 2020 and *kharif* season of the year 2021 at Vallampadugai Village, Cuddalore district, Tamil Nadu state, India. Based on the preliminary screening, four genotypes namely EC-724316, EC-42712, EC-107183, EC-43972 found promising against aphids were selected in comparison with a susceptible genotype EC-98442-II. Similarly, four genotypes namely IC-39870, IC-39890, IC-52118, IC-39869 found promising against legume pod borer were selected in comparison with EC-161916. In the present study, aphid infestation was observed from 16 DAS on young leaves. Among the genotypes tested against aphids, two were rated as highly resistant, two were moderately

Table 4: Screening of cowpea genotypes against aphids, *A. craccivora*

S. no	Genotypes	Overall mean infestation	Category
1	EC-724316	0.40 (1.18)	Resistant
2	EC-42712	1.57 (1.60)	Moderately resistant
3	EC-107183	0.74 (1.31)	Resistant
4	EC-43972	1.86 (1.69)	Moderately resistant
5	EC-98442-II	3.69 (2.16)	Highly susceptible
	SE (m)	0.008	
	C.D. at 5%	0.026	
	C.V.	1.046	

resistant and one genotype fell under highly susceptible category. The aphid population was the least in EC-724316 with mean infestation index of 0.40 which falls under highly resistant category and it was followed by

EC-107183. In contrast to this, EC-98442-II with mean infestation index of 3.69 was grouped under highly susceptible category (Table 4).

In an earlier study, Jayappa (1984) [8] reported that cowpea genotypes *viz*., P-93, P-144, TVx-1997-3D and P-965 as resistant, moderately resistant, intermediate resistant and susceptible, respectively. According to Anusha *et al*. (2013) [2], genotypes C-152, GC-3, and DC-15 were highly resistant, whereas DC-47-1 was moderately resistant. The genotypes RC-101 and PGCP-6 on the other hand, were considered as highly susceptible.

Table 5: Screening of cowpea genotypes against legume pod borer, *M. vitrata*

S. No	Genotypes	Mean percent pod damage	Score	Category
1	IC-39870	11.43 (19.74)	1	Highly resistant
2	IC-39890	26.86 (31.19)	2	Moderately resistant
3	EC-161916	86.21 (65.16)	5	Highly susceptible
4	IC-52118	18.76 (25.65)	1	Highly resistant
5	IC-39869	35.66 (36.64)	2	Moderately resistant
	SE (m)	0.379		
	C.D. at 5%	1.181		
	C.V.	2.124		

Among the genotypes tested against legume pod borer, two were rated as highly resistant and two were moderately resistant. Per cent infestation on pods among the tested genotypes ranged from11.43 per cent to 86.21 per cent and the lowest percent pod damage was noted on IC-39870 followed by IC-52118. In contrast, highest damage was noted on EC-161916 (Table 5).

Anusha (2013) [2] recorded lowest percentage of pod infestation on C-152, DC-15 and GC-3 followed by DC-47-1, RC-101 and PGCP-6. Similarly, Lalasangi (1984) [9] recorded that cowpea varieties 52-38, PI-339, P-869 and MS-90-82/2 had minimum pod damage. Oghiakhe *et al*. (1992) [11] reported that, higher percent pod damage was noted on IT82D-716 than in Tvu 946 and MRx109-84M. In the present study, pod infestation commenced from 49 DAS and reached its peak on 63 DAS.

Conclusion

In the light of these findings, genotypes EC-724316 for aphids and IC-39870 for legume pod borer are selected for future breeding programmes and also large scale cultivation, after multi-location evaluation.

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