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RESEARCH PAPER

Screening of fodder cowpea germplasm against pod borers

MEGHA[1], N. S. KULKARNI[1], K. SRIDHAR[2] AND R. CHANNAKESHAVA[1]

[1]Department of Entomology, [2]Department of Genetics & Plant Breeding, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, India
*E-mail: megha.khed@gmail.com

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Abstract: A field experiment was conducted during *kharif* 2024 at ICAR–Indian Grassland and Fodder Research Institute (IGFRI), Southern Regional Research Station, Dharwad, to evaluate 150 fodder cowpea (*Vigna unguiculata* [L.] Walp.) germplasm lines along with five checks for resistance against pod borers under natural field conditions. Pod damage was assessed using the visual rating scale of Jackai and Singh (1982). The results revealed significant variation among germplasm lines, with pod damage ranging from 23.47 to 79.67%. Based on the extent of damage, 26 lines were categorized as moderately resistant (21-40% damage), 87 as intermediate (41-60%) and 37 as susceptible (61-80%), while no line exhibited complete resistance (0-20%). The study identified FC125, FC39, FC8, FC141 and FC142 as promising entries with lower pod damage. These findings provide valuable insights for identifying resistance sources and can be utilized in breeding programs aimed at developing pod borer-resistant fodder cowpea varieties.

Key words: Cowpea, Fodder germplasm, ICAR–IGFRI, *Maruca vitrata*, Pod borer, Resistance screening

Introduction

Livestock production constitutes a vital component of agricultural systems across India and other developing nations, serving as a cornerstone for rural livelihoods, food security and national economic growth. However, its full potential is hindered by a chronic deficit in quality fodder-both in quantity and nutritive value-which constrains animal performance and diminishes yields of milk, meat and other livestock-derived products. Within the diverse array of forage resources, leguminous fodder crops hold a pivotal role, offering protein-rich feed while simultaneously enriching soil fertility through biological nitrogen fixation (Singh, 2023).

Among these, cowpea (*Vigna unguiculata* [L.] Walp.), historically cultivated as a pulse and vegetable, has gained prominence as a superior fodder crop due to its rapid biomass accumulation, short growth duration and remarkable adaptability to a wide range of agro-climatic conditions, including drought-prone and marginal lands unsuitable for other forages. The foliage of cowpea is abundant in crude protein (18-24%), essential amino acids, minerals and digestible nutrients, rendering it an excellent feed source for cattle, buffaloes, sheep and goats. Its high palatability promotes better intake and utilization, leading to enhanced growth, reproductive performance and milk yield. Furthermore, cowpea provides valuable green fodder during lean summer periods or after cereal harvests, thereby bridging seasonal feed shortages. When cultivated as a sole crop or intercropped with cereals such as maize, sorghum, or pearl millet, it contributes to improved total forage yield and nutritive balance by combining protein-dense legumes with energy-rich cereals (Tarawali *et al*., 1997).

Despite these advantages, cowpea productivity is severely constrained by biotic stresses-particularly infestation by the pod borer complex, primarily *Maruca vitrata* (Fabricius) and *Cydia ptychora* (Meyrick). These pests inflict considerable damage to flowers and pods, leading to reduced seed set and deterioration in fodder quality. *M. vitrata* typically attacks floral structures and young pods, producing characteristic webbing and flower shedding, while *C. ptychora* bores into developing pods, impairing grain formation and compromising total biomass. Alongside secondary pests such as aphids and leafhoppers, these borers pose a major threat to sustainable fodder cowpea cultivation. Moreover, shifting climatic patterns further exacerbate pest dynamics, influencing their incidence, severity and temporal activity. Hence, systematic studies on the seasonal population dynamics of *M. vitrata* and *C. ptychora*, their correlations with meteorological parameters and their interactions with natural enemies are indispensable for devising eco-friendly pest management strategies. Such insights are crucial for sustaining cowpea productivity, preserving fodder quality and ensuring reliable feed resources for livestock in diverse agro-ecological systems (Soratur *et al*., 2017). Varying yield loss has been reported *viz*. 20-60 per cent in cowpea (Singh and Alen, 1980), 9.14-34.95 per cent in dolichos bean (Rekha and Mallapur, 2007).

Material and methods

A field experiment was carried out at the Indian Grassland and Fodder Research Institute (IGFRI), Southern Regional Research Station, Dharwad, during *kharif* 2024 to evaluate the incidence of pod borers on core set fodder cowpea germplasm. A total of 150 fodder cowpea germplasm lines were screened under field conditions. Each germplasm was sown in a single row of 2 m length following a spacing of 30 × 10 cm between rows and plants, respectively. The crop was raised following the recommended package of practices to ensure uniform growth and minimize external variability.

Table 1. Visual rating scale for legume pod borer damage to cowpea (Jackai and Singh, 1988)

Rating	Per cent pod damage	Category
1	0–10	Highly resistant
2	11–20	
3	21–30	Moderately resistant
4	31–40	
5	41–50	Intermediate resistant
6	51–60	
7	61–70	Susceptible
8	71–80	
9	81–90	Highly susceptible
10	91–100	

Assessment of pod borer damage

Observations on pod borer damage were recorded during the peak incidence period. The extent of pod damage was assessed visually using the 1-10 rating scale developed by Jackai and Singh (1988) for legume pod borer damage in cowpea. For each germplasm line, three plants were randomly selected and the percentage of pod damage was calculated using the following formula:

Based on the classification proposed by Jackai and Singh (1982), the germplasm lines were categorized into five resistance groups: highly resistant, moderately resistant, intermediate resistant, susceptible and highly susceptible, as presented in Table 1.

Results and discussion

During *kharif* 2024, a comprehensive screening trial was conducted at ICAR-IGFRI, Southern Regional Research Station, Dharwad, to evaluate 150 fodder cowpea germplasm lines along with five checks (BL-1, BL-2, BL-4, EC-4216 and IGFRI-DC-215) for resistance to pod borer infestation under natural field conditions. Pod damage was recorded at the peak infestation stage, approximately one week before harvest and the percentage of pod damage was calculated following the classification of Jackai and Singh (1982).

The screening revealed significant variation in pod borer damage among the germplasm lines, with per cent pod damage ranging from 23.47 to 79.67% (Table 2). Based on the extent of damage, the germplasm were grouped into moderately resistant, intermediate and susceptible categories (Table 3).

Among the tested entries, FC125 (23.47%), FC39 (25.69%), FC8 (27.78%), FC141 (28.80%) and FC142 (29.46%) recorded the lowest pod damage, indicating moderate resistance to pod borer infestation. Several other entries such as FC40 (43.98%), FC34 (44.44%), FC109 (45.36%) and FC35 (46.42%) exhibited intermediate resistance with moderate levels of pod damage.

Conversely, FC102 (79.67%), FC49 (71.34%) and FC55 (62.67%) were identified as highly susceptible, along with FC13 (62.56%), FC18 (54.69%), FC28 (61.26%), FC148 (68.47%) and FC151 (69.46%), which sustained severe pod damage. The check varieties also exhibited high pod damage, confirming uniform pest pressure across the experiment. Pod damage among checks ranged from 61.74% in EC-4216 to 75.79% in BL-2, placing all in the susceptible group.

Based on the classification of Jackai and Singh (1982), none of the evaluated germplasm lines were highly resistant (0-20% pod damage). A total of 26 lines were categorized as moderately resistant (21-40% pod damage), 87 lines as intermediate (41-60% pod damage) and 37 lines as susceptible (61-80% pod damage), including the check varieties. No germplasm lines were recorded in the highly susceptible category (81-100% pod damage). The overall distribution indicated that the majority of the germplasm exhibited intermediate to high levels of pod damage under natural infestation conditions.

The present study demonstrated significant variability in pod borer damage among fodder cowpea germplasm lines evaluated under natural field conditions. Pod damage ranged from 23.4 to 75.35%, increasing progressively with crop age. This trend corroborates the findings of Jackai and Singh (1988), who reported that the peak infestation of *Maruca vitrata* coincides with the podding stage, leading to maximum damage during crop maturity.

Among the 150 germplasm lines screened, 26 lines were categorized as moderately resistant, 77 as intermediate resistant and 22 as susceptible, based on the scale of Jackai and Singh (1982). Most of the evaluated germplasm were recently developed entries from ICAR-IGFRI, Dharwad, with limited prior information available regarding their resistance to pod borers. Hence, field screening under natural pest pressure was instrumental in identifying potential resistance sources. The absence of highly resistant lines (0-20% pod damage) aligns with earlier reports suggesting that complete resistance to pod borers in cowpea is rare, owing to the pest's adaptability and the polygenic nature of host resistance (Jackai and Singh, 1988). Nevertheless, the identification of 26 moderately resistant lines (21-40% pod damage) provides valuable material for resistance breeding. Similar observations were made by Aarthi and Selvanarayanan (2022), who identified 52 moderately resistant lines (≤ 40% pod damage) among 280 genotypes and by Jakhar *et al.* (2017), who reported partial resistance (10-20% pod damage) in genotypes GC 5 and GC 0815.

The predominance of germplasm lines in the intermediate category (41-60% pod damage) highlights the overall vulnerability of the existing genetic pool. Although these lines may not be directly suitable for cultivation, they represent a useful base for incorporating resistance through breeding. Singh *et al.* (2016) emphasized that intermediate lines can serve as donors for pyramiding resistance genes when combined with moderately resistant sources, thereby enhancing the durability of resistance in cowpea cultivars.

Conversely, 37 lines, along with the check varieties, were classified as susceptible (61-80% pod damage), confirming the high pest pressure during the screening. Similar susceptibility patterns were reported by Tamo *et al.* (2012) and Ekesi *et al.* (2003), who observed that several traditionally cultivated cowpea varieties are highly prone to *M. vitrata* infestation. The absence of germplasm in the highly susceptible category (81-100% pod damage) suggests that extreme susceptibility may be limited by environmental factors or minor tolerance

Table 2. Reaction of fodder cowpea germplasm lines against pod borers during *kharif* 2024

Sl. No	Germ plasm	Pod damage (%)	Sl. No	Germ plasm	Pod damage(%)	Sl. No	Germ plasm	Pod damage (%)	Sl. No	Germ plasm	Pod damage(%)
1	FC1	67.35 (55.15)	40	FC43	35.30 (36.45)	79	FC85	42.06 (40.43)	118	FC130	42.77 (40.84)
2	FC2	69.81 (56.67)	41	FC44	56.13 (48.52)	80	FC86	41.47 (40.09)	119	FC131	66.11 (54.40)
3	FC3	44.29 (41.72)	42	FC45	43.17 (41.07)	81	FC87	54.68 (47.69)	120	FC132	41.99 (40.39)
4	FC4	67.45 (55.21)	43	FC46	28.28 (32.13)	82	FC88	67.82 (55.44)	121	FC133	34.60 (36.03)
5	FC5	45.02 (42.14)	44	FC47	48.41 (44.09)	83	FC89	33.27 (35.23)	122	FC134	33.20 (35.18)
6	FC6	37.59 (37.81)	45	FC48	45.54 (42.44)	84	FC90	42.95 (40.95)	123	FC136	29.29 (32.77)
7	FC7	62.23 (52.08)	46	FC49	71.34 (57.63)	85	FC91	63.34 (52.74)	124	FC137	44.68 (41.95)
8	FC8	27.78 (31.81)	47	FC50	48.94 (44.39)	86	FC92	59.17 (50.28)	125	FC138	50.00 (45.00)
9	FC9	48.61 (44.20)	48	FC51	65.34 (53.93)	87	FC93	50.53 (45.30)	126	FC139	36.21 (37.00)
10	FC10	45.04 (42.15)	49	FC52	45.56 (42.45)	88	FC94	66.96 (54.91)	127	FC140	43.06 (41.01)
11	FC11	42.33 (40.59)	50	FC53	55.32 (48.05)	89	FC95	63.45 (52.80)	128	FC141	28.80 (32.46)
12	FC12	51.50 (45.86)	51	FC54	42.68 (40.79)	90	FC98	43.60 (41.32)	129	FC142	29.46 (32.87)
13	FC13	62.56 (52.27)	52	FC55	62.67 (52.34)	91	FC100	62.64 (52.32)	130	FC143	41.11 (39.88)
14	FC14	60.45 (51.03)	53	FC57	41.26 (39.97)	92	FC101	45.56 (42.45)	131	FC144	45.83 (42.61)
15	FC15	40.78 (39.69)	54	FC58	40.74 (39.66)	93	FC102	79.67 (63.20)	132	FC145	32.64 (34.84)
16	FC16	51.54 (45.88)	55	FC59	39.96 (39.21)	94	FC103	52.05 (46.17)	133	FC146	46.36 (42.91)
17	FC17	64.45 (53.4)	56	FC60	45.24 (42.27)	95	FC104	46.92 (43.23)	134	FC147	61.23 (51.49)
18	FC18	54.69 (47.69)	57	FC61	35.04 (36.30)	96	FC105	67.58 (55.29)	135	FC148	68.47 (55.84)
19	FC19	63.21 (52.66)	58	FC62	53.62 (47.08)	97	FC108	33.62 (35.44)	136	FC150	54.04 (47.32)
20	FC22	58.47 (49.88)	59	FC63	41.94 (40.36)	98	FC109	45.36 (42.34)	137	FC151	68.39 (55.79)
21	FC24	61.12 (51.43)	60	FC64	62.45 (52.21)	99	FC111	45.37 (42.34)	138	FC152	53.10 (46.78)
22	FC25	58.69 (50.00)	61	FC65	50.53 (45.30)	100	FC112	68.67 (55.96)	139	FC153	66.21 (54.46)
23	FC26	53.85 (47.21)	62	FC67	45.40 (42.36)	101	FC113	45.73 (42.55)	140	FC154	43.06 (41.01)
24	FC27	52.71 (46.55)	63	FC68	32.70 (34.88)	102	FC114	41.58 (40.15)	141	FC155	68.80 (56.04)
25	FC28	61.26 (51.51)	64	FC69	43.67 (41.36)	103	FC115	61.23 (51.49)	142	FC157	69.46 (56.45)
26	FC29	47.58 (43.61)	65	FC71	45.19 (42.24)	104	FC116	42.33 (40.59)	143	FC159	41.11 (39.88)
27	FC30	54.60 (47.64)	66	FC72	45.24 (42.27)	105	FC117	48.68 (44.24)	144	FC160	45.83 (42.61)
28	FC31	39.90 (39.17)	67	FC73	63.23 (52.67)	106	FC118	60.34 (50.97)	145	FC161	32.64 (34.84)
29	FC32	47.08 (43.33)	68	FC74	45.29 (42.30)	107	FC119	46.15 (42.79)	146	FC162	46.36 (42.91)
30	FC33	69.67 (56.58)	69	FC75	46.41 (42.94)	108	FC120	30.16 (33.31)	147	FC163	36.47 (37.15)
31	FC34	44.44 (41.81)	70	FC76	51.20 (45.69)	109	FC121	42.31 (40.58)	148	FC164	39.90 (39.17)
32	FC35	36.47 (37.15)	71	FC77	48.03 (43.87)	110	FC122	47.62 (43.64)	149	FC165	66.34 (54.54)
33	FC36	54.70 (47.70)	72	FC78	52.08 (46.19)	111	FC123	37.46 (37.74)	150	FC166	47.58 (43.61)
34	FC37	65.45 (54.00)	73	FC79	43.49 (41.26)	112	FC124	44.44 (41.81)		C1	75.79 (60.53)
35	FC38	53.74 (47.14)	74	FC80	46.02 (42.72)	113	FC125	63.47 (52.81)		C2	71.35 (57.64)
36	FC39	25.69 (30.45)	75	FC81	46.02 (42.72)	114	FC126	41.08 (39.86)		C3	69.39 (56.41)
37	FC40	43.98 (41.54)	76	FC82	48.25 (44.00)	115	FC127	64.56 (53.46)		C4	61.74 (51.79)
38	FC41	51.27 (45.73)	77	FC83	51.43 (45.82)	116	FC128	49.44 (44.68)		C5	66.99 (54.93)
39	FC42	33.60 (35.43)	78	FC84	53.55 (47.04)	117	FC129	65.20 (53.85)			
		S. Em. (±)						3.90			
		C.D (p=0.05)						11.79			
		C.V (%)						12.82			

**Fig in parentheses are arcsine transformed values

Table 3. Categorization of cowpea germplasm based on per cent pod damage as per scale given by Jackai and Singh, 1982

Scale	Per cent pod damage	Category	Number of germplasm lines	Per cent pod damage observed
1	0-20	Highly resistant	-	-
2	21-40	Moderately resistant	26	23.47-40.78
3	41-60	Intermediate	87	41.11-60.34
4	61-80	Susceptible	37+5	61.12-75.35
5	81-100	Highly susceptible	-	-
Total	150 + 5			

mechanisms within genotypes, as also observed by Sreekanth *et al.* (2021).

The results of this study are consistent with those of Muchhadiya *et al.* (2023), who identified cowpea lines GC-6 and GC-1605 with low pod borer damage under field conditions. Collectively, these findings underscore the practical significance of moderately resistant germplasm as a foundation for developing improved fodder cowpea varieties with stable and sustainable resistance to pod borers.

Conclusion

The present investigation revealed significant variability in the response of fodder cowpea germplasm lines to pod borer infestation under natural field conditions. None of the evaluated lines exhibited complete resistance; however, 26 lines showed moderate resistance with comparatively lower pod damage (21–40%), making them valuable genetic resources for resistance breeding. The predominance of intermediate and susceptible lines indicated the need for incorporating resistant sources into breeding programs. The identified moderately resistant lines can serve as potential donors for developing improved fodder cowpea cultivars with stable and sustainable resistance to *Maruca vitrata*, thereby enhancing fodder productivity and quality.

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