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RESEARCH PAPER

Studies on population dynamics of pod borers in fodder cowpea *Vigna unguiculata* (L.) Walp

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Abstract: The present study investigated the population dynamics of the pod borer complex, *Maruca vitrata* (Fabricius) and *Cydia ptychora* (Meyrick), along with their natural enemies in fodder cowpea during *kharif* 2024 at ICAR-IGFRI, SRRS, Dharwad. Cowpea variety BL-4 was grown in a 200 m² plot without plant protection measures and weekly observations were recorded from pod initiation to crop maturity. *M. vitrata* infestation began in mid-September, with larval populations peaking in late October–early November (5.38 larvae/plant; 30.05% pod damage). *C. ptychora* appeared slightly later but reached higher levels, peaking at 9.23 larvae/ plant and 39.60% pod damage, indicating its greater destructive potential. Natural enemies, mainly coccinellids and spiders, contributed significantly to pest suppression. Coccinellids exhibited density-dependent fluctuations, peaking along side initial pod borer outbreaks, while spiders maintained consistent activity throughout, peaking in early November. Correlation analysis revealed that maximum temperature positively influenced *M. vitrata*, while minimum temperature and relative humidity showed significant negative correlations with both pod borers and pod damage. Spiders showed strong positive associations with pest populations, highlighting their ecological role. The study emphasizes the importance of pest monitoring, conservation of natural enemies and climatic considerations in developing eco-friendly management strategies for sustainable cowpea fodder production.

Keywords: Cowpea, *Cydia ptychora*, Pod borer complex, Pod damage, Population dynamics, *Maruca vitrata*,

Introduction

Livestock production forms an integral part of agricultural systems in India and other developing countries, contributing substantially to rural livelihoods, food security and the overall economy. However, the sector is constrained by a persistent shortage of quality fodder, both in terms of availability and nutritive value, which limits animal productivity and reduces milk, meat and other livestock-derived outputs. Among the diverse forage resources, leguminous fodder crops play a crucial role as they provide nutritionally rich feed and enhance soil fertility through biological nitrogen fixation (Singh, 2023).

Cowpea (*Vigna unguiculata* (L.) Walp.), traditionally cultivated as a pulse and vegetable, has emerged as a high-yielding and highly nutritious fodder crop owing to its rapid growth, short duration and adaptability to varied agro-climatic conditions, including drought-prone and marginal soils where other forages perform poorly. Cowpea foliage is rich in crude protein (18-24%), essential amino acids, minerals and digestible nutrients, making it highly suitable for feeding cattle, buffaloes, sheep and goats, with demonstrated benefits in growth, reproductive efficiency and milk yield. Its high palatability ensures greater intake and utilization by livestock, while the provision of succulent green fodder during lean summer months or post-harvest periods helps bridge seasonal feed gaps. The crop can be grown as a sole forage or intercropped with cereals such as maize, sorghum or pearl millet, enhancing both total forage yield and nutritive balance by combining protein-rich legumes with carbohydrate-rich cereals (Tarawali *et al*., 1997).

Despite these advantages, cowpea production is threatened by biotic stresses, particularly the pod borer complex, dominated by *Maruca vitrata* (Fabricius) and *Cydia ptychora* (Meyrick), which cause substantial pod damage and reduce fodder quality. *M. vitrata* feeds on flowers, buds and pods, producing webbing and premature shedding, whereas *C. ptychora* bores into developing pods, affecting seed formation and overall forage productivity. Alongside other pests such as aphids and leafhoppers, these borers represent major constraints to fodder cowpea cultivation. Furthermore, changing climatic conditions influence pest incidence, severity and crop performance. Therefore, studies focusing on the weekly population fluctuations of *M. vitrata* and *C. ptychora*, their correlation with weather parameters and their ecological relationships with predators are essential to optimize cowpea productivity, maintain fodder quality and ensure sustainable feed resources for livestock (Soratur *et al*., 2017).

Material and methods

Experimental design

Field investigations on the population dynamics of the cowpea pod borer complex (*Maruca vitrata* Fabricius and *Cydia ptychora* Meyrick) and the natural enemies were conducted during *kharif* 2024 at ICAR–IGFRI, SRRS, Dharwad. The fodder cowpea variety BL-4 was sown in a 200 m² block at spacing of 45 × 15 cm, following the recommended agronomic practices. The crop was maintained without plant protection measures to allow natural pest build-up.

Sampling and observations

Fifty plants were randomly selected and tagged, including 40 from four quadrants and 10 from the centre. Weekly

observations were recorded from pod initiation until crop maturity. Pod damage was assessed as the proportion of damaged pods to the total pods per plant. Predators were sampled from 10 plants in each quadrant using sweep nets, hand-picking and a poison bottle. Pod borer–infested pods were collected from the field and reared in the laboratory inside cages. These were monitored daily for parasitoid emergence and any emerged parasitoids were collected, preserved and identified. Field predators were pinned and preserved for identification.

Meteorological Data

Weather data on maximum and minimum temperature (°C), relative humidity (%) and rainfall (mm) were obtained from the Meteorological Unit, MARS, UAS, Dharwad.

Data Analysis

Weekly mean populations of pod borers and natural enemies were calculated. The relationship between pest incidence and abiotic factors was analyzed using correlation. The pod borer complex population was treated as the dependent variable, while weather parameters were considered independent variables. Statistical analyses followed the method of Snedecor and Cochran (1967).

Results and discussion

The population dynamics of pod borers and their natural enemies were monitored weekly during *kharif* 2024, from mid-August to early December. The study focused on larval populations of *Maruca vitrata* and *Cydia ptychora*, per cent pod damage and the abundance of key natural enemies, particularly coccinellids and spiders. (Table 1) *Maruca vitrata*, the legume pod borer, was absent during the first four weeks of crop growth (12th August–8th September), indicating minimal early-stage infestation. Larvae were first observed during 38th SMW (16th –22nd September), averaging 0.40 larvae per plant and causing 2.20% pod damage. Populations increased steadily thereafter, reaching a peak during 44 SMW (28th October–3rd November) with 5.38 larvae per plant, resulting in 40.05% pod damage at 45th SMW. Following this peak, larval numbers gradually declined towards early December. This pattern highlights the mid- to late-stage susceptibility of cowpea to *M. vitrata* and underscores its capacity to cause substantial pod damage if not managed timely.

Cydia ptychora, another important pod borer, exhibited a slightly delayed infestation pattern. No larvae were recorded during the first five weeks of crop growth. The species was first detected during 40th SMW (30th September–6th October), at 0.90 larvae per plant, causing 5.30% pod damage. Larval populations peaked during 46th SMW (18th November- 24th November) at 10.89 larvae per plant, causing 43.68 % pod damage at 48th SMW, exceeding the peak damage of *M. vitrata*. Although numbers declined slightly towards late November, pod damage remained high, reflecting cumulative feeding over time and highlighting the significant destructive potential of *C. ptychora*.

Natural enemies, mainly coccinellids and spiders, played a crucial role in regulating pod borer populations. Coccinellids were absent during early crop stages but appeared from mid-September onwards, peaking at 8.26 per plant during 40th SMW (30th September–6th October), coinciding with the initial rise in *M. vitrata* populations. Their numbers fluctuated in accordance with pest density, demonstrating their opportunistic predation. Spiders appeared slightly earlier than coccinellids and were consistently present throughout the monitoring period, peaking at 2.98 per plant during 44th SMW (28th October–3rd November). Their continuous presence indicates their role as generalist predators, contributing to sustained ecological suppression of pod borers.

Correlation analysis (Table 2) provided insights into the influence of environmental factors on pest dynamics. *M. vitrata* larval population showed a significant positive correlation with

Table 1. Population dynamics of pod borers and natural enemies with prevailing weekly weather parameters during *kharif* 2024

Standard meterological weeks		*Maruca vitrata*		*Cydia ptychora*		Coccinellids/ plant (Grubs and adults)	Spider/ plant	Rainfall (mm)	Temperature (°C)		Relative humidity (%)	
		Larve/ plant	Per cent pod damage	Larve /plant	Per cent pod damage				Max	Min	Max	Min
33	12th Aug -18th Aug	0	0	0	0	0	0	3.40	30.70	20.90	89.30	68.10
34	19th Aug-25th Aug	0	0	0	0	0	0	30.60	28.10	20.90	92.40	82.10
35	26th Aug-1st Sept	0	0	0	0	0	0	21.00	26.70	20.40	91.00	85.00
36	2nd Sept-8th Sept	0	0	0	0	0	0	17.00	27.90	20.50	87.30	81.70
37	9th Sept-15th Sept	0	0	0	0	0.9	0	4.60	28.60	19.50	88.3	74.70
38	16th Sept-22nd Sept	0.40	2.20	0	0	3.20	0	13.60	29.50	19.30	88.70	57.40
39	23rd Sept-29th Sept	1.02	0.13	0	0	7.80	0.20	50.60	28.40	19.20	87.90	54.70
40	30th Sept-6th Oct	2.01	12.32	0.90	5.30	8.26	0.70	30.40	31.70	20.50	85.10	71.40
41	7th Oct-13th Oct	2.91	15.56	2.23	19.02	6.89	0.90	140.80	30.40	20.30	88.30	77.70
42	14th Oct-20th Oct	3.56	18.90	5.30	22.43	5.72	1.25	76.00	28.30	20.90	91.90	74.30
43	21st Oct-27th Oct	4.26	27.89	7.67	34.31	5.49	1.85	13.60	29.90	20.10	86.30	60.40
44	28th Oct-3rd Nov	5.38	30.05	9.23	39.60	4.72	2.98	11.00	30.90	19.90	86.30	58.90
45	4th Nov-10th Nov	3.89	40.05	9.89	40.22	3.80	4.05	0.00	30.70	16.8	68.10	49.90
46	11th Nov-17th Nov	2.80	27.05	10.89	41.53	2.89	2.32	0.00	30.00	18.20	76.60	49.60
47	18th Nov-24th Nov	0.98	18.23	10.02	41.91	0.90	1.38	0.00	29.30	14.20	69.90	42.10
48	25th Nov-2nd Dec	0.51	11.05	8.50	43.68	0	0.30	0.00	28.30	14.20	64.90	56.90

Table 2. Correlation of pod borers with natural enemies and weather parameters during *kharif* 2024

Variables		Meterological parameters				
		Temperature(°C)		Relative humidity(%)		Rainfall
		Max temp	Min temp	MaxRH	MinRH	(mm)
Maruca vitrata	Larvae/ plant	0.556*	0.039	-0.134	-0.331	0.198
	Per cent pod damage	0.353	-0.710*	-0.803**	-0.700**	-0.210
Cydia ptychora	Larvae/ plant	0.317	-0.641**	-0.738**	-0.716**	-0.285
	Per cent pod damage	0.324	-0.660**	-0.752**	-0.675**	-0.187
Coccinellids (grubs and adult)	0.497	0.256	0.179	-0.130	0.599	
Spiders	0.533*	-0.275	-0.477	-0.555*	-0.144	

**Correlation is significant at 1% *Correlation is significant at 5%

maximum temperature (r = 0.556), while correlations with maximum and minimum relative humidity were negative but non-significant (r = -0.134 and -0.331). Rainfall and minimum temperature had non-significant effects, suggesting limited influence on larval abundance. Per cent pod damage exhibited significant negative correlations with minimum temperature (r = -0.710) and relative humidity (maximum r = -0.803; minimum r = -0.700), indicating that cooler and more humid conditions may suppress pest impact.

For *C. ptychora*, larval population displayed a weak positive correlation with maximum temperature (r = 0.317), while significant negative correlations were observed with minimum temperature (r = -0.641) and relative humidity (maximum r = –0.738; minimum r = -0.716), suggesting that cooler, humid conditions adversely affect larval survival. Rainfall showed a non-significant negative effect (r = -0.285) and pod damage followed a similar trend with negative correlations for temperature and humidity.

Natural enemy populations also correlated with pest abundance. Coccinellids had no significant influence with weather parameters. Spiders showed strong positive correlations with maximum temperature (r = 0.533), but a significant negative correlation with minimum relative humidity (r = -0.555), reflecting their consistent and effective predation under specific conditions.

The study revealed that the spotted pod borer, *Maruca vitrata* and *Cydia ptychora*, were the major pests infesting fodder cowpea. Infestation by *M. vitrata* began in the 38th SMW and persisted up to harvest, with a peak larval density of 5.38 larvae per plant during the 44th SMW, coinciding with the flowering and early podding stages. Pod damage increased steadily from 2.2% to 40.05% by the 45th SMW, confirming the pest's strong association with the flowering phase. The pest's preference for tender floral tissues and developing pods often results in severe economic losses if left unmanaged. These findings agree with Sandhya Rani *et al*. (2013), who reported peak *M. vitrata* infestation and pod damage in greengram during flowering and podding. Similarly, *C. ptychora* infestation commenced in the 40th SMW, peaking at 10.89 larvae per plant during the 46th SMW, with pod damage rising to 43.68% by 48th SMW. This pest showed a preference for developing pods and its decline toward maturity was likely due to pod hardening and reduced nutritional suitability. Comparable results were observed by Patel *et al*. (2013), who reported peak *C. ptychora* infestation between the 45th and 47th SMW in greengram. In confirmation, Rekha and Mallapur (2007) reported the peak infestation of *C. ptychora* in October and November months on dolichos bean crop. which closely coincides with the present findings.

Correlation analysis revealed that *M. vitrata* population was positively correlated with maximum temperature (r = 0.556), while *C. ptychora* showed a negative correlation with minimum temperature (r = - 0.641), indicating that warmer days and cooler nights favored pest development. Relative humidity showed weak negative correlations with both pests, suggesting a suppressive effect. Among natural enemies, spiders and coccinellids were dominant, with peak populations during the 44th SMW, coinciding with high pest incidence. Spider populations were positively correlated with maximium temperature (r = 0.533), indicating that warm conditions favored their activity. Coccinellids showed moderate correlations with pests but weaker links with weather factors, suggesting a density-dependent response. These findings, consistent with Sreekanth *et al*. (2010), highlight that temperature and rainfall significantly influence pest–predator interactions, emphasizing the importance of weather-based pest forecasting and eco-friendly management in sustainable cowpea cultivation.

Conclusion

The study of pod borer dynamics in cowpea during *kharif* 2024 revealed distinct temporal patterns for *Maruca vitrata* and *Cydia ptychora*, with the latter causing higher peak pod damage. *M. vitrata* populations increased in mid- to late-season, while *C. ptychora* exhibited a slightly delayed but more destructive infestation. Natural enemies, particularly coccinellids and spiders, played complementary roles in pest suppression, with coccinellids responding rapidly to pest surges and spiders maintaining consistent predation. Environmental factors, including temperature and humidity, influenced pest abundance and damage. These findings underscore the importance of integrating pest monitoring, conservation of natural enemies and climatic considerations into eco-friendly cowpea pest management strategies

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