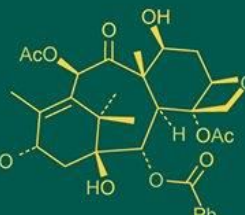
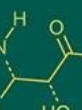
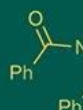


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Nivedita Choori
Ph.D. Scholar, Department of
Entomology, University of
Agricultural Sciences,
Dharwad, Karnataka, India

SB Jagginavar
Dean (Agri.) and University
Head of the Department
(Entomology), College of
Agriculture, Vijayapura, UAS,
Dharwad, Karnataka, India

SS Karabhantanal
Principal Scientist
(Entomology), AICRP on
Sorghum, RARS, Vijayapura,
UAS, Dharwad, Karnataka,
India

GS Yadahalli
Associate Professor, College of
Agriculture, UAS, Dharwad,
Karnataka, India

Corresponding Author:
Nivedita Choori
Ph.D. Scholar, Department of
Entomology, University of
Agricultural Sciences,
Dharwad, Karnataka, India

Management of pea blue butterfly (*Lampides boeticus* L.) and pink pod borer (*Cydia ptychora* Meyrick) in cowpea

Nivedita Choori, SB Jagginavar, SS Karabhantanal and GS Yadahalli

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Abstract

Cowpea (*Vigna unguiculata* (L.) Walp.) productivity is severely affected by the pea blue butterfly (*Lampides boeticus* L.) and the pink pod borer (*Cydia ptychora* Meyrick), which damage crops during flowering and pod formation. A field experiment evaluated various insecticides through two sequential sprays, recording larval populations at 1, 3, 7 and 10 days after treatment. Pre-treatment populations were uniform across treatments. Chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml L⁻¹ recorded the lowest larval populations at all intervals, reducing *L. boeticus* to 0.75, 0.44, 0.20 and 0.18 larvae plant⁻¹. It was statistically comparable to thiamethoxam + lambda-cyhalothrin, acephate + cypermethrin and chlorantraniliprole 18.5 SC. The highest reduction over control was observed with this treatment (83.32% after first spray and 86.90% after second spray). Thus, chlorantraniliprole + lambda-cyhalothrin is the most effective option for managing both pests in cowpea and can be recommended for IPM programs.

Keywords: Cowpea, pod borers, insecticide efficacy, integrated pest management, yield protection

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is an important pulse crop cultivated widely in tropical and subtropical regions of the world, particularly in Africa and South Asia. In India, cowpea is grown for grain, vegetable and fodder purposes and plays a significant role in ensuring food and nutritional security, especially in rainfed and semi-arid ecosystems. The crop is valued for its high protein content (20-25%), essential amino acids, vitamins and minerals and also contributes to soil fertility through biological nitrogen fixation (Oyewale and Bamaiyi, 2013) [5]. Despite its importance, the productivity of cowpea remains low, mainly due to damage caused by insect pests at different growth stages (Singh, 1978) [8]. More than 150 insect species have been reported to infest cowpea, of which about 20 are considered economically important. Among these, pod borers are the most destructive because they attack the reproductive parts of the plant, resulting in direct yield loss. The pea blue butterfly, *Lampides boeticus* (L.) (Lepidoptera: Lycaenidae), and the pink pod borer, *Cydia ptychora* Meyrick (Lepidoptera: Tortricidae), are major pod-boring pests of cowpea (Jackai and Daoust, 1986; Suh *et al.* 1986; Reddy, 1961) [3, 9, 7]. The larvae of *L. boeticus* feed on flower buds, flowers and developing pods by boring into them and consuming the seeds, leading to shrivelled grains and poor pod filling, Kaushik and Gulab Singh (1985) [4]. Similarly, the larvae of *C. ptychora* bore into pods and feed on the developing seeds while remaining concealed inside, making their detection and management difficult (Gubbaiah *et al.*, 1975) [2]. Yield losses due to pod borers in cowpea have been reported to range from 30 to 50 percent under severe infestation.

Management of these pests largely depends on chemical control, particularly during the flowering and pod formation stages when the crop is most vulnerable. However, indiscriminate and repeated use of conventional insecticides has resulted in several problems such as the development of insecticide resistance, pest resurgence, destruction of natural enemies, environmental contamination and health hazards. Moreover, many older insecticides have become less effective over time, necessitating the evaluation of newer molecules with novel modes of action, better selectivity and improved environmental safety.

Therefore, it is essential to evaluate the field efficacy of such newer insecticides against major pod borers of cowpea under local agro-climatic conditions. In this context, the present investigation was undertaken to evaluate the efficacy of selected insecticides against the pea blue butterfly and pink pod borer in cowpea and to identify effective and economically viable options for their management. The results of this study are expected to contribute to the development of sustainable and environmentally sound pest management strategies for cowpea cultivation.

Materials and Methods

Experimental site and season

The field experiment was conducted during the *kharif* season of 2022-23 at the College of Agriculture, Vijayapura, University of Agricultural Sciences, Dharwad, Karnataka, India. The experimental site falls under the Northern Dry Zone of Karnataka and is characterized by a semi-arid climate with an average annual rainfall of about 600 mm. The soil of the experimental field was medium black with good drainage.

Experimental design and crop details

The experiment was laid out in a Randomized Block Design (RBD) with three replications and eleven treatments. Cowpea variety DC-15 was used for the study. The crop was sown at a spacing of 45 cm × 20 cm following the recommended agronomic practices. All standard cultural practices were adopted uniformly for all treatments except for pest management interventions.

The insecticidal treatments evaluated were

1. Chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml L⁻¹
2. Thiamethoxam 12.6% + lambda-cyhalothrin 9.5% ZC @ 0.5 ml L⁻¹
3. Acephate 45% + cypermethrin 5% DF @ 1.0 g L⁻¹
4. Chlorantraniliprole 18.5 SC @ 0.1 ml L⁻¹
5. Lambda-cyhalothrin 5 EC @ 1.0 ml L⁻¹
6. Thiamethoxam 25 WG @ 0.25 g L⁻¹
7. Acephate 75 SP @ 1.0 g L⁻¹
8. Cypermethrin 10 EC @ 1.0 ml L⁻¹
9. Fenvalerate 20 EC @ 0.5 ml L⁻¹
10. Imidacloprid 600 FS (seed treatment) @ 1.25 ml kg⁻¹ seed
11. Untreated control

Two foliar sprays were applied using a manually operated knapsack sprayer fitted with a hollow cone nozzle. The first spray was applied at 50% flowering stage and the second at pod formation stage (approximately 15 days after the first spray). Seed treatment with imidacloprid was done by uniformly coating the seeds before sowing and shade drying for 30 minutes. Spraying was done in the early morning hours (07:00-09:00 h) under calm weather conditions to minimize drift and ensure uniform coverage.

Five plants were randomly selected and tagged in each net plot for recording observations. Larval population of *Lampides boeticus* and *Cydia ptychora* was recorded one day before spray (pre-treatment count) and at 1, 3, 7 and 10 days after each spray (DAS). Pod damage was assessed at maturity by counting the total number of pods and the number of damaged pods on tagged plants and expressed as percentage pod damage. The crop was harvested plot-wise and grain yield was recorded and converted to quintals per hectare (q ha⁻¹).

Statistical analysis

Larval population data were subjected to square root transformation and percentage data were arcsine transformed before analysis. Data were analyzed using analysis of variance (ANOVA). Treatment means were separated using Critical Difference (CD) at 5% level of significance.

Results and Discussion

The larval populations of pea blue butterfly and pink pod borer recorded one day before imposition of treatments did not differ significantly among the all treatments, indicating a uniform initial infestation and proper randomization of the experiment. The pre-treatment larval population ranged from 2.12 to 2.85 larvae plant⁻¹ for pea blue butterfly and from 1.22 to 1.53 larvae plant⁻¹ for pink pod borer, confirming homogeneous pest distribution.

Effect of insecticides on Pea blue butterfly, *Lampides boeticus* L.

After the first spray, significant variation in larval population of *L. boeticus* was observed among treatments. Chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml L⁻¹ (0.42 larvae/plant) recorded the lowest larval population at all observation intervals (1, 3, 7 and 10 days after spray), followed by thiamethoxam 12.6% + lambda-cyhalothrin 9.5% ZC (0.51 larvae/plant), acephate 45% + cypermethrin 5% DF @ 1.0 g/L (0.54 larvae/plant), chlorantraniliprole 18.5 SC at 0.1 ml/L (0.57 larvae/plant), cypermethrin 10 EC @ 1 ml/L (0.66 larvae/plant) and fenvalerate 20 EC @ 0.4 ml/L (0.85 larvae/plant), showed better control than other treatments based on the mean population of larvae/plant.

The highest percent reduction over control was found in chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml/L (83.32%). It was followed by thiamethoxam 12.6% + lambda-cyhalothrin 9.5% ZC @ 0.5 ml/L (79.77%), acephate 45% + cypermethrin 5% DF @ 0.4 ml/L (78.51%) and chlorantraniliprole 18.5 SC @ 0.1 ml/L (77.57%). It was followed by cypermethrin 5% DF @ 0.4 ml/L (73.90%) and fenvalerate 20 EC @ 0.4 ml/L (66.30%), the next best treatment. The least percent reduction over the untreated control was achieved by lambda-cyhalothrin 5 EC @ 1 ml/L (57.98%), acephate 75 SP @ 1 g/L (41.39%), thiamethoxam 25 WG @ 0.25 g/L (40.76%) and imidacloprid 600 FS @ 1.25 ml/kg (7.36%).

After the second spray, a similar trend was observed, with chlorantraniliprole + lambda-cyhalothrin consistently maintaining the lowest larval population and the highest percent reduction over control. The superior efficacy of chlorantraniliprole is attributed to its activation of ryanodine receptors, resulting in muscle paralysis and feeding cessation, while lambda-cyhalothrin provides rapid knockdown effect.

The present results were also line with the studies of Swami and Ameta in the year 2017. Who evaluate the efficacy of some new insecticides and their combinations against pod borer infesting pigeon pea and results were revealed that, lowest population of larvae was recorded in chlorantraniliprole 9.6% + lambda-cyhalothrin 4.6% at 300 ml/ha, compare to sole application of chlorantraniliprole 18.5 SC and lambda + cyhalothrin 4.9% SC. All treatments were recorded the low larval population over untreated control. Patel (2015) [6] stated that among the various insecticides, chlorantraniliprole 18.5 SC @ 30 g a.i./ha was the most effective insecticide against blue butterfly in

pigeon pea. It was followed by chlorantraniliprole 9.3% Lambda + cyhalothrin 4.6% ZC and lambda-cyhalothrin 4.9% CS.

Balikai (2005) ^[1] who conducted the field experiment in RARS, Vijayapura, to evaluate the newer insecticidal formulations for their efficacy against chickpea pod borer, *Helicoverpa armigera*. The results revealed that, the treatments viz., cypermethrin 5 + acephate 45 DF @ 425 g a.i./ha, acephate 75 DF 600 g ai/ha were equally effective against pod borer. It was followed by cypermethrin 5 DF @ 60 g a.i./ha. These findings were close agreement with the present investigations.

Effect of insecticides on pink pod borer, *Cydia ptychora* M.

The population of pink pod borer also differed significantly among treatments. Chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml/L recorded the lowest larval population (0.27 larvae/plant) and pod damage, followed by thiamethoxam 12.6% + lambda-cyhalothrin 9.5% ZC @ 0.5 ml/L (0.32 larvae/plant), acephate 45% + cypermethrin 5% DF @ 1.0 g/L (0.37 larvae/plant), chlorantraniliprole 18.5 SC @ 0.1 ml/L (0.39 larvae/plant), fenvalerate 20 EC @ 0.4 ml/L (0.47 larvae/plant), cypermethrin 10 EC @ 1 ml/L (0.48 larvae/plant) and lambda-cyhalothrin 5 EC at 1 ml/L (0.57 larvae/plant), showed effective control than other treatments based on the mean population of recorded as larvae/plant.

The highest percent reduction over control was found in chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml/L (85.38%). It was followed by thiamethoxam 12.6% + lambda-cyhalothrin 9.5% ZC @ 0.5 ml/L (82.51%), acephate 45% + cypermethrin 5% DF @ 0.4 ml/L (79.60%) and chlorantraniliprole 18.5 SC at 0.1 ml/L (78.46%). It was followed by fenvalerate 20 EC @ 0.4 ml/L (74.50%), cypermethrin 5% DF @ 0.4 ml/L (73.91%) and lambda-cyhalothrin 5 EC at 1 ml/L (68.85%), were next best treatment. The least percent reduction over the untreated control was achieved by acephate 75 SP @ 1 g/L (60.15%),

thiamethoxam 25 WG @ 0.25 g/L (57.38%) and imidacloprid 600 FS at 1.25 ml/kg (28.08%).

The results were also line with the work of Vinod and Patil (2015) ^[11] they concluded that chlorantraniliprole 20 SC @ 0.2 ml/L was significantly superior in reducing pink pod borer larval populations which was indicated by 80.85 percent population reduction over control and resulted in highest yield of 2364 kg/ha and BC ratio of 2.32 in soybean. The superior efficacy of chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC against both *Lampides boeticus* and *Cydia ptychora* can be attributed to their novel modes of action, translaminar movement and compatibility with pest biology. Chlorantraniliprole acts by activating ryanodine receptors, causing muscle paralysis and rapid feeding cessation, which is particularly effective against lepidopteran larvae and concealed feeders such as *C. ptychora*. The premix with lambda-cyhalothrin provides an additional knockdown effect, ensuring both immediate and residual control. The poor performance of imidacloprid seed treatment may be attributed to its activity being mainly against sucking pests and early crop stages, whereas pod borers attack during flowering and pod formation.

The reduction in larval population and pod damage in effective treatments resulted in significantly higher grain yield and economic returns, confirming the importance of protecting reproductive structures for yield improvement in cowpea. Moreover, selective insecticides such as chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml/L and thiamethoxam 12.6% + lambda-cyhalothrin 9.5% ZC are relatively safer to natural enemies and therefore suitable for inclusion in integrated pest management programs. Their use, along with rotation of insecticides with different modes of action, can delay resistance development and promote sustainable pest management. Thus, the present study emphasizes that insecticide selection should be based on mode of action, selectivity and compatibility with pest biology rather than solely on cost or availability.

Tables

Table 1: Efficacy of different insecticides against blue butterfly, *Lampides boeticus* (L.) on cowpea during kharif, 2022-23 (First spray)

Sl. No.	Treatments	Dosage/l	No. of larvae/plant						Percent reduction over control
			1 DBS	1DAS	3DAS	7DAS	10DAS	Mean	
1	Chlorantraniliprole 10% + Lambda cyhalothrin 5% ZC	0.5 ml	2.85 (1.83)	0.75 (1.12) ^a	0.44 (0.97) ^a	0.20 (0.84) ^a	0.18 (0.82) ^a	0.42	83.32
2	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC	0.4 ml	2.12 (1.62)	0.99 (1.24) ^a	0.46 (0.98) ^a	0.27 (0.88) ^a	0.21 (0.84) ^a	0.51	79.77
3	Acephate 45% + Cypermethrin 5% DF	1 g	2.77 (1.81)	1.04 (1.26) ^a	0.51 (1.00) ^a	0.35 (0.92) ^a	0.32 (0.90) ^a	0.54	78.51
4	Chlorantraniliprole 18.5 SC	0.1 ml	2.67 (1.78)	1.07 (1.22) ^a	0.61 (1.05) ^a	0.36 (0.93) ^a	0.34 (0.92) ^a	0.57	77.57
5	Lambda cyhalothrin 5 EC	1 ml	2.62 (1.77)	1.57 (1.44) ^b	1.10 (1.26) ^b	0.83 (1.15) ^b	0.73 (1.11) ^b	1.06	57.98
6	Thiamethoxam 25 WG	0.25 g	2.37 (1.69)	2.20 (1.64) ^c	1.70 (1.48) ^c	1.20 (1.30) ^c	0.85 (1.16) ^c	1.49	40.76
7	Acephate 75 SP	1 g	2.42 (1.71)	2.19 (1.64) ^c	1.67 (1.47) ^c	1.05 (1.24) ^c	0.98 (1.22) ^c	1.47	41.39
8	Cypermethrin 10 EC	1 ml	2.75 (1.80)	1.08 (1.25) ^a	0.75 (1.12) ^a	0.42 (0.96) ^a	0.38 (0.94) ^a	0.66	73.90
9	Fenvalerate 20 EC	0.5 ml	2.76 (1.81)	1.44 (1.39) ^b	1.21 (1.31) ^c	0.47 (0.98) ^a	0.37 (0.93) ^a	0.85	66.30
10	Imidacloprid 600 FS (Seed treatment)	1.25 ml/Kg	2.25 (1.66)	2.28 (1.67) ^d	2.30 (1.67) ^d	2.34 (1.69) ^d	2.39 (1.70) ^d	2.33	7.36
11	Untreated control	-	2.26 (1.66)	2.32 (1.68) ^d	2.49 (1.73) ^d	2.53 (1.74) ^d	2.71 (1.79) ^d	2.51	
	SEM		0.12	0.08	0.09	0.06	0.07		
	CD (P = 0.05)		NS	0.23	0.26	0.18	0.21		
	C.V. (%)		11.45	9.22	11.85	9.18	10.92		

DBS-Day before spray, DAS-Day after spray; Values in parenthesis are $\sqrt{x + 0.5}$ transformed.

Table 2: Efficacy of different insecticides against blue butterfly, *Lampides boeticus* (L.) on cowpea during kharif, 2022-23 (Second spray)

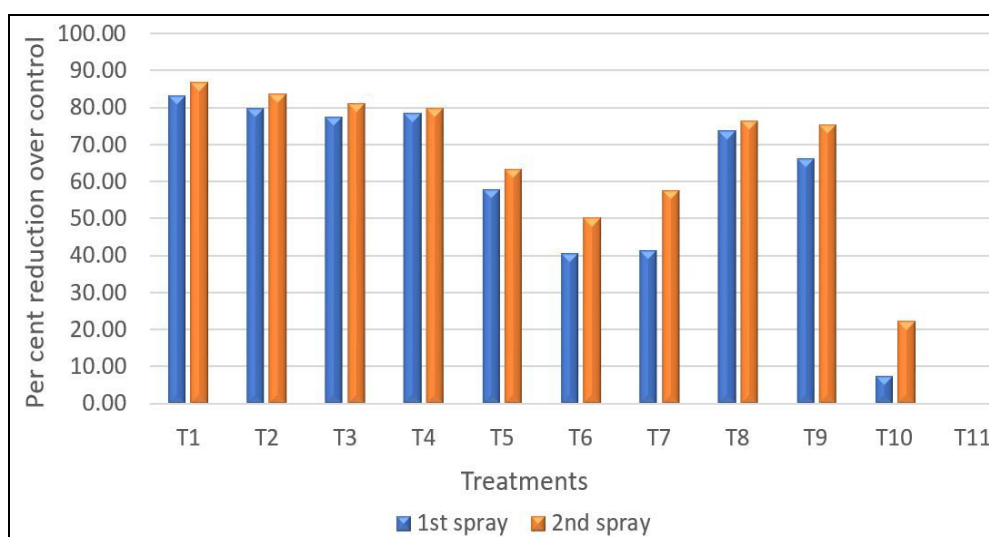
Sl. No.	Treatments	Dosage/l	No. of larvae/plant						Percent reduction over control
			1 DBS	1 DAS	3 DAS	7 DAS	10 DAS	Mean	
1	Chlorantraniliprole 10% + Lambda cyhalothrin 5% ZC	0.5 ml	1.48 (1.41)	0.44 (0.97)a	0.32 (0.91)a	0.23 (0.86)a	0.16 (0.81)a	0.30	86.90
2	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC	0.4 ml	1.56 (1.44)	0.63 (1.06)a	0.38 (0.94)a	0.24 (0.86)a	0.19 (0.83)a	0.36	83.87
3	Acephate 45% + Cypermethrin 5% DF	1 g	1.53 (1.42)	0.71 (1.10)a	0.49 (1.00)a	0.26 (0.87)a	0.20 (0.84)a	0.43	81.14
4	Chlorantraniliprole 18.5 SC	0.1 ml	1.60 (1.45)	0.75 (1.12)a	0.57 (1.03)a	0.33 (0.91)a	0.21 (0.85)a	0.45	79.92
5	Lambda cyhalothrin 5 EC	1 ml	1.64 (1.46)	1.23 (1.32)b	0.96 (1.21)b	0.64 (1.07)b	0.46 (0.98)a	0.82	63.53
6	Thiamethoxam 25 WG	0.25 g	1.74 (1.50)	1.56 (1.44)c	1.14 (1.28)c	0.91 (1.19)c	0.88 (1.17)c	1.12	50.28
7	Acephate 75 SP	1 g	1.69 (1.48)	1.30 (1.34)b	1.16 (1.29)c	0.74 (1.11)c	0.62 (1.06)b	0.96	57.66
8	Cypermethrin 10 EC	1 ml	1.64 (1.46)	0.97 (1.21)a	0.62 (1.06)a	0.32 (0.91)a	0.21 (0.84)a	0.53	76.52
9	Fenvalerate 20 EC	0.5 ml	1.62 (1.46)	1.20 (1.31)b	0.52 (1.01)a	0.28 (0.88)a	0.22 (0.86)a	0.56	75.38
10	Imidacloprid 600 FS (Seed treatment)	1.25 ml/Kg	1.69 (1.48)	1.71 (1.49)d	1.72 (1.49)d	1.78 (1.51)d	1.81 (1.52)d	1.76	22.26
11	Untreated control	-	1.81 (1.52)	1.98 (1.57)d	2.16 (1.63)d	2.24 (1.66)d	2.65 (1.77)d	2.26	-
	SEM		0.11	0.10	0.07	0.06	0.07		
	CD (P = 0.05)		NS	0.29	0.21	0.18	0.21		
	C.V. (%)		11.27	12.42	9.83	9.40	11.17		

DBS-Day before spray, DAS-Day after spray; Values in parenthesis are $\sqrt{x} + 0.5$ transformed.**Table 3:** Efficacy of different insecticides against pink pod borer, *Cydia ptychota* (M.) on cowpea during kharif, 2022-23

Sl. No.	Treatments	Dosage/l	No. of larvae/plant						Percent reduction over control
			1 DBS	1 DAS	3 DAS	7 DAS	10 DAS	Mean	
1	Chlorantraniliprole 10% + Lambda cyhalothrin 5% ZC	0.5 ml	1.35 (1.36)	0.43 (0.96)a	0.25 (0.87)a	0.21 (0.84)a	0.18 (0.83)a	0.27	85.38
2	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC	0.4 ml	1.53 (1.42)	0.58 (1.04)a	0.27 (0.88)a	0.24 (0.86)a	0.19 (0.83)a	0.32	82.51
3	Acephate 45% + Cypermethrin 5% DF	1 g	1.22 (1.31)	0.59 (1.05)a	0.43 (0.97)a	0.25 (0.87)a	0.22 (0.85)a	0.37	79.60
4	Chlorantraniliprole 18.5 SC	0.1 ml	1.41 (1.38)	0.75 (1.12)a	0.37 (0.93)a	0.22 (0.85)a	0.24 (0.86)a	0.39	78.46
5	Lambda cyhalothrin 5 EC	1 ml	1.40 (1.38)	1.04 (1.24)b	0.50 (1.00)a	0.43 (0.97)a	0.31 (0.90)a	0.57	68.85
6	Thiamethoxam 25 WG	0.25 g	1.29 (1.34)	1.14 (1.28)c	0.80 (1.14)b	0.61 (1.06)c	0.57 (1.03)c	0.78	57.38
7	Acephate 75 SP	1 g	1.37 (1.37)	1.11 (1.27)c	0.79 (1.14)b	0.57 (1.03)b	0.52 (1.01)b	0.73	60.15
8	Cypermethrin 10 EC	1ml	1.40 (1.38)	0.80 (1.14)a	0.48 (0.99)a	0.33 (0.91)a	0.30 (0.89)a	0.48	73.91
9	Fenvalerate 20 EC	0.5 ml	1.28 (1.34)	0.85 (1.16)a	0.43 (0.97)a	0.33 (0.91)a	0.25 (0.87)a	0.47	74.50
10	Imidacloprid 600 FS (Seed treatment)	1.25 ml/Kg	1.34 (1.36)	1.50 (1.41)d	1.53 (1.42)c	1.57 (1.44)d	1.60 (1.45)d	1.55	28.08
11	Untreated control	-	1.70 (1.48)	1.72 (1.49)e	1.77 (1.51)c	1.86 (1.54)d	1.97 (1.57)d	1.83	-
	SEM		0.08	0.06	0.07	0.06	0.06		
	CD (P = 0.05)		NS	0.19	0.21	0.18	0.16		
	C.V. (%)		10.46	9.38	11.67	10.15	9.51		

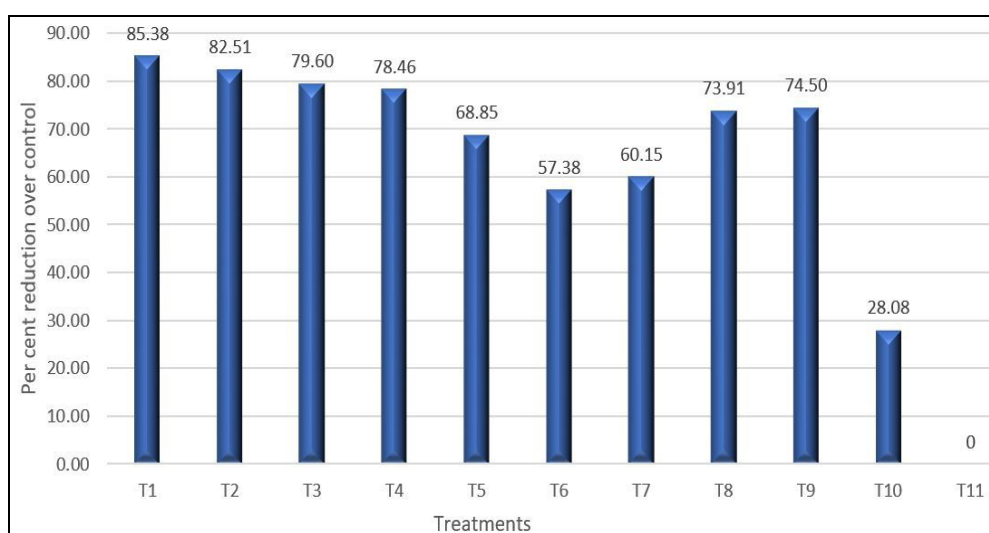
DBS-Day before spray, DAS-Day after spray; Values in parenthesis are $\sqrt{x} + 0.5$ transformed.

Figures



Note: T₁: Chlorantraniliprole 10% + Lambda-cyhalothrin 5% ZC @ 0.5 ml/L, T₂: Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC @ 0.4 ml/L, T₃: Acephate 45% + Cypermethrin 5% DF @ 1 g/L, T₄: Chlorantraniliprole 18.5 SC @ 0.1 ml/L, T₅: Lambda-cyhalothrin 5 EC @ 1 ml/L, T₆: Thiamethoxam 25 WG @ 0.25 g/L, T₇: Acephate 75 SP @ 1 g/L, T₈: Cypermethrin 10 EC @ 1 ml/L, T₉: Fenvalerate 20 EC @ 0.5 ml/L, T₁₀: Imidacloprid 600 FS @ 1.25 ml/Kg (Seed treatment), T₁₁: Untreated control.

Fig 1: Efficacy of different insecticides against blue butterfly, *Lampides boeticus* (L.) on cowpea during kharif, 2022-23



Note: T₁: Chlorantraniliprole 10% + Lambda-cyhalothrin 5% ZC @ 0.5 ml/L, T₂: Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC @ 0.4 ml/L, T₃: Acephate 45% + Cypermethrin 5% DF @ 1 g/L, T₄: Chlorantraniliprole 18.5 SC @ 0.1 ml/L, T₅: Lambda-cyhalothrin 5 EC @ 1 ml/L, T₆: Thiamethoxam 25 WG @ 0.25 g/L, T₇: Acephate 75 SP @ 1 g/L, T₈: Cypermethrin 10 EC @ 1 ml/L, T₉: Fenvalerate 20 EC @ 0.5 ml/L, T₁₀: Imidacloprid 600 FS @ 1.25 ml/Kg (Seed treatment), T₁₁: Untreated control.

Fig 2: Efficacy of different insecticides against pink pod borer, *Cydia pythor* (M.) on cowpea during kharif, 2022-23

Summary and Conclusion

The present investigation was conducted to evaluate the efficacy of different insecticides against pea blue butterfly (*Lampides boeticus* L.) and pink pod borer (*Cydia pythor* Meyrick) infesting cowpea (*Vigna unguiculata* (L.) Walp.). Ten insecticidal treatments were tested through two sequential sprays during flowering and pod formation stages. The results revealed that significant differences existed among treatments in their ability to suppress larval populations and reduce pod damage. Chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml L⁻¹ consistently recorded the lowest larval population and pod damage of both pests, followed by thiamethoxam 12.6% + lambda-

cyhalothrin 9.5% ZC @ 0.5 ml/L and acephate 45% + cypermethrin 5% DF @ 1g/L showed effective control than other treatments based on the mean population of recorded as larvae/plant.

Effective suppression of pod borers in the superior treatments resulted in significantly higher grain yield and benefit-cost ratio, indicating the economic viability of these insecticides. The study further demonstrated that selective insecticides with novel modes of action are more effective and environmentally safer. Based on the results, chlorantraniliprole 10% + lambda-cyhalothrin 5% ZC @ 0.5 ml L⁻¹ can be recommended as the most effective option for managing both *L. boeticus* and *C. pythor* in cowpea.

Integration of these insecticides with cultural and biological practices will contribute to sustainable and economically viable pest management in cowpea.

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