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Efficacy of Different Insecticides against *Apion clavipes* of Pigeonpea (*Cajanus cajan* (L.) Millsp.) in Nagaland, India

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ABSTRACT

The experiment on different insecticides was conducted against *Apion clavipes*. Eight treatments viz. Lambda Cyhalothrin 5 EC, Profenophos 50 EC, Fenvalerate 20 EC, Fipronil 80 WG, Thiamethoxam 25 WG, Spinosad 45 SC, Indoxocarb 15.8 SC and Cypermethrin 25 EC on variety PAU-881 were imposed using RBD with three replications. Eleven insect pests were reported with *Apion clavipes* (Coleoptera: Curculionidae) as one of the most destructive insect pests. The population of *A. clavipes* started to appear during the mid-October i.e. 42[nd] SMW with a mean population of 0.60 weevil/plant. The population gradually started to increase reaching its highest peak during the mid-November i.e. 46[th] SMW with a mean population of 4.40 weevil/plant and its second peak observed during the first week of November (45[th] SMW) with a mean population of 4.20 weevil/plant. Correlation studies indicated that *A. clavipes* had a significant positive correlation to maximum relative humidity but non-significant to maximum and minimum temperature, minimum relative humidity and rainfall. Results revealed that the different treatments were significantly superior to the untreated control plots. The highest per cent reduction was found in Cypermethrin 25 EC (74.95%) treated plots followed by Fipronil 80 WG (72.25%) and Fenvalerate 20 EC (70.41%). The lowest pod and grain damage was obtained in Cypermethrin 25 EC treated plots. Amongst all the treatments, the highest benefit cost ratio was attained by Cypermethrin 25 EC (1.85:1).

Keywords *Apion clavipes*, Efficacy, Insecticides, Pigeonpea.

INTRODUCTION

Pigeonpea (*Cajanus cajan* (L.) Millsp.) also known as red gram or arhar is a short lived perennial legume and is the second important pulse crop after chickpea, often grown in semi-arid and tropical regions of In-

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dia (Sarkar *et al.* 2020). It is a legume with 20-22% protein, 1.2% fat, 65% carbohydrate and 3.8% ash (FAO 1982). The crop also plays a significant role in prevention soil erosion in erosion prone areas that is usually caused by water and wind (Saxena 2000).

In North Eastern India, pigeonpea are tall with large flower, bigger pods and seeds. The yield of pigeonpea in this region is greatly affected due to the insect pests. The main constraints on the production of pigeonpea are biotic and abiotic stresses. Among the biotic stresses, insect pest attack and physiological shrivelling are the main causes of the low yield of pigeonpea. Most pests attack the crop during reproductive stage resulting in immediate losses.

Pigeonpea is infested mainly by Pod boring weevil (*Apion clavipes*), Pod borers (*Helicoverpa armigera*, *Maruca vitrata*, *Euchrysops cnejus* and *Etiella zinkenela*) and Blister beetles (*Myllabris pustulata* and *M. phalerata*). Amongst, pod-boring weevil (*A. clavipes*) is the major pest of pigeonpea causing upto 100% damage. The primary goal of this experiment is to evaluate the effectiveness of different insecticides against *Apion clavipes* of pigeonpea in Nagaland.

MATERIALS AND METHODS

The field experiment was carried out in the Experimental farm of School of Agricultural Sciences, Nagaland University, Medziphema, Nagaland during *kharif* season, 2022. The experiment was laid out in Randomized Block Design (RBD) with three replications and eight treatments using variety PAU-881. Eight treatments viz. Lambda Cyhalothrin 5 EC, Profenophos 50 EC, Fenvalerate 20 EC, Fipronil 80 WG, Thiamethoxam 25 WG, Spinosad 45 SC, Indoxocarb 15.8 SC and Cypermethrin 25 EC were imposed in all three replications randomly.

Two sprays were done at 15 days interval. First spray of insecticides was applied at flowering stage and second spray was given after 15 days interval. Observation on the efficacy of different insecticides was recorded as pre and post treatment. The pre-treatment count was recorded one day before the application of insecticides and the post treatments counts was recorded at 3, 7 and 10 days after spraying to observe the efficacy of different insecticides.

The data obtained during period of investigation was analyzed by using one way analysis of variance (ANOVA) given by Gomez and Gomez (1984)

RESULTS AND DISCUSSION

Population dynamics of *Apion clavipes* and its correlation with abiotic factors

During the period of investigation, 11 insect pests were observed feeding on pigeonpea crop, viz., *Apion clavipes*, *Maruca vitrata*, *Riptortus dentipis*, *Mylabris pustulata*, *Hypomece spulviger* , *Lampides boeticus*, *Leptoglossus phyllopus*, *Oxyrachistarandus, Amphimallon* sp., *Melanagromyza obtuse* and *Euproctis fraternal*. The pests were observed in the field at different crop stages starting from vegetative till harvesting stage. *Apion clavipes* was one of the major feeders of the crop.

During the study period, it was observed that population of *A. clavipes* started to appear during the mid-October i.e. 42nd SMW with a mean population of 0.60 weevil/plant. The population gradually started to increase reaching its highest peak during the mid-November i.e. 46th SMW with a mean population of 4.40 weevil/plant followed by 45th SMW with a mean population of 4.20 weevil/plant (Table 1). The present study was contradictory to that of Faiz and Ahmed (2018) who recorded the appearance of *A. clavipes* during 39th Standard Week.

The population of *A. clavipes* showed significant positive correlation with maximum relative humidity ($r = 0.555$) but non-significant with other parameters i.e. maximum ($r = 0.257$) and minimum temperature ($r = 0.102$), minimum relative humidity ($r = -0.190$) and rainfall ($r = 0.152$) (Table 2). The above findings are in contrast with Kumar *et al.* (2003) who reported that the maximum, minimum temperature and relative humidity were highly correlated with *A. clavipes*. Variations may be due to difference in locations, climate, variety, sowing time and other ecological parameters.

Table 1. Population dynamics of *Apion clavipes* on pigeonpea during study period. *SMW= Standard mean week.

Sl. No.	SMW	Date of observation	Temperature °C Max	Temperature °C Min	Relative humidity % Max	Relative humidity % Min	Rainfall (mm)	Mean *Apion clavipes*
1	42	17-10-2022	30.9	20.6	94	65	2.9	0.6
2	43	24-10-2022	28.1	19.9	95	71	19.7	1.2
3	44	31-10-2022	29.8	17.1	96	60	41.0	3.6
4	45	7-11-2022	29.3	16.7	96	57	0.0	4.2
5	46	14-11-2022	27.9	14.6	98	56	0.0	4.4
6	47	21-11-2022	27.7	12.8	96	52	0.0	2.0
7	48	28-11-2022	27.8	14.3	96	67	0.0	1.8
8	49	5-12-2022	27.6	12.0	95	49	0.0	2.0
9	50	12-12-2022	26.4	11.3	96	50	0.0	1.6
10	51	19-12-2022	25.7	11.0	96	51	0.2	2.2
11	52	26-12-2022	22.7	11.2	97	60	15.2	1.6
12	1	2-01-2023	23.2	9.2	97	50	0.0	1.8
13	2	9-01-2023	25.4	8.8	96	55	0.0	1.2

Table 2. Correlation coefficient (r) of *Apion clavipes* with abiotic factors in pigeonpea. Note: df = 13-2 = 11, r0.05 = 0.553, r0.01 = 0.684. * = Significant at 5% level of significance, ** = Significant at 1% level of significance, NS = Non-significant at 5% level of significance.

Pest	Pearson's correlation coefficient: Temperature (°C) Max	Temperature (°C) Min	Relative humidity (%) Max	Relative humidity (%) Min	Rainfall (mm)
Apion clavipes	0.257^{NS}	0.102^{NS}	0.555*	-0.190^{NS}	0.152^{NS}

Table 3. Effect of different insecticides against pod boring weevil, *Apion clavipes* on pigeonpea. Note: Figures in the table are mean values and those in parenthesis are angular transformed value. *NS: Non-significant at 5% level of significance.

Treatments	First spray: Pre-treatment count	First spray Percent reduction: 3 DAS	7 DAS	10 DAS	Second spray: Pre-treatment count	Second spray Percent reduction: 3 DAS	7 DAS	10 DAS	Cumulative mean data
T_1: Lambda cyhalothrin 5 EC @ 25 g a.i./ha (1.0 mi/l)	5.33	62.82 (52.44)	72.22 (58.23)	60.44 (51.03)	2.44	64.17 (53.27)	75.00 (60.05)	62.50 (52.24)	**66.19**
T_2:Profenophos 50 EC @ 500 g a.i./ha (2.0 ml/l)	4.67	60.50 (51.09)	70.29 (57.04)	62.32 (52.15)	2.56	58.21 (49.74)	68.57 (55.91)	63.57 (52.88)	**63.91**
T_3: Fenvalerate 20 EC @ 75 g a.i./ha (0.75 ml/l)	4.33	67.67 (55.36)	78.75 (62.59)	68.50 (55.86)	2.44	65.42 (54.01)	76.67 (61.12)	65.42 (54.01)	**70.41**
T_4: Fipronil 80 WG @ 50 g a.i./ha (0.125 g/l)	4.00	66.57 (54.69)	79.62 (63.21)	70.00 (56.79)	2.56	66.07 (54.40)	80.54 (63.86)	70.71 (57.24)	**72.25**
T_5: Thiamethoxam 25 WG @ 50 g a.i./ha (0.4 g/l)	3.11	52.47 (46.42)	63.76 (52.99)	56.51 (48.76)	2.33	55.56 (48.25)	64.44 (53.48)	58.89 (50.17)	**58.61**
T_6: Spinosad 45 SC @ 73 g a.i./ha (0.3 ml/l)	4.44	56.48 (48.73)	65.49 (54.03)	60.22 (50.92)	2.44	56.43 (48.69)	67.14 (55.04)	60.54 (51.10)	**61.05**
T_7: Indoxacarb 15.8 EC @ 50 g a.i./ha (0.7 ml/l)	3.44	64.52 (53.44)	74.58 (59.78)	67.32 (55.14)	2.11	65.14 (53.82)	76.29 (60.87)	68.00 (55.57)	**69.31**

Table 3. Continued.

Treatments	Pre-treat-ment count	First spray Percent reduction 3 DAS	7 DAS	10 DAS	Pre-treat-ment co-unt	Second spray Percent reduction 3 DAS	7 DAS	10 DAS	Cumulative mean data
T_8: Cypermethrin 25 EC @ 50 g a.i./ ha (0.4 ml/l)	5.56	72.73 (58.58)	80.39 (63.73)	74.55 (59.72)	2.11	68.71 (56.04)	78.43 (62.39)	74.86 (59.91)	**74.95**
T_9: Untreated control	3.78	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.78	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	**0.00**
SEm±	**0.55**	**1.95**	**2.02**	**2.18**	**0.36**	**2.83**	**1.92**	**2.17**	-
CD (p=0.05)	**NS**	**5.86**	**6.06**	**6.54**	**NS**	**8.48**	**5.77**	**6.52**	-

Efficacy of different insecticides against pod boring weevil, *Apion clavipes*

From the experiment, it was revealed that the mean population of *A. clavipes* at one day before spraying ranged from 3.11 – 5.56 per plant. The findings revealed that all treatments were significantly superior compared to the untreated control plots (Table 3).

The data recorded at 3,7 and 10 Days after 1st spray revealed that plots treated with Cypermethrin 25 EC have the highest per cent reduction of 72.73%, 80.39% and 74.55%. The lowest per cent reduction was found in plots with Thiamethoxam 25 WG (52.47%, 63.76% and 56.51% respectively.

Second spraying was applied fifteen days after the first spray. The mean population of *Apion clavipes* at one day before spraying ranged from 2.11 – 3.78 per plant. Similarly, the data recorded at 3,7 and 10 DAS revealed that plots treated with Cypermethrin 25 EC have the highest per cent reduction of 68.71%, 78.43% and 74.86% respectively, while the lowest per cent reduction was recorded in plots with Thia-

Table 4. Effect of different insecticides on reducing the pod and grain damage as well as yield. Note: Figures in the table are mean values and those in parenthesis are angular transformed values.

Sl. No.	Treatments	Pod damage (%) After 1st spray	after 2nd spray	Grain damage (%)	Yield (kg/ha)
1	Lambda cyhalothrin 5 EC @ 25 g a.i./ha (1.0 ml/l)	13.33 (21.33)	8.00 (13.47)	8.74 (17.18)	340.65
2	Profenophos 50 EC @ 500 g a.i./ha (2.0 ml/l)	12.67 (20.42)	6.67 (14.72)	9.16 (17.58)	382.72
3	Fenvalerate 20 EC @ 75 g a.i./ha (0.75 ml/l)	12.00 (19.91)	6.67 (12.23)	7.82 (16.21)	424.33
4	Fipronil 80 WG @ 50 g a.i./ha (0.125 g/l)	16.67 (23.62)	7.30 (15.47)	9.75 (17.93)	407.86
5	Thiamethoxam 25 WG @ 50 g a.i./ha (0.4 g/l)	18.67 (25.34)	15.33 (22.66)	11.96 (20.20)	323.73
6	Spinosad 45 SC @ 73 g a.i./ha (0.3 ml/l)	14.00 (21.86)	8.00 (16.35)	9.00 (17.14)	395.52
7	Indoxacarb 15.8 EC @ 50 g a.i./ha (0.7 ml/l)	12.67 (20.66)	6.00 (13.58)	8.46 (16.90)	480.57
8	Cypermethrin 25 EC @ 50 g a.i./ha (0.4 ml/l)	10.33 (18.63)	4.67 (12.42)	7.27 (15.57)	533.15
9	Untreated control	56.67 (48.85)	60.00 (50.81)	49.95 (44.94)	137.17
	SEm±	**2.61**	**3.83**	**1.79**	**71.61**
	CD (p=0.05)	**7.83**	**11.48**	**5.36**	**214.68**

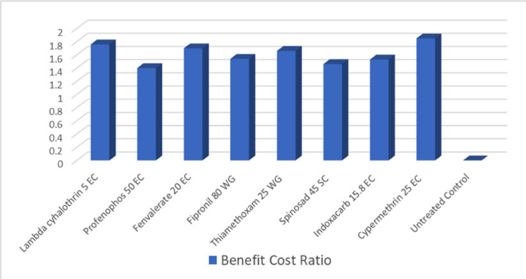

Fig. 1. Effect of different insecticides on benefit cost ratio of pigeonpea.

methoxam 25 WG of 55.56%, 64.44% and 58.89%.

It is evident that all the treatments significantly reduced the population of *A. clavipes*. The cumulative mean data showed that Cypermethrin 25 EC (74.95%) was the most superior treatment followed by Fipronil 80 WG (72.25%), Fenvalerate 20 EC (70.41%). The least effective was found to be Thiamethoxam 25 WG (58.61%). Khape *et al.* (2020) reported similar finding who indicated that Cypermethrin 25 EC proved to be significantly superior in controlling *A. clavipes* on pigeonpea.

Effect of different insecticides on reducing pod and grain damage as well as yield of pigeonpea

The data recorded on pod damage, grain damage and yield of pigeonpea are represented in Table 4. From the present findings, it was observed that Cypermethrin 25 EC showed the lowest pod damage with 10.33% after the first spray and 4.67% after the second spray. Also, the lowest grain damage was recorded in the plot treated with Cypermethrin 25 EC (7.27%) followed by Fenvalerate 20 EC (7.82%), Indoxocarb 15.8 EC (8.46%), while the highest was recorded in Thiamethoxam 25 WG (11.96%). The highest grain yield was observed from the plot treated with Cypermethrin 25 EC (533.15 kg/ha) and the lowest in Thiamethoxam 25 WG (323.73 kg/ha) treated plot. All the treated plots gave higher yield as compared to the untreated control plot. Similar findings were reported by Khape *et al.* (2020) who reported that Cypermethrin 25 EC had the lowest pod damage and the highest grain yield on pigeonpea.

Effect of different insecticides on benefit cost ratio

It is evident from the Fig. 1 that the maximum benefit cost ratio was obtained from plots treated with Cypermethrin 25 EC (1.85:1) followed by Lambda cyhalothrin 5 EC (1.76:1), Fenvalerate 20 EC (1.70:1) and Thiamethoxam 25 WG (1.66:1). Whereas, the lowest benefit cost ratio was obtained in Profenophos 50 EC (1.40:1). The findings in the investigation was in agreement with the findings of Khape *et al.* (2020) who reported that treatment with Cypermethrin 25 EC had the highest benefit cost ratio.

CONCLUSION

The population dynamics of *A. clavipes* was found to be destructive as it starts attacking from the early flowering stage up to harvesting stage causing great loss in the yield. *Apion clavipes* had positive significant correlation with maximum relative humidity. The findings of the study proved that Cypermethrin 25 EC was the most effective insecticide among the eight insecticides to reduce the population of *Apion clavipes* of pigeonpea.

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