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Bioefficacy of various insecticides against pest complex in cowpea [*Vigna unguiculata* (L) Walp]

Bindu Panickar and R. C. Jhala

Department of Entomology, B. A. College of Agriculture
Anand Agricultural University, Anand - 388110 (Gujarat)

Abstract

Various insecticides were tested for bioefficacy against pest complex of cowpea. The data on per cent reduction over control worked on the basis of pest population (Pod borer damage in case of *Maruca vitrata*) pooled over 3 days (1, 3 and 7 day(s) after each spray), 2 sprays (first spray at 50% flowering and second at 50% pod setting) and 2 years revealed that deltamethrin tablet recording highest per cent reduction (72.51%) in pod borer damage was found most effective treatment. Against aphid, *Aphis craccivora*, alphamethrin, fenvalerate and lambda-cyhalothrin recording more than 80% reduction were found most effective insecticides. Methyl-o-demeton recording highest reduction of 68.77%, 52.65% and 37.28% was found most effective insecticide against leaf hopper, *Amrasca kerri*; thrips, *Megaleurothrips sjostedti* and leaf miner, *Acrocercops caerulea*, respectively.

Keywords: Bioefficacy, pest complex and cowpea

Introduction

Cowpea, *Vigna unguiculata* (Linnaeus) Walpers [Syn. *Vigna sinensis* (Linnaeus)] is one of the most versatile pulse crop because of its drought tolerating characters, soil restoring properties and multipurpose uses. Cowpea is called vegetable meat due to high amount of protein in grain with better biological value on dry weight. As many as 21 insect pests of different groups are observed from germination to maturity of cowpea crop. Of course, only few of them are considered to be major pests of cowpea. The insects act either as vectors of diseases or as destroyers of seedlings, foliage or fruiting bodies. In cowpea the avoidable losses in yield due to insect pest are recorded in range of 66-100% (1, 2 and 3). A number of synthetic and conventional insecticides have been tested against of cowpea. Very few researchers have studied the bioefficacy of synthetic pyrethroids against pest complex of cowpea.

Material and methods

A field trial was conducted at college farm, B. A. College of Agriculture, A.A.U., Anand during *kharif* season of the year 2002 and 2003 to evaluate different insecticides for their comparative efficacy to major insect pests *viz.*, spotted pod borer, *M. vitrata*; aphids, *A. craccivora*; leaf hopper, *A. kerri*; thrips, *M. sjostedti*; leaf miner, *A. caerulea*. The insecticides were sprayed twice, first spray at initiation of flowering and second spray twenty days after first spray.

The observation on damage by *M. vitrata* on pods were started from pod setting stage of crop and continued till end of the crop period. For the purpose, green pods were harvested at weekly interval and all the pods were observed for presence or absence of holes made by the larvae. The data on per cent pod damage were computed based on number of damaged pods out of total number of pods. Five plants were selected randomly and tagged in the net area of each plot and observations on populations of aphid, leaf hopper, thrips and leaf miner were made before spray as well as one, three and seven days after each spray. The aphid (*A. craccivora*) population was recorded on three randomly selected twigs (about 10 cm in length) from each plant and mean number of aphids per twig was worked out. For recording the population (nymphs + adults) of leaf hopper (*A. kerri*), three leaves each from top, middle and bottom region of selected plant were observed critically using magnifying glass and mean number of leaf hopper per leaf were computed. The thrips (*M. sjostedti*) population (nymphs + adults) was recorded on five flowers selected randomly on each selected plant and mean number per flower was worked out. In case of leafminer (*A. caerulae*) observations were made by critically observing all the leaves on each selected plant and the number of *A. caerulae* larva (e) per plant were recorded.

Results and discussion

The bio-efficacy of different insecticides against aphid (*A. craccivora*), leaf hopper (*A. kerri*), thrips (*M. sjostedti*) and leaf miner (*A. caerulea*) has been judged based on their population while against pod borer (*M. vitrata*), it is judged based on per cent pod damage.

Spotted pod borer (M. vitrata)

Based on pooled data of two years on per cent pod borer damage (Table 1), the chronological order of various treatments was: T_{13} (15.73) > T_{12} (18.15) > T_8 (20.17) > T_1 (21.35) > T_6 (22.85) > T_5 (24.13) > T_2 (25.85) > T_4 (27.69) > T_3 (29.39) > T_7 (31.90) > T_{11} (34.73) > T_{10} (36.38) > T_9 (38.50) >Control (57.22). Treatment – 13 recording lowest per cent of pod borer damage was found most effective and it was at par with T_{12}. Treatment – 9 recording highest percent damage was least effective and was at par with T_{10}, T_{11} and T_7. Thus, based on per cent reduction in pod damage over control it is evident that deltamethrin – tablet (T_{13}) recording highest (>70% reduction was comparatively more effective, while endosulfan (T_1), indoxacarb (T_6), methomyl (T_8) and deltamethrin EC formulation (T_{12}) recording 60-70% reduction were next in order. Alphamethrin (T_2), methyl-o-demeton (T_4) and quinalphos (T_5) recording 50-60% reduction were moderately effective. Whereas, fenvalerate (T_3) and lambda-cyhalothrin (T_7) were comparatively less effective in controlling *M. vitrata*. Rest of treatments with < 40% reduction were least effective against this pest. The reports on higher effectiveness of endosulfan than quinalphos (4, 5 and 6), methyl-o-demeton (7 and 8), NSKE (9) and Gronim (6); quinalphos than methyl-o-demeton (8) and Gronim (6); alphamethrin than methyl-o-demeton (8); lambda-cyhalothrin than NSKE (10); methyl-o-demeton and deltamethrin than Gronim (6) and deltamethrin than quinalphos (6) tally with the present results.

Aphid (*A. craccivora*)

From Table 1, aphid population pooled over years indicated the chronological order of various treatments as: T_7 (8.04) > T_3 (10.72) > T_2 (12.46) > T_1 (14.17) > T_{13} (15.66) > T_{12} (18.08) > T_4 (19.12) > T_5 (23.02) > T_6 (25.41) > T_8 (28.55) > T_{11} (37.82) > T_{10} (44.79) > T_9 (50.19) > Control (70.40). All treatments were significantly superior to control. All the treatments except T_{12} and T_4 which were at par to each other differed significantly from each other. However, it can be inferred from the pooled data on aphid population that azadirachtin based formulations (Gronim and NSKE) and *Btk* (Biolep) recording more than 30 aphids per twig were found least effective. Lambda-cyhalothrin recording less than 10 aphids/twig was found most effective. While fenvalerate, alphamethrin and endosulfan recording aphid population between 10 to 15 per twig were more effective than deltamethrin (tablet), deltamethrin (EC), methyl-o-demeton, quinalphos, indoxacarb and methomyl which recorded aphid population between 15 to 30 per twig.

Based on per cent reduction over control, the insecticides (alphamethrin, fenvalerate, lambda-cyhalothrin) recording more than 80 per cent reduction of *A. craccivora* were comparatively more effective than endosulfan, methyl-o-demeton, deltamethrin tablet and EC formulations recording 70-80% reduction over control. Whereas, quinalphos and indoxacarb recorded 60-70% reduction over control. Methomyl recording per cent reduction between 50 to 60 was comparatively less effective, while NSKE, *Btk* and azadirachtin based formulations (Gronim) recording <50 per cent reduction over control were found least effective insecticidal treatments. The reports on better effectiveness of methyl-o-demeton than quinalphos (11, 12 and 6) and azadirachtin (6 and 13); deltamethrin than methyl-o-demeton (14) and methyl-o-demeton and endosulfan than azadirachtin (6 and 13) tally with the present results.

Leafhopper (A. kerri)

The data on leaf hopper population pooled over years (Table 1) revealed that the chronological order of various treatments was: T_4 (1.78) > T_7 (2.39) > T_3 (2.56) > T_2 (2.81) > T_{13} (3.03) > T_{12} (3.26) > T_5 (3.42) > T_1 (3.66) > T_6 (3.95) > T_8 (4.16) > T_{11} (4.61) > T_{10} (4.88) > T_9 (5.16) > Control (5.70). Treatment - 4 recording lowest population was found most effective and significantly superior over other treatments. Treatment - 9 recording higher population was found least effective than rest of the treatments except T_{10}, which was in turn at par with T_1.

Based on per cent reduction over control (Table 1), alphamethrin, fenvalerate, methyl-o-demeton and lambda-cyhalothrin recording a reduction between 50-70% were comparatively more effective than rest of treatments. Endosulfan, quinalphos, indoxacarb and deltamethrin (Tablet and EC formulation) recording a reduction between 30-50% were comparatively less effective. While rest of treatments (methomyl, NSKE, *Btk.* and Gronim) can be considered not effective against *A. kerri* as they have recorded less than 30% reduction in leaf hopper population over control.The reports on better effectiveness of fenvalerate than quinalphos, endosulfan and NSKE (15) tally with the present results. The better efficacy of methyl-o-demeton than quinalphos (8, 6 and 15), endosulfan (6 and 8), alphamethrin (8), deltamethrin and Gronim (6) reported by other workers also akin to the present study. The superiority of quinalphos to endosulfan reported by Vaghashiya (15); Ukey *et al.* (16) and Patel (6) and to NSKE reported by Vaghashiya (15) and Ukey *et al.* (16) are in accordance to the present results.

Thrips (M. sjostedti)

The chronological order of effectiveness of various insecticides, pooled over years, in comparison to control was: T_4 (7.34) > T_7 (8.68) > T_3 (9.55) > T_2 (10.13) > T_{13} (10.86) > T_{12} (11.20) > T_5 (11.82) > T_1 (12.17) > T_6 (13.12) > T_8 (13.79) > T_{11} (14.48) > T_{10} (14.87) > T_9 (15.10) > Control (15.50). Treatment-4 recording lowest population of *M. sjostedti* was found most effective and significantly differed from rest of the treatments. The next best treatment was T_7, which also differed significantly from other treatments. Treatment 9 and 10 were found ineffective in controlling thrips since they were at par with control.

Based on per cent reduction (Table 1), it can be seen that methyl-o-demeton recording 52.65% reduction over control was comparatively more effective than rest of treatments. Alphamethrin, fenvalerate and lambda-cyhalothrin recording a reduction between 30-45% were mediocre in effectiveness. Deltamethrin formulations (EC and tablet), quinalphos and endosulfan recording a reduction between 20-30% were found least effective treatments. Rest of treatments were found comparatively ineffective as they recorded less than 20 % reduction in thrips population over control. The reports on better effectiveness of fenvalerate than quinalphos, endosulfan and NSKE (15) and better efficacy of methyl-o-demeton than quinalphos, endosulfan (8, 6,15), NSKE (15), alphamethrin (8), deltamethrin and Gronim (6) tally with the present studies. The better performance of quinalphos than endosulfan (15 and 6), NSKE (15) and Gronim (6) reported by other workers also tally with the present results. The higher efficacy of lambda-cyhalothrin against *M. sjostedti* on cowpea reported by Amatobi (1994) is also in accordance with the present result.

Leafminer (A. caerulea)

The pooled result (Table 1) revealed that the chronological order of insecticides for their effectiveness against *A. caerulea* in comparison to control was: T_4 (3.30) > T_7 (3.62) > T_3 (3.78) > T_2 (3.91) > T_{13} (3.99) > T_{12} (4.12) > T_1 (4.21) > T_5 (4.38) > T_6 (4.61) > T_8 (4.79) > T_{11} (5.07) > T_{10} (5.16) > T_9 (5.26) = Control (5.26) (Figure 13). All the treatments except T_9 and T_{10} were significantly superior to control. However, T_{10} was at par with T_{11}. Treatment 4 and 7 differed significantly from each other and found significantly more effective than rest of treatments. Treatment-3 and 2, T_2 and T_{13}, T_{13} and T_{12} and T_{12} and T_1 was at par with each other.

The data on percent reduction over control (Table 1), indicated that all the insecticidal treatments recorded less than 40% reduction. However, among all the insecticides, alphamethrin, fenvalerate, methyl-o-demeton and lambda-cyhalothrin recording reduction between 30-40% can be considered as comparatively more effective insecticides for in controlling *A. caerulea*. The report on higher efficacy of quinalphos, endosulfan and deltamethrin than Gronim as reported by Patel (6) tally with the present results. Similarly, the reports on higher efficacy of methyl-o-demeton than alphamethrin (8), endosulfan, quinalphos, deltamethrin and Gronim (6) also tally with the present report.

Impact of insecticides on green pod yield

Based on pooled data (Table 2) on yield, the chronological order of various treatments was : T_{13} (6962) > T_{12} (5729) > T_8 (5364) > T_1 (5150) > T_6 (4454) > T_5 (4045) > T_2 (3742) > T_7 (3337) > T_4 (3160) > T_3 (2882) > T_{11} (2498) > T_{10} (2188) > T_9 (1890) > Control (1141). As per DNMRT, though all the insecticidal treatments were significantly superior over control, treatment 13 was significantly superior to all the insecticidal treatments. Treatment 9 was significantly inferior to rest of the insecticidal treatments except T_{10} which was in turn at par with T_{11}. Treatments - 12, 8 and 1 were at par with each other and differed significantly from rest of the insecticides.

Thus, from the view point of yield, deltamethrin tablet was found significantly most effective than rest of the insecticides. Deltamethrin EC, methomyl and endosulfan were next best insecticides. Though, NSKE, *Btk* and azadirachtin were more or less equally effective but they were least effective than other insecticidal treatments. Rest of the insecticidal treatments (alphamethrin, fenvalerate, methyl-o-

Table 1. Per cent reduction in insect- pests populations in various insecticidal treatments on cowpea.

Treatment No.	Treatments	*M. vitrata*		*A. craccivora*		*A. kerri*		*M.sjostedti*		*A. caerulea*	
		% damaged pods (Pooled)	% reduction over control	population per 10 cm long twig (pooled)	% reduction over control	Population per leaf	% reduction over control	population per flower	% reduction over control	population per plant	% reduction over control
T_1	Endosulfan 0.07%	27.52 (21.35)	62.69	3.83 (14.17)	79.87	2.04 (3.66)	35.79	3.56 (12.17)	21.48	2.17 (4.21)	19.96
T_2	Alphamethrin 0.01%	30.56 (25.85)	54.82	3.60 (12.46)	82.30	1.82 (2.81)	50.70	3.26 (10.13)	34.65	2.10 (3.91)	25.67
T_3	Fenvalerate 0.01%	32.83 (29.39)	48.64	3.35 (10.72)	84.77	1.75 (2.56)	55.09	3.17 (9.55)	38.39	2.07 (3.78)	28.14
T_4	Methyl-o-demeton 0.025%	31.75 (27.69)	51.61	4.43 (19.12)	72.84	1.51 (1.78)	68.77	2.80 (7.34)	52.65	1.95 (3.30)	37.26
T_5	Quinalphos 0.05%	29.42 (24.13)	57.83	4.85 (23.02)	67.30	1.98 (3.42)	40.00	3.51 (11.82)	23.74	2.21 (4.38)	16.73
T_6	Indoxacarb 0.00725%	28.56 (22.85)	60.07	5.09 (25.41	63.91	2.11 (3.95)	30.70	3.69 (13.12)	15.35	2.26 (4.61)	12.36
T_7	Lambda-cyhalothrin 0.0025%	34.39 (31.90)	44.25	3.04 (8.74)	87.59	1.70 (2.39	58.07	3.03 (8.68)	44.00	2.03j (3.62)	31.18
T_8	Methomyl 0.08%	26.69 (20.17)	64.75	5.39 (28.55)	59.45	2.16 (4.16)	27.02	3.78 (13.79)	11.03	2.30 (4.79)	8.93
T_9	Neem seed kernel extract 5%	38.35 (38.50)	32.72	7.12 (50.19)	28.71	2.38 (5.16)	9.47	3.95 (15.10)	2.58	2.40 (5.26)	0.00
T_{10}	Btk @ 0.75 kg/ha	37.10 (36.38)	36.42	6.73 (44.79)	36.42	2.32 (4.88)	14.39	3.92 (14.87)	4.06	2.38 (5.16)	1.90
T_{11}	Azadirachtin 0.001%	36.11 (34.73)	39.30	6.19 (37.82)	46.28	2.26 (4.61)	19.12	3.87 (14.48)	6.58	2.36 (5.07)	3.61
T_{12}	Deltamethrin 0.0014%	25.22 (18.15)	68.28	4.31 (18.08)	74.32	1.94 (3.26)	42.81	3.42 (11.20)	27.74	2.15 (4.12)	21.67
T_{13}	Deltamethrin 25% tablet @14 g a.i./ha	23.37 (15.73)	72.51	4.02 (15.66)	77.79	1.88 (3.03)	46.84	3.37 (10.86)	29.93	2.12 (3.99)	24.14
T_{14}	Control (Water spray)	49.15 (57.22)		8.42 (70.40)		2.49 (5.70)		4.00 (15.50)		2.40 (5.26)	
	Mean	32.22 (28.43)		5.03 (24.80)		2.02 (3.58)		3.52 (11.89)		2.21 (4.38)	
ANOVA		S.Em. (±)	1.50		0.06		0.03		0.03		0.01
		C.D. at 5%	4.60		0.18		0.08		008		0.04
		C.V. %	5.64		2.46		4.81		4.67		3.57

Notes: Figures in parentheses are retransformed values, those outside are $\sqrt{x + 0.5}$ transformed values

Table 2. Yield of green pods in various insecticidal treatments on cowpea

Treatment No.	Treatments	Yield (kg/ha)		
		2002	2003	Pooled
T_1	Endosulfan 0.07%	5015^{b}	5285^{c}	5150^{b}
T_2	Alphamethrin 0.01%	3511^{d}	3974^{ef}	3742^{de}
T_3	Fenvalerate 0.01%	2369^{fg}	3395^{gh}	2882^{fg}
T_4	Methyl-o-demeton 0.025%	2720^{ef}	3600^{fg}	3160^{f}
T_5	Quinalphos 0.05%	3885^{d}	4205^{de}	4045^{cd}
T_6	Indoxacarb 0.00725%	4356^{c}	4552^{d}	4454^{c}
T_7	Lambda-cyhalothrin 0.0025%	2967^{e}	3708^{efg}	3337^{ef}
T_8	Methomyl 0.08%	5320^{b}	5409^{c}	5364^{b}
T_9	Neem seed kernel extract 5%	1505^{i}	2276^{j}	1890^{i}
T_{10}	*Btk* @ 0.75 kg/ha	1713^{hi}	2662_{ij}	2188^{hi}
T_{11}	Azadirachtin 0.001%	1987^{gh}	3009^{hi}	2498^{gh}
T_{12}	Deltamethrin 0.0014%	5440^{b}	6019^{b}	5729^{b}
T_{13}	Deltamethrin (25% tablet) @14 g a.i./ha	6883^{a}	7041^{a}	6962^{a}
T_{14}	Control (Water spray)	1030^{j}	1254^{k}	1141^{j}
	Mean	3478	4028	3753
ANOVA	S.Em. (±)	128.08	154.63	172.11
	Treatment (T)	-	-	37.94
	Year(Y)	-	-	141.97
	T x Y	-	-	
C.D. at 5%	T	372.39	449.60	525.75
	Y	-	-	113.83
	T x Y	-	-	403.57
	C.V. %	6.38	6.65	6.55

Note : Figures with letter(s) in common do not differ significantly by DNMRT in respective column.

demeton, quinalphos, indoxacarb and lambda-cyhalothrin) were mediocre in their effectiveness. Ukey *et al.* (16) at Akola reported significantly higher yields in quinalphos treated plot (66.51 q/ha) followed by Neem seed extract (62.49 q/ha) and endosulfan (62.02 q/ha).

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