JBiopest 13(1):63-68 (2020)

Chosen biocides against *Vigna unguiculata* (L) Walp

Vijayaraghavan, C.[1], Pasupathy, S.[2], Zadda Kavitha[3] and Abdul Razak, T.[4]

ABSTRACT

Field trials were conducted with cowpea (Vamban 1) to evaluate some selected biocides against the cowpea insects. Among the biocides, spray of neem seed kernel extract (NSKE) at 5% was effective in reducing the population of cowpea sucking insect, whitefly followed by azadirachtin at 1%. Spotted pod borer, *M. vitrata* incidence is less in the biocides treatments. Among the tested biocides, NSKE at 5% was effective in the management of spotted pod borer followed by azadirachtin at 1%. Cumulative pod damage by cowpea pod borers was minimum in indoxacarb at 0.7 mL/L treatment followed by NSKE at 5%. High cowpea seed yield was recorded in the treatment, indoxacarb at 0.7 ml/litre followed by azadirachtin at 1%. In all the seasons, coccinellid beetles appeared in more numbers in the unsprayed plots followed by biocide treatments. In insecticide sprayed plots, comparatively this predatory beetle population was less. Number of spiders per 10 plants was more in the unsprayed plots. When insecticide and biocide treatments were compared, the biocide treatments harboured more spider population. Among the biocide treatments, in *Beauveria bassiana* at 10 gm/L sprayed plots, spiders were more followed by azadirachtin at 1%.

.

Keywords: Whitefly, *Maruca vitrata*, NSKE, Neem oil, Azadirachtin.

MS History: 14.04.2020 (Received)-30.04.2020 (Revised)- 05.05.2020 (Accepted).

Citation: Vijayaraghavan, C., Pasupathy, S., Zadda Kavitha and Abdul Razak, T. 2020. Chosen biocides against *Vigna unguiculata* (L) Walp. *Journal of Biopesticides,* **13**(1): 63-68.

INTRODUCTION

Among the grain legumes, cowpea is an important crop having high nutritive value and is widely cultivated in India. It is also considered as "vegetable meat" as cowpea grain contains high protein content. This is a multipurpose crop which increases the soil fertility through nitrogen fixation, a nutritious fodder crop for livestock, drought tolerant crop etc. Cowpea is damaged by an array of insect pests from sowing to harvest in the field as well as in the harvested produce in storage. Whitefly, *Bemisia tabaci*, pod damaging insects i.e., spotted pod borer, *Maruca vitrata* Geyer., gram pod borer, *Helicoverpa armigera* and pod sucking bugs are considered to be important in causing economic losses to the farmers. Indiscriminate use of insecticides for insect pest management has resulted in many harmful effects like, insect resistance, resurgence, harmful effects on the beneficial organisms & environment etc. So, there is a need to use alternative methods for insect pest control to reduce the frequency of insecticides utilized for pest management. When we probe through the alternatives to the chemical insecticides, plant based insecticides or biocides can fit to our needs. They contain natural phytochemicals having diverse actions against various insects thus inhibiting their damage on crop plants. In addition, they are not persistent, readily degradable, will not accumulate in the soil and are not stored in plant or animal tissue thus eco-friendly. Biocides are relatively harmless to non-target organisms thus allowing biological control under field conditions. Possibility of the insects developing resistance to botanical insecticides is also very less (Isman, 2006).

Hence, in the present study an attempt was made to evaluate the efficacy of some biocides to integrate them in the integrated pest management approaches for the management of important insect pests in cowpea.

MATERIALS AND METHODS

Field experiments were conducted with cowpea variety, Vamban 1 during autumn 2015, spring 2015 and autumn 2016 at National Pulses Research Centre, Vamban to study the role of some selected biocides in managing the important insects of cowpea with least disturbance to the natural enemies. Trials were conducted with seven treatments and four replications in a randomized block design. The treatments included neem seed kernal extract (NSKE) at 5%, azadirachtin at 1%, neem oil at 3%, *Beauveria bassiana* at 10 gm/ litre, dimethoate 30EC at 1ml/litre, indoxacarb 14.5SC at 0.7 ml/litre (Crop Production Guide, 2012) and untreated check. The trial was conducted with the cowpea variety, VBN 1 replicated thrice. Plot size of 5x4 metres was maintained for each replication. Neem seed kernels were purchased from the local market and pulverized in a blender. Neem seed kernel powder at 50 gram per litre water was soaked overnight and filtered through a clean cotton cloth. Khadi soap powder at 1 gram per litre was mixed in a little amount of water separately and added in the spray tank. Neem oil was purchased from the local market. Before spraying, khadi soap powder at 1 gram per litre was mixed in a little amount of water separately and added in the spray tank. The fungal biocide, *Beauveria bassiana* was purchased from Sun Agro Biotech Research Centre, Chennai. Three sprays were given at vegetative stage (30 days after sowing), flowering stage and pod development stage. At 5 days after the first spray (35 days after sowing), whitefly, *Bemisia tabaci* population was counted in all the treatments by bell-jar method in which the individual plant is covered with a glass jar and the flying insects were counted. At 5 days after the first spray (35 days after sowing), observations were recorded on the number of spotted pod borer, *Maruca vitrata* larva in various treatments. At harvest, 300 pods were collected randomly from each treatment and were observed for the pod damage by the pod borers *viz.*, *Maruca vitrata* and *Helicoverpa armigera*. For assessing the *H. armigera* and *M. vitrata* damage, pods with large and round holes and pods with small holes at the base of the pod were counted respectively and by adding both, cumulative pod damage was calculated and per cent cumulative pod damage was arrived. Natural enemies i.e., coccinellid beetles and spider complex were counted on ten randomly selected plants in all the treatments and expressed as number per plant. Yield data was also recorded in all the treatments. Data were statistically analyzed by using AgRes statistical software.

RESULTS

Effect of biocides against the insect pests of cowpea

During autumn 2015, among the biocides, spray of neem oil at 3% treatment recorded lowest whitefly population (7.0/plant) followed by *Beauveria bassiana* at 10 gm/litre while in untreated check it was 26.0/plant (Table 1).

Table 1. Efficacy of biocides against the insect pests of cowpea during autumn, 2015

Sl. No.	Treatment Details	Whitefly population on 35DAS (No./plant)	*Maruca* larval population on 35DAS (No./plant)	Cumulative Pod Damage at harvest (%)	Yield (Kg/ha)
T1	NSKE @ 5%	16.0^{f}	5.2^{a}	34.0^{d}	820.00^{d}
T2	Azadirachtin @ 1%	14.7^{e}	5.5^{b}	31.7^{c}	870.00^{b}
T3	Neem oil @ 3%	7.0^{b}	5.8^{c}	41.0^{f}	860.00^{c}
T4	*Beauveria bassiana* @10gm/litre	13.7^{d}	6.6^{f}	40.3^{e}	800.00^{f}
T5	Dimethoate @ 1ml/litre	6.3^{a}	6.1^{e}	27.3^{b}	810.00^{e}
T6	Indoxacarb @ 0.7 ml/litre	12.7^{c}	6.0^{d}	21.7^{a}	960.00^{a}
T7	Untreated Check	26.0^{g}	12.0^{g}	52.3^{g}	440.00^{g}
CD (.05)		0.0321	0.0124	0.0381	0.0023

When all the treatments were taken in to consideration, neem oil at 3% was found to be the next effective treatment to dimethoate at 1ml/litre in which 6.3 whiteflies/plant were recorded. However, in neem oil at 3% sprayed plots, less number of whiteflies were recorded than in the plots sprayed with indoxacarb at 0.7 ml/litre. With regard to the *M. vitrata* larval population, biocides treatments recorded less population. NSKE at 5% was effective in the management of spotted pod borer and recorded 5.2 larvae/plant as against 12 in untreated check. This treatment was followed by azadirachtin at 1% with 5.5 larvae/plant. The chemical treatments i.e., dimethoate at 1ml/litre and indoxacarb at 0.7 ml/litre have recorded 6.1 and 6.0 larvae per plant.

During spring 2015, minimum whitefly population was recorded in dimethoate at 1ml/litre treatment (5.11/plant) followed by NSKE at 5% (7.40/plant) while in control it was 24.00 per plant (Table 2). Comparatively in the treatment indoxacarb at 0.7 ml/litre, more whitefly population (10.20/plant) was noted than the biocide treatments i.e., azadirachtin at 1% (8.00/plant) and neem oil at 3% (9.00/plant). *M. vitrata* larval population was low in NSKE at 5% treatment with 6.10 larvae per plant. The next best treatment was azadirachtin at 1% (6.30/plant) and in control, 11.00 larvae were observed per plant.

During autumn 2015, cumulative pod damage was less in chemical control treatments (21.7 to 27.3% damage) than the biocide treatments (31.7 to 41.0% damage) while in unsprayed plots, 52.3 per cent damage was observed. Among the biocides, in azadirachtin at 1% treatment, less cumulative pod damage (31.7%) was recorded followed by NSKE at 5% (34%). High yields were realized from indoxacarb at 0.7 ml/litre sprayed plots (960 kg/ha) followed by azadirachtin at 1% sprayed plots (870 kg/ha) while in untreated check it was 440 kg/ha (Table 1). During spring 2015, cumulative pod damage was minimum in indoxacarb at 0.7 ml/litre treatment (22.20%) followed by NSKE at 5% (25.30%) and azadirachtin at 1% (28.20%). In untreated check, cumulative pod damage was 39.70 % (Table 3). From the indoxacarb at 0.7 ml/litre sprayed plots, high yield was obtained (920 kg/ha) followed by azadirachtin at 1% sprayed plots (830 kg/ha) while in untreated check, 420 kg/ha yield was obtained (Table 2).

Table 2. Efficacy of biocides against the insect pest of cowpea during spring, 2015

Sl. No.	Treatment Details	Whitefly population on 35DAS (No./plant)	*Maruca* larval population on 35DAS (No./plant)	Cumulative Pod Damage at harvest (%)	Yield (Kg/ha)
T1	NSKE @ 5%	7.40[b]	6.10[a]	25.30[b]	780.00[d]
T2	Azadirachtin @ 1%	8.00[c]	6.30[b]	28.20[c]	830.00[b]
T3	Neem oil @ 3%	9.00[d]	6.80[c]	33.10[e]	820.00[c]
T4	*Beauveria bassiana* @10gm/litre	12.00[f]	8.60[f]	36.25[f]	750.00[f]
T5	Dimethoate @ 1ml/litre	5.11[a]	7.10[e]	29.00[d]	770.00[e]
T6	Indoxacarb @ 0.7 ml/litre	10.20[e]	7.00[d]	22.20[a]	920.00[a]
T7	Untreated Check	24.00[g]	11.00[g]	39.70[g]	420.00[g]
	CD (.05)	0.0328	0.0161	0.0325	0.0024

Effect of biocides against the insect pests of cowpea (autumn, 2016)

Among the treatments, minimum whitefly population was observed in dimethoate at 1ml/litre treatment (4.33/plant) and this was followed by NSKE at 5% (6.20/plant) while in untreated control it was 18.00/plant (Table 3). Among the biocides, *Beauveria bassiana* at 10 gm/litre was the least effective by recording 11 whiteflies per plant. Spotted pod borer larvae were found to be minimum in NSKE at 5% (3.2/plant) sprayed plots followed by azadirachtin at 1% (3.5/plant) and neem oil at 3% (3.8/plant). Among all the treatments,

Table 3. Efficacy of biocides against the insect pests of cowpea in autumn, 2016

Sl. No.	Treatment Details	Whitefly population on 35DAS (No./plant)	*Maruca* larval population on 35DAS (No./plant)	Cumulative Pod Damage at harvest (%)	Yield (Kg/ha)
T1	NSKE @ 5%	6.2 [b]	3.2 [a]	24.0 [b]	750.00 [f]
T2	Azadirachtin @ 1%	6.8 [c]	3.5 [b]	27.0 [c]	850.00 [b]
T3	Neem oil @ 3%	7.0 [d]	3.8 [c]	32.0 [d]	810.00 [c]
T4	*B. bassiana*@10gm/litre	11.0 [f]	4.6 [f]	36.0 [e]	780.00 [e]
T5	Dimethoate @ 1ml/litre	4.33 [a]	4.1 [e]	24.0 [b]	800.00 [d]
T6	Indoxacarb @ 0.7 ml/litre	8.66 [e]	4.0 [d]	21.7 [a]	950.00 [a]
T7	Untreated Check	18.00 [g]	10.0 [g]	38.3 [f]	380.00 [g]
CD(.05)		0.0348	0.0220	0.0364	0.0028

cumulative pod damage by pod borers was less in the treatment, indoxacarb at 0.7 ml/litre with 21.7% pod damage. Next to this, NSKE at 5% and dimethoate at 1ml/litre were found to be equally effective with 24% cumulative pod damage. The highest yield recorded was 920 kg/ha in the indoxacarb at 0.7 ml/litre treatment followed by azadirachtin at 1% (850 kg/ha) and in untreated check, yield was 380 kg/ha (Table 3).

Evaluation of the safety of biocides to the natural enemies in cowpea ecosystem

Coccinellid beetles

Among the various treatments, number of coccinellid beetles per 10 plants ranged from 4.00 to 12.00, 2.00 to 11.00 and 4.00 to 13.00 during autumn 2015, spring 2015 and autumn 2016 respectively (Table 4).

In all the seasons, coccinellid beetles appeared in more numbers in the unsprayed plots followed by biocide treatments. In insecticide sprayed plots, comparatively this predatory beetle population was less. Among the biocide treatments, azadirachtin at 1% recorded more number of predatory beetles followed by *Beauveria bassiana* at 10 gm/litre. In untreated check, 12.00, 11.00 and 13.00 beetles were recorded during autumn 2015, spring 2015 and autumn2016 respectively.

Spiders

Among the various treatments, number of spiders per 10 plants was more in the unsprayed plots i.e., 14.00, 12.00 and 16.00 during autumn 2015, spring 2015 and autumn 2016 respectively (Table 4).

Table 4. Effect of biocides on the natural enemies of cowpea

Treatment	Autumn 2015		Spring 2015		Autumn 2016	
	No. /10 plants					
	Coccinellid beetles	Spiders	Coccinellid beetles	Spiders	Coccinellid beetles	Spiders
NSKE @ 5%	6.00[e]	8.00[c]	4.00[e]	7.00[c]	7.00[e]	10.00[c]
Azadirachtin @ 1%	11.00[b]	7.00[d]	9.00[b]	6.00[d]	11.00[b]	11.00[d]
Neem oil @ 3%	7.00[d]	5.00[e]	6.00[d]	7.00[c]	8.00[d]	8.00[b]
B. bassiana @ 10 gm/litre	10.00[c]	10.00[b]	7.00[c]	9.00[b]	9.00[c]	8.00[b]
Dimethoate @ 1ml/litre	5.00[f]	4.00[f]	3.00[f]	4.00[f]	4.00[f]	6.00[a]
Indoxacarb @ 0.7 ml/litre	4.00[g]	3.00[g]	2.00[g]	5.00[e]	4.00[f]	6.00[a]
Untreated Check	12.00[a]	14.00[a]	11.00[a]	12.00[a]	13.00[a]	16.00[e]
CD(0.05)	0.0357	0.0486	0.0656	0.0313	0.0401	0.0256

Comparatively in biocide treatments, spider population was more and they recorded 5.00 to 10.00, 6.00 to 9.00 and 8.00 to 11.00 spiders during autumn 2015, spring 2015 and autumn 2016 respectively. Among the biocide treatments, *Beauveria bassiana* at 10 gm/litre was safe to the spiders followed by azadirachtin at 1%. The insecticide treatments recorded 3.00 to 4.00, 4.00 to 5.00 and 6.00 spiders during autumn 2015, spring 2015 and autumn 2016 respectively.

DISCUSSION

Among the biocides, spray of NSKE at 5% was effective in reducing the population of cowpea sucking insect, whitefly followed by azadirachtin at 1%. When all the treatments were taken in to consideration for the management of whiteflies, NSKE at 5% was the next effective treatment to dimethoate at 1ml/litre. Comparatively in the treatment indoxacarb at 0.7 ml/litre, more whitefly population was noted than the biocide treatments i.e., NSKE at 5%, azadirachtin at 1% and neem oil at 3%. However, in *Beauveria bassiana* at 10 gm/litre sprayed plots more whitefly population was observed than indoxacarb at 0.7 ml/litre. Spotted pod borer, *M. vitrata* incidence is less in the biocides treatments. Among the tested biocides, NSKE at 5% was effective in the management of spotted pod borer followed by azadirachtin at 1%. The present findings are in agreement with Nikul Berani *et al.,* 2018 who reported that azadirachtin 0.15 EC at 0.0006%, NSKE at 5%, neem oil at 0.3% and neem leaf extract at 10% were highly effective in managing bihar hairy caterpillar, *Spilosoma obliqua* and spotted pod borer, *Maruca vitrata* in black gram. Reed and Reed (1985) reported more than 60 per cent reduction of corn earworm, *Helicoverpa zea* a major pest of corn by applying the seed extracts of *A. indica*. Extracts of neem contains antifeedant activity resulting in feeding inhibition. Mechanism of action includes disturbance of the stimulation perception of eating, affecting the growth and development of hormonal system (Ridha *et al.*, 2018). Neem products also play an important role in moulting inhibition so that the insects fail to moult resulting in physical abnormalities and death (Shuklar *et al.*, 1996). Spotted pod borer larvae were found to be minimum in NSKE at 5% (3.2/plant) sprayed plots followed by azadirachtin at 1% (3.5/plant) and neem oil at 3% (3.8/plant). This is in accordance with Bhat *et al.*, 1988 who stated that the neem seed kernel extract (NSKE) was effective against, legume pod borer, *Maruca vitrata* in cowpea. In the unsprayed plots, 10 larvae were observed per plant. Better performance of the plant based insecticides in comparison with the control is in agreement with the findings of Saxena (1981), Jackai and Oyediran (1991), Jackai, *et al.* (1992), Jackai, (1993) and Zongo, *et al.* (1993) who reported that neem products showed efficacy against the pod borer (*Maruca vitrata*), pod sucking bug complex (*Clavigralla tomentosicollis*) and other insect pests. According to Sinha (1993), at higher levels (>30%) of pod borer damage in redgram, neem products afforded 50 to 60 per cent reduction in pod damage.

Cumulative pod damage by cowpea pod borers was minimum in indoxacarb at 0.7 ml/litre treatment followed by NSKE at 5%. High cowpea seed yield was recorded in the treatment, indoxacarb at 0.7 ml/litre followed by azadirachtin at 1%. In all the seasons, coccinellid beetles appeared in more numbers in the unsprayed plots followed by biocide treatments. In insecticide sprayed plots, comparatively this predatory beetle population was less. Among the various treatments, number of spiders per 10 plants was more in the unsprayed plots. When insecticide and biocide treatments were compared, biocide treatments were safer to the spider population. Among the biocide treatments, *Beauveria bassiana* at 10 gm/litre was safe to the spiders followed by azadiractin at 1%.

ACKNOWLEDGMENT

The authors acknowledge the Professor and Head, National Pulses Research Centre, Vamban for facilitating this study.

REFERENCES

Bhat, N.S., Raju, G.T., Manjunatha, M., Nagabhushana, G.G. and Deshpande, V.P.

1988. Chemical control of cowpea pod borer, *Indian Journal of Plant Protection,* 16: 197-200.

Crop Production Guide. 2012. Department of Agriculture, Government of Tamil Nadu and Tamil Nadu Agricultural University, Coimbatore – 3. 115 & 232 PP.

Isman, M.B. 2006. Botanical insecticides, deterrents and repellents in modern agriculture and an increasingly regulated world. *Annual Revision of Entomology*, **51**: 45- 66.

Jackai, L. E. N., and Oyediran, I. O. 1991. The potential of neem, *Azadirachta indica* A. Juss for controlling post-flowering pests of cowpea, *Vigna unguiculata* (L.) Walp, *Insect Science and its Application*, **12**: 103-109.

Jackai, L. E. N., Inang, E. E., and Nwobi, P. 1992. The potential for controlling post-flowering pests of cowpea, *Vigna unguiculata* Walp using neem, *Azadirachta indica* A. Juss. *Tropical Pests Management*, **38**: 56-60.

Jackai, L. E. N. 1993. The use of neem in controlling cowpea pests. *IITA Research*, **7**: 5-11.

Reed, D. K., and Reed, G. I. 1985. Control of vegetable insects with neem seed extracts. *Proceedings of Indian Academic Science*, **94**: 335-339.

Ridha, K., Nurdin, S., and Rosnani, N. 2018. Antifeedent activity from neem leaf extract (*Azadirachta indica* A Juss). *Journal Nature*, **18**(1):7-10.

Saxena, R. C. 1981. Neem seed oil for leaf folder control. *Plant Proceeding News*.10: 48-50.

Shuklar, Y. N., Rani, A., Tripathi., and Sharma, S. 1996. Antifeedant activity of ursolic acid isolation from *Duboisia myoporoides*. *Phytotheraphy*, **10**(2):359-360.

Sinha, S.N. 1993. Control of *Helicoverpa armigera* infesting chickpea and field efficacy of neem products and insect growth regulators. *Indian Journal of Plant Protection*, **21**: 80-84.

Nikul K Berani., Godhani, P. H., and Bhatt, N.A. 2018. Bio-efficacy of botanical insecticides against lepidopteran insect pest infesting black gram. *Journal of Entomology and Zoology Studies*, **6**(4): 642-646.

Zongo, J. O., Vincent, C., and Stewart, R. K. 1993. Effects of intercropping sorghum-cowpea on natural enemies of the sorghum shoot fly, *Atherigona soccata* Rondani (Diptera; Muscidae) in Burkina Faso. *Biology Agricultural & Horticulture*, **9**: 201-213.

Vijayaraghavan, C[1*], Pasupathy, S.[2], Zadda Kavitha[3] and Abdul Razak, T.[4]

[1] Agricultural College and Research Institute, Kudumiyanmalai - 622 104

[2]Sugarcane Research Station, Cuddalore

[3]Agricultural College and Research, Institute, Madurai - 625 104

[4]Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam

***Communication author**

Email: vijayaraghavanento@yahoo.co.in