Int.J.Curr.Microbiol.App.Sci (2017) *6*(6): 2030-2037

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 6 (2017) pp. 2030-2037**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.606.239

Efficacy of Different Combination of Insecticides against Cowpea Pod Borer in Cowpea [*Vigna ungiculata* (L.) Walp.]

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Keywords

Cowpea, Cowpea pod borer, H. *armigera*, Chemical control, Insecticides

Article Info

Accepted:
23 May 2017
Available Online:
10 June 2017

A B S T R A C T

Different combinations of insecticides were tested on cowpea crop against cowpea pod borer (*Helicoverpa armigera*) during 2012-2014 at different time intervals and revealed that lowest *H. armigera* population was recorded in the treatment of imidacloprid 17.8 SL in combination with spinosad 45 SC (0.57 larva/plant). The next effective treatments were acetamiprid 20 SP in combination with spinosad 45 SC (0.65 larva/plant), thiamethoxam 25 WG in combination with spinosad 45 SC (0.66 larva/plant). Imidacloprid 17.8 SL in combination with novaluron 10 EC (0.88 larva/plant), thiamethoxam 25 WG in combination with novaluron 10 EC (0.93 larva/plant) and acetamiprid 20 SP in combination with novaluron 10 EC (0.93 larva/plant) were the next best treatments. The highest *H. armigera* population was observed in control (3.70 larvae/plant). Maximum reduction of larvae was found in the treatments in which spinosad is present followed by the treatments in which novaluron is present. With respect to BCR, highest BCR (1:8.70) was registered in the treatment imidacloprid 17.8 SL in combination with indoxacarb 14.5 SC which was followed by thiamethoxam 25 WG in combination with indoxacarb 14.5 SC (1:6.52) and acetamiprid 20 SP in combination with indoxacarb 14.5 SC (1:6.43).

Introduction

Cowpea (*Vigna unguicualata* L. Walp.) is an annual legume that is adapted to warm conditions and sensitive to low temperatures. Cowpeas are grown mostly for their edible beans, although the leaves, green peas and green pea pods can also be consumed, meaning the cowpea can be used as a food source before the dried peas are harvested (Ehlers and Hall, 1997). Cowpeas thrive in poor dry conditions, growing well in soils up to 85% sand (Obatolu, 2003). This makes them a particularly important crop in arid, semi-desert regions where not many other will grow. Cowpea as an important source of food for humans in poor arid regions the crop can also be used as feed for livestock. In India the stock is fed cowpea as forage or fodder (Singh *et al.*, 1997). The nitrogen fixing ability means that as well as functioning as a sole-crop, the cowpea can be effectively intercropped with sorghum, millet, maize, cassava or cotton (Blade *et al.*, 1997). In India, cowpea is grown in almost 1.3 m ha particularly in Western, Central and peninsular regions in some of Indian states including Maharashtra, this crop is grown in

all the three seasons (Kumar and Prathap, 2005). Insects are one of the very important reasons for the loss of yield. In bad infestations insect pressure is responsible for over 90% loss in yield (Jackai and Daoust, 1986). *H. armigera* cause damage by attacking on various plant parts *viz.*, leaves, buds, flowers and pods of cowpea. Young larvae feed on the leaves, later stage larvae feed on the pods by thrusting its head into the pod and keeping remaining body out. It feeds on the pods by making circular holes. About 21.30 per cent fruit damage was estimated due to *H. armigera*. Due to wider host range, multiple generations, migratory behavior, high fecundity and existing insecticide resistance this became a difficult pest to tackle (Ahmed *et al.*, 2000). In this trial, imidacloprid, thiamethoxam, acetamiprid were mixed with spinosad, novaluron, indoxacarb and flubendiamide each.

Materials and Methods

The investigation on chemical control of pest complex of Cowpea [*Vigna ungiculata* (L.) Walp.]" Was carried out at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat during 2012-2014. The design used is Randomized block design. The variety used is Pusa Phalguni, the soils are black soils.

In order to determine the effectiveness of some insecticides against cowpea pod borer (*Helicoverpa armigera*), insecticides were sprayed with the initiation of pest and 5 plants were randomly selected from net plot area and tagged. The details of the insecticide combinations sprayed are given in the table 1. Before spray, pre-treatment counts were made from the tagged plants from net plot area before 24 hours and post-treatment counts were made at 1, 3, 7 and 15 days after spraying.

The observations on population of pest were recorded in the morning hours. Pod borer incidence was recorded by counting total number of larvae on each tagged plant at weekly interval from 10 days after sowing. Per cent pod borers damage was also recorded from each treatment at each picking. For this purpose, pods of each treatment were harvested separately from the five selected plants and 100 pods selected at random were observed for the assessment of per cent pod damage. Spraying was done with the help of lever operated knapsack sprayer. Care was taken during spraying to obtain uniform coverage of insecticides on each plot and plant.

Results and Discussion

The differences in population of *H. armigera* recorded before spraying was found to be non- significant among different treatments which indicated that the infestation of *H. armigera* was in homogenous condition (Table 2).

The perusal of data (Table 2) recorded on first day after spraying indicated that all the insecticidal treatments recorded lower *H. armigera* population as compared to control (water spray). Among different insecticidal combinations, imidacloprid 17.8 SL in combination with Spinosad 45 SC (0.86 larva/plant) was found most effective treatment and it was at par with acetamiprid 20 SP in combination with spinosad 45 SC (0.93 larva/plant) and thiamethoxam 25 WG in combination with spinosad 45 SC (0.93 larva/plant). Imidacloprid 17.8 SL in combination with novaluron 10 EC (1.06 larvae/plant), thiamethoxam 25 WG in combination with novaluron 10 EC (1.13 larvae/plant), acetamiprid 20 SP in combination with novaluron 10 EC (1.13 larvae/plant), imidacloprid 17.8 SL in combination with indoxacarb 14.5 SC, (1.20

larvae/plant) and acetamiprid 20 SP in combination with flubendiamide 480 SC (1.20 larvae/plant) were the next best treatments and were at par with each other. Imidacloprid 17.8 SL in combination with flubendiamide 480 SC, acetamiprid 20 SP in combination with indoxacarb 14.5 SC, thiamethoxam 25 WG in combination with indoxacarb 14.5 SC and thiamethoxam 25 WG in combination with flubendiamide 480 SC recorded 1.26, 1.26, 1.34 and 1.33 larvae per plant respectively. The highest *H. armigera* population was observed in control (3.13 larvae/plant).

Data recorded on the third day after spraying (Table 2) indicated that all the insecticidal treatments recorded lower *H. armigera* population as compared to control. The same trend was followed as in the first day after spray, among different insecticidal combinations, imidacloprid 17.8 SL in combination with Spinosad 45 SC (0.73 larva/plant) was found most effective treatment and it was at par with acetamiprid 20 SP in combination with spinosad 45 SC (0.80 larva/plant) and thiamethoxam 25 WG in combination with spinosad 45 SC (0.80 larva/plant). Imidacloprid 17.8 SL in combination with novaluron 10 EC (0.93 larva/plant), thiamethoxam 25 WG in combination with novaluron 10 EC (1.00 larva/plant), acetamiprid 20 SP in combination with novaluron 10 EC (1.00 larva/plant), imidacloprid 17.8 SL in combination with indoxacarb 14.5 SC, (1.07 larvae/plant) and acetamiprid 20 SP in combination with flubendiamide 480 SC (1.06 larvae/plant) were the next best treatments and were at par. Imidacloprid 17.8 SL in combination with flubendiamide 480 SC, acetamiprid 20 SP in combination with indoxacarb 14.5 SC, thiamethoxam 25 WG in combination with indoxacarb 14.5 SC, and thiamethoxam 25 WG in combination with flubendiamide 480 SC recorded 1.13, 1.13, 1.20 and 1.20 larvae per plant respectively. The highest *H. armigera* population was observed in control (3.27 larvae/plant).

The same trend was followed as in case of first and third days after spray on the seventh day after spraying (Table 2). Among different insecticidal combinations, imidacloprid 17.8 SL in combination with Spinosad 45 SC (0.26 larva/plant) was found most effective treatment and it was at par with acetamiprid 20 SP in combination with spinosad 45 SC (0.33 larva/plant) and thiamethoxam 25 WG in combination with spinosad 45 SC (0.40 larva/plant).

Table.1 Details of insecticidal treatments

Sr. No.	Technical Name	Trade Name
1	Imidacloprid 17.8 SL @ 0.005 % + Novaluron 10 EC @ 0.015%	Confidor, Rimon
2	Imidacloprid 17.8 SL @ 0.005% + Indoxacarb 14.5 SC @ 0.007%	Confidor, Avaunt
3	Imidacloprid 17.8 SL @ 0.005% + Spinosad 45 SC @ 0.014%	Confidor, Tracer
4	Imidacloprid 17.8 SL @ 0.005% + Flubendiamide 480 SC @ 0.144%	Confidor, Fame
5	Thiamethoxam 25 WG @ 0.01% + Novaluron 10 EC @ 0.015%	Actara, Rimon
6	Thiamethoxam 25 WG @ 0.01% + Indoxacarb 14.5 SC @ 0.007%	Actara, Avaunt
7	Thiamethoxam 25 WG @ 0.01% + Spinosad 45 SC @ 0.014%	Actara, Tracer
8	Thiamethoxam 25 WG @ 0.01% + Flubendiamide 480 SC @ 0.144%	Actara, Fame
9	Acetamiprid 20 SP @ 0.006% + Novaluron 10 EC @ 0.015%	Pride, Rimon
10	Acetamiprid 20 SP @ 0.006% + Indoxacarb 14.5 SC @ 0.007%	Pride, Avaunt
11	Acetamiprid 20 SP @ 0.006% + Spinosad 45 SC @ 0.014%	Pride, Tracer
12	Acetamiprid 20 SP @ 0.006% + Flubendiamide 480 SC @ 0.144%	Pride, Fame

Table.2 Effect of insecticide combinations against *H. armigera* on cowpea

Sr. No.	Treatment	Mean no. of *H. armigera* larvae/ plant					
		Before spraying	1 DAS	3 DAS	7 DAS	15 DAS	Pooled
1	Imidacloprid 17.8 SL @ 0.005 % + Novaluron 10 EC @ 0.015%	1.89 (3.06)*	1.25 (1.06)*	1.10 (0.93)*	1.08 (0.66)*	1.17 (0.86)*	1.17 (088)*
2	Imidacloprid 17.8 SL @ 0.005% + Indoxacarb 14.5 SC @ 0.007%	1.95 (3.33)	1.30 (1.20)	1.25 (1.07)	1.14 (0.80)	1.25 (1.07)	1.24 (1.03)
3	Imidacloprid 17.8 SL @ 0.005% + Spinosad 45 SC @ 0.014%	1.85 (2.93)	1.17 (0.86)	1.11 (0.73)	1.87 (0.26)	0.94 (0.40)	1.02 (0.57)
4	Imidacloprid 17.8 SL @ 0.005% + Flubendiamide 480 SC @ 0.144%	1.78 (2.67)	1.33 (1.26)	1.28 (1.13)	1.17 (0.86)	1.22 (1.00)	1.25 (1.06)
5	Thiamethoxam 25 WG @ 0.01% + Novaluron 10 EC @ 0.015%	1.81 (2.80)	1.28 (1.13)	1.22 (1.00)	1.11 (0.73)	1.17 (0.86)	1.10 (0.93)
6	Thiamethoxam 25 WG @ 0.01% + Indoxacarb 14.5 SC @ 0.007%	1.83 (2.86)	1.34 (1.34)	1.29 (1.20)	1.10 (0.93)	1.20 (1.20)	1.28 (1.16)
7	Thiamethoxam 25 WG @ 0.01% + Spinosad 45 SC @ 0.014%	1.81 (2.80)	1.10 (0.93)	1.14 (0.80)	0.93 (0.40)	1.01 (0.53)	1.07 (0.66)
8	Thiamethoxam 25 WG @ 0.01% + Flubendiamide 480 SC @ 0.144%	1.94 (3.27)	1.35 (1.33)	1.30 (1.20)	1.10 (0.93)	1.25 (1.06)	1.28 (1.13)
9	Acetamiprid 20 SP @ 0.006% + Novaluron 10 EC @ 0.015%	1.79 (2.73)	1.28 (1.13)	1.22 (1.00)	1.11 (0.73)	1.17 (0.86)	1.19 (0.93)
10	Acetamiprid 20 SP @ 0.006% + Indoxacarb 14.5 SC @ 0.007%	1.76 (2.60)	1.33 (1.26)	1.28 (1.13)	1.17 (0.86)	1.33 (1.26)	1.28 (1.13)
11	Acetamiprid 20 SP @ 0.006% + Spinosad 45 SC @ 0.014%	1.79 (2.73)	1.10 (0.93)	1.14 (0.80)	0.89 (0.33)	1.01 (0.53)	1.06 (0.65)
12	Acetamiprid 20 SP @ 0.006% + Flubendiamide 480 SC @ 0.144%	1.81 (2.80)	1.30 (1.20)	1.25 (1.07)	1.17 (0.87)	1.25 (1.06)	1.24 (1.05)
13	Control	1.87 (3.00)	1.91 (3.14)	1.94 (3.27)	2.09 (3.87)	2.24 (4.53)	2.04 (3.70)
S. Em. ±		0.05	0.04	0.04	0.04	0.05	0.04
C. D. at 5%		NS	0.12	0.13	0.13	0.14	0.12
C. V. %		5.57	5.58	6.04	6.95	6.93	6.36
S. Em. ± (P X T)		-	-	-	-	-	0.04
CD at 5 % (P X T)		-	-	-	-	-	0.129

*Figures in parenthesis are original values while those outside are arcsine transformed value

Table.3 Effect of insecticide combinations on per cent pod damage caused by *H. armigera*

Sr. No.	Treatment	1st picking	2nd picking	3rd picking	4th picking	Pooled
1	Imidacloprid 17.8 SL @ 0.005 % + Novaluron 10 EC @ 0.015%	14.48 (6.27)*	15.17 (6.87)*	15.52 (7.20)*	15.68 (7.33)*	15.21 (6.91)*
2	Imidacloprid 17.8 SL @ 0.005% + Indoxacarb 14.5 SC @ 0.007%	15.41 (7.06)	16.14 (7.73)	16.55 (8.13)	17.43 (9.00)	16.38 (7.98)
3	Imidacloprid 17.8 SL @ 0.005% + Spinosad 45 SC @ 0.014%	9.15 (2.53)	10.73 (3.47)	11.91 (4.33)	11.20 (3.80)	10.75 (3.53)
4	Imidacloprid 17.8 SL @ 0.005% + Flubendiamide 480 SC @ 0.144%	16.21 (7.80)	16.35 (7.93)	16.61 (8.20)	17.84 (9.46)	16.75 (8.34)
5	Thiamethoxam 25 WG @ 0.01% + Novaluron 10 EC @ 0.015%	14.56 (6.33)	15.25 (6.93)	15.65 (7.33)	15.92 (7.53)	15.34 (7.03)
6	Thiamethoxam 25 WG @ 0.01% + Indoxacarb 14.5 SC @ 0.007%	15.33 (7.00)	16.06 (7.66)	16.88 (8.46)	17.38 (8.93)	16.41 (8.01)
7	Thiamethoxam 25 WG @ 0.01% + Spinosad 45 SC @ 0.014%	9.27 (2.60)	10.51 (3.33)	12.45 (4.46)	11.92 (4.27)	10.94 (3.66)
8	Thiamethoxam 25 WG @ 0.01% + Flubendiamide 480 SC @ 0.144%	16.14 (7.73)	16.49 (8.06)	16.63 (8.26)	17.54 (9.13)	16.60 (8.30)
9	Acetamiprid 20 SP @ 0.006% + Novaluron 10 EC @ 0.015%	13.40 (5.47)	15.02 (6.73)	15.44 (7.13)	15.47 (7.13)	14.86 (6.62)
10	Acetamiprid 20 SP @ 0.006% + Indoxacarb 14.5 SC @ 0.007%	15.48 (7.13)	16.28 (7.87)	16.63 (8.27)	16.83 (8.40)	16.30 (7.92)
11	Acetamiprid 20 SP @ 0.006% + Spinosad 45 SC @ 0.014%	9.27 (2.60)	11.14 (3.73)	12.38 (4.60)	11.59 (4.06)	11.09 (3.74)
12	Acetamiprid 20 SP @ 0.006% + Flubendiamide 480 SC @ 0.144%	16.07 (7.67)	16.49 (8.06)	16.84 (8.40)	16.48 (9.06)	16.72 (8.29)
13	Control	27.25 (21.33)	30.55 (26.07)	30.45 (26.00)	32.93 (29.67)	30.29 (25.77)
S. Em. ±		0.92	0.81	1.29	0.80	0.02
C. D. at 5%		2.71	2.38	3.78	2.35	0.09
C. V. %		10.89	8.91	13.68	8.28	6.68
S. Em. ± (P X T)		-	-	-	-	0.05
CD at 5 % (P X T)		-	-	-	-	0.15

*Figures in parenthesis are original values while those outside are arcsine transformed value

Imidacloprid 17.8 SL in combination with novaluron 10 EC (0.66 larva/plant), thiamethoxam 25 WG in combination with novaluron 10 EC (0.73 larva/plant) and acetamiprid 20 SP in combination with novaluron 10 EC (0.73 larva/plant) were the next best treatments. Imidacloprid 17.8 SL in combination with indoxacarb 14.5 SC, (0.80 larva/plant) and acetamiprid 20 SP in combination with flubendiamide 480 SC (0.87 larva/plant), imidacloprid 17.8 SL in combination with flubendiamide 480 SC, acetamiprid 20 SP in combination with indoxacarb 14.5 SC, thiamethoxam 25 WG in combination with indoxacarb 14.5 SC, and thiamethoxam 25 WG in combination with flubendiamide 480 SC recorded 0.86, 0.86, 0.93 and 0.93 larva per plant respectively. The highest *H. armigera* population was observed in control (3.86 larvae/plant). The data recorded on fifteenth day after spraying indicated that among different insecticidal combinations, imidacloprid 17.8 SL in combination with Spinosad 45 SC (0.40 larva/plant) was found most effective treatment and it was at par with acetamiprid 20 SP in combination with spinosad 45 SC (0.53 larva/plant) and thiamethoxam 25 WG in combination with spinosad 45 SC (0.53 larva/plant). Imidacloprid 17.8 SL in combination with novaluron 10 EC (0.86 larva/plant), thiamethoxam 25 WG in combination with novaluron 10 EC (0.86 larva/plant) and acetamiprid 20 SP in combination with novaluron 10 EC (0.86 larva/plant) were the next best and recorded same number of larvae in three treatments. Imidacloprid 17.8 SL in combination with indoxacarb 14.5 SC, acetamiprid 20 SP in combination with flubendiamide 480 SC, imidacloprid 17.8 SL in combination with flubendiamide 480 SC, acetamiprid 20 SP in combination with indoxacarb 14.5 SC, thiamethoxam 25 WG in combination with indoxacarb 14.5 SC, and thiamethoxam 25 WG in combination with flubendiamide 480 SC recorded 1.07, 1.06, 1.00, 1.26, 1.20 and 1.06 larvae per plant respectively. The highest *H. armigera* population was observed in control (4.53 larvae/plant).

Pooled data (Table 2) over periods indicated that all the treatments showed significant superiority in controlling the *H. armigera* population over control. However, significantly lowest *H. armigera* population was recorded in the treatment of imidacloprid 17.8 SL in combination with Spinosad 45 SC (0.57 larva/plant). The next effective treatments were acetamiprid 20 SP in combination with spinosad 45 SC (0.65 larva/plant), thiamethoxam 25 WG in combination with spinosad 45 SC (0.66 larva/plant). Imidacloprid 17.8 SL in combination with novaluron 10 EC (0.88 larva/plant), thiamethoxam 25 WG in combination with novaluron 10 EC (0.93 larva/plant) and acetamiprid 20 SP in combination with novaluron 10 EC (0.93 larva/plant) were the next best treatments and were at par. Imidacloprid 17.8 SL in combination with indoxacarb 14.5 SC, acetamiprid 20 SP in combination with flubendiamide 480 SC, imidacloprid 17.8 SL in combination with flubendiamide 480 SC, acetamiprid 20 SP in combination with indoxacarb 14.5 SC, thiamethoxam 25 WG in combination with flubendiamide 480 SC and thiamethoxam 25 WG in combination with indoxacarb 14.5 SC recorded 1.03, 1.05, 1.06, 1.13, 1.13 and 1.16 larvae per plant respectively. The highest *H. armigera* population was observed in control (3.70 larvae/plant). Maximum reduction of larvae was found in the treatments in which spinosad is present followed by the treatments in which novaluron is present.

When Per cent pod damage was calculated for different insecticide combinations, none of the treatments were found free from the damage of cowpea pod borer, *H. armigera*

(Table 3). However, lowest pod borer damage was recorded in the treatment imidacloprid 17.8 SL in combination with Spinosad 45 SC (3.53%) and this was at par with thiamethoxam 25 WG in combination with spinosad 45 SC (3.66%) and acetamiprid 20 SP in combination with spinosad 45 SC (3.74%). The next effective treatments were acetamiprid 20 SP in combination with novaluron 10 EC (6.62%), imidacloprid 17.8 SL in combination with novaluron 10 EC (6.91%) and thiamethoxam 25 WG in combination with novaluron 10 EC (7.03%). The treatments acetamiprid 20 SP in combination with indoxacarb 14.5 SC, imidacloprid 17.8 SL in combination with indoxacarb 14.5 SC, thiamethoxam 25 WG in combination with indoxacarb 14.5 SC, acetamiprid 20 SP in combination with flubendiamide 480 SC, thiamethoxam 25 WG in combination with flubendiamide 480 SC and imidacloprid 17.8 SL in combination with flubendiamide 480 SC, recorded 7.92, 7.98, 8.01, 8.29, 8.30 and 8.34 per cent pod damage respectively. The highest per cent pod damage was observed in control (25.77 %).

The present findings are in agreement with Thejaswi *et al.,* (2009). They found that spinosad 2.5 SC emerged as best treatment which brought about 36.44, 27.9 and 29.24 per cent reduction in pod borer populations after first, second and third spray, respectively as well as least pod and seed damage of 14.38 and 10.66 per cent respectively with maximum yield. Imidacloprid 17.8 SL @ 25 g a.i./ha in combination with spinosad 45 SC @ 75 g a.i./ha and acetamiprid 20 SP @ 20 g a.i./ha in combination with spinosad 45 SC @ 75 g a.i./ha recorded the significantly lower number of *H. armigera* larva (0.65 larva /plant) whereas they were at par with thiamethoxam 25 WG @ 35 g a.i./ha in combination with spinosad 45 SC @ 75 g a.i./ha, imidacloprid 17.8 SL @ 25 g a.i./ha in combination with Novaluron 10 EC @ 33.5 g a.i./ha, acetamiprid 20 SP @ 20 g a.i./ha in combination with Novaluron 10 EC @ 33.5 g a.i./ha and thiamethoxam 25 WG @ 35 g a.i./ha in combination with novaluron 10 EC @ 33.5 g a.i./ha (Anonymous, 2013). The results obtained in present investigations are in exact match with the above report. The results were more or less similar to that of Gurjar, 2006. He stated that among the eleven different insecticides tested against *H. armigera*, spinosad 0.002 per cent recorded the lowest percentage of pod damage (4.11%) which was followed by novaluron 0.0075 per cent. The findings are also in line with Thejaswi *et al.,* (2009). According to them least pod and seed damage due to *H. armigera* was found in the treatment spinosad 2.5 SC. The results are in contradictory with Deshmuk *et al.,* (2010) who stated that the highest control of *Helicoverpa armigera* was recorded in the treatment of flubendiamide 0.007 per cent followed by indoxacarb 0.0075 per cent, spinosad 0.009 per cent in chickpea crop. Babariya *et al.,* (2010) reported that indoxacarb gave the higher per cent mortality of gram pod borer than spinosad in pegion pea.

The results of Bio efficacy of different insecticide combinations against lowest *H. armigera* population was recorded in the treatment of imidacloprid 17.8 SL in combination with Spinosad 45 SC (0.57 larva/plant). The next effective treatments were acetamiprid 20 SP in combination with spinosad 45 SC (0.65 larva/plant), thiamethoxam 25 WG in combination with spinosad 45 SC (0.66 larva/plant). Lowest pod borer damage was recorded in the treatment imidacloprid 17.8 SL in combination with Spinosad 45 SC (3.53%) and this was at par with thiamethoxam 25 WG in combination with spinosad 45 SC (3.66%) and acetamiprid 20 SP in combination with spinosad 45 SC (3.74%). It was found that maximum reduction of larvae

was found in the treatments in which spinosad is present followed by the treatments in which novaluron is present. Percent pod damage was also lowest in the treatments with spinosad followed by novaluron.

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How to cite this article:

Swathi Yadav Kattula, H.V. Pandya, S. Shiva Kumar and Srasvan G. Kumar. 2017. Efficacy of Different Combination of Insecticides against Cowpea Pod Borer in Cowpea [*Vigna ungiculata* (L.) Walp.]. *Int.J.Curr.Microbiol.App.Sci.* 6(6): 2030-2037.
doi: https://doi.org/10.20546/ijcmas.2017.606.239