BIOEFFICACY OF A- CYANO PYRETHROID AND PHENYL ORGANOTHIOPHOSPHATE INSECTICIDE AGAINST H.ARMIGERA ON PIGEONPEA

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A B S T R A C T

The field experiments were conducted in Nagpur area during kharif season for consecutive two years to evaluate the bioefficacy of deltamethrin (2.8 EC) an α-cyano pyrethroid insecticide and profenofos (50 EC) a phenyl organothiophosphate insecticide against gram pod borer H. armigera on pigeonpea that causes serious damage to the developing pods.Deltamethrin was evaluated at the spray concentrations of 0.0014, 0.0028 and 0.0042 per cent while profenofos was evaluated at the spray concentrations of 0.1, 0.125 and 0.15 per cent. Two sprays were given at an interval of 15 days by initiating the first spray at 50% flowering of pigeonpea crop. Significant reduction in pod damage as compare to 25.17 per cent in untreated crop was noticed in all spray treatments. Although higher concentration of deltamethrin 0.0042 per cent and profenofos 0.15 per cent showed superiority, lower concentration of deltamethrin 0.0014, 0.0028 per cent and profenofos 0.1 and 0.125 per cent were considered to be appropriate. The pod damage ranged from 15.5 to 17.0 and 13.17 to 14.0 per cent in respect of spray treatment of deltamethrin and profenofos, respectively. Among two pesticides profenofos was found more effective in arresting infestation of H. armigera on pigeonpea crop.

Keywords: Pyrethroid, deltamethrin, profenofos, H.armigera, Pigeonpea

1. Introduction

Pesticides are used globally for the control of various kinds of pests that cause harm to crops and reduce the productivity. In India, estimated annual production losses due to pests are as high as US$ 42.66 million (Sushil, 2016). Insecticides, fungicides and herbicides are commonly used for pest control in agriculture. However, insecticides form the highest share in total pesticide use in India. As on June 2017, total 279 products (265 chemicals and 14 bio-pesticides) and 658 formulations including combinations are registered with CIB&RC. As per the source from States/UTs Zonal Conferences on Inputs (Plant Protection),consumption of chemical pesticides in Maharashtra during 2010-11 was 8317 metric tonnes (Tech. Grade) which increased to 13496 metric tonnes Tech. Grade) in the year 2016-17**.**

Among food grains, India is world's largest producer and consumer as well as importer of pulses in the world. The major pulse crops grown in India are chickpea, pigeonpea, lentil, moongbean, urdbean and fieldpea. Pigeonpea is considered as second most important pulse crop in India accounting for 18-20% of total pulse production and is a multipurpose crop, used for fodder, soil fertility enhancement, soil erosion control and for fuel (Janboonme *et al.*, 2007). However, pigeon pea yields have remained stagnant for the past 2-3 decades due to heavy infestation of an array of pest complex (Dar *et al.,* 2005).The pod borer complex *Helicoverpa armigera* (Hubner), *Maruca vitrata* (Geyer) and podfly (*Melanagromyza obtusa Malloch*) are important constraints in attainment of desired production and productivity of pigeonpea (Sharma. *et al.*, 2008) and considered as major pest problems of pigeonpea. Among these pigeonpea pod borer *Helicoverpa armigera* is one of the world's most important agricultural pests (Tay *et al.*, 2013) inflicting 80 to 90 percent of loss

(Kooner *et al*., 2006) .There is higher incidence of pod borers during flowering and pod formation stage .The economic threshold level is 8- 10 eggs or 3-5 small larvae per plant , at this stage chemical control measures become necessary as an average infestation of one larva per plant may cause a yield loss of 10-15 kg haG[1](Chandurkar *et al*., 2005). Some of the synthetic insecticides currently used for controlling this pest are imidacloprid, spinosad, abamectin, deltamethrin, cypermethrin, lambda-cyhalothrin, profenofos, and chlorpyrifos. However lot of care is to be taken in selecting insecticide and their recommended doses as *H. armigera* is very easily selected to insecticide resistance (Tay *et al.*, 2013). In vidarbha region deltamethrin and profenofos are the two prominent and widely used insecticides recommended against control of *H. armigera* pests.

Deltamethrin ((S)-α-cyano-3-phenoxybenzyl, (1R)-cis-3-(2,2-dibromovinyl)-2,2 dimethyl-cyclopropane carboxylate) an α-cyano pyrethroid insecticide, is widely used in agriculture and forestry against a broad spectrum of insect pests. Profenofos ((O-4-bromo-2–chlorophenyl) O-ethyl S-propyl phosphorothioate) a phenyl organothiophosphate insecticide is widely used for agricultural and household purposes.

The insecticidal effects of deltamethrin is believed to result from its binding to a distinct receptor site on voltage-gated sodium channels and prolonging the open state by inhibiting channel deactivation and inactivation (Du *et al*.,2010) while mode of action of profenofos is non-systemic insecticide with contact and stomach action.Profenofos exhibits a translaminar effect and is a cholinesterase inhibitor. For the control of *Helicoverpa armigera*, deltamethrin 2.8 EC @ 750 ml ha^{-1}, profenophos 50 EC @ 1500 ml ha^{-1} are recommended (Anonymous, 2011). Deltamethrin 2.8 EC at 1ml/lit and profenophos 50 EC at 2.5 ml/lit is recommended (Pdkv-2013).

Therefore their effectiveness against crop pests and persistence in environment should be considered essential to minimize or avoid adverse effects also keeping in mind to minimize the cost of inputs required for chemical control of gram pod borer infesting pigeonpea, deltamethrin 2.8 EC and profenofos 50 EC were evaluated through field trials for two consecutive seasons.

2. Materials and Methods

In order to study the bioefficacy of deltamethrin and profenofos against gram pod borer (*H. armigera*) infesting pigeonpea, field experiments were conducted in Mahurzari, Nagpur during kharif 2013 and 2014. The trail was laid out in randomized block design (RBD) with three replications of seven treatments. Each treatment plot was of 3m x 3m with inter plot and inter replication distance of 1.2m and 1.8 m respectively as shown in Fig.1.

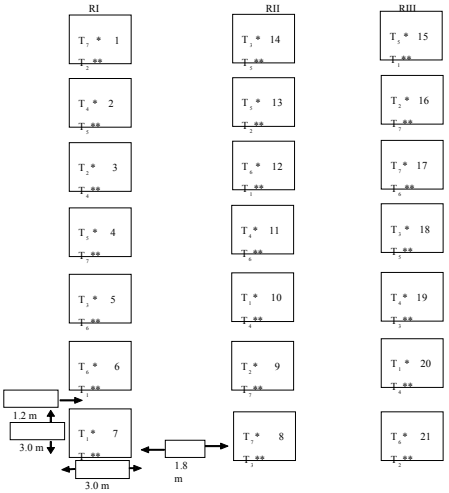

Fig.1: Plan of Layout of Pigeonpea

* Year: 2013-2014 ** Year: 2014-2015

Treatments

T_1-Profenofos 0.10% T_4- Deltamethrin 0.0014%
T_2- Profenofos 0.125% T_5- Deltamethrin 0.0028%
T_3- Profenofos 0.15% T_6- Deltamethrin 0.0042%
T_7 -Untreated control

Seeds of variety Asha were used for sowing at the spacing of 60 cm x 30 cm, which was performed in the month of July in both experimental seasons. Rest of the cultivation practices were followed as per the recommendation in Maharashtra as shown in (Table 1).

Table 1: Details of field the experiment

Particulars	Pigeonpea
Plan of Layout	Fig.No.7
Design	R.B.D (Randomised Block Design)
No.of treatments	7
No.of replications	3
Total No.of Plots	21
Plot size	3mx3m
Crop variety	ASHA TUR ANK
Spacing	60 x30 cms
Inter-replication spacing	1.8m
Inter -Plot spacing	1.2m
Total No.of Plants/Plot	50
Method of sowing	Dibbling
Date of sowing	
Year 2013-14	06/07/2013
year 2014-15	13/07/2014
Cultural Practices (fertilizers etc)	Recommended practices
Date of spraying:	
Year 2013-14	22/11/2013 & 07/12/2013
year 2014-15	25/11/2014 & 10/12/2014
No.of sprays	Two

Formulated products, deltamethrin 2.8 per cent EC was evaluated by taking three spray concentrations i.e. of 0.0014, 0.0028 and 0.0042 per cent active ingredient and profenofos 50 per cent EC was evaluated by taking three spray concentrations i.e. 0.1, 0.125 and 0.15 per cent active ingredient .Hand operated Knap-sac sprayer was used for spraying by keeping the fluid rate at 500 L/ ha. Each insecticide spray treatment consisted of two sprays which were given at an interval of 15 days. The first spray was initiated at 50% flowering stage when the infestation of *H. armigera* larvae was noticed. Effectiveness of treatment was judged on the basis of damaged pods with typical big hole due to feeding of larva. Observations were recorded by taking representative samples from 5 selected plants from each treatment plot. Total 100 pods were collected from five observational plants from each plot and were observed for pod damage. The data on percent pod damage was recorded which was further subjected to statistical analysis for comparing the treatments on the basis of critical difference by using the software Web Agri Stat Package (version 1.0, ICAR, Goa, India). The detail of the insecticidal treatments for pigeonpea is as shown in **(**Table 2).

Table: 2 Detail of the insecticide treatments pigeonpea crop

Sr. No.	Treatment No.	Insecticide	Concentration of insecticide (Trade product)	Concentration used in spray (%) (a.i. %)
1	T_1	Profenofos	50 EC	0.1
2	T_2	Profenofos	50EC	0.125
3	T_3	Profenofos	50EC	0.15
4	T_4	Deltamethrin	2.8EC	0.0014
5	T_5	Deltamethrin	2.8EC	0.0028
6	T_6	Deltamethrin	2.8EC	0.0042
7	T_7	Untreated control	--------	--------

3. Result and Discussion

The data on infestation of pods due to *H. armigera* borer obtained from two years' experiments were pooled and mean per cent pod damage obtained in crop of spray treatments and untreated (control) was calculated and presented in (Table 3 and Fig 2) .

Data presented in table 3 revealed that, all the insecticidal treatments were significantly superior over untreated control against the pest. All the insecticidal treatments of deltamethrin 2.8 EC at 0.0014, 0.0028 and 0.0042 per cent and profenofos 50 EC at 0.1, 0.125 and 0.15 per cent tested against podborer *H. armigera* were found effective and superior over untreated control. The infestation levels of the pest were arrested to the levels between 11.84 to 17 per cent against 25.17 per cent in untreated control plots.The most effective treatment was profenofos 0.15 followed by profenofos 0.125 and 0.10, deltamethrin 0.0042, 0.0028 and 0.0014 per cent recording 11.84, 13.17, 14, 14.5, 15.5, 17.0 per cent infestation of the pod borer, *Helicoverpa armigera* on pigeonpea, respectively. Spray concentration of deltamethrin in the range of 0.0014 and 0.0028 per cent and profenofos in the range of 0.10 and 0.125 per cent can be considered more appropriate which will minimize the pesticide quantity and load of toxicant as compared to higher concentration of 0.0042 per cent deltamethrin and 0.15 per cent profenofos.

Table 3: Average percentage pod damage infestation of *H.armigera* due to the treatments of profenofos and deltamethrin on pigeonpeas

Sr.No	Treatment No.	Insecticidal concentration (in per cent a.i.)	Arcsin mean per cent		Arcsin pooled mean per cent	Original mean per cent infestation		Original mean percent infestation
			Year 2013	Year 2014		Year 2013	Year 2014	
1	T_1	Profenofos 0.1	20.79	23.04	21.95	12.67	15.33	14
2	T_2	Profenofos 0.125	20.26	22.23	21.26	12	14.33	13.17
3	T_3	Profenofos 0.15	19.03	21.1	20.1	10.67	13	11.84
4	T_4	Deltamethrin 0.0014	23.52	25.1	24.34	16	18	17
5	T_5	Deltamethrin 0.0028	22.42	23.8	23.18	14.67	16.33	15.5

6	T_6	Deltamethrin 0.0042	21.62	23.02	22.38	13.67	15.33	14.5
7	T_7	Untreated control	29.31	30.86	30.1	24	26.33	25.17
F test			Sig.	Sig.	Sig.	Sig.	Sig	sig.
SE±			0.82	0.72	1.34	1.06	1.01	1.8
CD at 5.0 per cent			3.52	2.74	0.626	4.54	3.63	0.655
CV			8.83	6.38	1.097	17.22	12.02	1.685

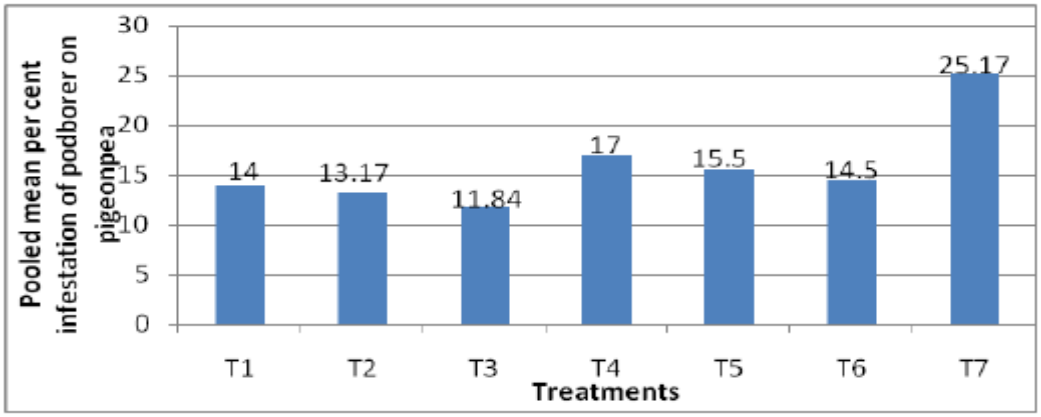

Fig 2. Bioefficacy of deltamethrin 2.8 EC and profenofos 50 EC against podborer on pigeonpea based on pooled mean per cent pod damage

Treatment

T_1-Profenofos 0.1%
T_2- Profenofos 0.125%
T_3- Profenofos 0.15%
T_4- Deltamethrin 0.0014 %
T_5- Deltamethrin 0.0028 %
T_6- Deltamethrin 0.0042%
T_7 -Untreated control

Similarly on the basis of mean original data of percentage pod damage, percentage reduction over control was calculated and presented in (Table 4)

Table.4. Pooled average reduction percentage of pod damage on pigeonpea, treated with deltamethrin and profenofos (years 2013 & 2014)

Treatment No.	Insecticidal concentration (in per cent a.i.)	Year 2013-14		Year 2014-15		Mean per cent reduction over control
		% pod damage	Reduction %age over control	% pod damage	Reduction% age over control	
T_1	Profenofos (0.1)	12.67	47.21	15.33	41.78	44.49

T_2	Profenofos (0.125)	12	50	14.33	45.58	47.79
T_3	Profenofos (0.15)	10.67	55.54	13	50.63	53.08
T_4	Deltamethrin (0.0014)	16	33.33	18	31.64	32.48
T_5	Deltamethrin 0.0028	14.67	38.88	16.33	37.98	38.43
T_6	Deltamethrin (0.0042)	13.67	43.04	15.33	41.78	42.41
T_7	Untreated control	24		26.33		

As shown in (Table 4) the highest reduction (53.08) over control was registered with the treatment profenofos 0.15 per cent, followed by profenofos 0.125 per cent, profenofos 0.10 per cent, deltamethrin 0.0042 per cent, deltamethrin 0.0028 per cent and deltamethrin 0.0014 per cent registering 47.79, 44.49, 42.41, 38.43 and 32.48 per cent reduction of the *H.armigera* on pigeonpea respectively over the untreated control treatment.

Effective control of pigeonpea pod borer infestation by spraying of deltamethrin and profenofos on other vegetable crops also was earlier reported by many authors.The present findings are in agreement with (Deshmukh *et al.*,2010) who found deltamethrin 0.005 per cent, to be effective in reducing the *H. armigera* population and pod damage of chickpea by recording 11.65 per cent pod damage.The findings that deltamethrin 0.0028 is effective against pod borer is corroborating with (Faqiri & Kumar,2016) who recorded lowest infestation of *H.armigera* in treatments of profenophos 50% EC (Curacron 2ml/lit) (4.350) per cent infestation compared with deltamethrin 2.8% EC (Decis 1ml/lit.) (5.90), both the treatments are superior over control (13.24).The present findings that deltamethrin 0.0014 per cent is is effective against *H. armigera* is in agreement with (Hussain & Sheikh, 2007) who observed deltamethrin 2.8 EC 0.01% effective after imidacloprid at 0.03% against *H. armigera* infesting tomato.(Yogeeswarudu and Venkata 2014) found profenofos 50 EC @ 2.0 ml/l to be effective in controlling *H. armigera larval* population and in reducing the pod infestation in chickpea. (Kumar, 2013) in his studies on bioefficacy of profenophos 50 EC @ 1000 g a.i. ha $^{-1}$, against *H. armigera* on tomato reported, profenophos @ 1000 g a.i. ha $^{-1}$ as the best and superior to the remaining treatments recording 65.20% fruit borer population reduction compared to untreated check where fruit borer population reduction is 0.00% also recorded lowest number of damaged fruits (28.80%). (Narkhede & Singh, 2012) reported the effectiveness of profenofos 50 EC @ 1000 gai/ ha against the pest.Similar work on bioefficacy against *H.armigera* on pigeonpea was carried by (Urkude *et al*., 2016) using different insecticides. Pesticides have beneficial effect on agricultural productivity however, their indiscriminate use has been associated with unintended environmental and human health consequences. (Jumde & Gurnule, 2016) in their studies reported that heavy metal ions in environment can be due to chemicals.

Conclusion

Keeping in the view the results obtained in the present investigation, two sprays of 0.0014 and 0.0028 per cent deltamethrin (2.8 EC) and 0.1 and 0.125 per cent profenofos (50 EC) at an interval of 15 days, by initiating first spray at 50 % flowering of pigeonpea crop, can be advocated for minimizing the losses caused by *H.armigera* to pigeonpea crop . Such spray

treatment should be considered riskless to the consumers. It is also concluded that profenofos was found more effective than deltamethrin in arresting infestation of *H.armigera* on pigeonpea crop.

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