The Pharma Innovation Journal 2017; 6(2): 186-190

www.ThePharmaJournal.com

The Pharma Innovation

ISSN: 2277- 7695
TPI 2017; 6(2): 186-190

www.thepharmajournal.com
Received: 19-12-2016
Accepted: 15-01-2017

SS Lande
Associate Professor,
Department of Entomology,
SSAC, Amravati, Maharashtra,
India

YR Sable
Assistant Professor,
Department of Entomology,
SSAC, Amravati, Maharashtra,
India

SR Pawar
Assistant Professor,
Department of Entomology,
RMAC, Navha, Maharashtra,
India

KP Budhvat
Assistant Professor,
Department of Entomology,
SSAC, Amravati, Maharashtra,
India

PB Salunke
Ph.D., Student,
Department of Entomology,
Dr. PDKV, Akola, Maharashtra,
India

Correspondence
SS Lande
Associate Professor,
Department of Entomology,
SSAC, Amravati, Maharashtra,
India

Evaluation of different modules for management of *Exelastis atomosa* in Pigeon pea

SS Lande, YR Sable, SR Pawar, KP Budhvat and PB Salunke

Abstract
The present study was conducted at Department of Entomology, Dr. PDKV, Akola to Evaluate the different Modules for management of *Exelastis atomosa* in Pigeon pea. In this investigation, four different modules and an untreated control were tested. The observations on the effect of different modules on larval population of *Exelastis atomosa* were found statistically significant. However, as regards to the influence of different modules against larval population of *E. atomosa*, the Chemical module-II (M2) recorded minimum population of *E. atomosa* i.e. 0.45 larvae per plant and was significantly superior over all other modules, followed by the Chemical module-I (M1) and IPM module (M4) with 0.98 and 1.13 larvae of *E. atomosa* per plant, and were statistically at par with each other. However, the Bio-control module (M3) recorded comparatively higher i.e. 1.43 *E. atomosa* larvae and was significantly superior over an untreated control which recorded highest population i.e. 2.13 larvae per plant. However, the highest grain yield of pigeon pea (2103 kg/ha) was obtained in the Chemical module-II (M2). The Chemical module-I (M1) and the Bio-control module (M3) registered yield levels of 1968 and 1780 Kg/ ha, respectively. The IPM module (M4) recorded lower yield of 1680 kg/ha as against 1543 Kg/ha in an untreated control. The highest ICBR of 1:4.00 was estimated in the Chemical module-II (M2) and was economically most viable module. It was followed by the Chemical module-I (M1) which recorded ICBR of 1:3.59, whereas, the Bio-control module (M3) and the IPM module (M4) recorded comparatively lower ICBR of 1:3.46 and 1:0.96, respectively.

Keywords: *Exelastis atomosa*, pigeonpea, management Modules

Introduction
Exelastis atomosa in Pigeon pea is the important pest commonly known as Plume moth. Pigeonpea, *Cajanus cajan* (L) Mill. vernacularly known as Red gram, *Arhar* or *Tur* is one of the most important pulse crop. Among the biotic and abiotic factors responsible for low yields of pigeonpea, insect pests are the major ones. More than 250 insect pests are reported on pigeonpea and extent of damage caused by insect pests varies from 30 to 80 per cent (Sharma *et al.*, 2010) [12]. Various methods have been tried for the control of pod borer complex, but agrochemicals are still the first choice of farmers. Management of pod borer complex in pigeonpea relies heavily on insecticides, often to the exclusion of other methods of control, because of their quick action, effectiveness and adaptability to various situations. Considerable numbers of insecticides have been tested and few of them found effective against the pod borers in pigeonpea (Yadav and Dahiya, 2004) [18]. Sole reliance on chemical pesticides led to development of resistance and resurgence of secondary pests. With reports of pesticide resistance in pod borer (Kranthi *et al.*, 2002) [9] and subsequent promotion of IPM, highlighted the need for development of safe, economic and effective pest management strategies. The use of alternatives, based on botanical pesticides (eg. neem) and insect pathogens, particularly the *Helicoverpa armigera* nuclear polyhedrosis virus (*Ha*NPV), gained popularity as safe for applicators, beneficial insect fauna, targeting pod borer and pod fly and the environment (Sharma *et al.*, 2011) [13]. The present investigation was carried out to evaluate the different modules for management of *Exelastis atomosa* in Pigeon pea for to identify ideal module for pest management.

Materials and Methods
The investigations were carried out with a view to evaluate the effective module for the management of *Exelastis atomosa* of pigeon pea. The experiments were carried on the field as well as in the laboratory of the Department of Entomology, Dr. P.D.K.V., Akola continuously for two years i.e. 2012-13 and 2013-14. The field trial was conducted using CRBD Completely Randomised Block Design in Kharif season with five treatments (Modules 1-5) replicated four

times for Management of Helicoverpa armigera in pigeonpea crop variety ICPL87119 (Asha) with spacing of 90X30 cm in the gross plot size of 7.2 X 3.6 m^2 (Net Size 5.4x 3.0 m^2)

Treatment details are as under

M1 - Chemical module I (University Recommended)

- First spray of azadirachtin 10,000 ppm, 10 ml/10 lit of water at 50 per cent flowering.
- Second spray of emamectin benzoate 5% SG, 3 g/10 lit of water, 15 days after 1st spray.
- Third spray of deltametrin 1% + triazophos 35%EC, 25 ml/10 lit of water, 15 days after 2nd spray.

M2 - Chemical module II

- First spray of profenophos 50 EC @ 25 ml/10 lit of water at bud initiation stage
- Second spray of flubendamide 20 WDG @ 5 g/10 lit of water at 50 per cent flowering.
- Third spray of indoxacarb 15.8 EC @ 5 ml/10 lit of water at 15 days after 50 per cent flowering.

M3 - Bio-control module

- Azadirachtin 10000 ppm @ 10 ml/10 lit of water at bud initiation stage.
- *Ha*NPV @ 500 LE/ha + Silver nano particle 0.80 micro liter/ml *Ha*NPV at 50 per cent flowering.
- Spinosad 45 SC @ 3ml /10 lit of water at 15 days after 50 per cent flowering.

M4 - IPM module

- Ploughing in summer
- Removal and destruction of stubbles
- Removal of alternate hosts
- Seed treatment with *Trichoderma*
- Mechanical collection of larvae
- Spraying of recommended insecticides at ETL if needed

M5 - Untreated Control

Spray Material Preparation

The spray material of desired concentration of emamectin benzoate, indoxacarb, spinosad, flubendiamide, azadirachtin, deltametrin 1% + triazophos 35%, profenophos and *Ha*NPV was freshly prepared in the field separately just before the start of spraying operation. The quantity of spray material required for coverage of crop was prepared by adopting the following formula:

V = C x A / % a.i.

Methods of recording observations

The observations were recorded on three, 10 cm twigs of five randomly selected plants per net plot and labelled. The first pretreatment observations were recorded 24 hours before treatment followed by weekly observations. The observations were recorded on the following aspects, Larval population of *Exelastis atomosa*, Pod damage on green pods separately. Pod damage, Grain damage and yield at harvest separately.

Larval population of *H. armigera* and *E. atomosa*

Five plants from each net plot and three twigs/plant i. e. one each from top, middle and bottom were selected and tagged for observation. The total number of *E. atomosa* larvae were recorded on these twigs. Pretreatment observations were recorded 24 hours before application of treatments and the post treatment observations were noted at an interval of 7 days (weekly) after pre treatment observation. From these the population of *E. atomosa* was calculated separately.

Economics of Different Treatments

The data on grain yield were used to calculate the economic viability of each treatment. The costs of each treatment and labours required for application were calculated as per market rate. Similarly, the income obtained from the sale of grains as per prevailing rates was also calculated for each treatment. The data thus obtained were used to calculate the monitory returns and incremental cost benefit ratio (ICBR) of various treatments.

The data collected from each year of experimentation were averaged out for respective parameter and subjected for analysis of variance. Similarly, the result of both the years were pooled and averages were worked out. The data thus obtained were transformed appropriately to arc sine and square root transformation wherever necessary as per Gomez and Gomez (1984) and further statistical analysis was done for testing of the level of significance.

Results and Discussion

The data thus obtained were subjected to statistical analysis after appropriate transformations and are presented in Table 1 and 2. Pooled data of two years are presented in Table No.3

1. Effect of different modules on larval population of *Exelastis atomosa* (Mean) 2012-13.

The Module effect calculated on the basis of mean of weekly data, recorded on 7 to 56 days and presented in Table1 shows that all the modules tested against *E. atomosa* were found significantly superior over control. However, the Chemical module-II (M2) emerged as most effective recording minimum population of *E. atomosa* i.e. 0.53 larvae per plant and was found significantly superior over all other modules. This was followed by the Chemical module-I (M1), IPM module (M4) and Bio-control module (M3) which recorded statistically significant differences over untreated control (M5).

However, the modules M1, M4 and M3 recorded 1.11, 1.25 and 1.53 number of *E. atomosa* larvae and were statistically at par with each other. While, an Untreated control (M5) recorded the highest population of 2.33 larvae per plant.

2. Effect of different modules on larval population of *E. atomosa* (Mean) 2013-14.

The module effect calculated on the basis of mean of weekly data, recorded on 7 to 56 days after initiation of first spray of the module and presented in Table 2 revealed that all the modules tested against *E. atomosa* were found significantly superior over control. Whereas, the Chemical module-II (M2) noted minimum (0.37 larvae/plant) larval population of *E. atomosa* and was found significantly superior over all other modules, followed by the Chemical module-I (M1) which recorded 0.85 larvae/plant and was found statistically similar with M4, i.e. IPM module which recorded 1.01 larvae/plant and significantly superior over the Bio-control module (M3) and an untreated control (M5).

However, the Bio-control module (M3) recorded comparatively higher population of 1.33 larvae/plant was found significantly superior over an untreated control (M5) which recorded highest population of 1.94 *E. atomosa* larvae per plant.

Effect of Different Modules on Larval Population of *E. atomosa* (Pooled)

The pooled mean data of 2012-13 and 2013-14 presented in Table 3 indicated that all the modules tested against *E. atomosa* were found significantly superior over an untreated control. However, the Chemical module-II (M2) recorded minimum population of *E. atomosa* i.e. 0.45 larvae per plant and was found significantly superior over all other modules, followed by the Chemical module-I (M1) and IPM module (M4) possessing 0.98 and 1.13 larvae of *E. atomosa* per plant, and were statistically at par with each other.

However, the Bio-control module (M3) recorded comparatively higher i.e. 1.43 *E. atomosa* larvae but was significantly superior over an untreated control. An untreated control recorded highest population i.e. 2.13 larvae per plant.

The effectiveness of Chemical module-II, which includes (first spray of profenophos 50 EC at bud initiation stage, second spray of flubendiamide 20 WDG at 50 per cent flowering, third spray of indoxacarb 15.8EC at 15 days after 50 per cent flowering) against *E. atomosa,* has been widely demonstrated by several workers like Bhandari and Ujagir (2002), Kaushik *et al.*,(2006), Jayashri Ughade *et al.*, (2008) [8], Dey *et al.*, (2012) [4], Priyadarshini *et al.*, (2013) [10] and Wadaskar *et al.*, (2013) [17] on pigeonpea crop. Moreover, the insecticide molecule was reported as most effective against *E. atomosa* by Patel and Patel, (2013), stating that profenophos 50 EC @ 250 g a.i./ha was the most effective insecticide against *tur* plume moth *E. atomosa*. Priyadarshini *et al.*, (2013) [10], also stated that among all the chemicals, flubendiamide 480 SC at 60 g a.i. ha^{-1} was found to be the most effective with a maximum reduction in lepidopteran pod borers.

Reduction of *E. atomosa* larval population, 7 and 14 days after the treatment to the extent of 95.4 per cent, over control by flubendiamide 20 WDG @ 0.5 g/l was recorded by Wadaskar *et al.*, 2013 [17]. This confirms the present findings.

3. Pooled Effect of Different Modules on Grain Yield of Pigeonpea

The pooled yield data presented in Table 4 was found statistically significant. The maximum yield was recorded in the Chemical module-II (M2) (2103 Kg/ha). The next effective modules were the Chemical module-I (M1) and the Bio-control module (M3), which recorded 1968 and 1780 Kg/ ha yields, respectively and were found statistically similar. The IPM module (M4) and an untreated control, recorded lower yields of 1680 and 1543 Kg/ha, respectively and both the modules were at par with each other.

The efficacy of Chemical module-II, with first spray of profenophos 50 EC at bud initiation stage, second spray of flubendiamide 20 WDG at 50 per cent flowering, third spray of indoxacarb 15.8 EC at 15 days after 50 per cent flowering in terms of grain yield realisation, has been demonstrated by Giraddi *et al.*, (2002) [7], Singh and Yadav, (2005), Chandrakar *et al.*, (2006) [3], Singh and Yadav (2006[b]), Dodia *et al.*, (2009) [6], Deshmukh *et al.*, (2010) [5], Dey *et al.*, (2012) [4], Tavaragondi *et al.*, (2013) [15], Wadaskar *et al.*, (2013) [17] and Ajagol *et al.*, (2014) [1].

Moreover, the insecticide molecule - Profenophos, Flubendiamide and Indoxacarb were reported as most effective for recurring grain yield by Giraddi *et al.*, (2002) [7] stating that Indoxacarb 15.8 EC was found more effective against *H. armigera* recording average seed yield of 1.40 t/ha. Based on residual toxicity, Profenophos was most effective in larval control. Application of Profenophos produced significantly higher grain yield (1516 kg/ha) (Chandrakar *et al.*, 2006) [3]. Singh and Yadav (2006[b]) revealed that, indoxacarb gave best results in reducing crop damage. The study also indicated that maximum grain yield was received from indoxacarb treatment.

Deshmukh *et al.*, (2010) [5] reported flubendiamide 0.007 per cent, indoxacarb 0.0075 per cent, as the effective insecticide in reducing the *H. armigera* population translating into higher yield in the treatment of flubendiamide 0.007 per cent (1850 kg/ha) and was followed by indoxacarb 0.0075 per cent (1805 kg/ha). Dey *et al.*, (2012) [4] stated that the highest seed yield was recorded in the treatment of flubendiamide 480 SC.

Wadaskar *et al.*, (2013) [17] revealed superiority of flubendiamide 20 WDG treatment which resulted into highest yield, which supports the present findings.

4. Incremental Cost Benefit Ratio (ICBR) of Different Treatments

The values of different treatments are presented in Table 37 and graphically illustrated in Fig. 36.

The data indicated that the Chemical module-II (M2) was most economically viable treatment, since this treatment recorded highest ICBR of 1:4.00. It was followed by the Chemical module-I (M1) which recorded the ICBR of 1:3.59. However, the modules such as the Bio-control module (M3) and the IPM module (M4) were also found economically better recording the higher ICBR of 1:3.46 and 1:0.96, respectively.

The efficacy of Chemical module-II, which includes first spray of profenophos 50 EC at bud initiation stage, second spray of flubendiamide 20 WDG at 50 per cent flowering, third spray of indoxacarb 15.8 EC at 15 days after 50 per cent flowering in terms of ICBR, has been demonstrated by several worker such as Singh and Yadav (2006[b]), Dodia *et al.*, (2009) [6], Deshmukh *et al.*, (2010) [5], Priyadarshini *et al.*, (2013) [10], Tavaragondi *et al.*, (2013) [15] and Wadaskar *et al.*, (2013) [17].

However, the insecticide molecule -Profenophos, Flubendiamide and Indoxacarb were reported as most effective in recording higher ICBR by Singh and Yadav (2006[b]), revealing that, indoxacarb gave best results in reducing crop damage and also indicated that maximum profit was received from indoxacarb treatment which gave benefit of Rs. 18.82 against one rupee investment.

Dodia *et al.*, (2009) [6] stated that the maximum monitory return was gained in the treatment of indoxacarb (ICBR=1:6.88) followed by flubendiamide (ICBR=1:4.56). This was supported by Priyadarshini *et al.*, (2013) [10] stating that the highest net profit was obtained from the treatment flubendiamide 480 SC (Rs. 12,638) per hectare.

Wadaskar *et al.*, (2013) [17] revealed the superiority of flubendiamide 20 WDG against higher monetary returns (14,657 Rs/ha) and highest Incremental Cost Benefit Ratio (ICBR 1:6.8) rendering flubendiamide as a cost effective alternative for pod borer management in pigeonpea followed by indoxacarb 14.5 SC, stating that these insecticides may also be recommended as potent alternatives in management of pod borer complex of pigeonpea, which confirmed the present findings.

Table 1: Effect of Different Modules on Larval Population of *E. atomosa*, 2012-13

Tr. No. (Module)	Treatments	*E. atomosa* larvae/plant								Mean (Module effect)
		7 DAT	**14 DAT**	**21 DAT**	**28 DAT**	**35 DAT**	**42 DAT**	**49 DAT**	**56 DAT***	
M1	Chemical Module-I	1.80	1.90	1.50	1.80	0.40	0.55	0.60	0.35	1.11
		(1.34)	(1.37)	(1.22)	(1.34)	(0.61)	(0.73)	(0.76)	(0.59)	(0.99)
M2	Chemical Module-II	0.80	1.50	0.30	0.40	0.35	0.25	0.35	0.30	0.53
		(0.89)	(1.21)	(0.53)	(0.62)	(0.59)	(0.49)	(0.59)	(0.54)	(0.68)
M3	Bio-Control Module	2.20	2.30	2.30	2.10	1.00	1.00	0.80	0.55	1.53
		(1.47)	(1.51)	(1.50)	(1.45)	(0.99)	(0.99)	(0.89)	(0.73)	(1.19)
M4	IPM Module	2.00	2.00	1.70	1.90	0.45	0.80	0.70	0.45	1.25
		(1.41)	(1.41)	(1.30)	(1.36)	(0.65)	(0.88)	(0.83)	(0.67)	(1.06)
M5	Untreated Control	3.20	2.50	2.70	2.60	2.70	2.00	2.00	0.90	2.33
		(1.78)	(1.58)	(1.64)	(1.61)	(1.64)	(1.41)	(1.40)	(0.94)	(1.50)
F-test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E(m)		0.09	0.07	0.07	0.07	0.08	0.06	0.07	0.05	0.07
CD at 5%		0.27	0.23	0.21	0.21	0.24	0.17	0.22	0.15	0.21
CV%		12.64	10.37	11.04	10.67	17.14	12.22	15.92	13.93	12.33

Figures in parentheses are corresponding square root values * DAT- Days after first treatment

Table 2: Effect of Different Modules on Larval Population of *E. atomosa*, 2013-14

Tr. No. (Module)	Treatments	*E. atomosa* larvae/plant								Mean (Module effect)
		7 DAT	**14 DAT**	**21 DAT**	**28 DAT**	**35 DAT**	**42 DAT**	**49 DAT**	**56 DAT***	
M1	Chemical Module-I	1.00	0.80	1.45	1.70	0.55	0.55	0.45	0.30	0.85
		(0.99)	(0.88)	(1.20)	(1.30)	(0.72)	(0.73)	(0.67)	(0.54)	(0.88)
M2	Chemical Module-II	0.35	0.70	0.35	0.35	0.35	0.25	0.30	0.30	0.37
		(0.59)	(0.83)	(0.58)	(0.56)	(0.56)	(0.49)	(0.54)	(0.54)	(0.59)
M3	Bio-Control Module	1.40	1.30	1.90	2.30	1.00	1.00	1.20	0.55	1.33
		(1.18)	(1.14)	(1.37)	(1.51)	(0.99)	(0.99)	(1.09)	(0.73)	(1.13)
M4	IPM Module	1.10	0.90	1.80	1.90	0.55	0.80	0.55	0.45	1.01
		(1.04)	(0.94)	(1.34)	(1.36)	(0.72)	(0.88)	(0.73)	(0.65)	(0.96)
M5	Untreated Control	1.60	1.90	2.10	2.60	2.40	2.00	1.90	1.00	1.94
		(1.26)	(1.37)	(1.45)	(1.61)	(1.55)	(1.41)	(1.35)	(1.00)	(1.37)
F-test		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E(m)		0.07	0.07	0.08	0.07	0.08	0.07	0.07	0.06	0.05
CD at 5%		0.21	0.22	0.23	0.23	0.24	0.21	0.23	0.18	0.17
CV%		13.61	14.05	12.73	11.60	17.02	14.77	16.75	16.75	10.74

Figures in parentheses are corresponding square root values
* DAT- Days after first treatment

Table 3: Effect of Different Modules on Larval Population of *E. atomosa* (Pooled)

Tr. No. (Module)	Treatments	*E. atomosa* larvae / plant		
		2012-13	**2013-14**	**Pooled**
M1	MODULE:1 Chemical module I First spray of Azadirachtin 10,000 ppm, 10 ml/10 lit of water at 50 per cent flowering. Second spray of Emamectin benzoate 5%SG, 3g/10 lit of water, 15 days after 1st spray. Third spray of Deltametrin 1% + Triazophos 35%, 25 ml/10 lit of water, 15 days after 2nd spray.	1.11 (0.99)	0.85 (0.88)	0.98 (0.94)
M2	MODULE: 2 Chemical module II First spray of profenophos50 EC @ 25 ml/10 lit of water at bud initiation stage. Second spray of Flubendiamide 20 WDG@ 5g/10 lit of water at 50 per cent flowering. Third spray of Indoxacarb 15.8EC @ 5ml/10 lit of water at 15 days after 50 per cent flowering.	0.53 (0.68)	0.37 (0.59)	0.45 (0.64)
M3	MODULE: 3 Bio-control module Azadirachtin 10000 ppm @ 10 ml/10 lit of water at bud initiation stage. *Ha*NPV @ 500 LE/ha + Silver nano particle 0.80 micro liter/ml *Ha*NPV / *Ha*NPV @ 500 LE/ha at 50 per cent flowering. Spinosad 45 SC @ 3ml /10 lit of water at 15 days after 50 per cent flowering.	1.53 (1.19)	1.33 (1.13)	1.43 (1.16)
M4	MODULE: 4 IPM module Ploughing in summer, Removal and destruction of stubbles, Removal of alternate hosts, Seed treatment with *Trichoderma,* Mechanical collection of larvae, Spraying of recommended insecticides at ETL if needed.	1.25 (1.06)	1.01 (0.96)	1.13 (1.01)
M5	MODULE: 5 Untreated Control	2.33 (1.50)	1.94 (1.37)	2.13 (1.44)
	F- test	Sig.	Sig.	Sig.
	S.E(m)	0.07	0.05	0.04
	CD at 5%	0.21	0.17	0.12
	CV %	12.33	10.74	11.18

Figures in parentheses are corresponding square root values

Table 4: Effect of Different Modules on Grain Yield of Pigeonpea (Pooled)

Treatments		Yields Kg/ha.		
		2012-13	2013-14	Pooled
		Kg/ha	Kg/ha	Kg/ha
M1	Chemical Module I	1890	2045	1968
M2	Chemical Module II	2006	2199	2103
M3	Bio-control Module	1825	1736	1780
M4	IPM Module	1601	1760	1680
M5	Untreated Control	1466	1620	1543
F-test		Sig.	Sig.	Sig.
S.E(m)		88.90	112.13	74.54
CD at 5%		273.90	373.18	216.25
CV%		10.12	12.94	11.62

Table 5: Effect of Different Modules on ICBR.

Sr. No.	Treatments	Cost of module (Rs/ha)	Labour cost for each application (Rs/ha)	Labour cost for module (Rs/ha)	Sprayer cost	Total cost (Rs/ha) 'A'	Yield (q/ha)	Yield increased over control (q/ha)	Value of Increased Yield (in Rs.) 'B'	Incremental benefit B-A (in Rs.)	ICBR	Rank
1	M1	1965	600	1800	300	4065	19.68	4.24	18672.72	14607.72	3.59	2
2	M2	2825	600	1800	300	4925	21.03	5.59	24614.04	19689.04	4.00	1
3	M3	3221	600	1800	300	5321	17.80	2.37	10419.2	5098.2	0.96	4
4	M4	650	600	600	100	1350	16.80	1.37	6019.2	4669.2	3.46	3
5	M5						15.43	0.00				5

References

1. Ajagol M, Mallapur CP, Balikai RA, Chouraddi M. Evaluation of IPM modules for the management of pod borer complex in hybrid pigeonpea. Journal of Experimental Zoology. 2014;17(1):207-212.
2. Babariya PM, Kabaria BB, Patel VN, Joshi MD. Chemical control of gram pod borer, *Helicoverpa armigera* (Hubner) infesting pigeon pea. Legume Research. 2010;33(3):224-226.
3. Chandrakar MK, Chandrakar HK, Shrivastava SK. Efficacy of new insecticides against larvae of gram pod borer, *Helicoverpa armigera* (Hubn.) on gram. Journal of Applied Zoological Researches. 2006;17(1):43-44.
4. Dey PK, Chakraborty G, Somchoudhury AK. Evaluation of flubendiamide 480 SC against lepidopteran pod borers of pigeonpea [*Cajanus cajan* (L) Millsp.]. Journal of Interacademicia. 2012;16(4):857-862.
5. Deshmukh SG, Sureja BV, Jethva DM, Chatar VP. Field efficacy of different insecticides against *Helicoverpa armigera* (Hubner) infesting chickpea. Legume Research. 2010;33(4):269-273.
6. Dodia DA, Prajapati BG, Acharya S. Efficacy of insecticides against gram pod borer, *H. armigera* Hardwick, infesting pigeonpea. Journal of Food Legumes. 2009;22(2):144-145.
7. Giraddi RS, Dasareddy SV, Lingappa S. Bio-efficacy of newer molecule of insecticides against gram pod borer *Helicoverpa armigera* in pigeon pea. Indian Journal of Agricultural Science. 2002;72(5):311-312.
8. Jayashri Ughade, Sarkate MB, Tupat PP, Chavhan KR. Comparative performance of different insecticides against *H. armigera* and *E. atomosa* damage in pigeonpea at harvest. Crop Research. 2008;36(1/3):299-301.
9. Kranthi KR, Jadhav DR, Kranthi S, Wanjari R, Ali SS, Russell DA. Insecticide resistance in five major insect pests of cotton in India. Crop Protection. 2002;21(6):449-460.
10. Priyadarshini G, Reddy CN, Reddy DJ. Bioefficacy of Selective Insecticides against Lepidopteran Pod Borers in Pigeonpea. Indian Journal of Plant Protection. 2013;41(1):6-10.
11. Sharma HC, Varshney R, Gaur PM, Gowda CLL. Potential for using morphological, biochemical and molecular markers for resistance to insect pests in grain legumes. Journal of Food Legumes. 2008;21:211-217.
12. Sharma OP, Gopali JB, Yelshetty S, Bambawale OM, Garg DK, Bhosle BB. Pests of pigeonpea and their Management. Indian Journal of Agricultural Sciences. 2010;81(6):539-543.
13. Sharma OP, Bhosle BB, Kamble KR, Bhede BV, Seeras NR. Management of pigeonpea pod borers with special reference to pod fly (*Melanagromyza obtusa*). Indian Journal of Agricultural Sciences. 2011;81(6):539-543.
14. Srinivasan T, Durairaj C. Newer insecticides against pod borer complex of pigeonpea with special reference to *Helicoverpa armigera* and *Melanagromyza obtusa*. Indian Journal of Plant Protection. 2007;35(1):47-49.
15. Tavaragondi Vinayaka, Babu CSJ, Chetan T, Murali S, Reddy GN. Evaluation of efficacy of different botanicals and chemical insecticides against pigeonpea pod borers. Environment and Ecology. 2013;31(2C):1169-1173.
16. Thilagam P, Kennedy JS. Susceptibility of *Helicoverpa armigera* (Hub.) to insecticides on pigeonpea. Journal of Plant Protection and Environment. 2006;3(1):11-14.
17. Wadaskar RM, Bhalkare SK, Patil AN. Field efficacy of newer insecticides against pod borer complex of pigeonpea. Journal of Food Legumes. 2013;26(1,2):62-66.
18. Yadav GS, Dahiya B. Evaluation of new insecticides/chemicals against pod borer and pod fly on pigeonpea. Annals of Biology. 2004;20(1):55-56.
19. Yadav JL, Chauhan R, Yadav PR. Persistence and residual toxicity of some insecticides against *Helicoverpa armigera* in field pea. Indian Journal of Plant Protection. 2006;34(1):124-125.