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Bio-efficacy of some newer insecticides against tur plume moth (*Exelastis atomosa*) in Pigeonpea under field conditions

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Abstract
The present study was conducted at the Research cum Instructional Farm, IGKV, Raipur, Chhattisgarh during Kharif season 2013-2014. The bioefficacy of eight newer insecticidal molecules, acetamiprid 20SP, indoxacarb 14.5SC, acephate 75SP, spinosad 45SC, emamectin benzoate 5WSG, flubendiamide 20WG, rynaxipyr 18.5SC and thiamethoxam 25WG each at two doses against tur pod borer (plume moth) infesting pigeonpea were evaluated under field conditions including untreated control as check. The percent pod and grain damage ranged from 5.06 & 1.56 to 8.37 & 4.03. Management of pod borer by newer insecticides, Spinosad maintained its lethal effect as least pod damage of 5.06 %, followed by emamectin benzoate with pod damage of 6.02%. The least grain damage 1.56% was recorded with spinosad and highest grain damage 4.03% was recorded with flubendiamide. Of all the tested insecticides the highest grain yield 1360.54 Kg/ha was recorded with spinosad and lowest yield 1037.41Kg/ha was recorded with flubendiamide. In the check (control), the yield obtained was 816.32 Kg/ha which was least of all the insecticides tested.

Keywords: Tur plume moth, *Exelastis atomosa*, newer insecticides

1. Introduction

Our country has the distinction of being the largest producer of legumes with over a dozen of pulse crops, grown on about 25.43 million hectares of land and 18.24 million tonnes of production with the average productivity of 679 kg/ha (Anonymous 2011) [1]. Pulses occupy an area of 67.8 million hectares and contribute 55.2 million tonnes to world's food basket (Pushpa, 2007) [8]. The level of productivity of pulses in India lies between 600-650kg/ha, which is far below when compared to average productivity of the world being the largest producer and consumer of pulses throughout the world.

In India, pigeonpea is grown in 3.86 million hectares with an annual production of 2.65 million tonnes and 741 kg $ha^{-1}$of productivity (FAOSTAT, 2012) [4], which is $4/5^{th}$ share in the world total pigeonpea produced. About 90% of the global pigeonpea area falls in India (Anonymous, 2012) [2]. In Chhattisgarh, acreage under pigeonpea is 51.9 thousand hectares with a total production and productivity of 31 thousand tonnes and 597 kg/ha, respectively (Anonymous, 2013) [3].

About 250 species of insect's belongings to 8 orders and 61 families are found to attack on pigeonpea. Worldwide, over 30 species of Lepidoptera feed on pods and seeds of pigeonpea (Shanower *et al.*, 1999) [9], among these only few are economically important as pests *viz*., Tur plume moth, *Exelastis atomosa* (Walsh), Tur pod borer, *Helicoverpa armigera* (Hubner) and Tur Pod fly, *Melanagromyza obtusa* (Mall) collectively referred as "Pod borer complex" (Lal, 1998; Patil *et al*., 1990) [5, 7]. The plume moth is more common on medium to mid-long duration genotypes grown in southern and central India, the infestation being more common during November to January. The adult is a small, brown coloured moth with fringed, plume-like wings. About 6 generations may be completed from November to April.

After introduction of the new molecules, which were tested and found effective against the key polyphagous pests there is every need to study their effect on these species. Hence, the present study was mainly focused on the effective management strategies on the tur pod borer of pigeonpea at Chhattisgarh.

2. Materials and Methods

The Present study entitled Bio-efficacy of some newer insecticides against tur plume moth (*Exelastis atomosa*) in pigeonpea under field conditions was conducted during July 2013 to February 2014. A field experiment was laid in randomized block design (RBD) with nine treatments including untreated control, replicated three times in plot size of 19.6 m^2. The number of larvae was counted randomly selected five plants from each plot, 24 hours before spraying of insecticides and the post treatment counts were taken after 3, 5, 7, 10 and 15 days of spraying insecticides and were subjected to square root transformation ($\sqrt{x+0.5}$). The quantity of each insecticide was determined for a plot size of 19.6m^2. The spraying was done two times (first spray at pod formation stage and second spray at 15 days after first spray).

The data on pod and grain damage were first recorded from the plants and then converted into percent. The percent pod and grain damage were subjected to angular transformation X = $\sqrt{\sin^{-1}}$ P, where X = transformed value and P = Percent data. Percent pod and grain damage and grain yield was recorded with the help of following formulae;

Insecticides tested against pod borer complex in pigeonpea

Treatments	Insecticides	Doses(ai/ha)
T_1	Acetamiprid 20SP	20g
T_2	Indoxacarb 14.5 SC	50g
T_3	Acephate 75SP	750g
T_4	Spinosad 45SC	73g
T_5	Emamectin benzoate 5WSG	9.5g
T_6	Flubendiamide 20WG	50g
T_7	Rynaxipyr 18.5SC	30g
T_8	Thiamethoxam 25WG	75g
T_9	Control	-

$$\text{Pod damage (\%)} = \frac{\text{Number of damaged pods}}{\text{Total number of pods(healthy+damage)}} \times 100$$

$$\text{Grain damage (\%)} = \frac{\text{Number of damaged grains}}{\text{Total number of grains(healthy + damage)}} \times 100$$

$$\text{Grain yield (kg/ha)} = \frac{\text{weight of grains in Kg/plot}}{\text{plot area in m}^2} \times 10000$$

3. Results and Discussion

Larval population of *Exelastis atomosa* after first spraying

The larval population in the pre-treatment observations was non-significant and ranged from 4.06 to 4.93 larvae per plant. Table-2 shows pretreatment and post-treatment observations. After third day, spinosad was recorded best effective treatment with the minimum larval population per plant (0.23) which was at par with indoxacarb (0.36). The highest larval population per plant was recorded in plots treated with flubendiamide (1.83) which was least effective treatment. The untreated plot significantly differed over rest of treated plots with 4.81 larvae per plant. After fifth day, spinosad showed least larval population per plant (0.16) which was at par with indoxacarb (0.32). The highest larval population per plant (1.76) was recorded in flubendiamide. After seventh day, plots treated with spinosad again showed minimum larval population per plant (0.16) which was at par with indoxacarb (0.40) and emamectin benzoate (0.59). The highest larval population per plant (1.66) was recorded in flubendiamide. After tenth day, spinosad showed minimum larval population per plant (0.32) which was at par with indoxacarb (0.30) and emamectin benzoate (0.56). The highest larval population per plant (1.83) was recorded in flubendiamide. After fifteenth day, all the treatments showed significant reduction of larvae over control. The plots treated with spinosad proved to be the best with minimum larval population per plant (0.42) which was at par with indoxacarb (0.53) and emamectin benzoate (0.72). The highest larval population per plant was recorded in flubendiamide (1.79). Untreated control showed population of 4.96 larvae per plant.

Table 2: Average larval population of *Exelastis atomosa* in pretreatment and post treatment observations

Notation	Treatments and doses (a.i/ha)	Pre -treatment larval population			Post treatment larval population							
					First spray			Second spray				
			3rd day	5th day	7th day	10th day	15th day	3rd day	5th day	7th day	10th day	15th day
T_1	Acetamiprid 20SP @ 20g ai/ha.	4.06 (2.12)	1.26 (1.32)	1.19 (1.30)	1.26 (1.32)	1.23 (1.31)	1.36 (1.35)	1.06 (1.25)	1.01 (1.22)	1.03 (1.18)	1.06 (1.25)	1.19 (1.30)
T_2	Indoxacarb 14.5 SC @ 50g ai/ha.	4.73 (2.27)	0.36 (0.91)	0.32 (0.90)	0.40 (0.94)	0.30 (0.88)	0.53 (1.00)	0.56 (1.01)	0.39 (0.93)	0.32 (0.89)	0.53 (0.99)	0.66 (1.07)
T_3	Acephate 75SP @ 750g ai/ha.	4.66 (2.27)	1.53 (1.41)	1.39 (1.37)	1.36 (1.36)	1.43 (1.37)	1.50 (1.40)	1.30 (1.33)	1.34 (1.35)	1.44 (1.39)	1.46 (1.39)	1.69 (1.47)
T_4	Spinosad 45SC @73g ai/ha.	4.53 (2.24)	0.23 (0.84)	0.16 (0.81)	0.16 (0.81)	0.32 (0.89)	0.42 (0.96)	0.26 (0.86)	0.20 (0.83)	0.19 (0.83)	0.30 (0.88)	0.40 (0.94)
T_5	Emamectin benzoate 5WSG @ 9.5g ai/ha.	4.93 (2.33)	0.90 (1.18)	0.93 (1.19)	0.59 (1.01)	0.56 (1.01)	0.72 (1.10)	0.79 (1.13)	0.52 (0.99)	0.49 (0.99)	0.73 (1.10)	0.96 (1.16)
T_6	Flubendiamide 20WG @ 50g ai/ha.	4.73 (2.28)	1.83 (1.52)	1.76 (1.49)	1.66 (1.44)	1.83 (1.52)	1.79 (1.51)	1.72 (1.49)	1.76 (1.50)	1.79 (1.51)	1.84 (1.52)	2.10 (1.61)
T_7	Rynaxipyr 18.5SC @ 30g ai/ha.	4.48 (2.30)	1.63 (1.45)	1.66 (1.47)	1.56 (1.43)	1.66 (1.46)	1.69 (1.48)	1.60 (1.38)	1.53 (1.42)	1.66 (1.46)	1.59 (1.44)	1.90 (1.55)
T_8	Thiamethoxam 25WG @ 75gai/ha.	4.93 (2.33)	1.63 (1.45)	1.60 (1.42)	1.50 (1.41)	1.63 (1.45)	1.83 (1.52)	1.46 (1.39)	1.39 (1.37)	1.59 (1.44)	1.46 (1.39)	1.76 (1.50)
T_9	Control	4.66 (2.26)	4.81 (2.30)	4.94 (2.32)	4.93 (2.32)	4.54 (2.23)	4.96 (2.33)	4.72 (2.28)	4.80 (2.29)	4.98 (2.33)	4.80 (2.29)	4.66 (2.27)
SE(m)±		NS	0.07	0.08	0.10	0.07	0.07	0.10	0.08	0.09	0.08	0.08
C.D. (5%)			0.23	0.26	0.31	0.22	0.22	0.30	0.24	0.28	0.24	0.24

Figures in Parentheses are square root transformed values

Larval population of *Exelastis atomosa* after second spraying

After the third day, all the tested doses of insecticides showed significant difference over control. Among the treatments, minimum larval population of *Exelastis atomosa* per plant (0.26) was recorded in spinosad which was at par with indoxacarb (0.56) and emamectin benzoate (0.79). The highest larval population per plant was recorded in plots treated with flubendiamide (1.72). The untreated plot significantly differed over rest of treated plots with larval population of 4.72 per plant. After fifth day, all the treatments showed significant reduction of larvae over control. The plots treated with spinosad resulted in least larval population per plant (0.20) which was at par with indoxacarb (0.39) and emamectin benzoate (0.52). The highest larval population per plant (1.76) was recorded in flubendiamide. After seventh, plots treated with spinosad showed least larval population per plant (0.19) as on the previous observation which was at par with indoxacarb (0.32) and emamectin benzoate (0.49). The highest larval population per plant (1.79) was recorded in flubendiamide. After tenth day also all the treatments exhibited significant reduction of larvae over control.

The plots treated with spinosad again turned out to be the best treatment with least larval population per plant (0.30) which was at par with indoxacarb (0.53) and emamectin benzoate (0.73). The highest larval population per plant (1.84) was recorded in flubendiamide. After fifteenth day, all the treatments once again depicted significant reduction of larvae over control. The plots treated with spinosad resulted as the best treatment with least larval population per plant (0.40) was par with indoxacarb (0.66) and emamectin benzoate (0.96). The highest larval population per plant (2.10) was recorded in flubendiamide. Untreated control showed population of 4.66 larvae per plant.

The present findings agrees with Singh and Verma (2006) who mentioned that among the various treatments, spinosad 45SC @ 84g a.i/ha and emamectin benzoate 5WSG @ 9.5g a.i/ha showed best results in minimizing larval population of pod borers of pegionpea.

Percent pod damage by *Exelastis atomosa*

Among the treatments, the minimum percent pod damage by *E.atomosa* was recorded with spinosad 5.06% which was at par with indoxacarb 6.04% and emamectin benzoate 6.02%. The maximum percent pod damage was recorded in flubendiamide 8.37%. Percent pod damage by *E. atomosa* recorded in untreated control was 11.40%.

Percent grain damage by *Exelastis atomosa*

Among the treatments, the minimum percent grain damage 1.56% was noticed with spinosad which was at par with indoxacarb 2.30%. On the contrary a maximum of 4.03 percent grain damage was resulted in flubendiamide. The percent grain damage by *E. atomosa* recorded in untreated control was 5.46%.

Present findings are also in confirmation with Narasimhamurthy and Ram (2013) [6] as they also recorded significant differences in the percent grain damage in pigeonpea over control plot, and least percent grain damage of 2.36% was observed in spinosad 45SC @ 73g a.i./ha during 2009-2010 while percent grain damage of 2.58% was recorded in indoxacarb 14.5SC @ 60g a.i./ha during 2010-2011.

Grain yield (Kg/ha)

The highest grain yield (1360.54 Kg /ha) was recorded in spinosad which was at par with indoxacarb (1207.48 kg/ha) emamectin benzoate (1139.44 kg/ha) and acetamiprid (1122.44 kg/ha), while the lowest grain yield of 1037.41 Kg /ha was recorded in flubendiamide treated plots, and the untreated control resulted least (816.32 kg /ha) grain yield in comparison to newer insecticides treated plots.

Present findings are in agreement with Srinivasan and Durairaj (2007) [11] as they also recorded highest grain yield in indoxacarb 14.5SC @ 50g a.i./ha (864.0 kg/ha) and spinosad 45SC @ 73g a.i./ha (841.1 kg/ha) as against the minimum yield of 432.7 kg/ha in the untreated control plot.

Tamboli and Lolage (2008) [12] who working on newer insecticides in testing the efficacy of newer insecticides also recorded highest grain yield in spinosad 45SC @ 90g a.i./ha (1681 Kg/ha). The details of percent pod damage, percent grain damage and grain yield is represented in table-3.

Table 2: Percent pod and grain damage and grain yield recorded in different treatments.

Notation	Treatments and doses (a.i/ha)	Percent pod damage	Percent grain damage	Yield(kg/ha)
T_1	Acetamiprid 20SP @ 20g ai/ha.	6.16 (14.36)	3.26 (10.04)	1122.44
T_2	Indoxacarb 14.5 SC @ 50g ai/ha.	6.04 (14.17)	2.30 (8.68)	1207.482
T_3	Acephate 75SP @ 750g ai/ha.	6.83 (15.13)	3.60 (10.92)	1088.43
T_4	Spinosad 45SC @73g ai/ha.	5.06 (12.98)	1.56 (7.11)	1360.54
T_5	Emamectin benzoate 5WSG @ 9.5g ai/ha.	6.02 (14.18)	2.93 (9.77)	1139.45
T_6	Flubendiamide 20WG @ 50g ai/ha.	8.37 (16.81)	4.03 (11.58)	1037.41
T_7	Rynaxipyr 18.5SC @ 30g ai/ha.	7.39 (15.75)	3.76 (11.16)	1071.42
T_8	Thiamethoxam 25WG @ 75gai/ha.	7.54 (15.92)	3.96 (11.43)	1062.92
T_9	Control	11.40 (19.72)	5.46 (13.49)	816.32
	SE(m)±	0.42	0.60	86.90
	C.D. (5%)	1.27	1.83	260.53

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