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EFFECTIVNESS OF SYNTHETIC INSECTICIDES AGAINST *HELICOVERPA ARMIGERA* (HUBNER) HARDWICK AND *SPODOPTERA LITURA* (FABRICIUS) INFESTING GROUNDNUT

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ABSTRACT
An experiment was conducted at Anand Agricultural University, Anand during *summer,* 2011 to study on the evaluation of insecticides for the management of *Helicoverpa armigera* (Hubner) Hardwick and *Spodoptera litura* (Fabricius) infesting groundnut. Insecticides used in experiment were Emamectin benzoate 5 WG @ 0.002%, Thiodicarb 75 WP @ 0.075%, Indoxacarb 14.5 SC @ 0.007%, Spinosad 45 SC @ 0.018%, Novaluron 10 EC @ 0.01%, Lufeneuron 5 EC @ 0.005%, Flubendiamide 480 SC @ 0.014%, Chlorantraniliprole 20 SC @ 0.006% and Metaflumizone 22 SC @ 0.044%. Two sprays of respective insecticides were applied at 15 days interval. Among nine insecticides, chlorantraniliprole (0.006%), spinosad (0.018%) and emamectin benzoate (0.002%) were noticed higher effective and statistically at par with each other in protecting the groundnut crop from the infestation of both pests. Metaflumizone (0.044%) and lufeneuron (0.005%) were noticed poor in checking the incidence of *H. armigera* and *S. litura*. Highest cost benefit ratio 1: 3.3 was observed in chlorantraniliprole (0.006%) followed by indoxacarb treatment.

INTRODUCTION

Groundnut (*Arachis hypogaea* Linnaeus*)* is an annual legume crop and belongs to family Leguminoceae. It is also known as peanut, earthnut, monkeynut and goobers. It is world's largest source of edible oil and ranks 13th among the food crops as well as 4th most important oilseed crop of the world. It is grown in tropical and sub-tropical regions and in the continental part of temperate countries. The seed (kernels) contains up to 50 per cent of a non drying oil, 40-50 per cent fat, 20-50 per cent protein and 10-20 per cent carbohydrate (Mehta, 2002). More than 100 species of insect and mites are known to attack groundnut (Amin, 1988 and Nandagopal, 1992). A comprehensive list of insect and non insect pests of groundnut was given by Nandagopal and Prasad (2004). Among all insect pests lepidopteron defoliator i.e. *Helicoverpa armigera* (Hubner) Hardwick and *Spodoptera litura* (Fabricius) were most serious problem in groundnut crop. Flowering stage can result in 20 per cent and severe outbreak cause 30 to 40 per cent yield loss in groundnut due to *S. litura* (Kulkarni, 1989). Crop failures due to *S. litura* were reported when despite intensive pest management practices (Wightman and Ranga Rao, 1993). *H. armigera* causes 40 to 50 per cent damage to tomato fruits (Srivastava, 1970). It is known fact that these both lepidopteron defoliator showed certain levels of behavioral resistance to different class of insecticides, hence successful control of this pest is some extent difficult. Keeping this in view, study were under taken to test the effectiveness of some newer molecules against these pest in Groundnut.

MATERIALS AND METHODS

With a view to find out the effective and economical synthetic insecticides against *H. armigera* and *S. litura* infesting groundnut, the experiment was carried out at Agronomy farm, Anand Agricultural University, Anand. Attempts were made to evaluate the effect of nine insecticides (Table 1). The experiment was laid out in Randomized Block Design with three replications. Groundnut (GG 20) was sown at spacing of 75 cm between two rows and 10 cm within the rows during 2nd week of February, 2011 in a gross and net plot area of 4.0 x 3.0 m and 3.0 × 1.5 m, respectively. The first spray of respective synthetic insecticides was applied when *H. armigera* and *S. litura* larval population found more than one larva per five plants and subsequent sprays was given at 15 days interval. The observations on number of *H. armigera* as well as *S. litura* larvae were recorded from randomly selected five plants from each net plot area. Similarly, total and damaged leaves by *H. armigera* and *S. litura* were observed from three branches of each selected plant prior to one day as well as 1, 3, 7, 10 and 15 days after each spray. Statistical analysis of all the recorded data were subjected to analysis of variance in randomized block design with the procedure followed by Steel and Torrie (1980). The pods and haulm were weighed treatment wise from each net plot area. The avoidable losses due to *H. armigera* and *S. litura* was calculated with the help of formula described by Poul (1976). The economics of each synthetic insecticides was calculated.

RESULTS AND DISCUSSION

Larval population

The plots treated with chlorantraniliprole proved significantly superior (0.62 larvae/five plants) over all the tested insecticides. The plots treated with spinosad were next to chlorantraniliprole which showed 0.82 larvae per five plants. The treatments of emamectin, indoxacarb and flubendiamide exhibited larval population of 1.19, 1.32 and 1.43 per five plants, respectively. In contrast to this, the treatments of novaluron, thiodicarb, metaflumizone and lufeneuron proved inferior (1.96 to 2.67 larvae/five plant) in checking the *H. armigera* infestation on groundnut crop (Table 1).

Leaf damage

The lowest (10.82%) leaf damage was noted in plots treated with chlorantraniliprole and it was at par with spinosad, emamectin and indoxacarb. The plots treated with flubendiamide and novaluron showed 13.84 and 14.88 per cent leaf damage, respectively. In contrast to this, the treatments of metaflumizone (16.71%) and lufeneuron (17.51%) proved inferior in checking the *H. armigera* infestation on groundnut crop (Table 1).

Chowdary *et al*. (2010) mentioned that chlorantraniliprole was superior in reducing *H. armigera* larval population followed by spinosad, emamectin benzoate and flubendiamide. which was strongly supported to present finding. Randhawa *et al*. (2009) reported that Spinosad 48 SC found to be the most effective insecticide for the control *H. armigera* in berseem and this insecticide was closely followed by Indoxicarb 15 EC. The effectiveness of spinosad against *H. armigera* was proved by Sohail *et al*. (2004) and Sidde Gowda *et al*. (2006) on gram whereas Tamboli and Lolage (2008) and Babariya *et al*. (2010) on pigeon pea.

S. litura

Larval population

The plots treated with chlorantraniliprole (Table 2) were found significantly superior (0.71 larvae/five plants) to all the insecticides tested except spinosad (0.89). The treatments of emamectin, indoxacarb, flubendiamide and novaluron exhibited larval population between 1.27 and 2.00 per five plants. However, emamectin and indoxacarb, indoxacarb and flubendiamide as well as flubendiamide and novaluron were noticed at par with each other in controlling the *S. litura* on groundnut and found in descending order of their efficacy. In contrast to this, the treatments of novaluron, thiodicarb, metaflumizone and lufeneuron proved inferior (2.00 to 2.67 larvae/five plants) in checking the *S. litura* infestation in groundnut crop.

Leaf damage

The plots treated with chlorantraniliprole (Table 2) proved significantly superior (6.64%) to all the insecticides tested except spinosad (7.91%) in checking the leaf damage caused by *S. litura* on groundnut. The treatments of emamectin, indoxacarb, flubendiamide and novaluron exhibited leaf

Table 1: Effectiveness of synthetic insecticides against *H. armigera* on groundnut

Treatments		No. of larvae/5 plants after spray*			Damage (%) after spray**		
		First spray	Second spray	Pooled over spray	First spray	Second spray	Pooled over spray
Emamectin benzoate@ 0.002%		1.33(1.27)	1.23(1.01)	1.30(1.19)	19.82(11.50)	20.98(12.82)	20.40(12.15)
Thiodicarb@ 0.075%		1.62(2.12)	1.53(1.84)	1.60(2.06)	22.21(14.29)	24.41(17.08)	23.31(15.66)
Indoxacarb@ 0.007%		1.37(1.38)	1.33(1.27)	1.35(1.32)	20.35(12.09)	21.99(14.02)	21.17(13.04)
Spinosad@ 0.018%		1.17(0.87)	1.13(0.78)	1.15(0.82)	19.31(10.93)	20.24(11.97)	19.78(11.45)
Novaluron@ 0.01%		1.59(2.03)	1.53(1.84)	1.57(1.96)	21.54(13.48)	23.84(16.34)	22.69(14.88)
Lufeneuron@ 0.005%		1.83(2.85)	1.73(2.49)	1.78(2.67)	23.57(15.99)	25.90(19.08)	24.74(17.51)
Flubendiamide@ 0.014%		1.39(1.43)	1.33(1.27)	1.39(1.43)	20.82(12.63)	22.86(15.09)	21.84(13.84)
Chlorantraniliprole@ 0.006%		1.09(0.69)	1.03(0.56)	1.06(0.62)	18.87(10.46)	19.52(11.16)	19.20(10.82)
Metaflumizone@ 0.044%		1.82(2.81)	1.63(2.16)	1.76(2.60)	22.92(15.17)	25.34(18.32)	24.13(16.71)
Control		2.09(3.87)	1.93(3.22)	2.04(3.66)	25.64(18.72)	27.92(21.92)	26.78(20.30)
Mean		1.53	1.46	1.50	21.51	23.30	22.40
SEm ±	T	0.02	0.02	0.06	0.41	0.51	0.86
	P	0.02	0.02	0.02	0.33	0.42	0.19
	S	-	-	0.01	-	-	0.12
	T × P	0.06	0.06	0.03	1.03	1.33	0.37
	P × S	-	-	0.05	-	-	0.59
	T × S	-	-	0.02	-	-	0.86
	T × P × S	-	-	0.07	-	-	0.84
CD at 5%	T	0.07	0.07	0.06	1.14	1.42	2.25
	P	0.06	0.06	0.04	0.99	1.25	0.52
	S	-	-	0.07	-	-	0.33
	T × P	NS	NS	NS	NS	NS	NS
	P S	-	-	NS	-	-	NS
	T × S	-	-	NS	-	-	NS
	T × P × S	-	-	NS	-	-	NS
CV%	7.74	7.84	7.92	8.33	9.89	6.48	

* Figures outside the parenthesis are $\sqrt{x+0.5}$ transformed values, those inside are retransformed values

** Figures outside the parenthesis are arc sine transformed values, those inside are retransformed values

Table 2: Effectiveness of synthetic insecticides against *S. litura* infesting groundnut

Treatments		No. of larvae/5 plants after spray*			Damage (%) after spray**		
		First spray	Second spray	Pooled over spray	First spray	Second spray	Pooled over spray
Emamectin benzoate@ 0.002%		1.78(2.67)	1.65(2.22)	1.72(2.46)	19.00(10.60)	20.58(12.36)	19.79(11.46)
Thiodicarb@ 0.075%		1.74(2.53)	1.60(2.06)	1.67(2.29)	18.29(9.85)	19.60(11.25)	18.95(10.55)
Indoxacarb@ 0.007%		1.63(2.16)	1.47(1.66)	1.55(1.90)	16.23(7.21)	17.39(8.93)	16.81(8.36)
Spinosad@ 0.018%		2.05(3.50)	2.06(3.34)	2.06(3.42)	23.03(15.30)	25.17(18.09)	24.10(16.67)
Novaluron@ 0.01%		1.83(2.85)	1.70(2.39)	1.76(2.60)	19.90(11.59)	21.26(13.15)	20.58(12.36)
Lufeneuron@ 0.005%		1.69(2.36)	1.55(1.90)	1.62(2.12)	17.08(8.63)	18.57(10.14)	17.82(9.37)
Flubendiamide@ 0.014%		1.80(2.74)	1.70(2.39)	1.75(2.56)	21.83(13.83)	22.90(15.14)	22.36(14.47)
Chlorantraniliprole@ 0.006%		1.85(2.92)	1.76(2.67)	1.80(2.74)	22.24(14.33)	23.52(15.93)	22.88(15.12)
Metaflumizone@ 0.044%		1.86(2.96)	1.70(2.39)	1.78(2.67)	21.09(12.95)	22.01(14.05)	21.55(13.49)
Control		2.14(4.08)	2.12(3.99)	2.13(4.04)	23.71(16.17)	25.89(19.07)	24.80(17.59)
Mean		1.83	1.72	1.78	20.24	21.69	20.96
SEm ±	T	0.03	0.03	0.06	0.40	0.49	0.89
	P	0.03	0.02	0.01	0.33	0.40	0.19
	S	-	-	0.01	-	-	0.12
	T × P	0.08	0.07	0.02	1.04	1.28	0.38
	P × S	-	-	0.04	-	-	0.60
	T × S	-	-	0.02	-	-	0.27
	T × P × S	-	-	0.05	-	-	0.84
CD at 5%	T	0.09	0.08	0.18	1.13	1.37	2.63
	P	0.08	0.06	0.03	0.98	1.20	0.52
	S	-	-	0.02	-	-	0.33
	T × P	NS	NS	NS	NS	NS	NS
	P S	-	-	NS	-	-	NS
	T × S	-	-	0.05	-	-	NS
	T × P × S	-	-	NS	-	-	NS
CV%		7.70	7.29	5.03	8.94	10.20	6.97

* - Ar sine, ** - Square root

Table 3: Effect of synthetic insecticides on yield and its economics of groundnut due to lepidopteran defoliators

Treatments	Pod Yield (kg/ha)	Increased yield over control(%)	Avoidable losses(%)	Haulm Yield (kg/ha)	Increased yield over control (%)	Avoidable losses(%)	ICBR
Emamectin benzoate@ 0.002	966.67	43.21	24.18	4166.67	14.50	8.54	1 : 1.69
Thiodicarb @ 0.075	813.89	20.58	36.17	4000.00	9.92	12.20	1 : 1.10
Indoxacarb @ 0.007	922.22	36.63	27.67	4138.89	13.74	9.15	1 : 2.39
Spinosad @ 0.018	1036.11	53.50	18.74	4361.11	19.85	4.27	1 : 1.46
Novaluron @ 0.01	852.78	26.34	33.12	4138.89	13.74	9.15	1 : 0.52
Lufeneuron @ 0.005	736.11	9.05	42.27	3916.67	7.63	14.02	1 : 0.10
Flubendiamide @ 0.014	919.44	36.21	27.89	4055.56	11.45	10.98	1 : 1.13
Chlorantraniliprole @ 0.006	1275.00	88.89	0.00	4555.56	25.19	0.00	1 : 3.22
Metaflumizone @ 0.044	769.44	13.99	39.65	3972.22	9.16	12.81	1 : -0.13
Control	675.00	-	47.06	3638.89	-	20.13	-
S Em ±	-	85.55	-	-	141.00	-	-
CD at 5%	-	254.19	-	-	418.96	-	-
CV%	-	16.53	-	-	5.97	-	-

Labour charge- skilled- 170 Rs/day, ordinary- 100 Rs/day, Market price of groundnut pod and haulm 30 and 2 Rs/kg, respectively

damage per cent between 9.06 and 11.69 per cent. Among the tested insecticides, the highest (14.56%) leaf damage was recorded in plots treated with lufeneuron and it was at par with metaflumizone (13.83%) and thiodicarb (12.89%). Mutkule *et al*. (2009) proved the effectiveness of spinosad 0.018 per cent and emamectin benzoate 0.001 per cent against *S. litura* on groundnut. Satyanarayana *et al*. (2010) reported that emamectin benzoate 0.00725 per cent and indoxacarb 0.0145 per cent effectively reduced larval population of *S. litura* in groundnut.

The significantly highest 1275.00 and 4555.56 kg/ha pod and haulm yield recorded in plots treated with chlorantraniliprolethan. The lowest pod and haulm yield noted in plot treated with lufeneuron, metaflumizone and thiodicarb.

Looking to the NICBR, the highest (1:2.22) return was obtained with the treatment of chlorantraniliprole. The NICBR was 1:1.39, 1:0.69 and 1:0.46 in the treatments of indoxacarb, emamectin and spinosad, respectively. The remaining insecticides gave NICBR between 1:-1.13 and 1:0.13.

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