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EFFICACY OF INSECTICIDES AGAINST TOBACCO CATTERPILLAR *SPODOPTERA LITURA* (F) AND GRAM CATERPILLAR *HELICOVERPA ARMIGERA* (HUBN) ON GROUNDNUT

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ABSTRACT

A field experiment was carried out during kharif 2021 to evaluate the efficacy of some insecticides against *Spodoptera litura* (F) and *Helicoverpa armigera* (Hubn) on groundnut. Amongst these, chlorantraniliprole 18.5SC @ 30g a.i. ha^{-1} proved to be the most effective with least larval counts (0.93 and 1.00 plant^{-1}, respectively) and efficacy (63.27 and 63.70%, respectively) against *S. litura* and *H. armigera*, respectively after two sprays. This was followed by cyantraniliprole 10OD @ 90g a.i. ha^{-1} and novaluron 5.25+ indoxacarb 4.5SC @ 39.38+ 33.77g a.i. ha^{-1} giving maximum groundnut yield (22.37 q ha^{-1}) with 52% increase over untreated control. The evaluation of economics revealed that chlorantraniliprole 18.5SC gave the highest monetary return, net income (Rs. 55765.00) and cost: benefit ratio (1:6.80).

Key words: Efficacy, insecticides, chlorantraniliprole 18.5SC, cyantraniliprole 10OD, novaluron 5.25 + indoxacarb 4.5SC, C:B ratio, groundnut, *Helicoverpa armigera*, *Spodoptera litura*

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop giving 45-48% fat, and accounts for >40-50 % in area and 60 to 70% in production, and in India, it is grown in 47.31 lakh ha producing 100.96 lakh mt (Anonymous, 2020), with productivity of 903 kg/ ha in Uttar Pradesh (Anonymous, 2021). Groundnut crop is attacked by >350 species of insects (Amin,1987; Vijayalakshmi et al., 2017), of which the tobacco caterpillar *Spodoptera litura* (F) and gram caterpillar *Helicoverpa armigera* (Hubn) are polyphagous feeding on leaves causing considerable damage by defoliation. These are the most important constraints to groundnut production (Mehrotra, 1989; Sharma et al., 2005); *S. litura* causing maximum reduction in pod yield (Dhir et al., 1992), extending to a total yield loss up to 15-30% (Ghewande and Nandagopal, 1997); *H. armigera* was also found to be the major pest with damage intensity of 80-90% (Kim et al., 2018). Insecticides play a vital role in suppressing pests with great success but their indiscriminate and injudicious use causes imbalance of natural enemies' activity, resulting in pest resurgence, secondary pest outbreaks and insecticide resistance. Hence, alternative safer approaches are necessary in groundnut, and recently new insecticides viz., chlorantriniliprole, cyantraniliprole, flubendiamide, methoxyfenozide etc. are available. This study evaluates these insecticides against *H. armigera* and *S. litura* in groundnut.

MATERIALS AND METHODS

The field experiment was conducted during kharif 2021 at the instructional farm of Banda University of Agriculture and Technology, Banda (24º53′ 25º55′N, 80º07′ 81º34′E). Experiment was laid out in randomized block design with three replications and seven treatments including untreated control. The variety Dharani was sown on 18th July, 2021 in 5.0 x 4.0 m plot size with 30 cm spacing between rows and 10 cm between the plants. Standard agronomic practices except plant protection measures were followed. Insecticides viz, methoxyfenozide 21.8SC (T_1) @ 210 g a.i. ha^{-1} , chlorantraniliprole 18.5SC (T_2) @ 30 g a.i.ha^{-1}, lambda cyhalothrin 5EC (T_3) @ 25 g a.i.ha^{-1}, flubendiamide 20WG (T_4) @ 50 g a.i.ha^{-1}, cyantraniliprole 10OD (T_5) @ 90g a.i. ha^{-1} and novaluron 5.25+ indoxacarb 4.5SC (T_6) @ 39.38+33.77g a.i.ha^{-1} along with untreated control (T_7) were the treatments. These insecticides were applied twice as foliar spray using knapsack sprayer, first was applied when *H. armigera* incidence (no. of larvae plant^{-1}) reached its economic threshold level (2 larvae plant^{-1} or 20-25% defoliation at 40 days); second was given at 15 days after the first. Larval counts of *S. litura* and *H. armigera* were recorded one day before treatment and 3, 7 and 10 days after each spray on 10 randomly selected plants/ plot. Field efficacy of treatments were calculated using the formula given by

Henderson and Tilton (1955). The crop was harvested plot wise at maturity and nuts were picked manually. The well dried and cleaned nuts were weighed on net plot basis and converted into q ha^{-1} for calculating economics of the treatments. The data were analyzed statistically to test the significance. Prevailing market price of groundnut, insecticides' cost and cost of labour were considered for calculating the cost: benefit ratio to evaluate the economics based on net income obtained from additional yield over control.

RESULTS AND DISCUSSION

Data on larval counts of *S. litura* and *H. armigera* and efficacy of insecticides are presented in Table 1; there were non-significant differences among treatments before spray. The larval counts of *S. litura* and *H. armigera* varied from 0.43 to 6.90 and 0.29 to 5.42 $plant^{-1}$, respectively. The least counts were observed with chlorantraniliprole 18.5SC @ 30g a.i. ha^{-1} (0.93 and 1.0 $plant^{-1}$) followed by cyantraniliprole 10OD (1.38 and 1.05 $plant^{-1}$) and novaluron 5.25+ indoxacarb 4.5 SC (1.79 and 1.57 $plant^{-1}$); these treatments were statistically at par with chlorantraniliprole 18.5%SC. Thus, chlorantraniliprole 18.5SC was superior, in conformity with the results of many coworkers (Gadhiya et al., 2014; Maruthi et al., 2017; Khinchi and Kumawat, 2021) in various crops including groundnut. Cyantraniliprole 10OD @ 90g a.i. ha^{-1} was the second best compared to flubendiamide 20WG @ 50g a.i. ha^{-1} agreeing with the results of Natikar et al. (2016). Besides, novaluron 5.25+ indoxacarb 4.5SC was also found more effective than flubendiamide, methoxyfenozide and lambda cyhalothrin; these observations corroborate those of Ghosal et al. (2016). The results on flubendiamide 20WG agree with those of Narayanamma et al. (2013) in castor. In terms of reduction in larval incidence varied from 20.69 to 52.76 and 32.10 to 52.96%, respectively, with chlorantraniliprole 18.5SC. Cyantraniliprole 10 OD (47.30 and 52.52%) was statistically at par but differed significantly from novaluron+ indoxacarb and others. Chlorantraniliprole 18.5SC and cyantraniliprole 10OD are thus promising, in conformity with the results of Thara et al. (2019). Chlorantraniliprole gave significantly higher yield (22.37 q ha^{-1}) at par with cyantraniliprole (21.08 q ha^{-1}) confirming with Thara et al. (2019) and Waykule et al. (2020). Economics of insecticides computed considering prevailing market price of groundnut and treatments including labour charges revealed that net realization of Rs. 55765 was maximum in chlorantraniliprole 18.5SC followed by cyantraniliprole 10OD (Rs. 44026.70). Cost: benefit ratio was also maximum in chlorantraniliprole 18.5SC (1:6.80) followed by flubendiamide 20WG (1:5:12). Similar results were also recorded by Thara et al. (2019) and Waykule et al. (2020).

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AUTHOR CONTRIBUTION STATEMENT

J, MKM and RP devised and designed research and conducted the experiment. BKS and SKS conducted the statistical analysis. RP and MKM wrote the manuscript. All the authors read and approved the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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Table 1. Efficacy of insecticides against *S. litura* and *H. armigera* in groundnut

T. No.	Treatments	*S. litura* Larval count (no./ plant)		*S. litura* Efficacy (% reduction over control)	*H. armigera* Larval count (no./ plant)		*H. armigera* Field efficacy (% reduction over control)	Yield		Realization (Rs. ha^{-1})	Total cost for two sprays (Rs. ha^{-1})	Net profit (Rs. ha^{-1})	Benefit: cost ratio
		Before spray	After two sprays		Before spray	After two sprays		Qt ha^{-1}	% increase over control				
T_1	Methoxyfenozide 21.8SC (@ 210g a.i. ha^{-1})	2.12	2.20	22.97 (27.58)	1.84	1.84	43.19 (41.04)	15.34	30.02	25336.7	4550.0	19386.7	1:3.3
T_2	Chlorantraniliprole 18.5SC (@ 30g a.i. ha^{-1})	2.07	0.93	63.27 (52.76)	1.78	1.00	63.70 (52.96)	22.37	52.00	63965.0	6800.0	55765.0	1:6.8
T_3	Lambda cyhalothrin 5EC (@ 25g a.i. ha^{-1})	2.14	2.76	14.46 (20.69)	1.84	2.63	28.35 (32.10)	13.96	23.09	17728.3	2200.0	14128.3	1:3.9
T_4	Flubendiamide 20 WG (@ 50g a.i. ha^{-1})	2.09	2.02	27.02 (30.65)	1.85	1.95	44.91 (41.99)	17.64	39.13	37968.3	4799.5	31768.8	1:5.1
T_5	Cyantraniliprole 10OD (@ 90g a.i. ha^{-1})	2.09	1.38	54.04 (47.30)	1.75	1.05	62.46 (52.22)	21.08	49.08	56906.7	11480.0	44026.7	1:3.4
T_6	Novaluron 5.25 + Indoxacarb 4.5 SC (@ 39.38+33.77g a.i. ha^{-1})	2.10	1.79	32.30 (33.86)	1.82	1.57	45.45 (42.36)	18.36	41.53	41946.7	9200.0	31346.7	1:3.0
T_7	Untreated control (Water)	2.15	6.90	0.00	1.84	5.42	0.00	10.74	-	-	-	-	-
SE(m)±		0.04	0.13	(3.53)	0.09	0.18	(2.23)	0.60	-	-	-	-	-
C D (p=0.05%)		NS	0.41	(10.98)	NS	0.55	(6.96)	1.86	-	-	-	-	-
C V		3.52	8.80	(20.09)	8.42	13.93	(10.31)	6.04	-	-	-	-	-

Figures in parentheses angular transferred values; Labour charge for insecticides application @ Rs 350/ labour and requirement of labour (no.) = 4 ha^{-1}; Price of groundnut Rs 5500/ q

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