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Bio-efficacy of different insecticides against gram pod borer (*Helicoverpa armigera* H.) on groundnut

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Abstract
The present field experiment were conducted to evaluate "Bio-efficacy of different insecticides against gram pod borer (*Helicoverpa armigera*) on groundnut" under field condition during *Kharif* season of 2019 at research farm of Oilseed Research Station, Latur, Maharashtra, India. The observations on total number of gram pod borer larvae were recorded on top, middle and bottom leaves of five randomly selected plants from each treatment at one day before and 3, 7, and 14 days after first and second application of insecticides. The treatments of different insecticides *viz.*, Chlorantranilliprole 0.0185 percent, Indoxacarb 0.01 percent, Emamectin benzoate 0.002 percent, Cypermethrin 0.002 percent, Profenophos 0.1 percent and Quinalphos 0.005 percent were evaluated against gram pod borer (*Helicoverpa armigera* H.) revealed that among all the insecticides chlorantranilliprole 0.0185 percent was found most effective for managing gram pod borer larvae population followed by indoxacarb 0.01 percent, emamectin benzoate 0.002 percent, cypermethrin 0.002 percent, profenophos 0.1 percent and quinalphos 0.005 percent Significantly higher seed yield (3286 kg/ha) of groundnut was recorded in treatment chlorantranilliprole 0.0185 percent however, it was found at par with treatment Indoxacarb 0.01 percent (3133 kg/ha). The highest ICBR (1:5.02) was recorded with treatment chlorantranilliprole 0.0185 percent which was followed by Indoxacarb 0.01 percent (1:4.91).

Keywords: Bio-efficacy, different insecticides, gram pod borer

Introduction
Groundnut, *Arachis hypogaea* L., belonging to genus *Arachis* tribe Aechynomenae, family Fabaceae is a tetra foliate legume crop with yellow sessile flowers and subterranean pods. It is native of South America. It is a valuable cash crop for millions of small scale farmers in the semi-arid tropics and is the principle oilseed crop in India. Groundnut kernels are one of rich source of edible oil (43-55%), protein (25-28%) and also a valuable source of vitamins *viz.*, E, K and B (Smith, A. F. 2002) [23]. It is also known as 'Indian Almond' and eaten as roasted or boiled. After the oil extraction groundnut cake is a high protein animal feed and haulm provides quality fodder. A variety of value products like peanut butter, chikki, milk, burfi, bhujia and biscuits are made from groundnut. The groundnut shell used in industries as fuel, filler in fertilizers and in extraction of mustard facilitates better recovery and low energy consumption.

Kharif-2018 all India groundnut acreage was 38,90,000 hectares. Five states, Gujarat (14,67,600 ha; 37.7%), Andhra Pradesh (6,60,000 ha; 17%), Rajasthan (5,49,052 ha; 14.1%), Karnataka (3,82,940 ha; 9.8%) Maharashtra (1,95,594 ha 5.0%) jointly accounted for 83.7% of the national acreage. At the national level, there was a decrease in acreage by 6.3% with respect to kharif-2017. The maximum decrease was observed for Gujarat (10.0%) while it was negligible for Andhra Pradesh (1.0%). The observed increase in acreage in Karnataka was nominal (1.3%). A majority of groundnut farmers (51 to 67%) owned farm land smaller than two hectares. At national level, the peak period of sowing was 8 June to 5 July. The largest extent of sowing was done during 8 June to 14 June in both Rajasthan (28%) and Maharashtra (42%); and during 28 June to 5 July in Gujarat (31.2%); Andhra Pradesh (25.2%) and Karnataka (22.9%). (APEDA) [1].

Among the surveyed states, the highest yield of 2051 kg/ha was estimated for Rajasthan, followed by 1421 kg/ha for Gujarat, 1361 kg/ha for Maharashtra, 883 kg/ha for Andhra Pradesh and 750 kg/ha for Karnataka.

The national average yield was estimated at 1336 kg/ha. The combined production of these five states was estimated at 43,47,298 MT which accounted for 83.6% of the estimated national production. With 20,84,780 MT, Gujarat contributed 40.1% of the national production followed by Rajasthan (11,26,206 MT; 21.6%,) Andhra Pradesh (5,82,972; 11.2%), Karnataka (2,87,178 MT; 5.5%) and Maharashtra (2,66,162; 5.12%) while the joint contribution of the remaining states was estimated at 8,48,698 MT i.e. 16.4%. Thus the all-India *kharif* 2018 production was estimated at 51,95,990 MT.(APEDA) [1].

Materials and Methods

The studies on "Bio-efficacy of different insecticides against gram pod borer (*Helicoverpa armigera* H.) on groundnut" were conducted during *Kharif* season 2019 at Oilseed Research Station, Latur, Maharashtra, India. The experiment was conducted in a randomized block design (RBD) with seven treatments including untreated control with three replications. Groundnut crop was sown on 31 Jully, 2019 in a gross plot of 4.2m x 5 m maintaining net plot of 3.6 m x 4.8 m. The row to row distance of 30 cm and plant to plant distance of 10 cm was maintained. The dose of fertilizer at the rate of 20 kg N, 40 kg P_2O_5 and 40 kg K_2O per hectare was given at the time of sowing. The crop was grown under protective irrigation. The treatments of different insecticides *viz.*, Chlorantranilliprole 0.0185 percent, Indoxacarb 0.01 percent, Emamectin benzoate 0.002 percent, Cypermethrin 0.002 percent, Profenophos 0.1 percent and Quinalphos 0.005 percent were applied on appearance of lepidopteran pests and subsequent spray were given at 15 days interval using manually operated knapsack sprayer. The observations on total number of gram pod borer larvae was recorded per five plant from each on top, middle and bottom leaves of five randomly selected plants from each treatment at one day before treatment and 3, 7, and 14 days after first and second application of insecticides.

Result and Discussion

The bio-efficacy data regarding gram pod borer *Helicoverpa armigera* during *Kharif* 2019 on groundnut.

Gram pod borer *Helicoverpa armigera* First spray

Data related to effect of different insecticides on population of *Helicoverpa armigera* larvae on groundnut after first spray are presented in Table 1 and depicted in Fig. 1. no significant differences were observed among various treatments before one day of the spray. The results revealed that all the insecticides were found significantly superior over untreated control in reducing population of *Helicoverpa armigera* larvae at 3,7, and 14 days after first spray application.

At three day after first spray, significantly minimum population of *Helicoverpa armigera* larvae (0.33 larvae/five plant) was recorded from the plots treated with treatment T2 i.e. Chlorantranilliprole 18.5 SC @ 0.0185 percent. The next effective treatment was treatment T4 i.e. Indoxacarb 15.8 SC @ 0.01 percent (1.33 *Helicoverpa armigera* larvae/five plant) which was followed by treatment T6

i.e. Emamectin benzoate 5 WDG @ 0.002 percent (1.67 *Helicoverpa armigera* larvae/five plant) in reducing *Helicoverpa armigera* larvae population. Both these treatments were found statistically at par with each other. The subsequent order of effectiveness was treatment T3 i.e. Cypermethrin 10 EC @ 0.02 percent (3.00 *Helicoverpa armigera* larvae/five plant) and treatment T5 i.e. Profenophos 50 EC @ 0.1 percent (3.67 *Helicoverpa armigera* larvae/five plant). Both these treatments were found statistically at par with each other. The next best treatment observed was treatment T1 i.e. Quinalphos 25 EC @ 0.05 percent which recorded 4.33 *Helicoverpa armigera* larvae/five plant. Significantly highest *Helicoverpa armigera* population (6.67 *Helicoverpa armigera* larvae/five plant) was observed in treatment T7 i.e. untreated control.

At seven days after first spray more or less same trend was observed and the treatment T2 i.e. Chlorantraniliprole 18.5 SC 0.0185 percent observed significantly effective in minimizing *Helicoverpa armigera* larvae population (1.07 *Helicoverpa armigera* larvae/five plant). The next effective treatment was T4 i.e. Indoxacarb 15.8 SC @0.01 percent (2.67 *Helicoverpa armigera* larvae/five plant) which was followed by treatment T6 i.e. Emamectin benzoate 5 WDG @0.002 percent (3.67 *Helicoverpa armigera* larvae/five plant) in reducing *Helicoverpa armigera* larvae population. Both these T4 and T6 treatments were found statistically at par with each other. The subsequent order of effectiveness was treatment T3 i.e. Cypermethrin 10 EC @ 0.02 percent (4.33 *Helicoverpa armigera* larvae/five plant) both these treatments i.e. T6 and T3 were statistically at par with each other. The next effective treatment was T5 i.e. Profenophos 50 EC @ 0.1 percent (5.33 *Helicoverpa armigera* larvae/five plant). These T3 and T5 treatments were statistically at par with each other. The subsequent order of effectiveness was treatment T1 i.e. Quinalphos 25 EC @ 0.05 percent (7.00 *Helicoverpa armigera* larvae/five plant) and both these T5 and T1 were found statistically at par with each other. While the highest *Helicoverpa armigera* population of 8.07 *Helicoverpa armigera* larvae/five plant was recorded in treatment T7 i.e. untreated control.

At fourteen days after first spray, significantly lowest population of *Helicoverpa armigera* larvae (2.80 *Helicoverpa armigera* larvae/five plant) was observed in the plots treated with treatment T2 i.e. Chlorantraniliprole 18.5 SC @ 0.0185 percent observed significantly effective in minimizing *Helicoverpa armigera* larvae population. The next effective treatment were treatment T4 i.e. Indoxacarb 15.8 SC @ 0.01 percent (4.73 *Helicoverpa armigera* larvae/five plant) which was followed by treatment T6 i.e. Emamectin benzoate 5 WDG @ 0.002 percent (6.67 *Helicoverpa armigera* larvae/five plant) in reducing *Helicoverpa armigera* larvae population. Both these treatments were found statistically at par with each other. The next effective treatment was T3 i.e. Cypermethrin 10 EC @ 0.02 percent (7.33 *Helicoverpa armigera* larvae/five plant) then T5 treatment i.e. Profenophos 50 EC @

0.1 percent (8.53 *Helicoverpa armigera* larvae/five plant). These three treatments were found statistically at par with each other. The next effective treatment was T1

i.e. Quinalphos 25 EC @ 0.05 percent (9.33 *Helicoverpa armigera* larvae/five plant). These T3, T5 and T1 were at par with each other. The highest population of *Helicoverpa armigera* larvae (12.33 larvae/five plant) was recorded in treatments T7

i.e. untreated control.

Thus, after first spray it can be concluded that the *Helicoverpa armigera* larvae population was decreased for only initial three days after spray and thereafter the population slowly increased. Also, the plots treated with chlorantraniliprole 18.5 SC @ 0.0185 percent recorded

significantly lowest population of *Helicoverpa armigera* larvae on groundnut to the extent of 0.33,1.07,2.80 larvae/plant respectively at 3,7 and 14 days after spraying and found effective over rest of the treatments.

Table 1: Effect of different insecticides on the larval population of gram pod borer (*Helicoverpa armigera)* on groundnut (After first spray)

Tr. No.	Treatment	Concentration used (%)	Mean population of *Helicoverpa armigera* larvae per five plant			
			1 day before Spraying	Days after spraying		
				3	7	14
T1	Quinalphos 25 EC	0.005	2.27 (1.66)*	4.33 (2.20)	7.00 (2.73)	9.33 (3.13)
T2	Chlorantranilliprole 18.5 SC	0.0185	2.33 (1.68)	0.33 (0.91)	1.07 (1.25)	2.80 (1.81)
T3	Cypermethrin 10 EC	0.002	2.47 (1.72)	3.00 (1.86)	4.33 (2.20)	7.33 (2.80)
T4	Indoxicarb 15.8 SC	0.02	2.40 (1.70)	1.33 (1.34)	2.67 (1.77)	4.73 (2.29)
T5	Profenophos 50 EC	0.1	2.40 (1.70)	3.67 (2.03)	5.33 (2.40)	8.53 (3.00)
T6	Emamectin benzoate 5 WDG	0.002	2.40 (1.70)	1.67 (1.46)	3.67 (2.03)	6.67 (2.67)
T7	Untreated Control	-	2.40 (1.69)	6.67 (2.68)	8.07 (2.92)	12.33 (3.55)
	S.E. ±		0.085	0.106	0.113	0.133
	C.D. at 5%		NS	0.320	0.343	0.405
	C.V. (%)		8.745	10.266	8.956	8.406

*Figures in parentheses are square root (x + 0.5) transformed values. NS: Non significant

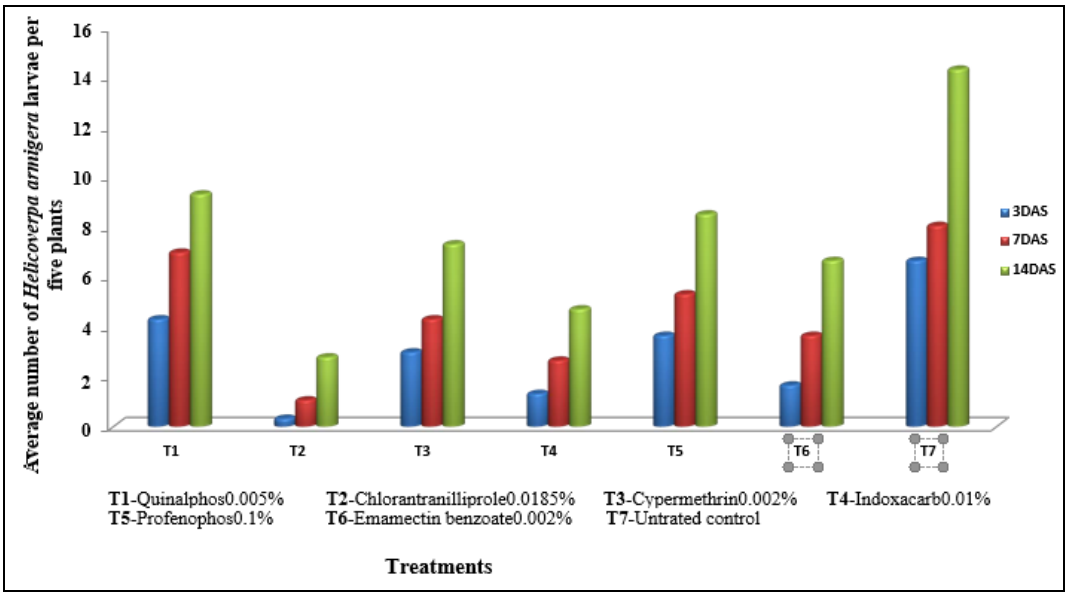

Fig 1: Effect of different insecticides on the larval population of *Helicoverpa armigera* (After first spray)

Second spray

The results of effect of distinct insecticides on population of *Helicoverpa armigera* after second spray are presented in Table 2 and Fig.2. The data revealed that similar trend was observed after second spray also and all the insecticides under investigation were observed to be significantly superior over untreated control in reducing the population of *Helicoverpa armigera* on groundnut at 3, 7 and 14 days after second spray.

At three day after second spray, significantly minimum population of *Helicoverpa armigera* larvae (2.07 *Helicoverpa armigera* larvae/five plant) was recorded from the plots treated with treatment T2 i.e. Chlorantranilliprole 18.5 SC @ 0.0185 percent. The next effective treatment was treatment T4 i.e. Indoxacarb 15.8 SC @ 0.01 percent (4.40 *Helicoverpa armigera* larvae/five plant) which was followed by treatment T6 i.e. Emamectin benzoate 5 WDG @ 0.002 percent (6.47 *Helicoverpa armigera* larvae/five plant) in reducing *Helicoverpa armigera* larvae population. Both these treatments were found statistically at par with each other. The subsequent order of effectiveness was treatment T3 i.e. Cypermethrin 10 EC @ 0.02 percent (7.27 *Helicoverpa armigera* larvae/five plant) and treatment T5 i.e. Profenophos 50 EC @ 0.1 percent (8.47 *Helicoverpa armigera* larvae/five plant). These three treatments were found statistically at par with each other. The next best treatment observed was treatment T1 i.e. Quinalphos 25 EC @ 0.05 percent which recorded 9.67 *Helicoverpa armigera* larvae/five plant. Significantly highest *Helicoverpa armigera* larvae population (11.67 *Helicoverpa armigera* larvae/five plant) was observed in treatment T7 i.e. untreated control.

At seven days after first spray more or less same trend was observed and the treatment T2 i.e. Chlorantraniliprole 18.5 SC 0.0185 percent observed significantly effective in minimizing *Helicoverpa armigera* larvae population (2.67 *Helicoverpa armigera* larvae/five plant). The next effective treatment was T4 i.e. Indoxacarb 15.8 SC @0.01 percent (5.13 *Helicoverpa armigera* larvae/five plant) which was followed by treatment T6 i.e. Emamectin benzoate 5 WDG @0.002 percent (6.67 *Helicoverpa armigera* larvae/five plant) in reducing *Helicoverpa armigera* larvae population. Both these T4 and T6 treatments were found statistically at par with each other. The subsequent order of effectiveness was treatment T3 i.e. Cypermethrin 10 EC @ 0.02 percent (7.67 *Helicoverpa armigera* larvae/five plant). The next effective treatment was T5 i.e. Profenophos 50 EC @ 0.1 percent (9.13 *Helicoverpa armigera* larvae/five plant). These treatments were found statistically at par with each other. The subsequent order of effectiveness was treatment T1 i.e. Quinalphos 25 EC

@ 0.05 percent (10.33 *Helicoverpa armigera* larvae/five plant). While the highest *Helicoverpa armigera* population of 13.33 *Helicoverpa armigera* larvae/five plant was recorded in treatment T7 i.e. untreated control.

At fourteen days after first spray lowest population of *Helicoverpa armigera* larvae (2.67 *Helicoverpa armigera* larvae/five plant) was recorded in the plots treated with treatment T2 i.e. Chlorantraniliprole 18.5 SC @ 0.0185 percent observed significantly effective in minimizing *Helicoverpa armigera* larvae population. The next effective treatment were treatment T4 i.e. Indoxacarb 15.8 SC @ 0.01 percent (5.67 *Helicoverpa armigera* larvae/five plant) which was followed by treatment T6 i.e. Emamectin benzoate 5 WDG @ 0.002 percent (7.33 *Helicoverpa armigera* larvae/five plant) in reducing *Helicoverpa armigera* larvae population. Both these treatments were found statistically at par with each other. The next effective treatment was T3 i.e. Cypermethrin 10 EC @ 0.02 percent (8.33 *Helicoverpa armigera* larvae/five plant) then T5 treatment i.e. Profenophos 50 EC @ 0.1 percent (10.00 *Helicoverpa armigera* larvae/five plant). These three treatments were found statistically at par with each other. The next effective treatment was T1 i.e. Quinalphos 25 EC @ 0.05 percent (11.00 *Helicoverpa armigera* larvae/five plant). These treatments T3, T5 and T1 were at par with each other. The highest population of *Helicoverpa armigera* larvae (14.33 *Helicoverpa armigera* larvae/five plant) was recorded in treatments T7 i.e. untreated control.

Thus, overall it was observed that the insecticidal treatments suppress the *Helicoverpa armigera* population for initial period only. The population increased slowly after three days onwards of the spray. Also, among the insecticides tested chlorantranilliprole 18.5 SC @0.0185 percent was found most effective as it recorded significantly lowest population of *Helicoverpa armigera* larvae on groundnut to the extent of 2.07, 2.67 and 2.67 larvae per plant at 3,7 and 14 days after spraying, respectively over rest of the insecticides.

Table 2: Effect of different insecticides on the larval population of *Helicoverpa armigera* larvae on groundnut (After second spray)

Tr. No.	Treatment	Concentration used (%)	Mean population of *Helicoverpa armigera* larvae per five plant			
			1 day before Spraying	Days after spraying		
				3	7	14
T1	Quinalphos 25 EC	0.005	7.67 (2.85)*	9.67 (3.15)	10.33 (3.29)	11.00 (3.38)
T2	Chlorantranilliprole 18.5 SC	0.0185	4.20 (2.16)	2.07 (1.60)	2.67 (1.77)	2.67 (1.77)
T3	Cypermethrin 10 EC	0.002	5.00 (2.34)	7.27 (2.79)	7.67 (2.86)	8.33 (2.97)
T4	Indoxicarb 15.8 SC	0.02	4.67 (2.26)	4.40 (2.21)	5.13 (2.37)	5.67 (2.48)
T5	Profenophos 50 EC	0.1	8.33 (2.96)	8.47 (2.99)	9.13 (3.10)	10.00 (3.24)
T6	Emamectin benzoate 5 WDG	0.002	8.00 (2.91)	6.47 (2.63)	6.67 (2.67)	7.33 (2.80)
T7	Untreated Control	-	12.93 (3.64)	11.67 (3.48)	13.33 (3.70)	14.33(3.83)
	S.E. ±		0.176	0.117	0.144	0.149
	C.D. at 5%		NS	0.356	0.437	0.452
	C.V. (%)		11.15	8.66	8.83	8.82

*Figures in parentheses are square root (√ 5) transformed values. NS: Non significant

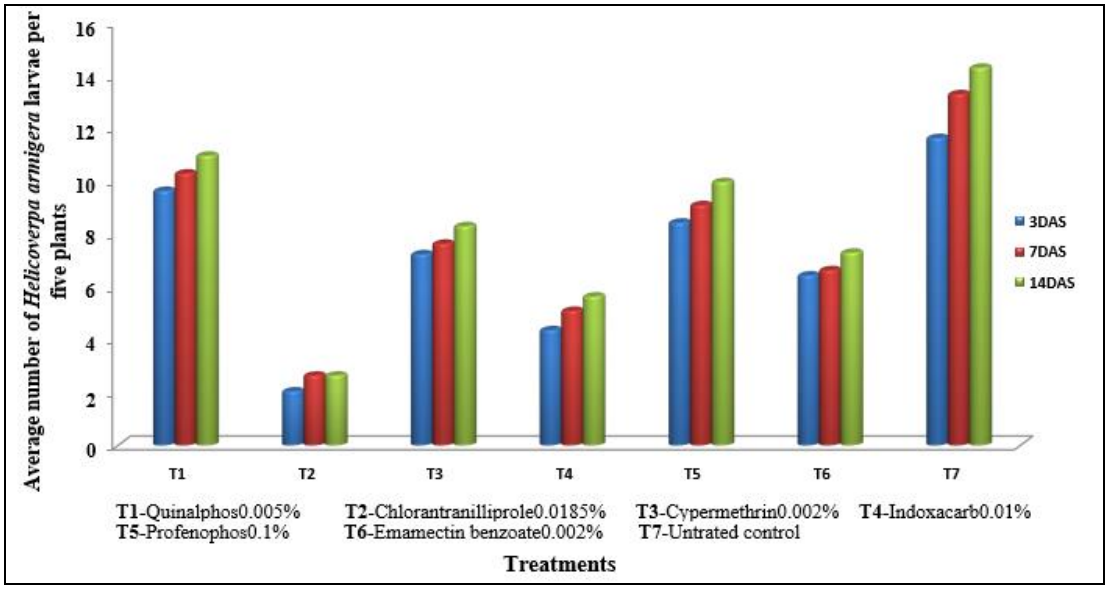

Fig 2: Effect of different insecticides on the larval population of *Helicoverpa armigera* larvae (After second spray)

Conclusion

The present study concluded that among the seven treatments, all the insecticide treatments were more effective than control in reducing the gram pod borer, (*Helicoverpa armigera* H) and chlorantranilliprole 0.0185 percent was found extremely effective for control of gram pod borer larvae population on groundnut.

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