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Bio-efficacy of botanicals on chickpea pod borer (*Helicoverpa armigera* Hubner) and its growth and development stages under Bundelkhand region of Jhansi

Anil Patidar, Pradeep Kumar, Vishal Sarsaiya and Vikas Kumar Dhurve

Abstract
Investigations were carried out on Studies on "Bio-efficacy of botanicals on Chickpea Pod Borer (*Helicoverpa Armigera* Hubner) under Bundelkhand region of Jhansi'' was carried out at the Experimental, Organic Research farm Kargunwa Ji Jhansi, Institute of Agricultural Sciences, Department of Entomology, Bundelkhand University Jhansi (Uttar Pradesh) during *Rabi* season of 2020-2021. During the course of investigation the present investigation was undertaken to find out suitable and low cost substitute for the management of *Helicoverpa armigera* (Hubner) on chickpea by using botanicals. The field trial was laid out in (RBD) design with three replications and nine treatments including control (water spray). The observations were recorded on average per cent pod damage caused by *Helicoverpa armigera* (Hubner) Mean number of chickpea pod borer per plant minimum was significantly recorded in (1.237, 1.210 and 1.020) in plot *Nerium indicum* at 0.05% foliar spray. Minimum pupal width was minimum in *Nerium indicum* (3.997) mm. in T_6 plot. Total development period of Pod borer (*Helicoverpa. armigera*) minimum (1.913) days of egg period in rose, while minimum (17.687) days of larval period in T_1 plot chickpea, minimum pre-pupal days (2.913) days of in T_1 plot chickpea. Minimum pupal days (14.597) days of pupal period in T_7 *Nerium indicum*. Total development (32.100) days of total development period in T_7 plot *Nerium indicum*. The highest grain yield was recorded (20.990) q/ha with T_7 *Nerium indicum* (0.05%) while lowest was (12.233) q/ha recorded in control T_0 plot.

Keywords: Bio-efficacy, botanicals, Chickpea, *Helicoverpa armigera* (Hubner), larva, pupal

Introduction
The gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae), is an insatiable feeder bug that feeds on more than 100 plant species including far reaching and monetarily significant yields like cotton, maize, tobacco, pigeonpea, chickpea, and tomato (Metcalf *et al*, 1992) [14]. The inclination of *Helicoverpa armigera* to benefit from the harvestable pieces of host plants, alongside its high polyphagy and fecundity, expansive geological assortment, transitory potential, facultative diapause, high fruitfulness, and tendency to develop resistance from insecticidal sprays (Mahmood *et al*, 2021 [13]; Meena *et al*, 2018 [12]; Kambrekar *et al*, 2016) [11]. Increases in intensive crop production technologies due to broad spectrum insecticides because of utilization of wide range, food plants just as constant availability of usually liked food plants have supported *Helicoverpa armigera* to turn into a major pest of gram (Gautam *et al*, 2018 [10]; Goutham *et al*, 2018 [9]; Golvankar 2015 [8].
Gram pod borer, *Helicoverpa armigera* (Hubner) is perhaps the most annihilating and polyphagous pest in worldwide and feeds on more than 300 plant species and exclusively liable for extensive harm to many medium estimated light earthy colored moths estimating around 40 mm across the wings have a dull bit and dim region on the forewings. Females lay a few little white eggs separately. After bring forth in 3-4 days the caterpillars feed on the leaves for a brief time frame and therefore assault the units. A completely mature caterpillar is around 34 mm long, greenish to caramel in shading with dispersed short white hairs and covers itself in the dirt to make an earthen cell inside which it pupates. (Fite *et al*, 2020, Fitt *et al*, Fitt *et al*, Fathipour *et al*,2012) [5, 6, 7].
The life cycle is completed in about 30-45 days. The pest finishes eight ages in a year. 30-40 pods before its development. Yearly losses are assessed to be 15% in chickpea. The low yield of chickpea is ascribed to the ordinary episodes of pod drill which is viewed as one of the significant nuisances of chickpea crop. Botanicals and have received a lot of viable

consideration as substitutes to manufactured synthetics. Consequently, the field try was directed to assess some obscure botanicals to deal with the (*Helicoverpa armigera Hubner*) in Chickpea. Botanicals debase quickly from daylight, air, and appropriate dampness, which by and large makes them less poisonous to the climate, however may likewise expect them to be applied all the more regularly, applied accurately, and with more exact planning. (Fathipour *et al*,2012) [4], (Babu *et al*,2015) [3],

Dating from traditional practices, different plant extracts have shown insecticidal properties and can be utilized adequately on field crops. Internationally botanical pest management is acquiring appreciation due to multiple mode of action, for example, antifeedant which hinder typical advancement of insect pest, repellant, antijuvenile chemical action, oviposition/incubating discouragement, antifertility/development disrupters and chemosterilants (Ahmed *et al*, 2012) [1]. The most notable and generally utilized is azadirachtin segregated from the seed, wood, bark, leaves and products of the neem tree (*Azadirachta indica*). *Azadirachtin* has both antifeedant and growth retardants properties (Babu *et al*, 2015) [3]. Thus, the natural control can be substitute framework, which might assume a significant part in accomplishing the objective of horticulture.

The pod borer *Helicoverpa armigera* Hubner is responsible for causing up to 90% damage in chickpea due to its regular occurence from the vegetative growth to the pod arrangement stage. To deal with this issue, cultivators are enticed to increase the measures of pesticides, however aimless utilization of pesticides has resulted in residues in food chain.

Botanicals are less expensive, promptly accessible, naturally protected and less hazardous in contrast with synthetic chemical insecticides (Fitt *et al*, 2000) [6]. The insecticidal properties of number of plants have been discovered long ago. Botanicals plants extracts are ecologically less destructive than manufactured pesticides to control pests. They have at least one valuable properties like biodegradability, wide range of movement and capacity to reduce insect resistance. Synergistic impact because of blending of various plant species assumes a vital part to control pest. Significant expense of chemical insecticides leads to search alternative source for pest management.

Materials and Methods

The present investigation was conducted at Experiment, Organic Research farm, Kargunwa Ji Jhansi, Institute of Agricultural Sciences, Department of Entomology, Bundelkhand University, Jhansi (Uttar Pradesh) during *Rabi* season of 2020-2021. Jhansi (Uttar Pradesh) which is situated at latitude 25^0 27'N'', longitude $78^0$35' E'' and at an altitude of 271 meters above the mean sea level. Seed of chickpea variety K-3256 was sown in well prepared experimental field at an area of (23.7×9 m^2).The data from the field experiment were subjected to $\sqrt{x+0.5}$ transformation and analyzed statistically for comparing treatments following Analysis of Variance techniques (ANOVA) for RBD design and the result were interpreted at 5% level of significance (Gomez and Gomez 1984). with 9 treatments including control with three replications with total plot size 2.0 m x 2.0 m (Gross) and 1.8 m x 1.8 m (Net) with spacing (30 x 10 cm).

Methodology

All the botanicals spray schedules were applied in the form of foliar spray with the help of knacksack sprayer (15 litre capacity). For deciding the amount of spray required per plot, the control plots were splashed with still up in the air the necessary shower liquid. The botanicals were sprayed at diverse yield stages i.e., pre-blooming stage, half blossoming stage, 100% blossoming stage and pod development.

Method of application

First spray application of respective botanicals was given on the initiation of the pests and subsequently one another spray was given after 20 days using manually operated knapsack sprayer having duromist nozzle with slight runoff stage. To prepare *Hibiscus rosa-sinensis*, J*asmine*, *Bougainvillea*, Marigold (*Tagetus erecta*), Chrysanthemum, *Gaillardia-pulchela*, Sadabahar (*Catharanthus roseus),Nerium indicum* flower extract, the required quantity of dried flowers was weighed (250g) on electric balance and grinded on electric grinder. The powder was kept in muslin cloth bag and soaked into 2 litres of water for overnight and thereafter, the bag was squeezed repeatedly until the out flowing fluid turns light in colour. Finally volume (5 litres) was prepared by adding water.

Method of recording observations

The data was collected at 7 days interval from the field and recorded on the basis of treatments and replications. The data collection was started at the flower initiation stage of the chickpea plant in the field and continued upto maturity of the pods and after harvest of the crops. The data was collected on different parameters of the study such as number of total pod per five selected plants/plot; number of borer infested pods /5 selected plant/plot; total number of plants/plot; total number of infested plants/plot; total yield / plot; yield of borer infested pod/5 selected plants; no. of larvae / 10 infested pods (at harvest); no. of borers/ 20 infested pods; no. of grain / 20 pods (at harvest); no. of pods / 5 selected plant; no. of seeds / 5 selected plant; weight of 5 selected plants pod; 1000 seed weight; yield of chickpea per plot.

$$\%\ \text{pod infestation} = \frac{\text{Number of infested pod}}{\text{Total number of pod}} \times 100$$

$$\%\ \text{increase or decrease over control} = \frac{\text{Mean value of treated plot}}{\text{Mean value of untreated plot}} \times 100$$

Nine botanicals *viz*., T_0 Control (water spray), T_1 *Hibiscus rosa-sinensis* flower extract at (5%), T_2 J*asmine* flower extract at (5%), T_3 *Bougainvillea* flower extract at (5%), T_4 *Tagetus erecta* flower extract at (5%), T_5 Chrysanthemum flower extract at (5%), T_6 *Gaillardia pulchela* flower extract at (5%), T_7 *Nerium indicum flower* extract at (5%), T_8 *Catharanthus roseus* flower extract at (5%) were assessed for their efficacy against the Bio-efficacy of botanicals on Chickpea Pod Borer (*Helicoverpa Armigera* Hubner) under Bundelkhand region of Jhansi.

Statistical analysis

The data recorded on various parameters was analyzed as per RBD design as suggested by Gomez and Gomez (1984). The results was interpreted on the basis of 'F' test value and critical difference (CD) was calculated at 5% level of significance. The analysis of variance was calculated as per given by Panse and Sukhatme (1985)

Results and Discussion

Mean number of chickpea pod borer per plant

The data presented in Table 1 reveals that mean population per tagged plants showed significant variation amongst the treatment in comparison to population of chickpea after the post treatment of different botanicals spray. The highest pre-treatment at days before spray population was (2.920) in untreated control plot T_0 treatment while the lowest (2.003) in T_7 treatment. The post treatment with botanicals spray at 3rd day after spray was maximum 3.010 in control plot $T_{0.}$ While minimum was (1.430) recorded in T_7 at *Nerium indicum* at 0.05% foliar spray. Similar trend in observation at post treatment of botanicals spray were recorded at 5, 7 and10 (DAS = days after spray), maximum was (3.990, 5.330 and 5.617) with T_0 control plot. Similarly minimum was significantly recorded in (1.237, 1.210 and 1.020) in plot *Nerium indicum* at 0.05% foliar spray. The present finding corroborates with (Fite *et al,* 2020; Meena *et al,* 2018) [7, 12].

Effect of Host on the pupal stage of Pod borer (*Helicoverpa. armigera*)

The data presented in Table 2 reveals that host leaves on pre-pupal period stage at 1st day after feeding with host leaves showed significant variation in all treatment, the maximum was recorded in chickpea (1.678) days in T_1 plot amongst the treatment in comparison to minimum (0.530) days, of pre-population period in *Nerium indicum*. The pupal period after 3rd day after feeding on host leaves were found significantly maximum in Chickpea (17.427) days in T_1 plot while the minimum pupal period was in *Nerium indicum* (14.713) days in T_7 plot. The present finding are accordance with (Golvankar *et al*,2015; Netam *et al,* 2018).

The data on pupal size length in (mm) was significantly maximum when feed with Chickpea (20.033) mm. in T_1 plot while the minimum pupal length was in *Nerium indicum* (14.993) mm. in $T_{6.}$ In terms of width the pupal size was significantly maximum in chickpea (6.343) mm. in T_1 plot while the minimum pupal width was minimum in *Nerium indicum* (3.997) mm. in T_6 plot as per the similar findings of (Neupane *et al*,. 2015; Netam *et al,* 2018).

Effect of host on the total development period of pod borer (*Helicoverpa armigera*)

Egg period (days)

The data presented in Table 3 reveals that host on egg period stage showed significant variation in all treatment, the maximum egg period was recorded in chickpea (2.460) days in T_1 plot amongst the treatment in comparison to minimum (1.913) days of egg period in rose.

Larval period (days)

The data presented on larval period in Table 3 reveals that host on larval period stage showed significant variation in all treatment, the maximum larval period (days) was recorded in linseed (18.183) days in T_5 plot amongst the treatment in comparison to minimum (17.687) days of larval period in T_1 plot chickpea.

Pre-pupal (days)

The data presented on pre-pupal (days) in Table 3 reveals that host on pre-pupal stage showed significant variation in all treatment, the maximum pre-pupal stage (days) was recorded in amaranthus (2.943) days in T_6 plot amongst the treatment in comparison to minimum (2.913) days of in T_1 plot chickpea.

Pupal period (days)

The data presented on pupal (days) in Table 3 reveals that host on pupal stage showed significant variation in all treatment, the maximum pupal stage (days) was recorded in *Chickpea* (18.310) days in T_1 plot amongst the treatment in comparison to minimum (14.597) days of pupal period in T_7 *Nerium indicum*.

Total development (days)

The data presented on total development of *Helicoverpa. armigera* (days) in Table 5 reveals that total development showed significant variation in all treatment, the maximum total development (days) was recorded in Chickpea (42.523) days in T_1 plot amongst the treatment in comparison to minimum (32.100) days of total development period in T_7 plot *Nerium indicum*.

Effect of different host on the length of larvae of different instar (mm) of (*Helicoverpa. armigera*)

First instar

The data presented on length of larvae of different instar (mm) of *Helicoverpa. armigera* (days) in Table 4 reveals that total development (1st instar) showed significant variation in all treatment. The (1st instar) length was recorded in chickpea (2.073) mm. in T_1 plot amongst the treatment in comparison to minimum in *Nerium indicum* (1.670) mm. of length in T_7 plot.

Second instar

The data presented on length of larvae of different instar (mm) of *H. armigera* (days) in Table 5 reveals that total development (2nd instar) showed significant variation in all treatment. The (2nd instar) length was recorded in chickpea (4.050) mm. in T_1 plot amongst the treatment in comparison to minimum in *Tagetus erecta* (3.590) mm. of length in T_4 plot.

Third instar

The data presented on length of larvae of different instar (mm) of *H.armigera* (days) in Table 5 reveals that total development (3rd instar) showed significant variation in all treatment. The (3rd instar) length was recorded in chickpea (11.870) mm. in T_1 plot amongst the treatment in comparison to minimum in *Nerium indicum* (8.120) mm. of length in T_7 plot.

Fourth instar

The data presented on length of larvae of different instar (mm) of *H.armigera* (days) in Table 5 reveals that total development (4th instar) showed significant variation in all treatment. The (4th instar) length was recorded in chickpea (12.540) mm. in T_1 plot amongst, the treatment in comparison to minimum in *Nerium indicum* (11.340) mm. of length in T_7 plot.

Fifth instar

The data presented on length of larvae of different instar (mm) of *H. armigera* (days) in Table 4 reveals that total development (5th instar) showed significant variation in all treatment. The (5th instar) length was recorded in chickpea (22.197) mm. in T_1 plot amongst the treatment in comparison to minimum in *Nerium indicum* (19.113) mm. of length in T_7 plot.

Sixth instar

The data presented on length of larvae of different instar (mm) of *H. armigera* (days) in Table 5 reveals that total development (6^{th} instar) showed significant variation in all treatment. The (6^{th} instar) length was recorded in chickpea (27.690) mm. in T_1 plot amongst the treatment in comparison to minimum in *Nerium indicum* (21.710) mm. of length in T_7 plot.

Seventh instar

The data presented on length of larvae of different instar (mm) of *Helicoverpa. armigera* (days) in Table 5 reveals that total development (7^{th} instar) showed significant variation in all treatment. The (7^{th} instar) length was recorded in chickpea (28.560) mm. in T_1 plot amongst the treatment in comparison to minimum in 21.957.

Eighth instar: The data presented on length of larvae of different instar (mm) of *H. armigera* (days) in Table 5 reveals that total development (8^{th} instar) showed significant variation in all treatment. The (8^{th} instar) length was recorded in chickpea (29.970) mm. in T_1 plot amongst the treatment in comparison to minimum in *Nerium indicum* (24.170) mm. of length in T_7 plot.

Mortality (%) of (*H. armigera*) larvae after spraying of botanicals

1^{st} days after spray

The data presented in Table 5 reveals that mean larvae population per tagged plants showed significant variation amongst the treatment. Mortality per cent of larvae showed significant difference in terms of mortality rate. At 1^{st} day treatment with highest mortality rate to minimum in *Nerium indicum* (29.807%) of length in T_7 plot.

2^{nd} days after spray

The data presented in Table 5 reveals that mean larvae population per tagged plants showed significant variation amongst the treatment. Mortality per cent of larvae showed significant difference in terms of mortality rate. At 2^{nd} day treatment with highest mortality rate was minimum in *Nerium indicum* (33.527%) of length in T_7 plot.

3^{rd} days after spray

The data presented in Table 5 reveals that mean larvae population per tagged plants showed significant variation amongst the treatment. Mortality per cent of larvae showed significant difference in terms of mortality rate. At 3^{rd} day treatment with highest mortality rate was minimum in *Nerium indicum* (40.350%) of length in T_7 plot, while lowest was recorded in untreated plot.

4^{th} days after spray

The data presented in Table 5 reveals that mean larvae population per tagged plants showed significant variation amongst the treatment. Mortality per cent of larvae showed significant difference in terms of mortality rate. At 4^{th} day treatment with highest mortality rate (45.723%) while lowest was recorded in untreated plot.

5^{th} days after spray

The data presented in Table 5 reveals that mean larvae population per tagged plants showed significant variation amongst the treatment. Mortality per cent of larvae showed significant difference in terms of mortality rate. At 5^{th} day treatment with highest mortality rate was highest mortality rate (50.090%) with plot T_7 in treatment *Nerium indicum* **w**hile, lowest was recorded in untreated plot.

6^{th}days after spray

The data presented in Table 5 reveals that mean larvae population per tagged plants showed significant variation amongst the treatment. Mortality per cent of larvae showed significant difference in terms of mortality rate. At 6^{th} day treatment with highest mortality rate was (56.190%) with *Nerium indicum* (0.05%) T_7 plot, which while lowest was recorded in untreated plot.

7^{th} days after spray

The data presented in Table 5 reveals that mean larvae population per tagged plants showed significant variation amongst the treatment. Mortality per-cent of larvae showed significant difference in terms of mortality rate. At 7^{th} day treatment with highest mortality rate was (64.290) with *Nerium indicum* (0.05%)T_7 plot, which while lowest was recorded in untreated plot.

Pupal mortality percentage (%)

The data presented in Table 5 reveals that mean pupal mortality per cent per tagged plants showed significant variation amongst the treatment. Mortality per cent of pupal showed significant difference in terms of mortality rate. The highest pupal mortality rate was (23.750%) with *Nerium indicum* (0.05%) in T_7 plot, which while lowest was (11.980%) recorded in Control (0.00%) in T_0 plot.

Adult emergence (%)

The data presented in Table 5 reveals that mean adult emergence per-cent per tagged plants showed significant variation amongst the treatment. Treatments showed significant difference in terms of mean adult emergence per cent. The highest mean adult emergence per cent was (88.590) % with untreated plot T_0 while lowest was (5.527%) recorded in Control (0.00%) in T_0 plot.

Yield parameters

Pod damage %

The data presented in Table 5 reveals that mean pod damage per-cent per tagged plants showed significant variation amongst the treatment. Treatments showed significant difference in terms of pod damage per-cent. The lowest mean pod damage per cent was (36.411%) with T_7 *Nerium indicum* with plot T_7 while highest was recorded (36.411%) in control T_0 plot.

Grain yield (q/ha)

The data presented in Table 5 reveals that grain yield (q/ha) plants showed significant variation amongst the treatment. Treatments showed significant difference in terms of grain yield. The highest grain yield was recorded (20.990) q/ha with T_7 *Nerium indicum* (0.05%) while lowest was (12.233) q/ha recorded in control T_0 plot.

Table 1: Mean number of *Helicoverpa. armigera* (Hubner) Population/5 plants

Treatments		Conc.%	Pre-treatment		Post treatment							
					3 days		5 days		7 days		10 days	
			Mean		Mean		Mean		Mean		Mean	
T_0	Control	W. Spray	2.350	0.000	3.010	0.000	3.990	0.000	5.330	0.000	5.617	0.003
T_1	*Hibiscus rosa-sinensis*	0.05%	2.081	0.039	1.551	0.000	1.320	0.000	1.877	0.003	3.100	0.001
T_2	*Jasmine*	0.05%	2.141	0.015	2.013	0.000	1.400	0.000	1.813	0.003	1.050	0.000
T_3	*Bougainvillea*	0.05%	2.170	0.000	1.493	0.032	1.330	0.017	1.830	0.000	1.160	0.000
T_4	*Tagetus erecta*	0.05%	2.900	0.000	1.497	0.012	1.380	0.000	1.220	0.000	2.810	0.000
T_5	Chrysanthemum	0.05%	2.920	0.010	1.510	0.000	1.410	0.000	1.310	0.000	2.843	0.001
T_6	*Gaillardia pulchela*	0.05%	2.737	0.193	1.710	0.000	1.610	0.000	1.490	0.000	1.230	0.000
T_7	*Nerium indicum*	0.05%	2.003	0.000	1.430	0.000	1.237	0.000	1.210	0.000	1.020	0.000
	C.D.		0.219		0.037		0.018		0.006		0.003	
	SE(m)		0.072		0.012		0.006		0.002		0.001	
	SE(d)		0.101		0.017		0.008		0.003		0.001	
	C.V.		5.136		1.162		0.599		0.169		0.078	

Figures in the parentheses are transformed values $\sqrt{x} + 0.5$ values

Table 2: Effect of Host on the pupal stage of *Helicoverpa armigera*

Treatments			Pre-Pupal Period 1 DBS		Pupal period (Days) 3 days		Pupal size (mm)			
							Length (mm)		Width (mm)	
			Mean		Mean		Mean		Mean	
				Mean		Mean		Mean		Mean
T_1	*Chickpea*	0.05%	1.678	0.000	17.427	0.357	20.033	0.103	6.343	0.160
T_2	*Jasmine*	0.05%	0.910	0.000	14.807	0.403	17.793	0.004	4.150	0.010
T_3	*Bougainvillea*	0.05%	1.283	0.000	15.030	0.021	16.407	0.297	4.440	0.020
T_4	*Tagetus erecta*	0.05%	1.430	0.000	15.480	0.240	16.460	0.270	5.020	0.010
T_5	Chrysanthemum	0.05%	1.263	0.000	15.213	0.107	16.200	0.180	4.523	0.063
T_6	*Gaillardia pulchela*	0.05%	1.193	0.000	15.660	0.330	17.127	0.563	4.873	0.063
T_7	*Nerium indicum*	0.05%	0.530	0.000	14.713	0.027	14.993	0.397	3.997	0.003
	C.D.		0.001		0.458		0.952		0.214	
	SE(m)		0.000		0.150		0.311		0.070	
	SE(d)		0.000		0.212		0.440		0.099	
	C.V.		0.046		1.680		3.149		2.502	

Figures in the parentheses are transformed values $\sqrt{x} + 0.5$ values

Table 3: Effect of different Host on the total development period of *Helicoverpa armigera*

Treatments		Egg period (Days)		Larval period(Days)		Pre-Pupal (days)		Pupal period (Days)		Total Development (days)	
		Mean		Mean		Mean		Mean		Mean	
			Mean		Mean		Mean		Mean		Mean
T_1	*Chickpea*	2.460	0.230	17.687	0.463	2.913	0.170	18.310	0.000	42.523	0.000
T_2	*Jasmine*	2.673	0.163	14.247	0.623	2.527	0.237	14.597	0.006	35.040	0.000
T_3	*Bougainvillea*	2.140	0.070	13.747	0.373	2.666	0.263	14.090	0.000	36.217	0.012
T_4	*Tagetus erecta*	2.193	0.097	15.927	0.343	2.660	0.170	14.130	0.000	34.770	0.000
T_5	Chrysanthemum	2.140	0.070	15.080	0.040	2.873	0.043	17.010	0.000	37.690	0.000
T_6	*Gaillardia pulchela*	2.007	0.043	14.140	0.070	2.860	0.070	15.710	0.000	39.147	0.333
T_7	*Nerium indicum*	1.913	0.003	14.280	0.140	2.473	0.063	14.597	0.000	32.100	0.333
	C.D.	0.350		0.858		0.339		0.356		0.654	
	SE(m)	0.114		0.280		0.111		0.116		0.214	
	SE(d)	0.162		0.396		0.156		0.165		0.302	
	C.V.	8.973		3.272		7.261		1.328		1.015	

Table 4: Effect of different Host on the total development period of *Helicoverpa armigera*

Treatments		Length of larvae of different instar in (mm)															
		1st instar		2nd instar		3rd instar		4th instar		5th instar		6th instar		7th instar		8th instar	
		Mean		Mean		Mean		Mean		Mean		Mean		Mean		Mean	
T_1	*Chickpea*	2.073	0.033	4.050	0.000	11.870	0.291	12.540	0.296	22.197	0.008	27.690	0.000	28.560	0.006	29.970	0.000
T_2	*Jasmine*	2.012	0.000	3.640	0.000	10.727	0.137	12.340	0.330	21.087	0.004	27.390	0.000	27.280	0.010	25.227	0.270
T_3	*Bougainvillea*	2.065	0.048	3.637	0.009	9.527	0.237	12.427	0.230	22.156	0.001	25.590	0.000	23.523	0.034	24.340	0.330
T_4	*Tagetus erecta*	2.001	0.000	3.590	0.000	8.870	0.000	11.490	0.330	22.183	0.000	21.990	0.000	24.983	0.007	27.460	0.270
T_5	Chrysanthemum	2.113	0.093	4.047	0.027	8.330	0.000	12.113	0.057	20.261	0.004	26.890	0.000	23.913	0.006	29.460	0.000
T_6	*Gaillardia pulchela*	1.980	0.000	4.010	0.000	8.253	0.127	12.023	0.006	20.211	0.004	25.990	0.000	27.490	0.000	28.540	0.000
T_7	*Nerium indicum*	1.670	0.000	4.030	0.000	8.210	0.000	11.340	0.000	19.113	0.000	21.710	0.000	21.957	0.000	24.170	0.000
	C.D.	0.107		0.030		0.511		0.497		0.070		0.018		0.044		0.462	
	SE(m)	0.035		0.010		0.167		0.162		0.023		0.006		0.014		0.151	

	SE(d)	0.050	0.014	0.236	0.229	0.032	0.009	0.021	0.213
	C.V.	2.996	0.427	2.848	2.268	0.190	0.040	0.096	0.921

Figures in the parentheses are transformed values $\sqrt{x}$ + 0.5 value

Table 5: Mortality (%) of *Helicoverpa armigera* larvae after spraying of biopesticides

Treatments		Conc.%	**Mortality of *Helicoverpa armigera* (%)**													
			1st		**2nd**		**3rd**		**4rth**		**5th**		**6th**		**7th**	
			Mean		**Mean**		**Mean**		**Mean**		**Mean**		**Mean**		**Mean**	
T_1	*Chickpea*	0.05%	11.540	0.230	22.420	0.290	29.387	0.307	42.700	0.007	50.070	0.014	49.990	0.015	59.990	0.000
T_2	*Jasmine*	0.05%	24.440	0.280	28.880	0.060	37.507	0.473	42.460	0.270	45.320	0.013	53.210	0.000	60.170	0.000
T_3	*Bougainvillea*	0.05%	23.993	0.097	32.687	0.157	39.897	0.000	44.203	0.008	46.290	0.013	54.320	0.014	63.980	0.000
T_4	*Tagetus erecta*	0.05%	29.707	0.147	29.913	0.237	39.973	0.015	45.150	0.013	41.690	0.000	55.570	0.000	62.180	0.000
T_5	Chrysanthemum	0.05%	26.980	0.007	29.387	0.307	39.860	0.070	43.297	0.000	43.980	0.000	54.190	0.000	64.290	0.000
T_6	*Gaillardia pulchela*	0.05%	25.913	0.043	29.360	0.320	39.920	0.160	41.230	0.020	41.390	0.000	51.320	0.014	60.280	0.000
T_7	*Nerium indicum*	0.05%	29.807	0.006	33.527	0.043	40.350	0.021	45.723	0.011	50.090	0.000	56.190	0.000	64.290	0.000
	C.D.		0.331		0.397		0.666		0.284		0.045		0.002		0.041	
	SE(m)		0.108		0.129		0.218		0.093		0.015		0.001		0.013	
	SE(d)		0.153		0.183		0.308		0.131		0.021		0.001		0.019	
	C.V.		0.868		0.870		1.129		0.422		0.064		0.002		0.043	

Figures in the parentheses are transformed values $\sqrt{x}$ + 0.5 value

Conclusion

Looking to the overall effectiveness of various botanicals spray schedules tested against Chickpea pod borer (*Helicoverpa. armigera*), it can be concluded that significant variation observed on the highest pre-treatment at days before spray population was significant amongst the treatment in comparison to population of chickpea after the post treatment of different botanicals spray. Significant variation in all treatment, the maximum was recorded in chickpea days in T_1 plot amongst the treatment in comparison to minimum days, of pre- population period in *Nerium indicum*. The pupal period after 3rd day after feeding on host leaves were found significantly minimum pupal period was in *Nerium indicum*. Minimum pupal length was in *Nerium indicum* mm. in $T_{6.}$ In terms of width the pupal size was significantly pupal width was minimum in *Nerium indicum* mm. Significant variation was observed on effect of Host on the total development period of Pod borer (*Helicoverpa. armigera*) in all treatment, the maximum egg period was recorded in chickpea in T_1 plot amongst the treatment in comparison to minimum days of egg period in rose.Significant variation was observed on larval period stage showed significant variation in all treatment, the maximum larval period (days) was recorded in linseed in T_5 plot amongst the treatment in comparison to minimum days of larval period in T_1 plot chickpea. Significant variation was observed on pre-pupal (days) reveals that host on pre-pupal stage showed significant variation in all treatment, the maximum pre-pupal stage (days) was recorded in amaranthus with days in T_6 plot amongst the treatment in comparison to minimum days of in T_1 plot chickpea. Significant variation was observed on pupal (days) reveals that host on pupal stage showed significant variation in all treatment, the maximum pupal stage (days) was recorded in *Chickpea* with days in T_1 plot amongst the treatment in comparison to minimum days of pupal period in T_7 *Nerium indicum*. Significant variation was observed on total development of *Helicoverpa. armigera* (days) reveals that total development showed significant variation in all treatment, the maximum total development (days) was recorded in Chickpea days in T_1 plot amongst the treatment in comparison to minimum days of total development period in T_7 plot *Nerium indicum*. Significant variation was observed on the total development (1stinstar) showed significant variation in all treatment. The (1stinstar, 2ndinstar, 3rdinstar, 4th instar, 5thinstar, 6thinstar, 7thinstar, 8th instar length was recorded minimum in *Nerium indicum* of length mm. in T_7 plot. Significant variation amongst the treatment due to mortality (%) of (*Helicoverpa. armigera*) larvae after spraying of botanicals. Mortality per cent of larvae showed significant difference in terms of mortality rate.

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