Study on population dynamics of chickpea pod borer *Helicoverpa armigera* and management

A

Synopsis

Submitted to the

Lovely Professional University

Degree of Master of Science (Agriculture)

In

Agriculture Entomology

By

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Lovely Professional University

DEPARTMENT OF AGRICULTURE ENTOMOLOGY

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Certificate

This is to certify the work recorded in this thesis entitled **"Study on population dynamics of chickpea pod borer *Helicoverpa armigera* and management."** Submitted by Monu (Reg. number- 11719059) in partial fulfilment of the requirements for the award of Degree of Master of Science (Agriculture) in Agriculture Entomology of Lovely Professional University, Phagwara, Punjab is the faithful and bonafide research work under my personal supervision and guidance.

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1. INTRODUCTION:

Chickpea is a most important legume crop that belongs to family fabaceae and cultivated in many countries of the world. Chickpea (*Cicer arietinum* L.) is one of the most important crops grown in India, accounting for 25% of global production from 35% of global area under pulses. Area occupied by chickpea is about 7.29 million ha with production of 5.77 million tones which accounts for 30 % and 38 % of the national pulse acreage and production, respectively. The share of different state in area and production of pulses for triennium average ending 2013-2014 indicates that state such as Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Karnataka and Punjab accounted for nearly 80% of total area under pulses. There are two major types of chickpea distinguished by seed size, shape and color. One is desi–type characterized by relatively smaller seeds of angular shape with dark seed coat, whereas other Kabuli-type is characterized by large owl or head shaped seeds with beige colored seed coat. It is the most important crop with high acceptability and widely user. It has high nutritive value enriched with vegetable protine, carbohydrate, and cholesterol lowering fiber, oil, ash, calcium and phosphorus.

Chickpea crop is under threat of many insect pests that attack on its roots, leaves, tender twigs, foliage and pods. It is infested of many insect pest in chickpea is the gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae). The larvae bore into the pods and feed on the seed inside of pods and cause loss to seed yield. Its caterpillars inserting the half portion of their body inside the pods, *Helicoverpa armigera* is the most noxious / polyphagous, multivoltine and cosmopolitan pest has resulted in substantial yield loss 37-50% and in severe cause up to 90% pod damage .Freshly laid eggs were shiny and faintly yellow in color, but within a couple of days with the embryo development the color become brown with blackish. The larvae six instar to become pupate. Immediately after hatching the newly hatched larvae was darker greenish color and typically consume their egg shells. Second instar larvae the head were darker and thorax was greenish color. The third instar the head was yellowish and thorax was brown dots black tubercles each bearing seta became prominent. The forth instar larvae appeared brownish green with pale brown head. The dorso lateral strips were dark brownish and chalky green color. The fifth instar larvae head color was yellow with brown patches and the dorso lateral strips were brownish, yellowish color. In the sixth instar larvae the body was green with brown tings. The head was yellowish brown with irregular white lines. The pre-pulpal stage lasted 2-4 days and during this tine larval activity decrease. The larvae moved below the soil surface to pupate. They were reported to pupate at depth of 3-5cm in depth of soil. Pupa color was dark brown color, the male adult moth was observed greenish grey in color compare to female adult with orange brown. *Helicoverpa armigera* was a series pest on the chickpea crops.

Keeping in view the infestation of Helicoverpa armigera in this region, I conducted a field experiment **"Study on population dynamics of chickpea pod borer *Helicoverpa armigera* and management"** with the following objective:

1. Population dynamics of *Helicoverpa armigera* in chickpea.

2. To study effect of biotic and abiotic factor on growth of *Helicoverpa armigera.*

3. To study efficiency of new molecular insecticide against *Helicoverpa armigera.*

4. To study of biology on growth of *Helicoverpa armigera.*

2. RIEW OF LITURATURE

2.1 Population dynamics of *Helicoverpa armigera* in chickpea.

Chatar *et.al*. (2010) studied that the results of the investigation on population dynamics of chickpea pod borer, *Helicoverpa armigera* (Hubner) on chickpea revealed that the pest appeared from 2nd week of December and attained a peak of 3.12 larvae per plant during 2nd week of January. The pest was active during the last week of December to 3rd week of January. Later on, the pest population declined gradually towards the maturity of the crop. Correlation of *H. armigera* with different weather parameters indicated that maximum temperature exhibited highly significant negative correlation (r= -0.7514) with larval population of H. armigera, whereas, minimum temperature (r= -0.5771) and mean temperature (r= -0.6836) exhibited significant negative correlation. However, the pest population showed highly significant positive correlation with morning relative humidity (r= 0.7098), evening relative humidity (r= 0.7293) and mean relative humidity (r= 0.8063)

Akhauri *and* Yadav (2002) determined the buildup of population trend and damage potential of the *H. armigera* on chick pea and found that larval population of spotted pod borer fluctuated widely in relation to seasonal changes beginning from the 2nd week of October until the end of December. The period of maximum activity was between the second and last week of November.

Sunil *et al*. (2003) studied the population dynamics of pod borer and found that the crop was infested with *M. obtusa*, *M. vitrata* and *H. armigera* during its flowering and podding stages. Infestation started during the first week of February lasted up to the 13th SW and decreased thereafter.

Waqas Wakil *et.al.(*2005) reported in resistance of nine chickpea genotypes (6153, 93127, 90261, CM-88, CM-98, CM-2000, CM-2100/96, CM-4068/97 and Punjab-2000) were evaluated under the natural infestation in Rawalpindi (Pakistan) against *Helicoverpa armigera (Hub.).* None of the genotypes could exhibit complete resistance to the pest or could evade the pest infestation. Based on the pod-infestation data, the genotype, 93127, was found to be comparatively susceptible (41.66%) and CM-4068/97 appeared to be resistant (15.71%) while on the basis of larval-population, the genotype, 90261 appeared to be susceptible (7.46 plant-1), followed by CM-98 (7.16 plant-1) and 93127 (6.53 plant-1) and CM-4068/97 appeared to be comparatively resistant (2.12 plant-1), followed by CM-2000 (2.39 plant-1) and CM-2100/96

(2.86 plant-1). As far as the yield was concerned, the genotype CM-2000 was found to be high yielding (1059.40 g plot-1), while, 93127 gave the minimum yield (39.57 g plot-1). The grain-yield was affected significantly in an inverse proportion to both pod-infestation and larval-population.

Gupta*et.al*. (2003) studied that insect pests are a major cause of crop loss globally. Pest management will be effective and efficient if we can predict the occurrence of peak activities of a given pest. Research efforts are going on to understand the pest dynamics by applying analytical and other techniques on pest surveillance data sets. In this study we make an effort to understand pest population dynamics using Neural Networks by analyzing pest surveillance data set of *Helicoverpa armigera* or Pod borer on chickpea (*Cicer arietinum L.*) Crop. The results show that neural network method successfully predicts the pest attack incidences for one week in advance

LOMASH KUMAR(2013) Studies on the population dynamics of *Helicoverpa armigera* (*Hubner)* on chickpea crop conducted at Pantnagar during 2009-10 and 2010-11 revealed that the infestation of the pest started in the second fortnight of December and attained its peak in the first week of April and last week of March during 2009-10 and 2010-11, respectively. The larval population of the pest occurred throughout the growth period of crop with maximum at pod and grain formation stages. Maximum and minimum temperatures, sunshine hours and wind speed showed significant positive correlation with larval population whereas relative humidity and rainfall exhibited negative impact on larval population.

Gautam *et.al*.(2018)The present investigations entitled "Studies on population dynamics of *Helicoverpa armigera (Hubner*) on chickpea" was carried out at Students' Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad during Rabi, 2016.All the treatments were found significantly superior over control, Indoxcarb (14.5 SC) performed best among the treatments followed by Neem oil. The effectiveness of treatment determined in the terms of grain yield of chickpea obtained in different treatments revealed that the Indoxacarb @ 14.5SC, Neem seed oil @ 5ml and karanj oil @ 5ml were significantly superior over untreated control. Indoxacarb 14.5@ SC, gave maximum grain yield of chickpea in compared to other treatments as well as in managing the population of *H. armigera.* Besides Neem seed oil @ 5ml and karanj oil @ 5 ml were found the second and third most effective treatments respectively

2.2 To study effect of biotic and abiotic factor on growth of *Helicoverpa armigera*

Reddy *et al.* (2001) reported that the population of pod borers showed positive correlation with maximum temperature, minimum temperature and morning relative humidity and a negative correlation with insect population and relative humidity, wind speed and sunshine hours.

Sahoo *et al.,* (2001) reported a positive correlation between populations of *M. vitrata, Callosobrauchus maculatus* and *Tanaostigmodes cajaninae* and the minimum, maximum and average temperatures. Average relative humidity had a negative effect on pod borer population.

Muhammad *et.al*,(2009)Gram Pod borer (*Helicoverpa armigera Hubner)* is the most imperative constraint in chickpea (*Cicer arietinum L*.) production causing severe losses or there may be complete crop failure inspite of several rounds of insecticidal applications. Most importantly, the alternatives to chemicals comprise the selection and use of tolerant and high yielding varieties against this pest. In the present studies, the response of 10 chickpea genotypes to gram pod borer *H. armigera* was checked at the farm conditions. Results indicated that C-727 behaved the best for holding the least borer's population and damage while CM-88 proved sensitive and the least productive. A marked feeding behavior of *Helicoverpa* on growing chickpea crop was recorded. Framers can be in the forefront of following host plant resistance and such eco-friendly practices may endow with an absolute foundation of holistic IPM (Integrated Pest Management) Programme**.**

Khorasiya SG *et.al*.(2017)Observed a field experiment was conducted during Rabi season of 2011-12 and 2012-13 at instructional farm, Junagadh Agricultural University, Junagadh to find effect of date of sowing and intercropping on pod damage caused by *Helicoverpa armigera (Hubner*) in chickpea. Results showed that the incidence of *H. armigera* on crop was found least per cent pod damage (17.47%) with the highest grain yield (793 kg ha1) sown on 15th November as compare to other date of sowing (1st November and 30th November). Coriander (2:1) was taken as intercrop with chickpea, it found lower per cent pod damage (13.73%), which also recorded the highest equivalent yield (831 kg ha-1). Whereas, the chickpea sown on 15th of November and intercropped with coriander also registered the highest equivalent yield (947 kg ha-1) with lower per cent pod damage (10.96%).

Khorasiya *et.al*.(2016) Reported the direct and indirect effect of various abiotic factors on population build-up of *H. armigera* indicated that maximum temperature exerted very high negative direct effect (-1.1428) while morning relative humidity registered positive and high direct effect (0.4842). Negative high indirect effect was noticed of minimum temperature (-0.8909), morning (-0.4419) and evening relative humidity (-0.3891) through maximum temperature. While remaining weather parameters showed moderate to low positive indirect effect except evening relative humidity on population build-up of *H. armigera* during 2011-12. Minimum temperature (-0.5537), morning relative humidity (-0.9521) and wind speed (-0.4425) exerted negative high direct influence while, evening relative humidity (0.9534) exerted positive high direct influence on population build-up of *H. armigera*. Morning relative humidity exerted high negative indirect effect (-0.8193) through evening relative humidity and high positive indirect effect through wind speed (0.4493) and evaporation (0.6588) during Rabi, 2012-13

Ojha *et.al*.(2016) Reported to determine the impact of abiotic factors and parasitization by Campoletis chlorideae on population dynamics of *Helicoverpa armigera*, investigations were undertaken in chickpea during winter 2010-11 and 2011-12. Weekly observations were recorded regarding abiotic factors in relation to larval intensity, larval parasitization, and rate of larval multiplication in field or lab conditions. It was concluded that during February month, the larval population had the highest peaks as 8.93 & 7.93 larvae m-1 row along with the highest multiplication rate as 0.44 & 0.33 larvae/day. The natural parasitization was the maximum during December month as 51.67 & 56.67%. Simple correlation coefficient (r) of temperature (maximum and minimum), wind speed, and evaporation rate had reflected positive values when relative humidity (morning and evening), rainfall and larval parasitization played a negative role on the pest population.

Jakhar *et.al*.(2016) Observed the annual monitoring of the population dynamics of *Helicoverpa armigera* in unprotected pigeon pea crop during kharif seasons of 2011 to 2014 for 4 years at the farmers field North Gujarat, India. Temperature, rainfall and host-plant species were analyzed with respect to population fluctuation of the insect pest. The observations revealed that, the average number of larval population per plant in the season (from 27th to 3rd standard weeks) was 0.97, 0.32, 0.30 and 0.38 larvae/plant during 2011, 2012, 2013 and 2014 respectively. Population of *Helicoverpa armigera* had significant and negative correlation with maximum temperature (r= -0.524), rainfall (r= 0.079) and relative humidity (r= -0.827, r= -0.595 morning and evening, respectively).

Ganai *et.al*.(2017) Reported the results of the investigation on population dynamics of pod borer (*Helicoverpa armigera Hubner)* in relation to abiotic factors revealed that the pest commenced from 7th standard week, which remained till 18th standard week with its peak activity during 15th standard week. The correlation studies indicated highly significant positive association between larval population of *H. armigera* and mean maximum temperature (0.349**) and highly significant negative association between *H. armigera* and mean relative humidity (morning) (-0.284**). The non-significant effect was observed between larval population of *H. armigera* and mean relative humidity (evening) (-0.256) and mean rainfall (-0.174). Mean minimum temperature had significant effect on the *H. armigera* population (0.404)

2.3 To study efficiency of new molecular insecticide against *Helicoverpa armigera*

Nitharwal *et.al*.(2017) Studied in Rabi season during 2014-2015 study the relative efficacy of different among all the treatments lowest number of gram pod borer was recorded in Spinosad (2.85). The next followed treatment was Chlorpyriphos (3.40), which was also statistically at par with Quinolphos (3.69), Cypermethrin (3.95). Remaining treatments are Fipronil (4.45) and Indoxcarb (4.63) were statistically at par Malathion (5.25) was recorded as least effective within the chemical insecticides. A maximum net return was recorded in T5 Spinosad (17.45 q/ha), followed by T3 Chlorpyriphos (16.24 q/ha), T2 Quinolphos (15.35q/ha), T1 Cypermethrin (13.92 q/ha), T4 Fipronil (12.20 q/ha), T7 Indoxcarb (11.90 q/ha), T6 Malathion (9.26 q/ha) as compared to control T0 plane water (7.25q/h). When cost benefit ratio was worked out, interesting result was achieved. Among the treatment studied, the best and most economical treatment was T5 Spinosad (1:3.40), followed by T3 Chlorpyriphos (1:3.03), T2 Quinolphos (1:2.99), T1 Cypermethrin (1:2.71), T4 Fipronil (1:2.36), T7 Indoxcarb (1:2.30), T6 Malathion (1:1.81) as compared to control T0 plane water Control (1:1.46).

Lekha *et.al*.(2015) reported that a field study was conducted to evaluate the efficacy of five insecticides viz., Lambdacyhalothrin 5 EC, Novaluron 10 EC, Clothianidin 50 WDG, Indoxacarb 14.5 SC and Quinalphos 25 EC (standard check) against gram pod borer (Helicoverpa armigera H.) on chickpea (Cicer arietinum L.) variety Pratap Channa-1. Lambdacyhalothrin 5 EC gave the highest reduction in the larval population of pod borer and was found statically at par with Indoxacarb 14.5 SC. The next effective treatments were

Clothianidin 50 WDG and Quinalphos 25 EC, However, Novaluron 10 EC @ 750ml/ha proved to be the least effective treatment as it resulted in lowest per cent reduction in the larval population. Highest cost benefit ratio of 1:2.10 was obtained from Lambdacyhalothrin 5 EC followed by Indoxacarb 14.5 SC (1: 1.65). The next cost effective treatment in terms of CBR was Quinalphos 25 EC (1:1.64), whereas, Novaluron 10 EC (1:1.15) and Clothianidin 50 WDG @ 500g/ ha (1:0.66) could not show any conspicuous gain over cost

Dinesh *et.al* (2017) reported that afield study was conducted at instructional farm, Rajasthan College of Agriculture, MPUAT, Udaipur during Rabi 2013-14 and 2014-15 to evaluate the efficacy of insecticides and biopesticides against gram pod borer *(Helicoverpa armigera H.)* on chickpea (*Cicer arietinum L.*) variety GNG 1581. T1 (Flubendiamide 480 SC @ 200 ml/ha) was most effective, which caused (70.31, 73.08 and 72.04) and (72.86, 75.97 and 72.84) highest mean percent reduction in population of gram pod borer larvae. It was followed by Indoxacarb 14.5 SC @ 500 ml/ha. The biopesticides treatment of T6 (HaNPV 200 LE @ 250 ml/ha) and T7 (Bt.k 8 L @ 1lit/ha) were least effective against gram pod borer. The highest seed yield of 22.78 and 24.53 q ha-1 was obtained from T1 (Flubendiamide 480 SC @200 ml/ha) and minimum yield 16.00 and 15.20 q ha-1 was recorded in T9 (HaNPV- Bt.K- Bt.K @ 250LE-1Lit-1Lit/ha), during rabi 2013-14 and 2014-15. The highest benefit: cost ratio of 1.26 and 1.42 was recorded in T1 (Flubendiamide 480 SC @200 ml/ha) and minimum benefit cost ratio 1.03 and 1.04 was recorded in T9 (HaNPV- Bt.K- Bt.K @ 250LE-1Lit-1Lit/ha, during Rabi 2013-14 and 2014-15

Umair *et.al* (2013) Observed the Insecticide resistance in *Helicoverpa armigera (Hubner)* (*Lepidoptera: Noctuidae*) was evaluated against nine insecticides, representing conventional group of neuro-toxic insecticides such as endosulfan, profenofos, carbosulfan, and deltamethrin and new chemistry insecticides such as Emamectin benzoate, abamectin, spinosad, lufenuron and methoxyfenozide at IPM Sub Station (PARC), Bahauddin Zakariya University, Multan during 2010-11 . Two bioassay techniques i.e. residual method through leaf dip and topical method through micro-applicator were used for comparison. Low to moderate levels of resistance were recorded against these conventional and new chemistry insecticides at different locations of Southern Punjab, Pakistan e. g. in residual method, endosulfan (05-23 folds), profenofos (02-13 folds), carbosulfan (06-64 folds), deltamethrin (07-108 folds), Emamectin benzoate (01-42 folds), abamectisn (03-06 folds), spinosad (01-07 folds), lufenuron (02-08 folds), methoxyfenozide (03-14 folds) and in topical method, endosulfan (05-36 folds),profenofos (02-65 folds), carbosulfan (19-105 folds), deltamethrin (13-35 folds), Emamectin benzoate (02-06 folds), abamectin (01-04 folds), spinosad (04-61 folds), lufenuron (02-07 folds), methoxyfenozide (02-07 folds .The results indicated the development of multiple resistances in the field populations of *H. armigera*. Bioassay techniques showed no significant effects on the toxicity of insecticides. Resistance ratios in topical method were found higher as compared to the residual method, which may be attributed to the delayed cuticular penetration and enhanced metabolism of the insecticides. A significantly negative correlation was observed between conventional and new chemistry insecticides. It is suggested that the rotational use of conventional insecticides along with the new chemistry insecticides may be an effective tool in the insecticide resistance management program of *H. armigera.*

Muhammad *et.al*. (2017) reported the study was carried out at pulse section of Agriculture Research Institute (ARI) Tandojam. Chickpea crop is significantly important and rich in protein considered as major pulse crop in Pakistan and its surrounding and is attacked by number of insect pests, especially pod borer. The results declared that the control plot showed maximum population of Helicoverpa armigera throughout the study period. Whereas, after spraying novel pesticide (Radiant) at 100 ml/acre, results were maximum found as (0.75, 0.70, 0.80/plant) after 24 hours, (0.86, 0.80, 0.91/plant) after 48 hours, (0.91, 0.97, 0.94/plant) after 72 hours, (1.03, 1.08, 1.14/plant) after one week and (1.41, 1.68, 1.98/plant) after two weeks. Whereas, after the spraying of (Belt) at 50 ml/acre results (0.75, 0.80, 0.75/plant) after 24 hours, (0.80, 0.75, 0.91/plant) after 48 hours, (0.86, 0.91, 0.96/plant) after 72 hours, (1.01, 1.10, 1.05/plant) after one week and (1.41, 1.71, 1.98/plant) after two weeks were depicted. The result further revealed that (0.75, 0.70, 0.75/plant) after 24 hours, (0.86, 0.80, 0.86/plant) after 48 hours, (0.96, 1.01, 0.89/plant) after 72 hours, (0.98, 1.17, 1.10/plant) after one week and (1.42, 1.68, 1.98/plant) after two weeks after the application of (Steward) at 90 ml/acre. In conclusion our study resulted that Radiant pesticide showed maximum effects on the population reduction of H. armigera in Chickpea crop followed by Belt and Steward, respectively.

G. V. Suneel Kumar (2015) Field studies were carried out to evaluate the efficacy and economics of some new insecticides against *lepidopteron* caterpillars viz., *Spodoptera* exigua and *Helicoverpa armigera* (*Hubner*) during Rabi season of 2012 and 2013 in chickpea. The pooled mean of two years showed that the number of S. exigua and *H. armigera* larvae per 10 plants were lowest in plots treated with chlorantraniliprole 20% SC (0.33 and 0.50), spinosad 45% SC (0.34 and 0.67) and flubendiamide 20% WG (0.50 and 0.84) as against untreated control plot (16.67 and 8.17 larvae/10 plants) with 98.0, 97.9 and 97.0 per cent reduction of S. exigua population and 93.9, 91.8 and 89.7 per cent reduction of H. armigera population, respectively. Pod damage due to pod borer, H. armigera was lowest in plots treated with spinosad 45% SC (1.53%), flubendiamide 20% WG (2.46%), chlorantraniliprole 20% SC (2.60%) and Emamectin benzoate 5% SG (2.85%) with 88.8, 81.9, 80.9 and 79.1 per cent reduction over control, respectively. Highest seed yield was recorded in spinosad 45% SC treated plots (1244.4 kg/ha) with 121.8 per cent increase over control, followed by chlorantraniliprole 20% SC (1180.5 kg/ha), flubendiamide 20% WG (1157.4 kg/ha) and Emamectin benzoate 5% SG (1078.7 kg/ha) with 110.4, 106.3 and 92.2 per cent increase over control, respectively as against the minimum yield of 561.1 kg/ha in the untreated control. The cost effectiveness of flubendiamide 20% WG was high with cost-benefit ratio of 1: 4.08 followed by Emamectin benzoate 5% SG (1:3.75), chlorantraniliprole 20% SC and spinosad 45% SC (1:3.57)

2.4 To study of biology on growth of *Helicoverpa armigera*

Ali *et.al*. (2009) Observation the insect pest that damage legumes worldwide, chickpea pod borer, *Helicoverpa armigera*, has been identified as the most harmful. The biological traits of H. armigera has been studied at 25 ± 1°C coupled with 65 ± 5% relative humidity and 12 L : 12 D photoperiod maintained in an incubator in the laboratory. The investigations revealed that single female produced 413.00 ± 1.89 eggs. The incubation period of egg was 3.37 ± 0.09 days and their size varied from 0.42 to 60 mm in length and 0.40 to 0.55 mm in breadth. The average duration of first, second, third, fourth, fifth, and sixth instar larvae were respectively: 2.27 ± 0.08, 2.42 ± 0.08, 2.67 ± 0.07, 2.83 ± 0.07, 3.40 ± 0.10 and 3.37 ± 0.11 days. The length and breadth of corresponding stages were respectively: 1.40 ± 0.06 and 0.45 ± 0.01 mm, 3.88 ± 0.11 and 0.75 ± 0.01 mm, 7.90 ± 0.19 and 2.28 ± 0.04 mm, 12.83 ± 0.45 and 2.85 ± 0.04 mm, 20.97 ± 0.61 and 3.25 ± 0.04 mm, and 32.50 ± 0.35 and 4.03 ± 0.04 mm. Aged larva showed lateral brown strips and yellow to green color. The head as well as prothoracic legs were brown to black. The pre pupa duration was 2.15 ± 0.16 days, whereas pupa period was 13.15 ± 0.27 days. The average length and breadth of pupa were 19.00 ± 0.30 and 5.72 ± 0.08 mm, respectively. The males were recorded greenish-grey in color, while females were orange-brown and difference between pre-emergence periods was 9.17 ± 0.42 days for male and 11.74 ± 0.51 days for female this moth.

Dahegaonkar (2014) Reported life history studies of *Helicoverpa armigera* were conducted on artificial diet under laboratory conditions at room temperature. The incubation period of egg was 3.42 ± 0.40, varies from 2 to 5 days. The size of the egg was 0.50 mm in length and about 0.48 mm in breadth. The total larval period of all six instars varies from 18 to 26 days and the length of first to sixth instar larvae were 2.58 ± 0.01mm, 3.93 ± 0.08mm, 8.73 ± 0.18mm, 12.03 ± 0.15mm, 22.67 ± 0.43mm and 35.99 ± 0.89mm, respectively. There was variation in color within larval instars. Full fed larvae pupated by constructing earthen cells in the soil. The pre-pupa period was 3.11 ± 0.27days, varies from 1-4 days. Average pupa period was 13.80 ± 2.87, varies from10 to 16 days. The males were recorded greenish-grey in color, while females were orange brown and the longevity of male and female was 7 to 10 (average 8.70 ± 0.55) days and 9 to 13 (average 11.80 ± 0.72) days, respectively. The males outnumbered the females in the laboratory as they comprised 60% of the population. The fecundity varies from 557 to 739 eggs per female. Egg-laying usually begins 3 days after the emergence and were always laid singly.

Sunita Singh (2017) The Indian council of agricultural research (ICAR) has identified *H.armigera* as the single most damaging insect on legumes. The losses of crop from pest attack have been subject of very limited economic studies. It has been conventionally estimated that about 10-20% of crops produce in India is lost due to pest and disease. (Tembhare 1997) gram pod borer was a serious pest on chick pea (*Cicer arietinum*). It was found in the pods of chick pea. Gram pod borer was a polyphagous pest also found infesting chick pea pods. Cicer arietinum is most important pulse crop of India. Chick pea is second most important pulse crop of India. Pigeon pea being a leguminous plant is capable of absorbing atmospheric nitrogen and thereby restores lots of nitrogen in the soil (Parpia, 1981). In Madhya Pradesh, the pest severely defoliated legumes in year 1977-78 and reduced grain yield by 20-30%. In sagar (M.P.) the in legumes was 67% amounting to a loss of 6,100/Ha (Lal and Rathore, 2001). The pest belongs to order: *Lepidoptera*, family: *Noctuidae* (Dudgeon, 1913). These studies were undertaken with the objective to study the life style, population density and nature of damage caused by *H. armigera* in Sagar (MP), the paper describes the effects of *H. armigera* on crops along with the its biology and population density.

Abida Nasreen (2000) Reported *to Helicoverpa armigera (Hubner) (Lepidoptera: Noctuidae)* completed its larval stage in 17.325±0.326 days passing through six instars under laboratory protocol, 26±1EC, 60-70% RH and 16 hours' daylight. The larvae moulted for 2nd instar, two days after hatching from eggs. Average stabile periods for 2nd, 3rd, 4th, 5th and 6th in stars were 2.07, 2.15, 2.48, 3.12, 3.55 and 3.95 days respectively. The last larval stage did not moult but was contracted and shortened into grub like pre-pupae stage. The average length measured for each instar (first to sixth) was 3.4, 4.6, 9.7, 17, 28.35, 36.85 mm respectively. The average pupae period was 13.2 days for female and 15.4 days for male. Fecundity of moths fed on sucrose solution was significantly higher than water fed females. The unfed females laid few eggs none was viable.

Dahegaonkar (2014) Reported life history studies of *Helicoverpa armigera* were conducted on artificial diet under laboratory conditions at room temperature. The incubation period of egg was 3.42 ± 0.40, varies from 2 to 5 days. The size of the egg was 0.50 mm in length and about 0.48 mm in breadth. The total larval period of all six instars varies from 18 to 26 days and the length of first to sixth instar larvae were 2.58 ± 0.01mm, 3.93 ± 0.08mm, 8.73 ± 0.18mm, 12.03 ± 0.15mm, 22.67 ± 0.43mm and 35.99 ± 0.89mm, respectively. There was variation in color within larval instars. Full fed larvae pupated by constructing earthen cells in the soil. The pre-pupa period was 3.11 ± 0.27days, varies from 1-4 days. Average pupa period was 13.80 ± 2.87, varies from10 to 16 days. The males were recorded greenish-grey in color, while females were orange brown and the longevity of male and female was 7 to 10 (average 8.70 ± 0.55) days and 9 to 13 (average 11.80 ± 0.72) days, respectively. The males outnumbered the females in the laboratory as they comprised 60% of the population. The fecundity varies from 557 to 739 eggs per female. Egg-laying usually begins 3 days after the emergence and were always laid singly.

3. Material and method:

The present study entailed "Study on population dynamics of chickpea pod borer *Helicoverpa armigera* and management" was conduct at Agricultural Research Farm, School of Agriculture, Lovely Professional University, Phagwara, Punjab during 2017-18. The research field is located at 31^0 15' North latitude, 75^0 32' East longitudes at 228 meter above mean sea level The soil of research field was typically sandy loam to clayey (pH 7.5 to 7.8) with moderate fertility and having good drainage facility.

3.1 Population dynamics of *Helicoverpa armigera* in chickpea

The present investigation was conducted at Student Instructional Farm, Lovely Professional University, and Jalandhar during 2017-2018 in a Randomized Block Design (R.B.D) with treatments. Each consisting of three replication. The total number of plot was 27 with total crop area 17m x 31m (527sq.m). Each treatment plot size was 5m x 3m (15sq.m) with row spacing 45cm and plant to plant distance 10cm. chickpea variety USHA- 362 was sown on 1st December 2017. The observation will be recorded from germination of crop till the harvesting of crop. Different pest population and natural enemies will be recorded at weekly interval.

3.2 To study effect of biotic and abiotic factor on growth of *Helicoverpa armigera*

The recorded different pest populations will be correlated with abiotic factors like Temperature, Humidity, Rainfall and Wind velocity and Biotic factor like different types parasite, Parasitoid and predators for find out the effectiveness.

3.3 To study efficiency of new molecular insecticide against *Helicoverpa armigera*

Design: R.B.D

Variety: USHA -362

Spacing: 45x10cm

Plot size: 5x3m

Replication: 3

Treatment: 9

For decide ETL the observation will be recorded after germination of crops at weekly interval. To decided ETL monitoring by visual observation and raising pheromone traps. When pest population cross ETL then spraying of different insecticides done .The observation will be recorded after 24 hrs. 3DAS,7DAS AND 15 DAS on five randomly selected plants/plot .

Preparation of insecticidal spray solution:

The insecticidal spray solution of desired concentration as per treatments was freshly prepared every time at the field of experiment just before the start of spraying operations. The quantity of spray chemical required for crop was gradually increased as the crop advanced in age. The spray solution of desired concentration was prepared by adoption the following formula (Singh et al., 2011) [18]

Formula: $N_1 V_1 = N_2 V_2$

N_1 : Concentration of commercial formulation in percent or grams

V_1 : Volume or amount of commercial formulation required in milliliter or grams

N_2 : Desired concentration of spray fluid in percent

V_2 : Volume or amount of spray fluid required (in milliliter)

Details of insecticides treatments:

S. No.	**Treatment**	**Formulation**	**Quantity/dose (lit.)**
1	Indoxacarb	14.5% SC	0.5ml/lit
2	Emamectin benzoate	5% SG	0.5ml/lit
3	Cypermenthrin	25% EC	0.5ml/lit
4	Chlorpyriphos	20% EC	2.5ml/lit
5	Lambda cyhalothein	4.9% CS	1ml/lit
6	Fipronil	5% SC	1ml/lit
7	Neem oil		2ml/lit
8	Indoxacarb	14.5% SC	0.70ml/lit
9	control		

POD damage analysis: for calculation of these five randomly selected plant pod counted infected and healthy pod on each plant /plot.

Pod damage analysis:

$$Percentage\ pod\ damage = \frac{number\ of\ affected\ pods}{Total\ number\ of\ pods} \times 100$$

Statistical analysis:

Statistical analysis was done to test the level of significance and to compare the treatments using the following formula (Kumar, et al. 2008) [7]

Benefit Cost Ratio:

Gross return was calculated by multiplying total yield with the market price of the produce. Cost of cultivation and cost of treatment imposition was deducted from the gross returns, to find out net returns and cost benefit ratio by following formula.

3.4 To study of biology on growth of *Helicoverpa armigera*

To study biology of *Helicoverpa armigera* on infesting chickpea. The larvae were collected farm, Lovely Professional University, Jalandhar in Punjab. They were reared in the laboratory in plastic jars/glass Petridis covered with muslin cloth and larvae feed on fresh chickpea leaves or pods. They were reared in the separate rearing box to avoid canabolism and for pupation soil layer set in the boxes. The larvae moved below the soil surface to pupate. They were reported to pupate at depth of 3-5cm in depth of soil. After pupal stage male and female kept in a rearing box for mating at that time provide artificial diet for viable egg laying. Glucose on the cotton is consumed and sucking by the adult of *Helicoverpa armigera.* Chickpea leave and pods will be changed daily for deposition of eggs. The freshly laid eggs on the leave and pods ere used for further studies. The observation will be recorded on three parameter

A-Pre-reproductive period

B-Reproductive period

C- Post reproductive period.

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