



E-ISSN: 2320-7078

P-ISSN: 2349-6800

www.entomoljournal.com

JEZS 2020; 8(2): 1800-1805

© 2020 JEZS

Received: 20-01-2020

Accepted: 22-02-2020

Minakshee K Landge

Vrunda S Thakare, Post
Graduate Institute, Dr.
Panjabrao Deshmukh Krishi
Vidyapeeth, Akola,
Maharashtra, India

GK Lande

Assistant. Prof. Post Graduate
Institute, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

Vrunda S Thakare

Ph.D. Scholar, Post Graduate
Institute, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

Corresponding Author:**GK Lande**

Assistant. Prof. Post Graduate
Institute, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

Per cent Incidence and study of various life stages of *Helicoverpa armigera* on chickpea

Minakshee K Landge, GK Lande and Vrunda S Thakare

Abstract

The Present study revealed that the incidence of eggs, Ist to IIIrd instar larvae, IVth and Vth instar larva, pre-pupal larva of *H. armigera* was observed from 49th MW to 4th MW, 48th to 4th MW, 49th to 4th MW, 49th MW to 3rd MW respectively. While studying the various life stages, parasitoids viz., *Eriborus spp.* and *Campoletis chloridae*, NPV and other reasons were found the most effective mortality factors. The overall mortality in Ist to IIIrd, IVth to Vth instar larvae, pre-pupal larva, and pupa was 30.77 and 31.37 15.49, and 31.67 per cent respectively due to different reasons viz., unknown, incomplete pupation and HaNPV, pupal deformities (no adult emergence). The Male: Female sex ratio was 1:1.35. The adult emergence was 68.33 per cent and the fecundity observed was 409.64 eggs/female.

Keywords: Per cent incidence, study of various, *Helicoverpa armigera*

Introduction

Chickpea (*Cicer arietinum*) is one of the most widely cultivated pulse crops in India. It is the third most important grain legume of the world [16, 15] grown in more than 50 countries. Among the biotic factors responsible for low yield of chickpea, damage due to insect pest is the major limiting factor. It suffers from damage by the pod borer *Helicoverpa armigera* – a major yield reducing factor. Pod borer damage varies considerably in different agroclimatic regions in India. *Helicoverpa armigera* is a cosmopolitan, multivoltine and highly polyphagous pest which attacks a number of crops of agricultural importance all over the world. *H. armigera* is highly polyphagous, cosmopolitan, devastating and worldwide distributed pest [16, 14]. It is the endemic pest which damages chickpea from 20 to 100% [18]. Yield losses due to this pest in chickpea may range from 70 to 95 per cent [10]. In favorable condition to pod borer, pod damage goes 90-95 per cent [17, 12]. A single caterpillar of this pest can damage 25-40 pods [13]. Farmers have become reluctant to cultivate chickpea due to his susceptibility to pod borer. Therefore, information on the incidence, population fluctuation, damage severity, various life stages study, natural key mortality factors is necessary for developing an IPM approach. In this context, the present work framed to know per cent incidence and key mortality factors by studying various life stages of *Helicoverpa armigera* on chickpea.

2. Methodology

During the experiment, Chickpea variety 'JAKI-9218' was cultivated without the selection pressure of insecticides on field, for Study of per cent incidence of *H. armigera*. And further various life stages study was carried out in Toxicology laboratory of Department of Entomology Dr. PDKV, Akola during the year 2015-2016.

2.1 Sampling procedure

Regular field visits were made in order to record the first incidence of *H. armigera* (egg stages) on chickpea. Counting of number of insects in the available stage was done with the appearance of insect on the crops. The sampling of *H. armigera* was carried out from the unsprayed chickpea plots from the beginning of pest incidence till incidence exist on the crop at an interval of 7 days and every time 10 randomly selected spot, each spot of one Meter Row Length (MRL) was examined for recording insect population. The absolute pest population was computed on hectare basis for preparing the life table. The samples were collected in the morning hours.

2.1.1 Eggs

Eggs were collected from ten randomly selected spots, each spot of one-meter row length (MRL) unsprayed chickpea crop. The collected eggs were reared singly in the plastic vials till hatching. The observations were recorded on the number of the eggs hatching into larva, per cent parasitization, type of parasitoid and those remained unhatched, separately.

2.1.2 Larvae

The larvae belonging to the small age group (younger larvae) i.e. Ist, IInd and IIIrd instar (together) and bigger age group (older larvae) i.e. IVth and Vth (together) were collected from 10 MRL plants of chickpea and kept in the plastic vials individually to avoid cannibalism in the laboratory till the pupation. Mortality and survival rate of each instar/group of larvae were also recorded.

2.1.3 Pre-pupae

About 25 full grown larvae i.e. pre-pupae were collected from experimental plots and they were allowed to pupate in the laboratory in the plastic vials provided with sterilized soil and reared in laboratory separately till adult emergence [8]. Survival rate, parasitoid emergence, male and female ratio was obtained from pupal morphology.

2.1.4 Adults

The adults were emerged out from the pupae obtained from the field collected larval population and were sorted out into male and female and known adult pairs were confined in mating cum oviposition chamber to record the fecundity per female.

3. Results and discussion

3.1 Survival and mortality of various life stages of *H. armigera* on chickpea

3.1.1 Egg

Incidence of *H. armigera* eggs were observed on the chickpea plants, from 49th MW to 4th MW. However, the highest incidence i.e. 23 eggs per 10 MRL was noticed in the 52nd MW, while lowest i.e. 5 eggs per 10 MRL in 4th MW.

The natural egg mortality of *H. armigera* was observed ranging between 10 to 28.57 per cent. Whereas, the highest egg mortality i.e. 28.57 per cent was observed on 49th MW and lowest in the 2nd MW i.e. 10 per cent. However, the reasons for mortality of eggs were unknown (may be unviability).

While the survival rate was maximum i.e. 0.90 during 2nd MW and minimum i.e. 0.71 during 49th MW. The overall mortality noticed during the period was 19.10 per cent with survival rate of 0.81 represented in Table 5.

The above result regarding highest incidence of eggs in 52nd MW is in close confirmation with the studies conducted by [9].

Regarding overall mortality in egg stage these results are in close confirmation with the research findings of [3], who reported that *H. armigera* on chickpea recorded overall 14.55 per cent mortality in egg stage, due to unviability.

3.1.2 Ist to IIIrd instar (younger larvae)

Incidence of *H. armigera* larvae was observed on the chickpea from 48th MW to 4th MW. However, the highest incidence of larvae i.e. 25 larvae per 10 MRL were observed in 51st MW and lowest incidence 3 larvae per 10 MRL were noticed in 4th MW.

The data regarding per cent mortality of *H. armigera* larvae revealed that the Ist to IIIrd instar larvae collected from field were found parasitized by *Campoletis chloridae* (Fig 2) and *Eriborus spp.* (Fig 1). The per cent mortality of Ist to IIIrd instar larvae was in the range of 21.43 to 35.29 per cent. The highest mortality was observed in the 52nd MW i.e. 35.29 per cent and lowest 21.43 per cent in the 50th MW.

The *C. chloridae* was found most effective during 49th MW (3-9 December) and 1st MW (1-7 January) recording the overall larval mortality of 8.65 per cent. The per cent mortality of Ist to IIIrd instar larvae due to *Eriborus spp.* was in the range of 5.56 to 33.33 per cent. The highest mortality was observed in the 4th MW i.e. 33.33 per cent and lowest 5.56 per cent in the 51st MW due to *Eriborus spp.* The survival rate was maximum i.e. 0.79 during 50th MW and minimum i.e. 0.65 during 52nd MW (Table 1).

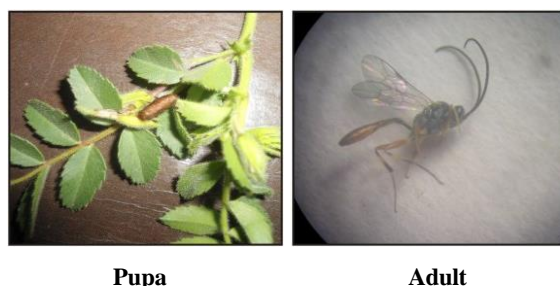


Fig 1: *E. argenteopilosus* recorded on early instar (I to III instar)

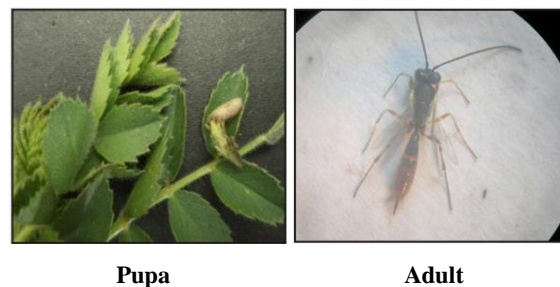


Fig 2: *C. chloridae* recorded on early instar (I to II instar)

Table 1: Survival and Mortality in Ist to IIIrd instar (younger larvae) of *H. armigera* on chickpea.

Stage of insect	Meteorological Week	Period of Week	Mortality factor	Survival rate	Per cent mortality
Larvae	48	26 Nov- 2 Dec	Unknown (2)	0.73	18.18
			<i>C. chloridae</i> (1)		9.09
	49	03-09 Dec	Unknown (3)	0.69	18.75
			<i>C. chloridae</i> (2)		12.5
	50	10-16 Dec	<i>C. chloridae</i> (1)	0.79	7.14
			<i>Eriborus spp.</i> (2)		14.29
	51	17- 23 Dec	Unknown (2)	0.67	11.11
			<i>C. chloridae</i> (2)		11.11
			<i>Eriborus spp.</i> (1)		5.56

	52	24-31 Dec	HaNPV (1)	0.65	5.56
			Unknown (3)		17.65
			<i>C. chloridae</i> (1)		5.88
			<i>Eriborus spp.</i> (1)		5.88
			HaNPV (1)		5.88
	1	01-07 Jan	Unknown (3)	0.69	18.75
			<i>C. chloridae</i> (2)		12.5
	2	08-14 Jan	Unknown (2)	0.67	22.22
			<i>Eriborus spp.</i> (1)		11.11
	3	15-21 Jan	-	-	-
	4	22- 28 Jan	<i>Eriborus spp.</i>	0.67	33.33

3.1.3 IVth and Vth instar (older larvae)

Highest incidence of IVth and Vth instar larvae i.e. 12 larvae per 10 MRL was noticed in 52nd MW and lowest incidence of larvae i.e. 3 larvae per 10 MRL was noticed in 4th MW.

The highest mortality of older larvae was found in 52nd MW (24-31 December) i.e. 18.18 per cent and lowest in 51st and 1st MW i.e. 12.5 per cent due to incomplete pupation. Mortality due to Nuclear Polyhedrosis Virus (Fig 3) was observed in 51st, 1st and 3rd MW with mortality of 12.5, 12.5 and 25 per cent, respectively. However, mortality due to unknown reasons were observed to the extent of 12.5 to 33.33 per cent during 49th, 50th, 51st, 52nd, 2nd and 4th MW.

The survival rate was maximum i.e. 0.80 during 50th MW (10-16 December) and minimum i.e. 0.63 during 51st MW (17-23 December) (Table 2).

Regarding the larval mortality of *H. armigera* due to unknown reasons, incomplete pupation and HaNPV is in

corroboration with the research findings of the research workers viz; [6, 2, 3, 11] and [7].



Fig 3: Viral disease (HaNPV) infection observed on early instar (I to III) and late instar (IV and V)

Table 2: Survival and Mortality in IVth and Vth instar (older larvae) of *H. armigera* on chickpea.

Stage of insect	Meteorological Week	Period of Week	Mortality factor	Survival rate	Per cent mortality
Larvae	48	36 Nov-2 Dec	-	-	-
	49	03-09 Dec	Unknown (1)	0.67	16.67
			Incomplete pupation (1)		16.67
	50	10-16 Dec	Unknown	0.80	20
	51	17-23 Dec	Unknown (1)	0.63	12.5
			Incomplete pupation (1)		12.5
			HaNPV (1)		12.5
	52	24-31 Dec	Unknown (2)	0.64	18.18
			Incomplete pupation (2)		18.18
	1	01-07 Jan	Incomplete pupation (1)	0.75	12.5
			HaNPV (1)		12.5
	2	08-14 Jan	Unknown	0.67	33.33
	3	15-21 Jan	HaNPV (1)	0.75	25
	4	22-28 Jan	Unknown	0.67	33.33

3.1.4 Pre-pupae

The mortality in pre-pupal larvae was observed in the range of 8.70 to 23.81 per cent and it was due to some abiotic factors. The overall mortality due to unknown reasons and incomplete pupation was 8.45 and 7.04 per cent, respectively. Highest mortality observed in 2nd MW i.e. 23.81 per cent and lowest 52nd MW i.e. 8.70. However, the survival rate was in the range

of 0.76 to 0.91 in different MW and overall mortality was 15.49 per cent with the survival rate of 0.85 (Table 3). This finding is in close confirmation with the studies conducted by [5] who reported that the pre-pupal larvae of *H. armigera* is reduced by Tachinid fly, unknown factors and incomplete pupation on chickpea.

Table 3: Survival and mortality in pre- pupae of *H. armigera* on chickpea

Stage of insect	Meteorological week	Period of week	Mortality factor	Survival rate	Per cent mortality
Pre-pupa	48	26 Nov-02Dec	-	-	-
	49	03-09 Dec	Unknown (2)	0.84	10.53
			Incomplete pupation (1)		5.26
	50	10-16 Dec	Unknown (1)	0.87	4.35
			Incomplete pupation (2)		8.70
	51	17-23 Dec	Unknown (2)	0.86	9.52
			Incomplete pupation (1)		4.76
	52	24-31 Dec	Unknown (1)	0.91	4.35

	1	01-07 Jan	Incomplete pupation (1)	0.85	4.35
			Unknown (2)		10
			Incomplete pupation (1)		5
	2	08-14 Jan	Unknown (2)	0.76	9.52
			Incomplete pupation (3)		14.29
	3	15-21 Jan	Unknown (2)	80	13.33
Incomplete pupation (1)			6.67		

3.1.5 Pupae

The maximum pupal mortality was observed in 2nd MW i.e. 37.50 per cent and lowest 25 per cent in 3rd MW. However, the survival rate of pupae was noted maximum in 3rd MW (0.75), followed by 51st MW (0.72).

From pupae, adults could not emerge or failed to complete the development (without any deformity) and thus, act as key mortality factor during pupal stage. Such mortality was highest in 1st MW (17.65 per cent) and lowest in 50th MW (5 per cent). The mortality achieved due to pupal deformity (no adult emergence) (Fig.4) was highest during 49th MW (18.75 per cent) and lowest during 50th MW (10 per cent). Whereas,

the mortality caused due to unsuccessful adult emergence was 15, 4.76 and 12.5 per cent in 50th, 52nd and 2nd MW, respectively.

The overall mortality noticed during research work was 31.67 per cent with survival rate of 0.68. Among that 13.33, 13.33 and 5 per cent mortality in pupae, respectively due to pupal deformity (no adult emergence) (Fig 5), adults not emerged (without any deformity) and unsuccessful adult emergence were noticed, respectively (Table 4).

Regarding the pupal mortality in *H. armigera* due to pupal deformity, adults not emerged and unsuccessful emergence recorded in adults are in corroboration with the studies of [3] on chickpea, [4] on cotton and [2] on pigeon pea.



Fig 4: Deformities found in pupa



Fig 5: Deformities found in Adult

Table 4: Survival and mortality in pupae of *H. armigera* on chickpea

Stage of insect	Meteorological week	Period of week	Mortality factor	Survival rate	Per cent mortality
Pupa	49	03-09 Dec	Pupal deformity (3)	0.69	18.75
			Adults not emerged (2)		12.5
			Unknown (2)		10
	50	10-16 Dec	Pupal deformity (2)	0.70	5
			Adults not emerged (1)		15
			Unsuccessful adult emergence (3)		11.11
	51	17-23 Dec	Pupal deformity (2)	0.72	16.67
			Adults not emerged (3)		14.29
	52	24-31 Dec	Pupal deformity (3)	0.67	14.29
			Adults not emerged (3)		4.76
			Unsuccessful adult emergence (1)		17.65
	1	01-07 Jan	Pupal deformity (3)	0.65	17.65
			Adults not emerged (3)		12.5
	2	08-14 Jan	Pupal deformity (2)	0.63	12.5
			Adults not emerged (2)		12.5
3	15-21 Jan	Unknown (2)	0.75	12.5	
		Pupal deformity (1)		16.67	
		Adults not emerged (2)		8.33	

3.1.6 Per cent pupation

The highest pupation (91.30 per cent) was observed during 52nd MW (24-31 December) while lowest i.e. 76.19 per cent observed during 2nd MW. Per cent pupation was in the range of 76.19 to 91.30 per cent. The overall per cent pupation

during study period was 84.51 per cent. The present findings on per cent pupation are in close confirmation with the research findings conducted by [3] who reported 81.98 per cent pupation of *H. armigera* on chickpea (Table 5).

Table 5: Survival and mortality of various life stages of *H. armigera* on chickpea

Met week	Period of week	Per cent mortality of egg	Per cent Survival of egg	Per cent pupation	Sex ratio	Per cent adult emergence
49	03-09 Dec	28.57	0.71	84.21	1:1.29	68.75
50	10-16 Dec	18.18	0.82	86.96	1:1.86	70
51	17-23 Dec	27.78	0.72	85.71	1.25:1	72.22
52	24-31 Dec	17.65	0.82	91.30	1:1.63	66.67
1	01-07 Jan	13.33	0.87	85	1:1.43	64.71
2	08-14 Jan	10	0.90	76.19	1:1.29	62.5
3	15-21Jan	14.29	0.86	80	1:1.4	75
4	22-28 Jan	25	0.75	-	-	-

3.1.7 Sex ratio (based on pupal morphology)

Highest sex ratio was observed in the 50th MW i.e. 1:1.86 and lowest during 49th and 2nd MW i.e.1:1.29 and overall sex ratio was 1:1.35, and are represented in Table 5.

3.1.8 Adult emergence

The per cent adult emergence was in the range of 62.5 to 75 per cent during different meteorological weeks. The maximum adult emergence i.e. 75 per cent was observed in the 3rd MW and minimum i.e. 62.5 was in the 2nd MW, depicted in Table 5.

The overall per cent of adult emergence of *H. armigera* is in close confirmation with the studies conducted by Bheemanna^[1] who reported the per cent adult emergence in *Bt* cotton, Non *Bt* cotton, red gram, Bengal gram and sunflower was 6.60, 42.80, 96.5, 80.2 and 57 per cent, respectively.

3.1.9 Fecundity of *H. armigera*

Highest fecundity was observed in 1st MW i.e. 438 eggs per female while lowest fecundity in 50th MW i.e. 389.67 eggs per female. The female oviposited for 5 days continuously after mating. The average fecundity observed was 389.67-438 eggs per female. The overall fecundity in *H. armigera* was 409.64 eggs per female (Table 5).

The results on fecundity of *H. armigera* finds the support in the work carried out by Ali *et al.* (2016) who recorded 299.68 to 492.28 eggs per female of *H. armigera* on different chickpea cultivars.

4. Conclusion

Egg and larval field activities of *H. armigera* started from December 2015 to January 2016 on chickpea with peak infestation from mid-December to fortnight of January. Among mortality factors i.e. parasitization was found to be the major mortality factors. Field collected population of younger larvae (Ist to IIIrd instars) were parasitized by two Ichneumonids i.e. *Eriborus spp.* and *Campoletis chloridae*. Hence it is necessary to observe early larval stages and follow practices for conservation of natural parasitoids and accordingly adoption of plant protection measures should be taken on *H. armigera*. HaNPV was also found to be one of the biotic mortality factors for field collected younger and older group larvae. Other mortality factors during late instars and pupal stages were incomplete pupation (larva-pupal intermediate stages), pupal deformity, pupal failure to complete the development (adults not emerged) and unsuccessful adult emergence, unknown reasons also contributed mortality in almost all stages of *H. armigera*. Among the field collected damaging larval stages to crop, older larvae (IVth and Vth instar) showed more mortality followed by younger larvae, which is mainly due to biotic factors indicating precautionary insecticidal/botanical application to protect the natural enemies and adopt the

measures to conserve the biotic fauna.

5. References

- Bheemanna M, Patil BV, Hosamani AC, Sharanabasappa. Synchrony in *Helicoverpa armigera* (Hubner) adult emergence from *Bt* cotton in comparison with the non *Bt* cotton and another alternate host. *J. Cotton Res.* 2011; 25(2):248-251.
- Bisane KD, Katole SR. Life table studies *Helicoverpa armigera* (Hubner) on Pigeon pea. *Indian J. Entomol.* 2008; 70(4):350-355.
- Bisane KD, Khande DM, Bhamare VK, Katole SR. Life table studies of *Helicoverpa armigera* (Hubner) on chickpea. *International J. Pl. Protec.* 2009a; 2(1):54-58.
- Bisane KD, Nehsare SK, Khande DM, Wasule DL. Life table of *Helicoverpa armigera* (Hubner) on cotton. *J. Cotton Res. Dev.* 2008a; 22(2):178-184.
- Bisane KD, Katole SR, Aherkar SK, Khande DM. Parasitization of larvae and pupae of *H. armigera* (Hubner) on cotton. *J. Appl. Zool. Res.* 2008b; 19(2):167-172.
- Gotarkar SB, Dhande VR, Asmita Suralkar, Thakare SV, Chauke YR, Aherkar SK. Life table study of *Helicoverpa armigera* (Hubner) on pigeonpea. *Crop production and protection.* 2005; 1(2):18-20.
- Mohapatra LN, Sahu BB. Age specific life tables for American bollworm, *Helicoverpa armigera* (Hub.) on cotton. *Journal of Entomological Research.* 2005; 29.1:9-14.
- Navrajan Paul, Ram Dass AV, Baldev Prasad. Sex determination of pupae of *Heliothis armigera* Hubner on gram. *Indian J. Ent.* 1979; 41(3):285-286.
- Patel CC, Koshiya DJ. Population dynamics of gram pod borer, *Helicoverpa armigera* (Hub.) on cotton, pigeonpea and chickpea. *GAU Res. J.*, 1999; 24(2):62-67.
- Prakash, MR, Ram U, Tariq A. Evaluation of chickpea (*Cicer arietinum* L.) germplasm for the resistance to gram pod borer, *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae). *J. Entomol. Res.* 2007; 31:215-218.
- Rai R, Nath P. Study of key mortality factors in the population dynamics of Chickpea pod borer, *Helicoverpa armigera* (Hubner) (Noctuidae: Lepidoptera) infesting chickpea, *Cicer arietinum* L. *Tropical Ecology.* 1999; 40(2):281.
- Sachan JN, Katti G. Integrated Pest Management. *Proceeding of International Symposium on Pulses Research*, 1994; New Delhi, India, 1994, 23-30.
- Sanap MM, Deshmukh RB. Testing of different insecticides for the control of *Heliothis armigera* (Hub.) on chickpea. *Int. Chickpea Newslet.* 1987; 17:14.
- Sarwar M, Ahmad N, Tofique M. Host plant resistance

- relationships in chickpea (*Cicer arietinum* L.) against gram pod borer (*Helicoverpa armigera*) (Hubner). Pak. J. Bot. 2009; 41:3047-3052.
15. Sarwar M, Nazir N, Toufiq M. Identification of susceptible and tolerant gram (*Cicer arietinum*) genotypes against gram pod borer (*Helicoverpa armigera* Hubner). Pak. J. Bot. 2011; 43:1265-1270.
 16. Sharma HC. *Heliothis/ Helicoverpa armigera* management: emerging trends and strategies for future research. 2005; New Delhi. India Oxford and IBH and science Publishers, USA, 2005, 469.
 17. Shengal VK, Ujagir R. Effect of synthetic pyrethroids, neem extracts and other insecticides for the control of pod damage by *Helicoverpa armigera* on chickpea and pod damage-yield relationship at Patancheru in Northern India. Crop Protec. 1990; 9:29-32.
 18. Vaishampayan SM. Seasonal abundance and activity of gram-pod borer, *Helicoverpa armigera* Hubner and its outbreak situation on gram at Jabalpur. Indian Journal of Entomology. 1980; 42:433-459.