A detailed survey of the available literature on various aspects of the present investigation has been done with specials reference to *Helicoverpa armigera*. The references have been arranged systematically and chronologically under the following appropriate heads.

2.1 Population Dynamics and Forecast Model

*Vaishmpayan and Veda (1980)* studied the population dynamics of *H. armigera* larvae during 1967-68 and 1973-74 to 1977-78 on chickpea around Jabalpur and ascertained that rainfall was found to be one of the key factors influencing the buildup of the larval population on the crop. Rainfall 250 mm. Or more in September and October was highly favourable to the build up of the first generation larval peak in the pre flowering stage. Winter rains of more than around 25mm in January and February were also favorable to the pest and rainfall at this time determined the size of the second generation at the pod formation stage. A minimum daily temperature between 10 to 14°C was found most favourable for the development of the pest.

*Sehgal (1990)* reported the relationship between yield reduction and pod damage of chickpea due to *H. armigera*. Significant positive correlation was found between yield reduction and pods damage. Severe pod damage close to maturity could not be compensated and was reflected in yield reduction. Foliar damage could compensate by plants resulting in significant relationship between reduction and pod damage.

*Pimbert and Srivastava (1991)* analyzed larval counts, light-trap data and weather patterns over a six-year period that inferred that prolonged rainfall deficits promote the growth of *H. armigera* populations in A.P., India. Drought stress resulting from rainfall shortages enhances the chemical cues involved in larval host-selection behaviour and improves the nutritional quality of many wild and cultivated host plants on which this polyphagous pest reproduces.

*Anwar et al. (1992)* experimented on the incidence of attack and population fluctuation of *H. armigera* in relation to chickpea phenology and environmental factors in Pakistan during 1989-92, they found that the larval population remained low during December and January and increased during February – March. The flowering and pod formation stage of the crop and relative high temperature favoured to increase the larval population.
Patel (1992) while studying on the incidence of *H. armigera* on chickpea to
abiotic environment he found that temperature (maximum and minimum) and relative
humidity play a vital in its incidence.

Singh and Singh (1992) found a serious infestation of safflower by *H.
armigera* occurred in Sehore, India in 1986 and recorded the mean larval population
of 2.34 / plant. In March, 5.24 larvae/plant were noted with cent percent loss.

Verma et al. (1994) reported that temperature played an important role in
regulating adult activity and two distinct peaks of *H. armigera* the first during mid-
March to the 1st week on June and the second during the 2nd week of June to the last
week on July. Larval development in cauliflower took the longest (25.7 days) followed
by chickpea (19.7), tomato (17.5) and pea (17.0). Overlapping generations was
observed after the occurrence of the first peak.

Dubey et al. (1995) experimented on the population dynamics of *H. armigera*
by feeding it on different crops viz. chickpea, pigeonpea, lentil and tomato in the
cropping season and tomato, berseem, bhindi, fodder and grain sorghum, soyabean,
hollyhock, *dhatura*, rose and bougainvillea during the off season (April August). The
pest showed peak activity in February and March. Chickpea and pigeonpea were the
most preferred hosts. Environmental factors (temperature, relative humidity and
rainfall) had the impact on the development of the pest population.

Patnaik et al. (1995) studied the population dynamics of the noctuid *H.
armigera* on chickpea in northern Orissa, India during 1988-92. Larval population
fluctuated greatly in the same field between fields in the same year. This response
could have been due to oviposition behaviour of females, which may have selected
specific locations, based on the suitability of the crop stage, for ensuring high survival
of the offspring.

Lal (1996) outbreak explored the situation of pod borer, *H. armigera* (Hub) on
chickpea and found that it is the most important pulse crop in eastern Uttar Pradesh in
India. Gram pod borer, *H. armigera* appears in great numbers during the active
vegetative growth at the pod formation stage. During 1995-96, the pest appeared by the
end of December-January in chickpea field and slowly increased. However, by the end
of February and early March, it transformed into a severe outbreak. It was found
damaging leaves tender shoots, apical tips, flower buds and the pods. The pest
population declined fast by the end of March 1996 with the rise in temperature. A
number of climatic factors like temperature; rainfall, relative humidity, sunshine and wind speed may be attributed to the population buildup and out break of *H. armigera*. To avoid such a situation in future, regular monitoring of the pest population is recommended.

**Patnaik and Senapati (1996)** investigated the population dynamics of *H. armigera* on chickpea during winter (November-March) 1989-90 to 1991-92 under the north central plateau agro-climatic zone of Orissa. The average data across the years indicated peak oviposition during the 52nd standard week, coinciding with the late vegetative to flower initiating stage of the crop. Peak egg density was observed within the thermal ranges of 24.60°C (mean maximum) to 11.50°C (mean minimum) and at a RH of 72.2%. The larval activity peaked between the 50th and 2nd std. week (i.e., 2nd week of Dec. to 2nd week of Jan.). A significant negative correlation prevailed between temperature and larval incidence.

**Singh and Singh (1996)** observed an unusual outbreak of gram pod borer, *H. armigera* on the rabi soybean variety JS335 in Sehore, Madhya Pradesh, India. Larvae appeared in the 1st week of March 1995 at the pod filling stage of the crop with an average population of 1.07-larvae/metre row length, which increased abruptly during the 3rd week of March 1995 (average = 13.92 larvae/m r l).

**Khurana (1997)** conducted field studies during the rabi season of 1990-91 in Sirsa, Haryana, India, the larval Population of gram pod borer, *H. armigera* on chickpea was highest during November and December but declined during the winter (January and February). Population crossed the economic threshold level (1 larvae/m row length) in the first week of March 1991.

**Patel and Koshiya (1997)** studied seasonal abundance of *H. armigera* during kharif and found that the pest initiated in groundnut from the first week of July 1993. There after, the pest moved to cotton from the last week of July and started to build up its population during the month of August to mid September. Simultaneously, the pest infestation was also noticed in sunflower and pearl millet during this period, but the population was very low in sunflower. However in pearls millet, there was a peak during September, 1993 in the rabi season, pest activity was observed in chickpea during November to January-February and the population was at its peak during December. During the summer season, the pest started its activity on groundnut in February and was found active up to June.
In Maharashtra, a Field study in 1993-94 was carried out by Jadav and Suryawanshi (1998) on chickpea infestation by *Helicoverpa armigera*. The pest incidence varied from 0.80 to 3.05 larvae/plant, beginning 27 days after sowing (DAS) and peaking at 48 DAS.

**Saini and Jaglan (1998)** surveyed chickpea crop in Hisar and Sirsa districts, Haryana, India in indifferent months during 1993-94 and recorded larval population of *H. armigera*. The population level was quite high (3.8 to 9.9 larvae/m row length) during mid November; however it declined sharply afterwards as the temperatures decreased and reached the lowest level (< 1 larva/metre row length) after the third week of December. A positive correlation of the population with temperature was observed and notices that most larvae were killed during the winter months and only a few were present at the pod formation stage of the crop. A model for predicting infestation of chickpea by *H. armigera* was developed, based on minimum and maximum temperature, morning and evening relative humidity and total rainfall/week (mm) (**Das and Kataria, 1999**).

**Patel and Koshiya (1999)** studied the population dynamics of *H. armigera* (Hub.) in chickpea during the year 1993-94 in Gujarat. The study clearly revealed, that the pest was first observed in the IIIrd week of November and reached a peak in the IIIrd week of December at crop podding stage. The pest activity was recorded from November to February. Among the various abiotic factors, maximum and minimum temperature as well as vapour pressure exhibited decreasing trend, which contributed to population fluctuations of *H. armigera* larvae.

**Kumar (2001)** while working on Helicoverpa population dynamics on pigeonpea he formed its activities in the first week of February (5th std. Week) and the population of larvae went down to a low ebb of 2.9 larvae/10 pods in the middle of April when atmospheric temperature, relative humidity, wind speed and evaporation rate, coincided 34.24%, 64.28%, 4.90 km/hr and 8.28 mm/day, respectively. Atmospheric temperature played a positive role in increasing the pest population, while other variables viz. relative humidity and evaporation rate behaved negatively. The coefficient of determination (R²) was computed as high as 69.12 per cent.

**Rai (2003)** surveyed forty-eight chickpea fields in 40 villages of 18 blocks covering four districts viz. Kanpur Dehat, Hamirpur, Jalaun and Jhansi of U.P. at crop maturity. Gram pod borer (*H. armigera* Hub.) was recorded to cause severe damage of
the pods. The district Jhansi exhibited higher infestation (25-72% plants 1.33-20% pods) than Kanpur Dehat (0.50% plants; 0-12.5% pods) and Jalaun (0.40% plants; 0-10.67% pods)

2.2 Evaluation of insecticide

Dabi et al. (1988) reported that the insecticide and dipel sprays alone give less than 50 per cent kill at 72 hours after treatment. The combination of Dipel and insecticides viz, carbaryl, endosulfan, malathion and monocrotophos rendered synergistic response, A mixture of dipel + endosulfan and dipel + monocrotophos both proved best and gave 100 percent kill with in 48 after treatment.

Ahmad et al. (1989) formed that the use of 250-500 LE (larval equivalents) of NPV/ha to be more effective against the larvae of H. armigera. It was also observed that use of NPV with half dose of endosulfan was as effective as full dose of endosulfan.

Sachan and Lal (1990) assessed chemical insecticides and botanicals and use of 5% NSKE was found to be effective and almost with the recommended insecticide endosulfan (0.07%) for controlling H. armigera chickpea and pigeonpea.

Mishra et al. (1991) conducted field trials in chickpea in Bihar and Uttar Pradesh during 1987 and showed that a single spray of 250 LE/ha NPV in 500 liters of water per ha resulted 97.2% mortality of H. armigera in 1987 and 24.4 to 78.8% larval mortality during 1988. NPV application considerable reduced pod damage and population of H. armigera.

Natarajan et al. (1991) observed that nuclear polyhedrosis virus (500LE/ha) and endosulfan (0.07%) were tested separately and together for the control of H. armigera on pigeonpea in Tamil Nadu, India, during kharif 1985. Pod damage was 5.6, 9.9 and 13.7% after treatment with virus followed by endosulfan with and interval of one week, 2 treatments with endosulfan and 3 virus treatments, respectively. The highest yields were recorded following treatment with endosulfan alone (259.6kg/ha) and virus followed by endosulfan (215.6kg/ha).

Talekar et al. (1991) undertaken field experiments in Maharashtra, India out of 10 insecticides tested. fenvalerate at 500g a.i./ha and methamidophos at 1200 g a.i./ha were the most effective treatments against H. armigera in gram in terms of pod damage reduction and the enhancement of respective crop yield.
Saxena et al. (1992) tested bioefficacy of three commercial preparation of Bacillus thuringiensis i.e. Delfin, Dipel and thuricide along with endosulfan against H. armigera in chickpea field. It was found that Delfin was found comparatively more effective.

Sachan and Lal (1993) studied the efficacy of neem seed kernel extract, neem leaf extract, neem oil, and fenvalerate. Cypermethrin endosulfan, quinalphos, B.H.C. (H.C.H.) and methyl parathion against H. armigera on chickpea and pigeonpea and was evaluated at several sites in India during 1982-89. All the treatments reduced the pest population with endosulfan being the most effective. Neem seed kernel extract and neem leaf extract was more effective for the controlling the pest on chickpea than pigeonpea.

Panchabhan et al. (1994) reported that the lowest percentage pod damage and highest gram yield were recorded when fenvalerate was applied twice at 15 days intervals followed by neem seed kernel extract at another 15 day interval.

Rabindra et al. (1994) evaluated the combined use of nuclear polyhedrosis virus (NPV) at 1.5 x 10^{12} polyhedral conclusion bodies (POB)/ha and at one lakh 2\textsuperscript{nd} instars larvae/ha for the management of H. armigera on chickpea. Release of C. carchae was an effective as NPV in increasing the grain yield and bio-control agents were as effective as endosulfan (350 g a.i. /ha) in the management of H. armigera on chickpea.

Sarode et al. (1995) found that Helicoverpa nuclear polyhedrosis virus and neem seed kernel extract gave better control of H. armigera on chickpea when applied in combination than when applied singly. Application of the virus at 500 larval equivalents/ha plus neem extract at 6% the maximum reduction in larval number 79.8 and 65.2%) 7 and 14 days after spraying, respectively.

Vyas and Lakhoaura (1996) stated that three sprays of NPV @ 250 L.E./ha significantly reduced the larval population and increased pest mortality. However two applications of 0.07% endosulfan were superior to NPV spraying and was the best treatment.

Gujar (1997) observed that Azadirachtin sample SPIC SSF22 was effective against the second instars larval. Treatments of the second instars larvae with a sub lethal dose of lug/insect led to their drastic growth inhibition for a considerable period after which insect died.
Jaglan et al. (1997) evaluated extracts of neem (*Azadirachta indica*) seeds and green leaves against *H. armigera* and reported that early stage larvae were more sensitive to the exposure of neem extract advanced stage larvae.

Khurana (1997) reported that the efficacy of 12 insecticides against *H. armigera* was conducted in trial in five farmers field. Chlorpyriphos, endosulfan, monocrotophos, quinalphos and triazophos were the proved most effective against early instars (2\textsuperscript{nd} to 4\textsuperscript{th}) larvae.

Sharma et. al. (1997) conducted field trials in M.P., India using nuclear polyhedrosis virus, *Trichogramma chilonis*, monocrotophos (Nuvacon 36 E.C.) and endosulfan (Thiodan 35 E.C.) and were evaluated for control of *H.armigera* on chickpea. It was concluded that nuclear polyhedrosis virus gave the best control of the pest.

Ujagir et al. (1997) tested profenofos *Bacillus thuringiensis* sub. Sp. Kurstaki (Dipel 8L), endosulfan (Thiodan 35 E.C.), *Helicoverpa* Nuclear polyhedrosis virus (HaNPV), HaNPV + endosulfan, lindane (Kanodane 1.3D and Kanodane 20 E.C.), azadirachtin (nimbecidine 0.03%) and cypermethrin + profenofos expect Nimbecidene and Dipel resulted in increased grain yields.

Sanap and Pawar (1998) laid out a field experiment in Maharashtra during 1993-96 for controlling *H. armigera* infesting chickpea. Integrated pest management treatment comprising of endosulfan 0.07%, neem seed kernel extract 5% and nuclear polyhedrosis virus @ 250 LE/he were evaluated. The field trial conducted during winter 1993-96 revealed that 3 spray applications starting from initiation of flowering and subsequent 2 spray at fortnightly interval with first 2 spray either with nuclear polyhedrosis virus @ 250 LE/he or neem seed kernel extract followed by a third spray with endosulfan 0.07% were proved most effective for controlling the pest and resulted in 26.94 and 27.29 per cent increase in yield respectively.

Kumawat and Jheeba (1999) reported that the efficacy of nuclear polyhedrosis virus (NPV) and *Bacillus thuringiensis* sub. sp. Kurstaki against *H. armigera* on chickpea. The treatments were tested with and without recommended insecticides (azadiractin, a neem product, endosulfan and monocrotophos). Treatments of plants with alternate spay of monocrotophos and endosulfan resulted in the lowest pod infestation and highest seed yield, but this treatment was not significantly different
from alternate sprays of NPV and endosulfan. The chemical treatment also gave the maximum net returns, followed by the NPV/endosulfan treatment.

Singh et al. (1999) studied that microbial pesticides (Dipel 8L/litre/ha) (Bacillus thuringiensis (subsp. Kurstaki), Delfin (1kg/he) and NPV (250 LE/he) were evaluated alone and in combination with endosulfan (35 E.C.) for their effectiveness against *H. armigera* on chickpea in the field in Bihar, India during *rabi* 1995-96. These bio-pesticides when used alone or in combination with endosulfan proved superior to the untreated control by significantly reducing pod damage and enhancing grain yield. However, when used in combination with endosulfan, they were more effective resulting in relatively low pod damage with average of 4.21 (Delfin), 5.65 (Dipel) and 6.66% (NPV) resulting in 49.7, 47.2 and 46.7% increase in grain yield, respectively.

Sudarshan et al. (1999) conducted field trial in West Bengal, India for two consecutive seasons to determine the field efficacy of azadirachitin and three other neems extracts of *Azadirachta indica* pesticides namely azadirachitin-iodine, neem seed, kernel extract (NSKE) and neem oil on the pod borer, *H. armigera*. The chemicals were applied at 2, 4, 7 and 9 ml a.i./litre, with the first spray given on 6 November. Azadirachitin showed a unique field efficacy when it was applied at 7 and 9 ml. a.i./litre and other neem treatments were moderately effective at these concentrations.

Suganthy and Kumar (2000) studies were conducted to evaluate the relative efficacy of various plant protection options against *H. armigera* in chickpea in A.P., India, after the rainy season in 1998-99. Integrated pest management (1 PM) was judged to be the best treatment in the management of *H. armigera* larvae (37% reduction over untreated control) followed by endosulfan (33%). HaNPV (nuclear polyhedrosis virus) (29%), neem (25%) and execting bird perches (23%) 1 PM registered the lowest percentage of pod damage (9.4%), followed by endosulfan (10.2%), compared to 18.8% in the untreated control. The maximum yield of 11.7q/ha was obtained with 1PM, followed by spraying endosulfan (10.5q/ha), compared to 7.4q/ha in untreated control, 1PM was concluded to be the best treatment in term of the cost benefit ratio (1:3:3) followed by the endosulfan treatment (1:6:1).

Bhagwat and Wightman (2001) undertaken a field trial during 1996 who found that application of NPV mixed with chickpea flour (1%) and jaggery (0.5%) significantly lowered pod damage to 18.4% and increased yield by 72.0% over control. In another field trial, the use of NPV with sandovit (0.02%) or ranipal (0.5%) was
found effective and recorded increased yield by 67.5% and 53.4%, respectively. An inform IPM research trial during 1985-86 and 1996-97 in collaboration with KVK, Zaheerabad and the farmers in Medak District of A.P., showed good performance of NPV against pod borer damage. These treatments were found effective in increasing yield against control.

Bhatt and Patel (2002) observed that the bio-efficacy of HaNPV and Bacillus thuringiensis var. kurstaki, individually and in combination with insecticides (endosulfan, fenvalerate, monocrotophos, nimbecidine and tobacco & nufi decoction) was evaluated on chickpea against *H. armigera* (Hub.) during *rabi* season (1998-99). The chickpea crop was sprayed twice with the respective insecticide when the pest population exceeded the economic threshold when the pest population exceeded the economic threshold level. Among the different bio-pesticides and synthetic insecticides tested, endosulfan 0.07% alone was significantly superior over rest of the treatments in controlling the larval population, reduction of pod damage and increasing the grain yield. The highest net ICBR was recorded in the treatment of fenvalerate 0.01% followed by monocrotophos 0.04%, endosulfan 0.035% + HaNPV 250 LE/he and fenvalerate 0.005% + HaNPV 250 LE/he and can be recommended for the management of the pest in chickpea crop.

Gupta and Deshraj (2003) studied on the extent of parasitism and seasonal activity of *Campopleis chloridae* Uchida, in chickpea ecosystem of lower hill of Himachal Pradesh in *rabi* season of 1997-99. The extent of parasitism by *C. chloridae* ranged from 4.5 to 32.0% and the fourth instars larvae were most frequently found killed by this parasitoid. The parasitoid remained active from the last week of March when the mean minimum temperature reached to 9.7 degrees to the 1st week of May. The activity of parasitoid ceased when the mean maximum temperature reached above 40 degrees. The activity of parasitoid exhibited significant positive and negative correlations with maximum temperature and relative humidity, respectively. Multiple regression analysis revealed that the mean minimum temperature strongly influenced the larval parasitism individually (53.7%) as well as in association with other abiotic factors to the extent of 75.6% relationship between larval density and K. - value (Killing power of parasitoid) reflected that parasitization was density dependent.

Shah and Shahzad (2005) conducted a field experiment on the population fluctuations with reference to different developmental stages of *Helicoverpa armigera*
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on chickpea and their relationship with the environment and observed that the pest population was low during 49th to 6th standard weeks but increased from 7th standard week onwards and declined again during 14th standard week. A positive correlation existed between the eggs, larval instars and over all density of H. armigera and the average maximum and minimum temperature. However, a negative correlation existed between the eggs, larval instars and overall density of H. armigera and the average morning percent relative humidity. The eggs, larval instar and over all density of this pest held no relationship with evening percent relative humidity.

Gupta et al (2006) worked out the relationship between moth activity and larval infestation of Helicoverpa armigera in chickpea to explore the possibility of predicting larval population in the field on the basis of moth catches. The earliest moth catch in pheromone trap was recorded in the 6th SW i.e. 2nd weak of February and the adult activity revealed three major peaks, first between 18-19 SW, second between 20-23 SW and third between 27-29 SW. These peaks of moth catch represent the three-generation of the pest over the year. Only first brood moths were responsible for inflicting damage in chickpea crop (27.0%). The moth catch in the (n-1) th week in pheromone traps best coincided with the larval infestation and coefficient of correlation (r) values between larval count in the nth week and pheromone catch data in the preceding (n-1) th week on chickpea (0.913) was significant indicating significant and positive correlation between larval population and moth catches.

Singh and Ali (2006) were carried out a field experiment on the seasonal incidence of H. armigera and C. chloridiae on chickpea CV K. 850 in Faizabad (U.P.) and he noticed the larval activity of H. armigera continued throughout the crop season with two peaks in both years (2000- 01and 2001-02), i.e. the first from 45 to 49 standard weeks and the second from 5 to 13 standard weeks. The highest mean larval populations of 6.3 and 6.4 larvae/m² were observed in 45 and 12 standard weeks, respectively. Minimum and Maximum temperature showed a positive correlation with both larval and adult population of H. armigera, while relative humidity showed a negative correlation. Maximum parasitization by C. chloridiae was observed 4 standard weeks. Parasitization declined from 44 to 50 standard weeks. Minimum and Maximum temperatures showed a negative correlation, and relative humidity a positive correlation, with parasitization.
Singh et al. (2006) conducted a field experiment at Sriganganagar, Rajasthan for the control of gram pod borer (H. armigera, Ha) Different modules of integrated pest management (IPM) comprising endosulfan at 0.75%, neem [Azadirachta indica] Oil at 0% Ha Nuclear polyhedrosis virus (Ha NPV) at 450 LE/ha and Bacillus thuringiensis at 1000 ml/ha were evaluated. Among the modules tested, the 3 sprays of endosulfan were found the most effective in controlling gram pod borer (6.83% Pod damage), resulting in the maximum grain yield (2489 kg/ha). This was followed by the module of neem oil Ha NPV-endosulfan (7.92% pod damage and 2267 kg/ha yield). The cost benefit ratio (CBR) varied from 0.17 to 6.97. The spray of neem oil and Ha NPV alternated with endosulfan was also found effective against the pest with a CBR of 1:2.92.

Visalakshmi et al. (2005) concluded that the application of neem effectively reduced the oviposition by H. armigera throughout the cropping period. The integration of various IPM components was found to be the best in reducing the pod damage (10.4%) with highest grain yield (1264.4 kg/ha) with 58.5% increase in yield over control (797.9 kg/ha). Among various IPM components, neem and Helicoverpa Nuclear polyhedrosis virus were as effective as endosulfan in reducing the larval population and pod damage. Endosulfan was found to be more harmful to the natural enemy population present in chickpea canopy. The highest cost-benefit ratio (1:3.01) was obtained in plots treated with IPM.

Probhuraj et al. (2003) evaluated the efficacy of Heterorhabditis sp. (200 IJ/ml). A local strain of Helicoverpa, Nuclear polyhedrosis virus (NPV at 250 LE/ha) and chilli + garlic + Kerosene extract (5%) on Helicoverpa armigera infesting Bengal gram (Cicer arietinum). Heterorhabditis was applied alone at vegetative, 50% Flowering and pod Formation Stages; at 50% flowering and pod formation; or at 50% flowering in combination with chlorpyrifos at 0.2% (at pod formation). The extracts were applied at a rate of 5% at 50% flowering and pod formation stages. NPV was applied at 50% flowering and pod formation. The lowest pod damage of 9.42% was obtained with the chemical insecticide, followed by Heterorhabditis applied twice and NPV, which showed 11.5 and 12.8%, respectively. The highest yield of 9.5 q/ha was obtained with the application of the nematode at 3 times, followed by the chemical spray at the flowering stage.
Singh and Devi (2004) carried out a study on three IPM modules consisting of application of endosulfan and monocrotophos applied twice at 0.5 kg a.i./ha along with an untreated control. They recorded the lowest larval population (2.80/m²) and pod damage (8.22%) with the highest seed yield (12.9 q/ha) and cost-benefit ratio (1:9.03), followed by the adoptive module (M2) involving the use of profenofos (1.0 kg a.i./ha), endosulfan (0.5 kg a.i./ha) and HaNPV (250 LE/ha), all applied once, and NSKE at 5.0%, applied twice, which had 3.90 larvae/m², 11.42% pod damage, 11.8-q seed yield/ha and 1:6.32 cost-benefit ratio. The bio-intensive module (M1) having no use of synthetic insecticide was significantly better than the untreated control but did not perform well compared to the other two modules (M2, M3).

Tomar et al. (2004) observed that the larval population d2 (upper critical limit) represent the economic threshold limits (ETL) when control measures become necessary. These ETL values are often first recorded at 50% flowering or pod initiation stage of the crop when the larval population caused a minimum yield loss. Government extension workers, decision makers, growers and private consultants can use the sequential sampling plan for effective timing of intervention points for IPM of H. armigera larvae in chickpea. Such an approach could prevent unnecessary environmental disturbances caused by excessive chemical treatments. Thus sequential sampling plans presented here help IPM professional to improve decision-making efforts. Spatial distribution patterns and sequential plans suited to pest densities in agro ecological zones should be worked out to improve IPM of H. armigera larvae in chickpea crop.