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Effect of HaNPV with Biopesticides and Chemical Insecticides on Egg Laying of *H. armigera* (Hubner) on Chickpea

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A B S T R A C T

The egg stage in some cases, the most vulnerable, it is probably the least studied in terms of its relative susceptibility. Indeed, in only the most obvious cases the attention been given to control programmes based on attacks in the egg stage. Quite aside from the question of control, the insect egg is of interest as a convenient unit for the study. The sequence of events in embryogenesis provides opportunities for studying the relationship between structure and function and the effect of toxicants on various biochemical systems. The present investigation on effect of HaNPV with biopesticides and chemical insecticides on egg laying of *H. armigera* (Hubner) on chickpea was carried out in Rabi 2014-2015 at PGI farm Dr. PDKV, Akola. It was found that the mean number of eggs laid by *H. armigera* on chickpea ranged from 0.03 to 0.13 eggs/plant after 3rd day of application whereas it reached to 0.00 to 0.05 eggs/plant after 14th day of application.

Introduction

Chickpea (*Cicer arietinum*) is one of the most widely cultivated pulse crops in India. 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. Insect pests are probably the main factor limiting the legume production. More than 150 species of insect pests are known to attack pulse crops in India. Of these, about 25 species cause serious damage to pulse crops grown during monsoon and winter (Bindra, 1968). Out of them, gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is a cosmopolitan, polyphagous and notorious pest which attacks numerous crops of agricultural importance and widely distributed in the tropics and sub-tropics. The low yield of chickpea is attributed to the regular outbreaks of pod borer, *H. armigera* which is considered as one of the major pests of chickpea. The insect feeds voraciously from seedling stage to maturity and causes about 50 to 60 per cent damage to the chickpea pods (Khare and Ujagir, 1977). In India, losses caused by *H. armigera* on chickpea and pigeonpea fields exceeded Rs.

12,000 million per year as per survey carried out by ICRISAT (Anonymous, 1996). Farmers of Asian countries in most cases solely depend on insecticides for the management of the pest. The *H. armigera* has developed resistance to all the major insecticide classes and it has become increasingly difficult to manage its population in India. This pest alone accounts for consumption of half of the total pesticides used in India for protection of different crops (Suryavanshi *et al.,* 2008). *Helicoverpa armigera* is a cosmopolitan, multivoltine and highly polyphagous pest which attacks a number of crops of agricultural importance all over the world. It is the endemic pest which damages chickpea from 20 to 100% (Vaishampayan, 1980).

As in other stages of insect life cycle, wide variations occur in the susceptibility of eggs of various species to a toxicant. Although the basis of differential susceptibility is of particular interest in designing selective control programmes, little attention has been given to this aspect. The susceptibility of egg to insecticide may change during its embryonic development and the relationship between the age of the egg and susceptibility may differ with both insecticide and the species (Salkeld and Potter, 1953). The eggs and first instar larvae of *H. armigera* are most important vulnerable stages within the easy reach of insecticides having potential ovicidal action (Vekaria and Vyas, 1985). This study is useful in determining suitability of host stage in life cycle of the pest, which contributes to the trend of population. It also determines the finite rate of increase which signifies the number of individuals added to the population per head per unit of time. Over-dependence of a particular group of chemicals is one of the important reasons for rapid development of resistance. Among the several avenues to overcome the insecticidal resistance problem, replacement with new molecules of insecticide is one of the important considerations. Therefore, it is necessary to evaluate the effect of HaNPV with biopesticides and chemical insecticides on egg laying of *H. armigera* (Hubner) on chickpea.

Materials and Methods

The present investigation was carried out at the Research Field of Department of Agril. Entomology, Post Graduate Institute, Dr.Panjabrao Deshmukh Krishi Vidyapeeth, Akola during Rabi 2014 -15. Field trial with chickpea variety JAKI 9218 was laid out in Randomized Block Design with twelve treatments (Table 1) replicated thrice. All the recommended agronomical practices were followed from time to time to raise the crop successfully as per recommendation of Dr. P.D.K.V. Akola. Two foliar sprays of HaNPV, botanical and insecticide and their combination with HaNPV were given at an interval of 15 days starting from 50% flowering stage of chickpea. The observations on egg laying of *H. armigera* were recorded on randomly selected five plants per plot from one meter row length of each row of net plot and represented into eggs/plant.

Results and Discussion

It is indicated from table 2 that data pertaining to mean number of eggs laid by *H.armigera* on chickpea at 3,7,10 and 14 DAS was found statistically significant.

3 days after spray

The treatment T_{10}- HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g/L was found to be significantly most effective in recording minimum eggs of *H. armigera* (0.03 eggs/plant) and it statistically at par with T_4 - emamectin benzoate 5 SG @ 0.3 g/ L (0.04 eggs/plant), T_{11} - HaNPV @ 500 LE/ha +

fenvalerate 20 EC @ 0.25 ml/L and T_8 - HaNPV @ 500 LE/ha + quinalphos 25 EC @ 1ml/L (0.05 eggs/plant) and superior to all other remaining treatment. The second best effective treatment T_4 - emamectin benzoate 5 SG @ 0.3 g/L (0.04 eggs/plant) was found to be statistically at par with $T_{11,}$ $T_{8,}$(0.05 eggs/plant), $T_{6,}$ $T_{9,}$ $T_{2,}$ (0.05 eggs/plant),T_5 and T_3 (0.05 eggs/plant). Significant maximum eggs of *H. armigera* was recorded in T_{12} - untreated control (0.13 eggs/plant).

7 days after spray

The treatment T_{10}- HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g/L was found to be significantly most effective in recording minimum eggs of *H. armigera* (0.03 eggs/plant) and it statistically at par with T_4 - emamectin benzoate 5 SG @ 0.3 g/ L (0.04 eggs/plant), T_{11} - HaNPV @ 500 LE/ha + fenvalerate 20 EC @ 0.25 ml/L and T_8 - HaNPV @ 500 LE/ha + quinalphos 25 EC @ 1ml/L (0.05 eggs/plant) and superior to all other remaining treatment. The second best effective treatment T_4 - emamectin benzoate 5 SG @ 0.3 g/L (0.04 eggs/plant) was found to be statistically at par with $T_{11,}$ $T_{8,}$ (0.05 eggs/plant), $T_{6,}$ $T_{9,}$ $T_{2,}$ (0.05 eggs/plant) ,T_5 and T_3 (0.05 eggs/plant). Significant maximum eggs of *H. armigera* was recorded in T_{12} - untreated control (0.13 eggs/plant).

10 days after spray

The treatment T_{10}- HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g/L, T_9 - HaNPV @ 500 LE/ha + emamectin benzoate 5 SG @ 0.15 g/ L and T_6 - Fenvalerate 20 EC @ 0.5 ml/L, were found to be significantly most effective in recording minimum egg laying of *H. armigera* (0.01 eggs/plant) and statistically at par with T_5 - Flubendiamide 20 WG @ 0.5 g/L (0.01 eggs/plant), T_4 - emamectin benzoate 5 SG @ 0.3 g/L, T_{11} - HaNPV @ 500 LE/ha + fenvalerate 20 EC @ 0.25 ml/L and T_8 - HaNPV @ 500 LE/ha + quinalphos 25 EC @ 1ml/L (0.02 eggs/plant) and superior to all other remaining treatments. Significantly maximum eggs laying of *H. armigera* was recorded in T_{12} - untreated control (0.07 eggs/plant) which in turn was found statistically at par with T_3 (0.06 eggs/plant) (Fig. 1).

Table.1 Details of microbial insecticide, biopesticide and chemical insecticides used in the experiment

Tr. No.	Treatment	Dose
T_1	HaNPV $1x10^9$ POB/ml	500 LE/ha
T_2	Azadirachtin 10,000 ppm	1 ml/L
T_3	Quinalphos 25 EC	2 ml/L
T_4	Emamectin benzoate 5 SG	0.3 g/L
T_5	Flubendiamide 20 WG	0.5 g/ L
T_6	Fenvalerate 20 EC	0.5 ml/L
T_7	HaNPV $1x10^9$ POB/ml + Azadirachtin 10,000 ppm	500 LE/ha + 0.5 ml/L
T_8	HaNPV $1x10^9$ POB/ml + Quinalphos 25 EC	500 LE/ha + 1ml/L
T_9	HaNPV $1x10^9$ POB/ml + Emamectin benzoate 5 SG	500 LE/ha + 0.15 g/L
T_{10}	HaNPV $1x10^9$ POB/ml + Flubendiamide 20 WG	500 LE/ha + 0.25 g/L
T_{11}	HaNPV $1x10^9$ POB/ml + Fenvalerate 20 EC	500 LE/ha + 0.25 ml/L
T_{12}	Untreated control	-

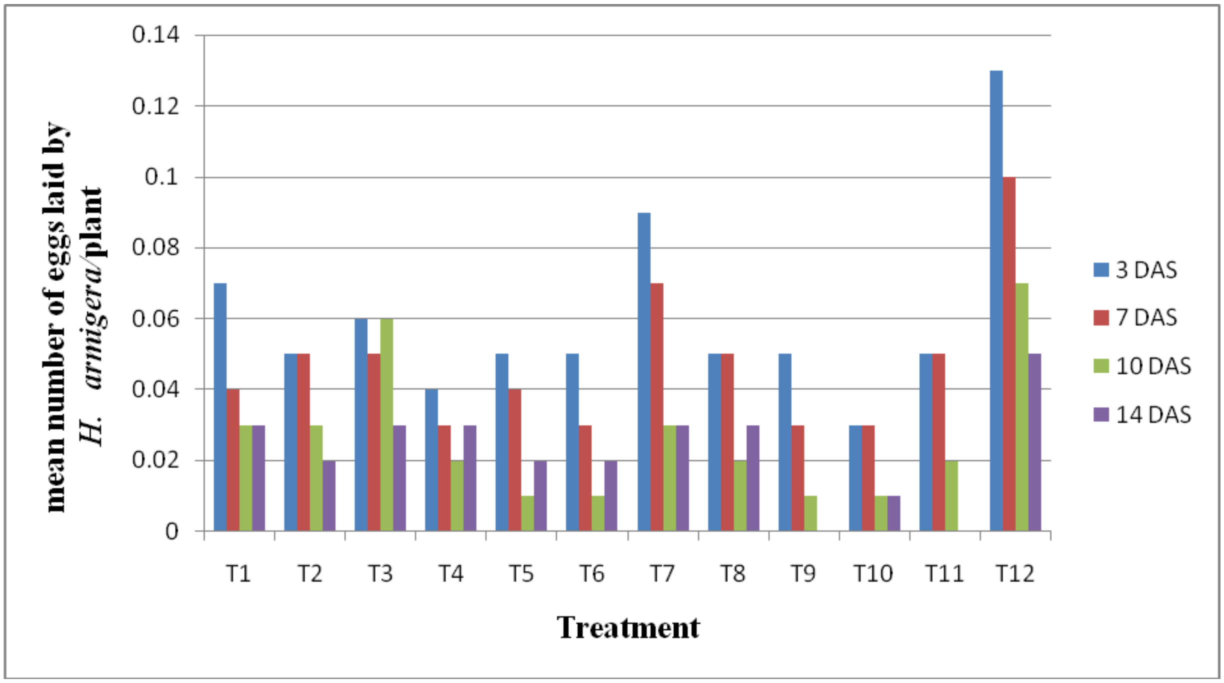
Table.2 Effect of HaNPV with biopesticides and chemical insecticides on mean number of eggs laid by *H. armigera* on chickpea based on average of two sprays

Treatment	Mean number of eggs/plant			
	3 DAS	7 DAS	10 DAS	14 DAS
T_1 - HaNPV 1x10^9 POB/ml @ 500 LE/ha	0.07 (0.27)*	0.04 (0.21)*	0.03 (0.16)*	0.03 (0.73)**
T_2 - Azadirachtin 10,000 ppm @1ml/L	0.05 (0.22)	0.05 (0.22)	0.03 (0.18)	0.02 (0.72)
T_3 - Quinalphos 25 EC @ 2 ml/L	0.06 (0.24)	0.05 (0.22)	0.06 (0.24)	0.03 (0.73)
T_4 - Emamectin benzoate 5 SG @ 0.3 g/L	0.04 (0.20)	0.03 (0.18)	0.02 (0.12)	0.03 (0.73)
T_5 - Flubendiamide 20 WG @ 0.5 g/L	0.05 (0.23)	0.04 (0.19)	0.01 (0.11)	0.02(0.72)
T_6 - Fenvalerate 20 EC @ 0.5 ml/L	0.05 (0.22)	0.03 (0.18)	0.01 (0.10)	0.02 (0.72)
T_7 - HaNPV 1x10^9 POB/ml @ 500 LE/ha + Azadirachtin 10,000 ppm @ 0.5 ml/L	0.09 (0.29)	0.07 (0.26)	0.03 (0.18)	0.03 (0.73)
T_8 - HaNPV 1x10^9 POB/ml @ 500 LE/ha + Quinalphos 25 EC @ 1ml/L	0.05 (0.21)	0.05 (0.22)	0.02 (0.15)	0.03 (0.73)
T_9 - HaNPV 1x10^9 POB/ml @ 500 LE/ha + Emamectin benzoate 5 SG @ 0.15 g/L	0.05 (0.22)	0.03 (0.18)	0.01 (0.10)	0.00 (0.71)
T_{10} - HaNPV 1x10^9 POB/ml @ 500 LE/ ha + flubendiamide 20 WG @ 0.25 g/L	0.03 (0.17)	0.03 (0.16)	0.01 (0.10)	0.01 (0.71)
T_{11}- HaNPV 1x10^9 POB/ml @ 500 LE/ha + fenvalerate 20 EC @ 0.25 ml/L	0.05 (0.21)	0.05 (0.22)	0.02 (0.15)	0.00 (0.71)
T_{12} - Untreated Control	0.13 (0.36)	0.10 (0.32)	0.07 (0.26)	0.05(0.74)
'F' test	Sig.	Sig.	Sig.	Sig.
S.E.(m) ±	0.02	0.008	0.02	0.003
C.D. at 5%	0.05	0.02	0.05	0.01
CV %	11.33	6.59	17.96	0.65

Note: *Figures in parenthesis are square root transformed values,

** Figures in parenthesis indicates $\sqrt{x + 0.5}$ transformed value, DAS- Days after spraying

Fig.1 Mean number of eggs laid by *H. armigera* on chickpea/plant based on average of two sprays



14 days after spray

The treatment T_{10}- HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g/L, T_{11} - HaNPV @ 500 LE/ha + fenvalerate 20 EC @ 0.25 ml/L and T_9 - HaNPV @ 500 LE/ha + emamectin benzoate 5 SG @ 0.15 g/L were found to be significantly most effective in recording zero eggs laying of *H. armigera* and statistically at par with, T_6 - fenvalerate 20 EC @ 0.5 ml/L, T_5 - flubendiamide 20 WG @ 0.5 g/L and T_2 - Azadirachtin 10,000 ppm @1ml/L (0.02 eggs/plant) and superior to $T_{8,}$ T_7 T_4 T_3 T_1 T_{12}. Significantly maximum egg laying of *H. armigera* was recorded in T_{12} - untreated control (0.05 eggs/plant) which in turn was found statistically at par with $T_{1,}$ $T_{3,}$ $T_{4,}$ T_7 and $T_{8.}$

From the above findings it is clear that treatment T_{10}- HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g/L, T_{11} - HaNPV @ 500 LE/ha + fenvalerate 20 EC @ 0.25 ml/L, T_9 - HaNPV @ 500 LE/ha + emamectin benzoate 5 SG @ 0.15 g/L, T_6 - fenvalerate 20 EC @ 0.5 ml/L, T_5 - flubendiamide 20 WG @ 0.5 g/L and T_2 - Azadirachtin 10,000 ppm @1ml/L are effective in minimizing the number of eggs/plant.

However there was a meager eggs laying of *H.armigera* in various all the treatments. Effect of HaNPV with biopesticides and chemical insecticides on egg laying of *H. armigera* (Hubner) on chickpea could not be compared for want of literature. Whereas, Patel and Patel (1989) evaluated toxicity of synthetic pyrethroids, organophoshates and cyclodiene insecticides against the eggs of H. armigera. Fenvalerate (0.02%) and quinalphos (0.05%) recorded cent per cent mortality of the eggs and the least mortality of eggs (45.02%) was observed with endosulfan (0.07%). Babar *et al.,* (2012) reported that among ten insecticides tested for ovicidal action against *H. armigera* eggs, flubendiamide @ 0.01% recorded highest egg mortality of 77.75 per cent followed by thiodicarb @ 0.075% (74.27%), rynaxypyr @ 0.006% (68.89%), novaluron @ 0.01% (66.32%), emamectin benzoate @ 0.0025% (64.63%), lufenuron @ 0.005% (58.61%), indoxacarb @ 0.015% (49.93%), spinosad @ 0.025% (45.72%) and endosulfan @ 0.07% (40.59%).

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