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MN Kakad
Student, Deptt. of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Krishi Nagar Akola, Maharashtra, India

Sumedha J Shejulpatil
Student, Deptt. of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Krishi Nagar Akola, Maharashtra, India

AY Thakare
Associate Prof, Deptt. of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Krishi Nagar Akola, Maharashtra, India

Correspondence
Sumedha J Shejulpatil
Student, Deptt. of Department of Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Krishi Nagar Akola, Maharashtra, India

Effect of HaNPV in combination with insecticides against *Helicoverpa armigera* (Hubner) in chickpea

MN Kakad, Sumedha J Shejulpatil and AY Thakare

Abstract
To evaluate the effect of HaNPV in combination with insecticides against *Helicoverpa armigera* (Hubner) in chickpea this experiment was conducted, on the field of Department of Entomology Dr. PDKV, Akola during *Rabi* 2014-15. Treatments in combination HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g/L and HaNPV @ 500 LE/ ha + fenvalerate 20 EC @ 0.25 ml/L found significantly effective in minimizing larval population of *H. armigera.*

Keywords: HaNPV, *H. armigera,* combination, chickpea

Introduction
Chickpea (*Cicer arietinum* L.) is a cool season legume crop and is grown in several countries worldwide as a food source. Seed is the main edible part of the plant and is a rich source of protein, carbohydrates and minerals especially for the vegetarian population. It is also known as Bengal gram or Gram, channa, garbanzo, egyptian pea etc. Chickpea occupies about 38 per cent of area under pulses and contributes about 50 per cent of the total pulse production of India so it is called as “King of pulses". Chickpea is the third most important food legume grown globally and India is the largest producer contributing to 65% of world’s chickpea production. The productivity of chickpea crop has not witnessed any significant jump as compared to the cereal crops, because of several biotic and abiotic constraints. In India, nearly 57 species of insect and other arthropods attacked on chickpea crop (Lal, 1992) [7]. Among them, pod borer *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is most important and causes more damage to chickpea crop.

Helicoverpa armigera is an insatiable feeder on chickpea plant. It infests the crop at the seedling stage and continues to devour flowers, pods and developing seeds until crop maturity (Reed *et al*., 1987) [9]. The larvae prefer nitrogen rich plant parts such as flowers and pods (Fitt, 1989) [4]. A single larva can damages several pods per day causes severe losses in crop yield (Patankar *et al*., 1999) [8]. It is very serious polyphagous pest and has assumed the status of ‘National Pest’ in India. In chickpea the yield loss due to this pest was reported as 10-60 per cent in normal weather conditions (Srivastava, 2003) [12], while in the states where frequent rains and cloudy weather are prevailing during the crop season that is in favorable weather conditions it was 50-100 per cent (Rheenen, 1991) [10]. Eventhough after heavy pesticide application H. armigera alone is responsible for annually Rs. 35000 million or more losses in India (Kumar and Kapur, 2003) [6] due to its high fecundity, migratory behaviour, high adoption of various agroclimatic conditions and resistance development to various insecticides. It causes damage to wide range of food, fiber, oil and fodder crops as well as on many wild plants and perennial horticultural crops.

Now a day there is a practice amongst farmers to mixed three to four chemical together for management of pest and disease, without knowing their phytotoxic effects on the crop. Due to this reason, farmers have to face many problems for crop growth, nutritive quality and yield deterioration and also improper management of insect. Combining in two or three insecticide or chemical could be more effective if they acted synergistically but more harmful when acted antagonistically.

Hence in order to know the a compatibility of HaNPV with insecticide and biopesticide, to test their synergistic or antogonstics action against the pest and its effect on crop, the present investigation will be undertaken to study the efficacy of HaNPV alone and in combination with insecticide and biopesticide against *Helicoverpa armigera* in chick pea.

Materials and Methods

The experiment was laid out in randomized block design (RBD) with twelve treatments (Table 1) replicated thrice on the field of Department of Entomology Dr. PDKV, Akola during *Rabi* 2014-15. The seeds of chickpea variety JAKI-9218 was provided by Department of Entomology, Dr. PDKV, Akola. The seeds of JAKI-9218 were sown at a spacing of 30 x 10 cm and each gross plot size was 4.2 m × 2.1 m. The plants were raised as per the recommended package of practices except plant protection measures. 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. Quantity of spray fluid required per plot was calculated by spraying untreated control plot with water. The spray volume used per ha was 500 liter. While applying HaNPV adjuvents like blue nil was used @ 0.1 ml/L.

The observations on larval population of *H. armigera* were recorded on randomly five selected spots per plot from one meter row length of each row of net plot. Pre-treatment count was recorded 24 hrs. before application of each spray and at 3, 7, 10 and 14 days after every spray for evaluate effect of HaNPV and insecticide alone and combination against larval population and in observations on mortality was recorded.

Table 1: Details of insecticides used in the experiment

Tr. No.	Treatment	Dose
T1	HaNPV 1x10^9 POB/ml	500 LE / ha
T2	Azadirachtin 10,000 ppm	1 ml / L
T3	Quinalphos 25 EC	2 ml / L
T4	Emamectin benzoate 5 SG	0.3 g/ L
T5	Flubendiamide 20 WG	0.5 g / L
T6	Fenvalerate 20 EC	0.5 ml / L
T7	HaNPV 1x10^9 POB/ml + Azadirachtin 10,000 ppm	500 LE / ha + 0.5 ml / L
T8	HaNPV 1x10^9 POB/ml + Quinalphos 25 EC	500 LE / ha + 1ml / L
T9	HaNPV 1x10^9 POB/ml + Emamectin benzoate 5 SG	500 LE / ha + 0.15 g/ L
T10	HaNPV 1x10^9 POB/ml + Flubendiamide 20 WG	500 LE / ha + 0.25 g / L
T11	HaNPV 1x10^9 POB/ml + Fenvalerate 20 EC	500 LE / ha + 0.25 ml / L
T12	Untreated control	-

Results

The effect of HaNPV alone and in combination with insecticides against *H. armigera* in chickpea was tested under field conditions. The cumulative mean larval population of *H. armigera* on chickpea based on average of two sprays recorded at 3, 7, 10, and 14 days after application of treatments (Table 2, Figure 1). The results were found to be statistically significant at every observation days. All the treatments were found significantly superior by giving higher mortality of *Helicoverpa* larvae to the control. The data recorded 3rd days after spray of 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_4 - emamectin benzoate 5 SG @ 0.3 g/L were found significantly most effective in order of merit in recording minimum larval population of *H. armigera* (0.40, 0.40 and 0.60 larva/meter row length) respectively as compared to 1.77 lv/mrl in untreated control.

Table 2: Effect of HaNPV with insecticides on cumulative mean larval population of *H. armigera* per meter row length on chickpea based on average of two sprays

Treatment	3 DAS	7 DAS	10DAS	14DAS
T_1 - HaNPV 1x10^9 POB/ml @ 500 LE/ha	1.27(1.13)*	1.37(1.17)*	1.20(1.09)*	0.70(0.84)*
T_2 - Azadirachtin 10,000 ppm @ 1ml/L	0.87(0.93)	1.50(1.22)	1.20(1.09)	0.70(0.84)
T_3 - Quinalphos 25 EC @ 2 ml/L	1.10(1.05)	0.93(0.96)	0.83(0.91)	0.63(0.80)
T_4 - Emamectin benzoate 5 SG @ 0.3 g/L	0.60(0.77)	0.50(0.70)	0.77(0.87)	0.40(0.63)
T_5 - Flubendiamide 20 WG @ 0.5 g/L	0.90(0.95)	0.47(0.68)	0.67(0.82)	0.37(0.60)
T_6 - Fenvalerate 20 EC @ 0.5 ml/L	1.00(1.00)	0.87(0.92)	0.70(0.84)	0.43(0.66)
T_7 - HaNPV 1x10^9 POB/ml @ 500 LE/ha + Azadirachtin 10,000 ppm @ 0.5 ml/L	0.87(0.92)	1.03(1.02)	1.03(1.01)	0.60(0.77)
T_8 - HaNPV 1x10^9 POB/ml @ 500 LE/ha + Quinalphos 25 EC @ 1ml/L	0.70(0.84)	1.00(1.00)	1.07(1.03)	0.57(0.75)
T_9 - HaNPV 1x10^9 POB/ml @ 500 LE/ha + Emamectin benzoate 5 SG @0.15 g/L	0.80(0.89)	0.87(0.92)	0.67(0.82)	0.47(0.68)
T_{10} - HaNPV 1x10^9 POB/ml @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g /L	0.40(0.63)	0.37(0.60)	0.40(0.61)	0.30(0.53)
T_{11} - HaNPV 1x10^9 POB/ml @ 500 LE/ha + fenvalerate 20 EC @ 0.25 ml/L	0.40(0.63)	0.53(0.72)	0.43(0.63)	0.33(0.58)
T_{12} - Untreated Control	1.77(1.33)	1.73(1.32)	1.60(1.26)	1.47(1.21)
'F' test	Sig.	Sig.	Sig.	Sig.
S.E.(m) ±	0.06	0.05	0.06	0.04
C.D. at 5%	0.17	0.16	0.17	0.12
CV %	11.25	10.27	10.87	9.63

N.B.- *Figures in parenthesis are square root transformed values,
DAS – Days after spraying

While the treatment T_{10}- HaNPV @ 500 LE/ ha + flubendiamide 20 WG @ 0.25 g /L, T_5 -flubendiamide 20WG @ 0.5 g /L, T_4 - emamectin benzoate 5 SG @ 0.3 g/ L and T_{11} - HaNPV @ 500 LE/ ha + fenvalerate 20 EC @ 0.25 ml/L were found significantly most effective in recording minimum larval population of *H. armigera* (0.37, 0.47, 0.50 and 0.53 lv/mrl) respectively as compared to 1.73 lv/mrl in untreated control at 7th days after spray. However treatment T_{10}- HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g / L and T_{11} - HaNPV @ 500 LE/ ha + fenvalerate 20 EC @ 0.25 ml/L were found significantly effective at 10th day after spray in keeping larval population of *H. armigera* of lowest level

(0.40 and 0.43 lv/mrl) respectively as compared to 1.60 lv/mrl in untreated control and 14th 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, T_5 -flubendiamide 20WG @ 0.5 g/L and T_4 - emamectin benzoate 5 SG @ 0.3 g/L were found significantly effective in keeping larval population of *H. armigera* at minimum level (0.30, 0.33, 0.37 and 0.40 lv/mrl) respectively as compared to 1.47 lv/mrl in untreated control.

Discussion

The result of the present investigation are in similar line with the findings of Bhatt and Patel (2002) [2] who reported the effectiveness of fenvalerate 0.005% + HaNPV 250 LE/ha for controlling larval population of *H. armigera* on chickpea. The present findings were also supported by Sirvi *et al*. (2013) [11]. Above result regarding efficacy of flubendiamide 20WG @ 0.5 g /L are agreement with Baber *et al.*, (2012) [1] who reported that flubendiamide 0.01% recording highest reduction in larval population of *H. armigera* in chickpea. Similar result were obtained by Dodia *et al.* (2009) [3] who reported efficacy of flubendiamide 20 WDG at 50 g a.i. ha-1 when sprayed against *H. armigera* infesting pigeonpea. As regards the efficacy of emamectin benzoate 5 SG @ 0.3 g/ L present finding are in confirmation with Kambrekar *et al.* (2012) [5] who reported emamectin benzoate 5 % SG @ 13 g a.i/ha resulted in maximum larval reduction of *H. armigera* lesser pod damage and higher grain yield of chickpea which was followed by the same insecticide @ 11 g a.i/ha without any adverse effects of different dosages on the three natural enemies and no phytotoxic effects on chickpea crop.

Conclusion

From the above data it is concluded that the treatments in combination HaNPV @ 500 LE/ha + flubendiamide 20 WG @ 0.25 g/L, HaNPV @ 500 LE/ ha + fenvalerate 20 EC @ 0.25 ml/L, emamectin benzoate 5 SG @ 0.3 g/L and flubendiamide 20WG @ 0.5 g /L found significantly effective in minimizing larval population of *H. armigera*.

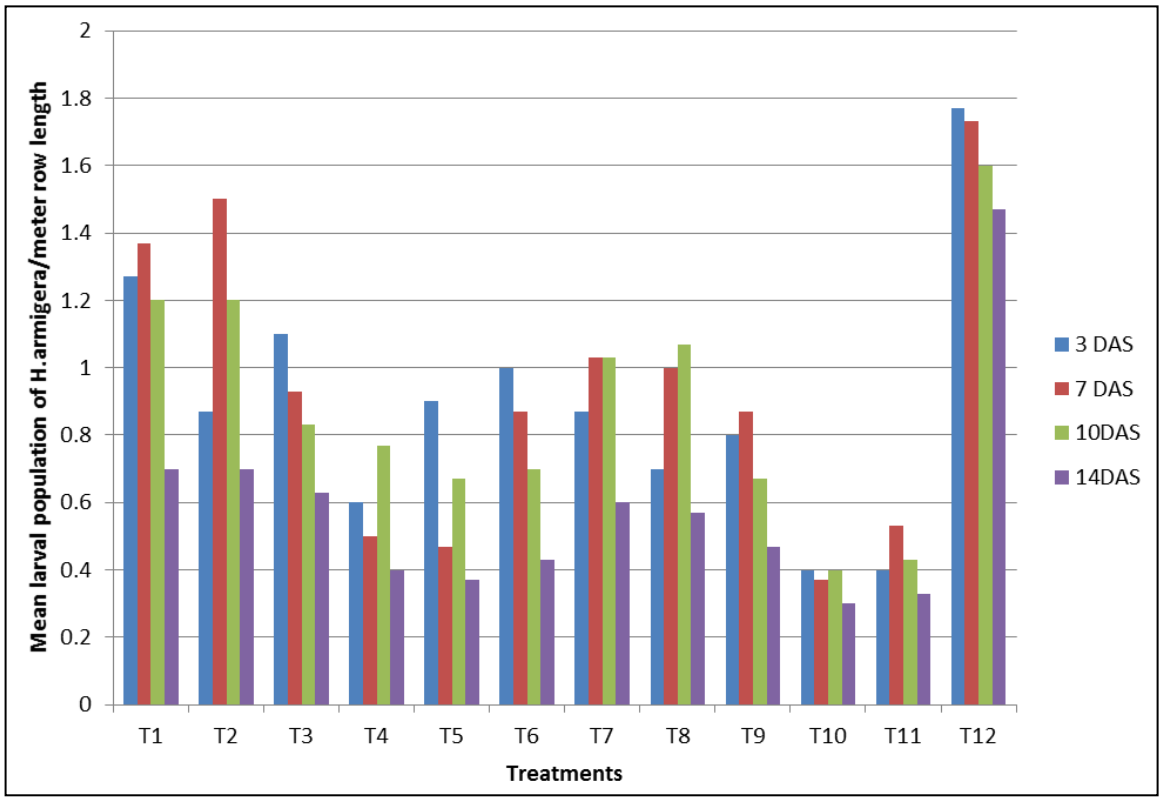

Fig 1: Effect of HaNPV with insecticides on cumulative mean larval population of *H. armigera* on chickpea based on average of two sprays**.**

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