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# EVALUATION OF DIFFERENT SPRAY SCHEDULES FOR THE EFFECTIVE MANAGEMENT OF *HELICOVERPA ARMIGERA* (HUBNER) ON CHICKPEA

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Field experiments were conducted to evaluate the bioefficacy of various spray schedules for the management of gram pod borer, *Helicoverpa armigera* (Hb.) on chickpea during two consecutive seasons (*rabi* 2001-02 and 2002-03) at the farm of JNKVV, Jabalpur (M.P.). The treatments HaNPV 0.43% AS, *Bacillus thuringiensis* kurstaki 5% WP, Endosulfan 35% EC and Neem Seed Kernel Extract 2% were applied on the crop alone and in different combinations thrice at 15 days interval using knapsack sprayer fitted with hollow cone nozzle. The larval population was recorded after 3, 7 and 10 days of each spray while pod damage and seed yield at harvest. The results showed that treatments $T_7$ (three applications of endosulfan 35% EC @ 1 lit/ha), $T_5$ (one application each of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha, *B. thuringienses* kurstaki 5% WP @ 1 kg/ha and endosulfan 35% EC @ 1 lit/ha) and $T_4$ (one application of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha followed by two applications of endosulfan 35% EC @ 1 lit/ha) were effective for controlling the gram pod borer larval population, reducing the pod damage and ultimately increasing the chickpea seed yield. Keeping in view the chemical pesticides load in the environment the use of endosulfan alone needs to be discouraged.

**Key words :** *Helicoverpa armigera*, chickpea, management, biopesticides.

## INTRODUCTION

Amongst pulses Chickpea (*Cicer arietinum* L.) commonly known as gram, Bengal gram or *chana* is an important pulse crop of India. It is a rich source of protein, carbohydrate, calcium, iron and niacin (Gopalan *et al.*, 1992). Though it is a poor's favourite crop, the dishes prepared from it in one or the other form ever find a place on the dining table of riches as well. It is predominantly grown under rainfed conditions and often on barren lands since it requires minimum input for cultivation. It harbours a number of insects, but gram pod borer, *Helicoverpa armigera* is the pest, which causes a great economical loss to the grower. Many insecticides have been recommended under the Insecticides Act, 1968 to control the pest. But they are not safer to use on gram, which is the only pulse consumed at all growth stages starting from green leaves to dry grains. They may also be toxic to the natural enemies associated with the crop ecosystem. On the other hand microbial and plant origin biopesticides, though slow acting, are safer and environment friendly. Hence, it is the need of the hour to find out the safer and effective way of pest control with the intermittent use of biological and chemical insecticides. Although literature is available on the use of chemical and biological insecticides against *H. armigera,* the present study was aimed to evaluate different spray schedules of biological and chemical insecticides for the effective management of *H. armigera* on chickpea under the agro-ecological conditions of Jabalpur region.

## MATERIALS AND METHODS

Field experiments were conducted in randomized block design at Live-stock farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) for two consecutive seasons during *rabi* 2001-02 and 2002-03. Chickpea variety JG 315 was sown @ 100 kg seed/ha in the last week of October during both the seasons in plots measuring 4 x 5 m. A distance of 1 m, 30 cm and 10 cm was maintained between plots, rows and plants, respectively. The seeds were uniformly treated with rhizobium culture and carbendazim 50% WP @ 2 g/kg seed before sowing for better germination and growth. The fertilizers were applied @ 20 N: 80 P: 20 K (urea and single super phosphate) at the time of sowing and crop irrigated twice at sowing and one month thereafter. Manual weeding was done during vegetative phase of the crop growth.

The treatments HaNPV 0.43% AS [M/s Pest Control (India) Ltd., Bangalore], *Bacillus thuringiensis* kurstaki 5% WP (M/s Wockhardt Limited, Mumbai), Endosulfan 35% EC [E.I.D. Parry (India) Limited, Chennai] and Neem Seed Kernel Extract 2% (Neem seed kernel purchased from the local market and extracted in the Entomology Deptt.) were applied on the crop alone and in different combinations (Table I) on the appearance of the pest. Spraying was done thrice at 15 days interval by knapsack sprayer fitted with hollow cone nozzle using spray fluid @ 500 lit/ha. The larval population of *H. armigera* was recorded before first spray and after 3, 7 and 10 days of each spray in an area of 50 cm x 50 cm and at 5 places per replication. Observation on pod damage was recorded based on randomly selected 500 pods per plot in the standing crop before harvest. Yield per plot was recorded once at harvest and expressed as q/ha.

**Table I :** Treatment and spray schedule details.

| Treatment | | Formulation dose/ha | Number of Spray | | |
|---|---|---|---|---|---|
| | | | First | Second | Third |
| $T_1$ | HaNPV 0.43% AS | 1.5 lit (250 LE) | ✓ | ✓ | ✓ |
| $T_2$ | *B. thuringiensis* kurstaki 5% WP | 1 kg | ✓ | ✓ | ✓ |
| $T_3$ | HaNPV 0.43% AS + NSKE 2% | 1.5 lit (250 LE) + 10 kg | ✓ | ✓ | ✓ |
| $T_4$ | HaNPV 0.43% AS | 1.5 lit (250 LE) | ✓ | | |
| | Endosulfan 35% EC | 1 lit | | ✓ | ✓ |
| $T_5$ | HaNPV 0.43% AS | 1.5 lit (250 LE) | ✓ | | |
| | *B. thuringiensis* kurstaki 5% WP | 1 kg | | ✓ | |
| | Endosulfan 35% EC | 1 lit | | | ✓ |
| $T_6$ | HaNPV 0.43% AS + *B. thuringiensis* kurstaki 5% WP | 0.75 lit (125 LE) + 0.5 kg | ✓ | ✓ | ✓ |
| $T_7$ | Endosulfan 35% EC | 1 lit | ✓ | ✓ | ✓ |
| $T_8$ | Control | - | | | |

**Table II :** Evaluation of different spray schedules for the management of *H. armigera* on chickpea.

| Treatment | | Formu-lation dose/ha | Larval population (mean of two seasons data) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pre-spray | First spray | | | Second spray | | | Third spray | | |
| | | | | 3 DAS | 7 DAS | 10 DAS | 3 DAS | 7 DAS | 10 DAS | 3 DAS | 7 DAS | 10 DAS |
| $T_1$ | HaNPV 0.43% AS | 1.5 lit (250 LE) | 10.83 (3.32) | 5.50 (2.22) | 7.17 (2.63) | 9.83 (3.12) | 6.17 (2.55) | 3.83 (2.03) | 6.33 (2.60) | 5.50 (2.40) | 4.83 (2.15) | 1.50 (1.39) |
| $T_2$ | *B. thuringiensis* kurstaki 5% WP | 1 kg | 11.50 (3.43) | 5.33 (2.34) | 7.00 (2.56) | 8.17 (2.87) | 5.83 (2.44) | 4.33 (2.17) | 9.67 (3.17) | 6.17 (2.56) | 5.00 (2.21) | 4.33 (2.14) |
| $T_3$ | HaNPV 0.43% AS + NSKE 2% | 1.5 lit (250 LE) + 10 kg | 10.17 (3.25) | 4.17 (2.10) | 4.83 (2.27) | 9.83 (3.09) | 10.33 (3.23) | 7.17 (2.73) | 6.00 (2.52) | 6.67 (2.65) | 3.17 (1.85) | 3.17 (1.91) |
| $T_4$ | HaNPV 0.43% AS and Endosulfan 35% EC | 1.5 lit (250 LE) & 1 lit | 12.00 (3.53) | 2.33 (1.68) | 4.17 (2.06) | 5.00 (2.33) | 4.00 (1.97) | 3.50 (1.96) | 4.33 (2.17) | 6.00 (2.52) | 6.33 (2.58) | 12.00 (3.51) |
| $T_5$ | HaNPV 0.43% AS, *B. thuringiensis* kurstaki 5% WP and Endosulfan 35% EC | 1.5 lit (250 LE), 1 kg & 1 lit | 12.50 (3.57) | 3.00 (1.84) | 4.17 (2.11) | 6.33 (2.61) | 2.00 (1.55) | 2.83 (1.80) | 5.83 (2.59) | 3.83 (2.07) | 5.50 (2.41) | 9.17 (3.07) |
| $T_6$ | HaNPV 0.43% AS + *B. thuringiensis* kurstaki 5% WP | 0.75 lit (125 LE) + 0.5 kg | 12.83 (3.62) | 3.83 (2.06) | 8.67 (2.87) | 10.50 (3.24) | 6.83 (2.63) | 5.83 (2.45) | 7.17 (2.75) | 4.67 (2.22) | 4.33 (2.09) | 10.83 (3.27) |
| $T_7$ | Endosulfan 35% EC | 1 lit | 12.00 (3.51) | 4.50 (2.16) | 5.33 (2.24) | 6.00 (2.50) | 4.50 (2.17) | 4.17 (2.09) | 9.33 (3.07) | 4.50 (2.18) | 4.00 (2.01) | 2.83 (1.80) |
| $T_8$ | Control | - | 11.83 (3.49) | 13.33 (3.41) | 22.67 (4.35) | 27.83 (5.21) | 18.33 (4.20) | 9.33 (2.99) | 19.67 (4.44) | 12.50 (3.52) | 5.17 (2.31) | 18.33 (4.31) |
| | SEM ± | | (0.29) | (0.41) | (0.40) | (0.32) | (0.33) | (0.29) | (0.30) | (0.30) | (0.33) | (0.29) |
| | C.D. 5% | | (NS) | (1.19) | (1.16) | (0.92) | (0.94) | (0.85) | (0.86) | (0.86) | (NS) | (0.83) |

## RESULTS AND DISCUSSION

The larval population recorded at different time intervals during both the seasons was pooled and mean data have been presented in Table II. It was observed that almost all the treatments were significantly more effective than control at each time interval except 7 days after second and third spray, where a sharp decline in the larval population in control plots was also recorded. Since the treatments ($T_1$ to $T_7$) were more or less equally effective at different time intervals, no set trend of their effectiveness was established. However, amongst treatments $T_7$ (three applications of endosulfan 35% EC @ 1 lit/ha), $T_5$ (one application each of HaNPV 0.43% AS 1.5 lit (250 LE)/ha, *B. thuringienses* kurstaki 5% WP @ 1 kg/ha and endosulfan 35% EC @ 1 lit/ha) and $T_4$ (one application of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha followed by two applications of endosulfan 35% EC @ 1 lit/ha) were more promising than others.

**Table III :** Per cent pod damage and seed yield.

| Treatment | | Formulation dose/ha | Per cent pod damage | Seed yield (q/ha) |
|---|---|---|---|---|
| $T_1$ | HaNPV 0.43% AS | 1.5 lit (250 LE) | 8.50 (16.48)* | 16.305 |
| $T_2$ | *B. thuringiensis* kurstaki 5% WP | 1 kg | 9.50 (17.81) | 14.649 |
| $T_3$ | HaNPV 0.43% AS + NSKE 2% | 1.5 lit (250 LE) + 10 kg | 10.03 (18.06) | 15.888 |
| $T_4$ | HaNPV 0.43% AS and Endosulfan 35% EC | 1.5 lit (250 LE) & 1 lit | 12.43 (20.60) | 18.915 |
| $T_5$ | HaNPV 0.43% AS, *B. thuringiensis* kurstaki 5% WP and Endosulfan 35% EC | 1.5 lit (250 LE), 1 kg & 1 lit | 12.70 (20.83) | 19.195 |
| $T_6$ | HaNPV 0.43% AS + *B. thuringiensis* kurstaki 5% WP | 0.75 lit (125 LE) + 0.5 kg | 10.07 (18.35) | 14.266 |
| $T_7$ | Endosulfan 35% EC | 1 lit | 9.43 (17.84) | 19.633 |
| $T_8$ | Control | – | 17.63 (24.76) | 14.963 |
| | SEM ± | | (1.07) | (1.17) |
| | C.D 5% | | (3.06) | (3.36) |

* Angular transformed values

The per cent pods damaged by the borer larvae and seed yield recorded during the two seasons were pooled and mean values have been presented in Table III. The result shows that per cent pods damaged in all the treatments were significantly low than untreated control. The seed yield was significantly more in the treatment $T_7$ (three applications of endosulfan 35% EC @ 1 lit/ha) followed by $T_5$ (one application each of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha, *B. thuringienses* kurstaki 5% WP @ 1 kg/ha and endosulfan 35% EC @ 1 lit/ha), $T_4$ (one application of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha followed by two applications of endosulfan 35% EC @ 1 lit/ha) and $T_1$ (three applications of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha). Similar to present studies, Jayraj *et al.* (1987) and Ahmad *et al.* (1999) have also reported application of HaNPV followed by insecticides to be effective against *H. armigera* in chickpea. Also

endosulfan alone has been reported to be more effective than NPV+endosulfan (Pawar *et al.*, 1987; Kumawat & Jheeba, 1999).

It was observed that there was no remarkable adverse effect of the application of various treatments on the activities of prevailing natural enemies and on the crop growth, hence non phytotoxic. Thus based on overall performance of the treatments, it may be concluded that treatments $T_7$ (three applications of endosulfan 35% EC @ 1 lit/ha), $T_5$ (one application each of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha, *B. thuringienses* kurstaki 5% WP @ 1 kg/ha and endosulfan 35% EC @ 1 lit/ha) and $T_4$ (one application of HaNPV 0.43% AS @ 1.5 lit (250 LE)/ha followed by two applications of endosulfan 35% EC @ 1 lit/ha) were effective for controlling the pod borer larval population, reducing the pod damage and ultimately increasing the chickpea seed yield.

Since parasitoid *Campoletis chlorideae* (Uchida) is a major larval parasitoid of *H. armigera* in chickpea agro-ecosystem, the use of chemical pesticides needs to be avoided during the activities of this parasitoid (Bohria & Shukla, 2006). Moreover keeping in view the chemical pesticides load in the environment the use of endosulfan alone needs to be discouraged.

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