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Evaluation of HaNPV against *Helicoverpa armigera* in chickpea

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Abstract

The research experiment was carried out at Insectary Field of Agril. Entomology Section, College of Agriculture, Nagpur during Rabi-2015 to evaluate the various HaNPV concentrations in combination with Neem and Quinolphos against *Helicoverpa armigera* on chickpea with nine treatments replicated thrice in Randomized Block Design. Results revealed that, treatment T_6- HaNPV @ 500 LE ha^{-1} + Quinolphos 25 EC @ 0.05 per cent was found most superior amongst all the treatments and recorded 0.22 L mrl^{-1} lowest larval population of *H. armigera* at 14 DAS of second spraying with minimum pod damage of 10.35 per cent and produced highest grain yield 18.30 q ha^{-1} of chickpea. Second best treatment was T_5- HaNPV 400 LE ha^{-1} + Neem seed extract 5 per cent and found at par with T_6. The maximum larval population (1.80 L mrl^{-1}) with highest pod damage (24.15%) and lowest grain yield (8.14 q ha^{-1}) was recorded in control. The highest Incremental Cost Benefit Ratio of 11.94 was recorded with the treatment T_8- Quinolphos 25 EC @ 0.05 per cent followed by T_7- Neem seed extract 5 per cent + Quinolphos 25 EC @ 0.05 per cent (9.94). Thus, there is possibility of alternating HaNPV with chemical insecticides for the effective management of pod borer *H. armigera* in chickpea.

Keywords: HaNPV, *Helicoverpa armigera*, chickpea

Introduction

Chickpea (*Cicer arientinum* L) also known as Bengal gram, Gram, Chana, Garbenza etc. is one of the most important pulse crop of India and is stated as “King of Pulses”. It is being the richest, cheapest and easiest source of best quality proteins, carbohydrates and fats. Among the many biotic factors responsible for low yield, damage due to insect pests is the major limiting factor. Chickpea crop is attacked by nearly 57 species of insect and other arthropods in India. Amongst them, pod borer *Helicoverpa armigera* (Hubner) is most important and its avoidable losses were estimated to be 63.64 per cent in the total damage caused by all the insect pests (Shinde *et al.* 2014) [12]. *H. armigera* is a cosmopolitan and polyphagous pest attacking on wide range of host and recorded to feed on 96 crops, 61 weeds and some wild species in India. Thus, the present study was carried out to evaluate the various concentrations of HaNPV in combination with Neem and Quinolphos against *H. armigera* on chickpea variety Jaki-9218.

Material and Methods

The research experiment was conducted at Insectary Field of Agril. Entomology Section, College of Agriculture, Nagpur, Maharashtra during Rabi-2015 with nine treatments replicated thrice in Randomized Block Design. Treatments comprised of T_1- HaNPV ($1x10^9$ POB ml^{-1}) 500 LE ha^{-1}, T_2- HaNPV ($1x10^9$ POB ml^{-1}) 400 LE ha^{-1}, T_3- Neem seed extract 5%, T_4- HaNPV ($1x10^9$ POB ml^{-1}) 500 LE ha^{-1} + Neem seed extract 5%, T_5- HaNPV ($1x10^9$ POB ml^{-1}) 400 LE ha^{-1} + Neem seed extract 5%, T_6- HaNPV ($1x10^9$ POB ml^{-1}) 500 LE ha^{-1} + Quinolphos 25 EC @ 0.05%, T_7- Neem seed extract 5% + Quinolphos 25 EC @ 0.05%, T_8- Quinolphos 25 EC @ 0.05%, T9- Control (Water spray). The chickpea cultivar Jaki-9218 was sown by dibbling method on 18th November, 2015. From the commercial solution, the quantity of the insecticide was worked out and used for spray. Fresh spray solution of Quinolphos 25 EC @ 0.05%, HaNPV ($1x10^9$ POB ml^{-1}) 400 LE ha^{-1}, 500 LE ha^{-1} was prepared at the time of application of spray and Neem seed extract 5% were prepared in separate containers day before the sowing. The first treatment spray was given when pest crossed ETL after emergence of crop. Second spray was given at an interval of 15 days. Average larval population of *Helicoverpa armigera* per meter row length was worked out and further calculations were done for working out per cent pod damage.

On the basis of prevailing cost of inputs, Incremental Cost Benefit Ratio (ICBR) was worked out. The data recorded in the various treatments were subjected to statistical analysis after suitable transformation by following standard procedures of Randomized Block Design experiment (Gomez and Gomez, 1984) [4].

Results and Discussion

The results were analyzed, presented in Table 1 & 2; Graph 1, 2, 3 and discussed below, Larval population of *H. armigera* at 14th days after first spray (Table 1).

The treatment T_6 was found to be significantly most effective with minimum larval population of *H. armigera* (0.65 L mrl^{-1}) and was statistically at par with T_7 (0.67 L mrl^{-1}) and followed by T_4 (1.06 L mrl^{-1}) which was also at par with T^5 (1.09 L mrl^{-1}), T_8 (1.10 L mrl^{-1}), T_1 (1.15 L mrl^{-1}), T_2 (1.21 L mrl^{-1}) and T_3 (1.28 L mrl^{-1}) except Control (3.27 L mrl^{-1}).

Larval population of *H. armigera* at 14th days after second spray (Table 1)

The treatment T_6 was found significantly effective in recording minimum larval population of *H. armigera* (0.22 L mrl^{-1}) and was statistically at par with T_7 (0.27 L mrl^{-1}) followed by T_8 (0.36 L mrl^{-1}); T_4 (0.53 L mrl^{-1}) at par with T_5 (0.58L mrl^{-1}), T_3 (0.70 L mrl^{-1}), T_1 (0.77 L mrl^{-1}) and T_2 (0.83 L mrl^{-1}). Significantly maximum larval population of *H. armigera* was recorded in Control (1.80 L mrl^{-1}). It is seen from the above results, treatment T_6 and T_7 found significantly effective in order of merit in keeping the larval population of *H. armigera* at lower level at 7th and 14th days after second spray. The findings are in line with the results of Munni *et al.* (2011) [8]. Allah Ditta Abid *et al.* (2020) [1] mixed HaNPV with two insecticides: spinetoram and emamectin benzoate in various combinations and applied to larvae of *H. armigera* in laboratory conditions and recorded that, there was synergistic effect of HaNPV @ 0.5×10^9 PIB ml^{-1} × Spinetoram @ 40, 20, 10 ml 100 L^{-1} of water. In case of emamectin benzoate, synergistic effects were recorded at 1×10^9 PIB ml^{-1} HaNPV × emamectin benzoate @ 100 ml 100 L^{-1} of water. However, 0.5×10^9 PIB/ ml^{-1} HaNPV has synergistic effects with all three doses of emamectin benzoate. Similarly, Reddy *et al.* (2010) reported maximum and highest larval reduction with NSKE 1.66% + HaNPV 250 LE ha^{-1} + Endosulphan 0.023% at 15 days interval in chickpea. Whereas, Gowda and Yelshetty (2007) [5] evaluated the different emulsifiable concentrations and dusts in rainfed chickpea ecosystem against *H. armigera* and recorded that, Chloropyriphos 20 EC @ 250 g a.i. ha^{-1}, Quinolphos 1.5 D @ 375 g a.i. ha^{-1} and Malathion 5D @ 1250 g a.i. ha^{-1} emerged as superior treatments resulting per cent larval reduction over initial population, a day after treatment.

Per cent pod damage at harvest (Table 1 & Graph 1)

The treatment T_6 was found significantly most effective in recording minimum pod damage (10.35%) and was found superior over all other treatments whereas, the next effective treatment was T_7 (10.70%). The remaining treatment in descending order of effectiveness were T_4 recorded comparatively minimum pod damage (15.85%) followed by T_5 (16.04%), T_8 (16.10%), T_1 (18.10%), T_2 (19.75%) and T_3 (19.88%). Significantly maximum pod damage was recorded in Control (24.15%). Babar *et al.* (2012) and Patil *et al.* (2007) reported minimum pod damage on chickpea and are in line with present results.

Grain yield (Table 1 & Graph 2)

Treatment T_6 found most effective in recording highest yield of chickpea (18.13 q ha^{-1}) and was at par with T_7 (17.30 q ha^{-1}). The second best effective treatment was T_4 (13.80 q ha^{-1}) and at par with T_5 (13.10 q ha^{-1}), T_8 (13.00 q ha^{-1}), T_1 (12.90 q ha^{-1}), T_2 (12.40 q ha^{-1}) and T_3 (12.05 q ha^{-1}) whereas, lowest yield of 8.14 q ha^{-1} was recorded in Control. Similar findings were also reported by Yadav *et al.* (2007) [13] and Bhalkare *et al.* (2007) [3]. Singh *et al.* (2013) [11] and Lingappa *et al.* (2000) [7] also studied the efficacy of insecticides and bio-pesticides against *H. armigera* on chickpea with maximum yield.

Economics (Table 2 & Graph 3)

On the basis of cost of inputs and market selling price of chickpea cultivar Jaki-9218, the ICBR was worked out to interpret the economics of different treatments. the treatment T_8- Quinolphos 25 EC @ 0.05% was the most economically viable treatment recorded highest ICBR of 1:11.94 due to its low cost of application which stood first rank amongst all the treatments followed by T_7 (1: 9.94) stood second rank and T_6 (1:5.73) third rank as compared to other treatments. The lowest ICBR of 1:2.14 was recorded in T_5 and T_4 (1:2.05) ranks seventh and eighth, respectively. Similar findings were reported by Bhalkare *et al.* (2007) [3]. Gupta (2007) [6] reported that, maximum net profit obtained from Quinolphos 25 EC @ 0.05% (Rs. 10470 ha^{-1}) against H. armigers in chickpea which is in tune with the present study.

Table 1: Effect of various treatments on larval population of *H. armigera* after first and second spray, per cent pod damage and grain yield of chickpea

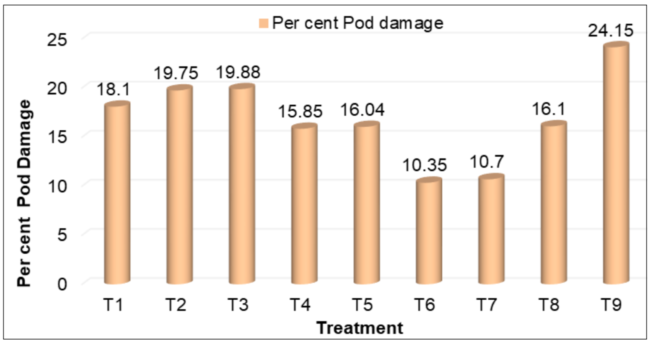
Tt.	Treatment Details	Larval Pre-treatment count*	Larval Population at First Spray*		Larval Population at Second Spray*		Per cent Pod Damage#	Gain Yield (q ha^{-1})
			7 DAS	14 DAS	7 DAS	14 DAS		
T_1	HaNPV 500 LE ha^{-1}	3.73(1.93)	2.41(1.55)	1.15(1.07)	0.95(0.97)	0.77(0.87)	18.10(4.25)	12.90
T_2	HaNPV 400 LE ha^{-1}	2.53(1.59)	2.50(1.58)	1.21(1.10)	0.96(0.97)	0.83(0.91)	19.75(4.44)	12.40
T3	Neem Seed Extract 5%	3.85(1.96)	2.51(1.58)	1.28(1.13)	0.98(0.98)	0.70(0.83)	19.88(4.46)	12.05
T_4	HaNPV 500 LE ha^{-1} + Neem Seed Extract 5%	3.00(1.72)	1.50(1.22)	1.06(1.03)	0.88(0.93)	0.53(0.72)	15.85(3.94)	13.80
T_5	HaNPV 400 LE ha^{-1} + Neem Seed Extract 5%	3.13(1.77)	1.73(1.31)	1.09(1.04)	0.90(0.94)	0.58(0.76)	16.04(4.00)	13.10
T_6	HaNPV 500 LE ha^{-1} + Quinolphos 25 EC @ 0.5%	2.64(1.62)	0.96(0.97)	0.65(0.80)	0.47(0.68)	0.22(0.46)	10.35(3.22)	18.13
T_7	Neem Seed Extract 5%+ Quinolphos 25 EC @ 0.5%	2.87(1.69)	0.98(0.98)	0.67(0.81)	0.53(0.73)	0.27(0.51)	10.70(3.27)	17.30
T_8	Quinolphos 25 EC @ 0.5%	3.27(1.80)	1.75(1.32)	1.10(1.04)	0.94(0.96)	0.36(0.60)	16.10(4.01)	13.00
T_9	Control- Water spray	3.70(1.92)	3.85(1.96)	3.27(1.80)	2.00(1.41)	1.80(1.34)	24.15(4.91)	8.14
‘F’ Test		NS	Sig	Sig	Sig	Sig	Sig	Sig
S.E. (m) ±		--	0.07	0.05	0.06	0.03	0.20	0.7
C.D. at 5%		--	0.22	0.17	0.18	0.10	0.61	2.1

*****Figures in parenthesis are square root transformed values
#Figures in parenthesis are angular transformed values

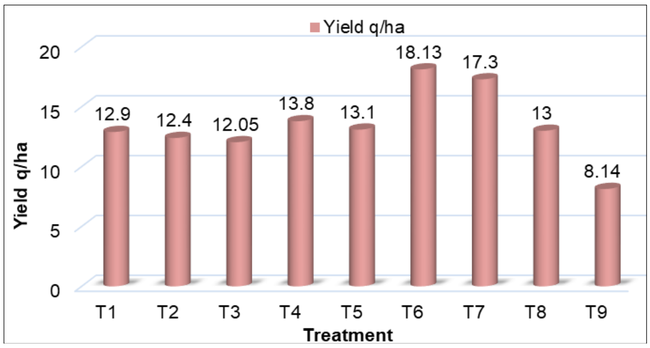
Table 2: Effect of various treatments on ICBR of chickpea

Tt. No.	Treatments	Quantity of treatment required for two spray kg/lit/ha.	Cost of treatment ha^{-1} for two spray (Rs)	Labour charges ha^{-1} for two spray (Rs).	Equipment hiring charges/ha two spray ha^{-1} (Rs)	Total cost of application of two spray (ha) (Rs) (A)	Yield kg ha^{-1}	Increasing yield over control (kg ha^{-1})	Value of increasing yield (Rs) (B)	Incremental benefit Rs ha^{-1} (B-A)= (C)	ICBR (C/A)	ICBR Ranking
T_1	HaNPV 500 LE ha^{-1}	2 L	3600	680	240	4520	1290	476	15,470	11,220	2.48	VI
T_2	HaNPV 400 LE ha^{-1}	1.5 L	2700	680	240	3620	1240	426	13,845	10,225	2.82	V
T_3	Neem Seed Extract 5%	50 kg	1500	680	240	2420	1205	391	12,707	10,287	4.25	IV
T_4	HaNPV 500 LE ha^{-1} + Neem Seed Extract 5%	2 L+50 kg	5100	680	240	6020	1380	566	18,395	12,375	2.05	VIII
T_5	HaNPV 400 LE ha^{-1} + Neem Seed Extract 5%	1.5L+50 kg	4200	680	240	5120	1310	496	16,120	11,000	2.14	VII
T_6	HaNPV 500 LE ha^{-1} + Quinolphos 25 EC @ 0.5%	2 L+0.50 L	3900	680	240	4820	1813	999	32,467	27,647	5.73	III
T_7	Neem Seed Extract 5%+ Quinolphos 25 EC @ 0.5%	50kg +0.50 L	1800	680	240	2720	1730	916	29,770	27,050	9.94	II
T_8	Quinolphos 25 EC @ 0.5%	0.500 L	300	680	240	1220	1300	486	15,795	14,575	11.94	I
T_9	Control- Water spray	-	-	680	240	920	814	-	-	-	-	-

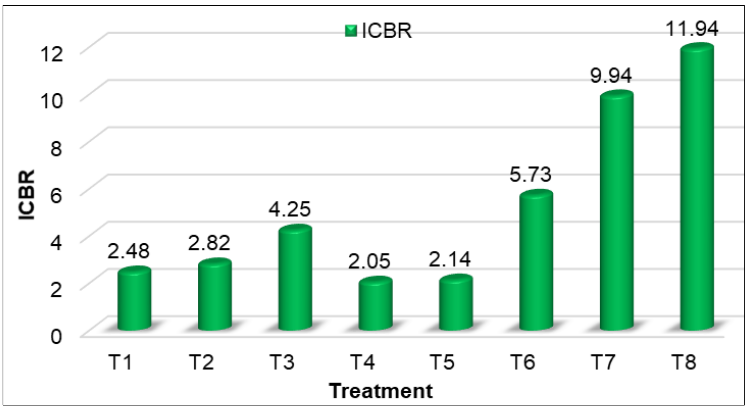
Cost of Inputs		
Labour charges: Rs 170 day^{-1} $labour^{-1}$	*HaNPV*: Rs. 180 lit^{-1}	Charges of hired spray pump: Rs. 60 day^{-1}
Quinalphos 25 EC: 600 Rs. Lit^{-1}	Sale price of Gram: 3250 Rs. q^{-1}	Neem seed: 30 Rs. Kg^{-1}
Charges of hired spray pump: Rs 30 day^{-1}	Stapler pin: Rs. 25 $pocket^{-1}$	(Considering 500 lit of water for one application ha^{-1} area of the crop)



Graph 1: Effect of treatments on per cent pod damage at harvest stage



Graph 2: Effect of treatments on grain yield of chickpea



Graph 3: Effect of treatments on ICBR of chickpea

Conclusion
Findings indicated the possibility of alternating NPV with chemical insecticides to manage the *H. armigera* infestation in chickpea ecosystem.

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