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Incremental Cost Benefit Ratio (ICBR) & Economics of different biopesticides and insecticides treatments on chickpea (*Cicer arientinum*) for management of *Helicoverpa armigera* (Hubner)

Tushar B Jagtap, Mahesh V Ugale and Vilas T Chavan

Abstract
The present investigation was undertaken to find out suitable and low cost substitute for the management of *Helicoverpa armigera* (Hubner) on chickpea by using microbials and botanicals. The field trial was laid out in the premises of Insectary, Entomology Section, College of Agriculture, Nagpur, during the rabi season of 2013-14. The experiment was laid out in randomized block design (RBD) with three replications and eight treatments including control (water spray). The observations were recorded on average per cent reduction in the larval population, average per cent pod damage caused by *Helicoverpa armigera* (Hubner) and average grain yield of chickpea. Population of natural enemies were also recorded after application of treatments. The incremental cost benefit ratio (ICBR) was calculated on the basis of prevailing cost of inputs and grain yield. The highest incremental cost benefit ratio (ICBR) of 39.74 was registered in the treatment with quinolphos 25 EC 0.05 %, followed by *Beauveria Basciana* 10^8 conidia/ml 2ml/l (22.29)-2nd rank. The treatment spinosad 45 SC 0.01 % although recorded highest larval reduction (76.17 %) and maximum yield (15.23 q/ha), which stands 5th rank registering ICBR i.e. 15.85.

Keywords: ICBR, Economics, Biopesticides, Insecticides, *Helicoverpa armigera*, Chickpea.

Introduction
Chickpea (*Cicer arientinum* Linn,) is the third most important pulse crop cultivated world wide and one of the most important staple legume food crop in India. It is the potent source of dietary constituent i.e. lysine, phosphorus and calcium and also a major part of the protein requirement. There are several pulse crops considered important at various locations throughout the world. Bengal gram or chickpea first domesticated in the Middle East, is widely cultivated in India, Mediterranean area, the Middle East, Ethiopia, Mexico, Argentina, Chile and Peru. Chickpea, one of the prime pulse crop of India in terms of both area and production. India is the largest producer of chickpea in the world sharing 65.25 and 65.49 per cent. Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Gujarat, Andhra Pradesh and Karnataka are the major chickpea producing states sharing over 95 per cent area. Insect pests stand as a major bottleneck in realizing higher yield. More than 50 species of the insect pests reported infesting chickpea under field and storage conditions (Garg and Surendra, 2000) [1]. Helicoverpa armigera (Hubner), (Family-Noctuidae, order-lepidoptera) popularly known as gram pod borer or American bollworm is a cosmopolitan, polyphagous and dynamic insect pest causing drastic yield losses in chickpea.
In India, annual crop losses caused due to this pest has been estimated at 2000 crores despite the use of chemical insecticides worth about 500 crores for combating this pest (Pawar, 1998) [5]. The population of this pest fluctuates drastically resulting in significant yield losses upto 70% (Lal *et al*. 1985) [2]. In Maharashtra losses due to this pest reported to the extent of 20% (Mahajan *et al*. 1990) [4]. In the present scenario the menace caused by *Helicoverpa armigera* (Hubner) becomes stumbling block in chickpea production. No doubt, several chemical insecticides have been found effective against this pest. However, due to overuse and misuse of these chemical insecticides, natural balance has been disturbed, leading to enormous problems such as resistance, residue, resurgence and destruction of natural enemies, pollution, and health hazards etc. There is need of comprehensive management strategy, to confront this pest and to find out ecofriendly, reliable substitute for such chemical insecticides. Biological

component viz. microbials and botanicals are found promising for the management of this pest. Keeping in view of the emerging crisis, pragmatic efforts have been made, in the present study for the suppression of this pest by using microbials and botanicals alone and in combination with recommended insecticide. In this context this research was aimed with the objective - to study the effect of different biopesticides and insecticides treatments on average per cent pod damage & grain yield of chickpea at harvest.

Materials & Methods

The field trial was laid out in the premises of Insectary, Entomology Section, College of Agriculture, Nagpur, during the rabi season of 2013-14 considering the objectives. To find out suitable and low cost substitute for the management of *Helicoverpa armigera* (Hubner) on chickpea.

A) Materials

For conducting the present investigation, required material like chickpea seed (Variety Jaki-9218), fertilizers, agricultural implements,bullock pair, chemical insecticide (quinolphos), neem seed, Neem oil, HaNPV, Beauveria bassiana, spinosad, polythene bags, measuring cylinder, labels, plastic bucket, pegs, threads, measuring tape etc. were made available by Entomology Section, College of Agriculture, Nagpur.

Beauveria bassiana was made available from Plant pathology Section, College Agriculture Nagpur. Also, Rhizobium and Phosphorus solubilising bacteria (PSB) culture for seed treatment was made available from Plant Pathology Section, College of Agriculture, Nagpur.

B) Treatment Details

Table 1: Treatment details as per following

Sr. No.	Treatment Number	Treatment Name	Concentration
1	T1	Neem Seed Extract	5%
2	T2	Neem oil + Detergent powder	2%
3	T3	Beauveria bassiana 108 conidia/ml	2ml/l
4	T4	Azadirachtin 1500 ppm	2.5ml/l
5	T5	HaNPV 500 LE/ha	1ml/l
6	T6	Spinopsad 45 SC	0.01%
7	T7	Quinoplhoos 25 EC	0.05%
8	T8	Control (Water spray)	--

C) Method of Recording Observations

1) Incremental Cost Benefit Ratio (ICBR)

Economics of different treatments was calculated, considering the cost of insecticide, biopesticides and botanical, its application cost, equipment charges etc. during the course of research work. The data on grain yield per hectare and its prevalent market price were used to work out the benefit derived from each treatment / ha. Based on Incremental benefit in yield over control and the cost involved, ICBR was worked out to establish economic ranking of various treatments. Various parameters used for working out the incremental benefit cost ratio are given below.

(A) Gross monetary benefits

It was obtained by multiplying the additional yield over control with prevailing minimum local market price of commodity (i.e chickpea grain).

(B) Cost of treatments

It was obtained by summing up all the cost of different treatments including labour and charges of hired equipments.

(C) Net monetary return

This was calculated by subtracting total cost of treatment (B) from the monetary benefit (A) i.e. A-B.

(D) Cost benefit ratio

It was calculated by dividing the net monetary return (C) by total cost i.e. C/B.

Result & Discussion

Economics of different treatments

On the basis of present costs of inputs and market selling price of chickpea (JAKI-9218 @ Rs. 3250/q), the Incremental Cost Benefit Ratio (ICBR) was worked out to interprete the economics of different treatments. The data presented in (Table no. 2 (A) & Table No. 2 (B) & Fig-1) indicated that, the treatment quinolphos 0.05% was the most economically viable treatment recording higher ICBR (39.74) due to its low cost of application which stands 1st rank amongst all the treatments. M.P. Gupta *et al.* (2007) [3] reported that, maximum net profit obtained from quinolphos 25 EC 0.05% (Rs. 10,740/ha) against *Helicoverpa armigera* (Hubner) in chickpea which is in tune with the present investigation.

The next treatment in descending order in respect of ICBR i.e. *Beauveria Basciana* 10^8 conidia/ml 2ml/l which stands 2nd rank and showed (28.29) ICBR, followed by treatment HaNPV 500 LE/ha 1ml/l (21.94) – 3rd rank, azadirachtin 1500 ppm 2.5 ml/l (20.12)-4th rank, treatment spinosad 45 SC 0.01% (15.85) 5th rank ICBR, neem oil + detergent powder 2% (10.12)-6 th rank ICBR. The lowest ICBR was recorded in neem seed extract 5% (8.44)-7th rank.

Table 2 (A): Incremental Cost Benefit Ratio (ICBR) in response of treatments

Tr. No	Treatments	Quantitiy of insecticide/ biopesticides required per ha (1 Spray)	Market price of insectifice/ biopesticides (Rs.)	Cost of tratments		Total cost Rs/ha (A)	Yield (q/ha)	Increased yield over control (q/ha)	Increased yield over control (Rs./ha) (B)	Net grain over control © (B-A)	ICBR (C/A)	Rank
				Cost of insecticides/ biopestcides (1 spray) Rs./ha	Labour Charges and rent of hired sprayer (1spray)							
T1	Neem seed Extrct 5%	25Kg	30/kg	750	290	1040	10.46	3.01	9782	8782	8.44	VII
T2	Neem oil + Detergent powder 2%	10 lit	70/lit	700	290	990	40.84	3.39	11017	10027	10.12	VI
T3	*Beauveria bassiana* 10^8 conidia/ml 2ml/l	1 lit	250/lit	250	290	540	10.32	3.87	12577	12037	22.29	II
T4	Azardirachtin 1500ppm 2.5ml/L	1.250 lit	250/lit	313	290	603	11.37	3.92	12740	12137	20.12	IV
T5	HaNPV 500 LE/ha 1ml/l	500 LE	900/lit	450	290	740	12.68	5.27	16997	16237	21.94	III
T6	Spinosad 45SC 0.01%	0.11 lit	11000/lit	1210	290	1500	15.23	7.78	25285	23785	15.85	V
T7	Quinolphos 25EC 0.5%	1 lit	250/lit	250	290	828	14.22	6.77	22002	21462	39.74	I
T8	Control (water Spray)						7.45					
	F' test											
	S.E. (m) ±											
	CD at 5%											

Table 2 (B): Incremental Cost Benefit Ratio (ICBR) in response of treatments (Cost of Inputs)

Cost of Inputs ⇒ ⇓	Quinolphos	Rs.250 /Lit	Cost of Azadiractin 1500 ppm	Rs.250/Lit
Labour charges – Rs. 120/day/man	HaNPV	Rs.900/Lit	Labour required / spray	2 labour
Changes of hired spray pump- Rs. 50 / Day	*Beauveria bassiana*	Rs.250 /Lit	Market price of chickpea	Rs. 3250/q
NSKE Charges- Rs. 30/kg	Neem oil	Rs.70 /Lit		
Spinosad – Rs- 11000/Lit				

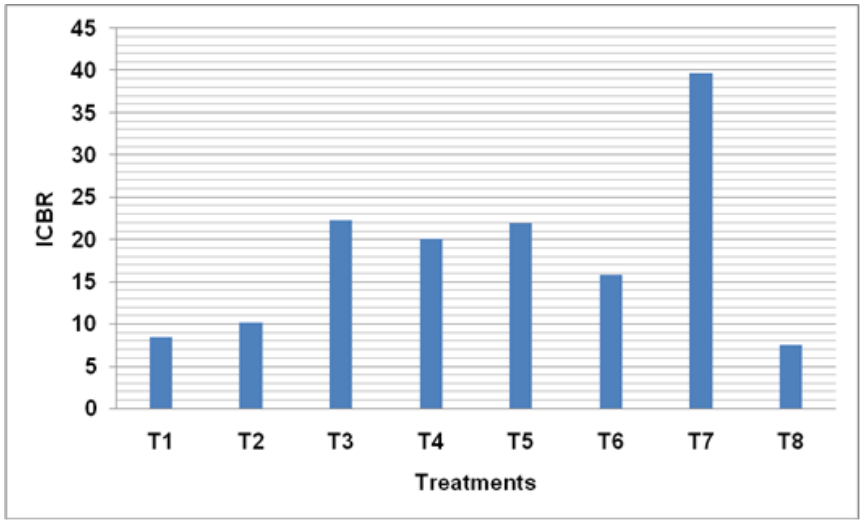

Fig 1: Incremental Cost Benefit Ratio (ICBR) in response of treatments.

Conclusion

From the above results it is concluded that, Considering the prevailing cost of inputs the highest incremental cost benefit ratio (ICBR) of 39.74 was registered in the treatment with quinolphos 25 EC 0.05 %. The next treatment in descending order in respect of ICBR i.e. *Beauveria Basciana* 10^8 conidia/ml 2ml/l which stands 2nd rank and showed (22.29) ICBR, followed by treatment HaNPV 500 LE/ha 1ml/l (21.94) – 3rd rank, azadirachtin 1500 ppm 2.5 ml/l (20.12)-4th rank and treatment spinosad 45 SC 0.01% (15.85) 5th rank, and the treatment neem oil + detergent powder 2% (10.12)-6th rank. The lowest ICBR was recorded in neem seed extract 5% (8.44)-7th rank.

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