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Effect of different biopesticides and insecticides treatments on chickpea (*Cicer arientinum*) for management of *Helicoverpa armigera* (Hubner)

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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 were recorded. Considering all the parameters, the treatment spinosad 45 SC 0.01 % recorded highest 76.17 per cent reduction in the larval population with minimum pod damage (18.64 %) and produced 15.23 q/ha yield.

Keywords: 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) [2]. *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) [7]. The population of this pest fluctuates drastically resulting in significant yield losses upto 70% (Lal *et al*. 1985) [4]. In Maharashtra losses due to this pest reported to the extent of 20% (Mahajan *et al*. 1990) [6]. 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. The advent of synthetic organic insecticides enabled us to gain an upper hand in struggle against insects to protect our crops, domesticated animals and ourselves from their pestiferous attack. There have been reports of loss of human life due to pesticide poisoning. Pesticide residues above tolerance limits have been reported in cereals, vegetables, fruits, vegetable oils, spices and even in human milk (Kale, 2006) [3]. 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 *Helicoverpa armigera* (Hubner) in chickpea crop.

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: 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)	--

Result & discussion

The management of most dangerous pest *Helicoverpa armigera* (Hubner) through insecticides no doubt has controlled to come extent but created low impact on environmental polluation and there are reports of lose of human life due to pesticide poisoning (Kale 2006) [3]. To cope up with this debackle some biorational products have shown promise in controlling the abnoxious pest. Testing such products and discovering their efficacy for the management of *Helicoverpa armigera* (Hubner) a challenge as for as natural conservation in concerned.

Table 1: Effect of treatments on average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 3 days after spraying.

Treat. No.	Treatment	Average per cent pod damage			Total	Mean
		R-I	R-II	R-III		
T1	Neem seed extract 5%	39.89 (38.58)	34.58 (36.01)	37.31 (37.65)	110.79 (112.25)	36.93 (37.41)
T2	Neem oil + detergent powder 2%	47.85 (43.77)	43.44 (41.23)	35.77 (36.73)	127.08 (121.74)	42.36 (40.58)
T3	*Beauveria bassiana* 10^8 conidia/ml 2ml/l	30.66 (33.62)	27.26 (31.47)	29.42 (32.84)	87.36 (97.65)	29.12 (32.65)
T4	Azadirachtin 1500 ppm 2.5 ml/l	43.73 (41.39)	39.70 (39.05)	32.69 (34.87)	116.13 (115.33)	38.71 (38.44)
T5	HaNPV 500 LE/ha 1ml/l	39.92 (39.18)	38.69 (38.46)	41.74 (40.25)	120.36 (117.89)	40.12 (39.29)
T6	Spinosad 45 SC 0.01%	81.59 (64.59)	74.08 (59.39)	61.00 (51.35)	216.69 (175.35)	72.23 (58.45)
T7	Quinolphos 25 EC 0.05%	53.06 (46.75)	58.51 (49.90)	62.90 (52.47)	174.48 (149.13)	58.16 (49.71)
T8	Control (water spray)	15.19 (22.94)	19.63 (26.30)	15.02 (22.80)	49.86 (72.05)	16.62 (24.01)
	'F' test					Sig.
	S. E.(m) ±					1.81
	CD at 5%					5.49

*Figures in parentheses are corresponding arcsine transformed values.

Effect of treatments on average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 3 days after spraying.

Perusal of the data (Table - 1) revealed that, all the treatments were found significantly superior over control (water spray). The average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 3rd day after spraying (DAS) ranged from 16.62 per cent to 72.23 per cent. The treatment spinosad 45 SC 0.01% was the most efficacious expressing 72.23 per cent reduction in the larval population. as against control (16.62%).

Singh *et al.* (2013) [11] observed effectiveness and bioefficacy of spinosad 45 SC @ 100 g a.i/ha against *Helicoverpa armigera* (Hubner) on chickpea and reported that spinosad was found best among all the treatments with 81.2 per cent reduction in larval population over control. These findings are in confirmation with the present results.

The next best treatment in descending order was quinolphos 25 EC 0.05% which recorded 58.16 per cent reduction in larval population of *Helicoverpa armigera* (Hubner) and was found statistically significant over control 16.62 per cent.

The treatment neem oil + detergent powder 2%, HaNPV 500 LE/ha 1 ml/l and azadirachtin 1500 ppm 2.5 ml/l recorded

42.36 per cent, 40.12 per cent and 38.71 per cent reduction in larval population of *Helicoverpa armigera* (Hubner) respectively and all these treatments were found on par with each other. However the treatment neem seed extract 5% (36.93%) found on par with azadirachtin 1500 ppm 2.5 ml/l (38.71%) and neem oil + detergent powder (42.36 %). The remaining treatment *Beauveria bassiana* 10^8 conidia/ml 2 ml/l found better over control (16.62%) in the reduction of larval population.

Table 2: Effect of treatments on average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 5 days after spraying.

Treat. No.	Treatment	Average per cent pod damage			Total	Mean
		R-I	R-II	R-III		
T1	Neem seed extract 5%	45.42 (42.37)	40.38 (39.45)	43.57 (41.31)	129.39 (123.14)	43.13 (41.04)
T2	Neem oil + detergent powder 2%	53.30 (46.89)	48.38 (44.07)	39.85 (39.14)	141.54 (130.11)	47.18 (43.37)
T3	*Beauveria bassiana* 10^8 conidia/ml 2ml/l	51.74 (45.99)	46.00 (42.70)	49.64 (44.79)	147.39 (133.50)	49.13 (44.50)
T4	Azadirachtin 1500 ppm 2.5 ml/l	45.39 (42.35)	41.20 (39.93)	33.93 (35.63)	120.54 (117.92)	40.18 (39.30)
T5	HaNPV 500 LE/ha 1ml/l	53.90 (47.23)	52.23 (46.28)	56.36 (48.65)	162.51 (142.18)	54.17 (47.39)
T6	Spinosad 45 SC 0.01%	81.11 (64.24)	73.64 (59.10)	60.64 (51.14)	215.40 (174.49)	71.80 (58.16)
T7	Quinolphos 25 EC 0.05%	52.17 (46.24)	57.53 (49.33)	61.85 (51.85)	171.57 (147.44)	57.19 (49.14)
T8	Control (water spray)	9.03 (17.49)	11.67 (19.97)	8.93 (17.39)	29.64 (54.85)	9.88 (18.28)
	'F' test					Sig.
	S. E.(m) ±					1.83
	CD at 5%					5.55

*Figures in parentheses are corresponding arcsine transformed values.

Effect of treatments on average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 5 days after spraying.

The observations on per cent reduction of larval population on 5 days after spraying on chickpea (Table-2) exhibited that the treatment spinosad 45 SC 0.01% (71.80%) was found statistically significant over all the treatments.

The present findings are in conformity with the investigations of Babar *et al*. (2012) [1] reported the promising effect of spinosad (spintor 45 SC) 0.013 per cent recorded efficacy based results on reduction in larval population (85.12%) against *Helicoverpa armigera* (Hubner) on chickpea.

Singh *et al*. (2013) [11] observed bioefficacy of spinosad 45 SC @ 100 g a.i/ha against *Helicoverpa armigera* (Hubner) on chickpea and reported 81.2 per cent reduction in larval population over control. This findings are in confirmation with our present investigation.

The treatment quinolphos 25 EC 0.05% (57.19%) was found next best treatment in reduction of larval population and showed similarity with the treatment HaNPV 500 LE/ha 1ml/l (54.17%) and the later shown parity with *Beauveria bassiana* 10^8 conidia / ml 2ml/l (49.13%) and Neem oil + detergent powder 2% (47.18%).

Rafiksab *et al*. (2003) [9] also reported the effectiveness of quinolphos 25 EC 0.05% in reduction of larval population (56.11%) against *Helicoverpa armigera* (Hubner) on chick pea. Pawar and Kadam (1995) [8] and Vyas and Lakhohaura (1996a) [13] also reported the effectiveness of HaNPV 250 LE/ha against *Helicoverpa armigera* (Hubner) in chickpea. The present findings are in agreement with the above findings.

The treatment neem seed extract 5% (43.13%) was on par with neem oil + detergent powder 2% (47.18%) and azadirachtin 1500 ppm 2.5 ml/l (40.18%) as compared to control which recorded lowest population reduction to the extent of 9.88 per cent.

Effect of treatments on average percent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 10 days after spraying.

The data on per cent reduction of population on 10 days after spraying (fig. 1.) indicated that all the treatment were statistically significant over control. The treatment spinosad 45 SC 0.01% recorded highest reduction of larval population 73.15 per cent and found on par with the treatment quinolphos 25 EC 0.05% (64.12%).

Rafiksab *et al*. (2003) [9] also reported the effectiveness of quinolphos 25 EC 0.05% reducing in larval population to the tune of 56.11 per cent against *Helicoverpa armigera* (Hubner) on chickpea. These findings are in agreement with present investigation. However, the treatment quinolphos 25 EC 0.01% shown similar effect to that of HaNPV 500 LE/ha 1ml/l (62.24%) and *Beauveria bassiana* 10^8 conidia / ml 2ml/l. (53.87%) in per cent reduction of larval population.

Sarode and Sonalkar (2000) [10] evaluated the efficacy of NPV against *Helicoverpa armigera* (Hubner) on chickpea and reported that, two applications of NPV 250 LE/ha resulted in lowest (7.41 and 6.1%) pod damage and highest reduction in larval population density (77.9 and 79.5%) respectively, recorded on 7 and 14 days after virus application. Saxena and Ahmad (1997) in the field studies reported the efficacy of *Beauveria bassiana* 2.82 x 10^7 spores/ml against *Helicoverpa armigera* (Hubner) on chickpea. The above findings are in corroboration with our present findings.

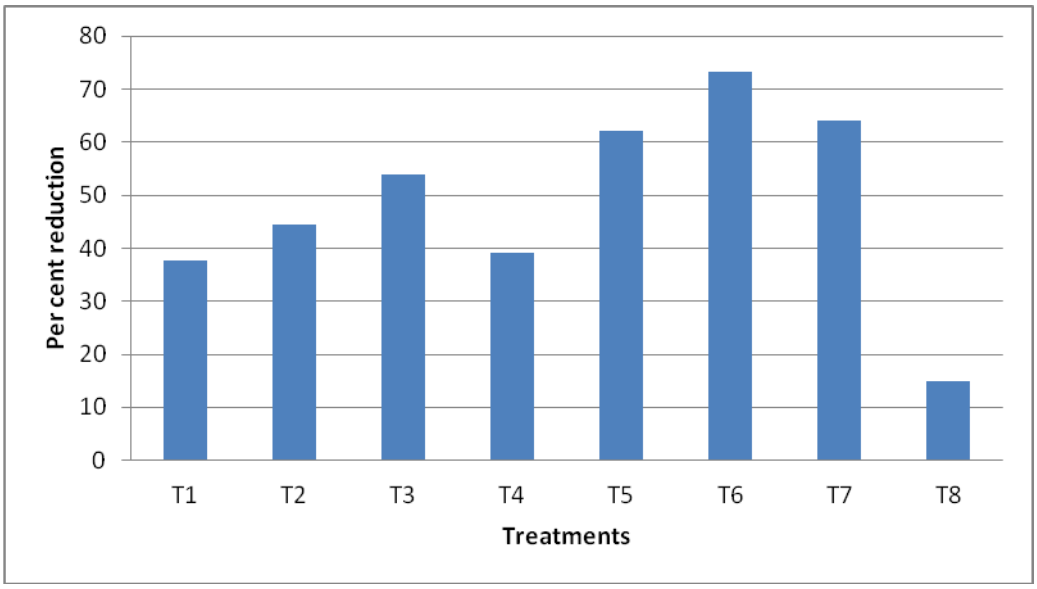

Fig 1: Effect of treatments on average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 10 days after spraying

The treatment Neem oil + detergent powder 2% (44.36%) and azadirachtin 1500 ppm 2.5 ml/l (39.14%) shown parity with each other. However, the treatment neem seed extract 5% (37.77%) was on par with treatment azadirachtin 1500 ppm 2.5 ml/l (39.14%) and shown reduction in larval population against *Helicoverpa armigera* (Hubner) on chickpea as compared to control i.e. 14.82 per cent larval population reduction.

1.4 Effect of treatment on average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 14 days after spraying.

The observation on per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 14 days after spraying (Fig-2) revealed that all the treatments were statistically superior over control. The average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 14 days after spraying ranged from 14.16 per cent to 76.17 per cent. The treatment spinosad 45 SC 0.01% was found most effective in reducing 76.17 per cent reduction in the larval population as against 14.16 per cent found in control.

Singh *et al*. (2013) [11] observed bioefficacy of spinosad 45 SC @ 100 g a.i./ha against *Helicoverpa armigera* (Hubner) on chickpea and reported 81.2 per cent reduction in larval population over control. This findings are in support of our present investigation.

Babar *et al.* (2012) [1] reported the promising effect of spinosad (spintor 45 SC) 0.0135% (85.12%) reduction in larval population reduction against *Helicoverpa armigera* (Hubner) on chickpea. Y.A. Shinde *et al*. (2013) also reported promising effect of spinosad 45 SC @ 73 g a.i./ha in controlling *Helicoverpa armigera* (Hubner) on chickpea.

The treatment quinolphos 25 EC 0.05 % (67.24%) was found on par with treatment spinosad 45 SC 0.01% (76.17%) and the treatment HaNPV 500 LE/ha 1ml/l (66.23%) in larval population reduction.

Rafiksab *et al.* (2003) [9] also reported the superiority of quinolphos 25 EC 0.05% in larval population reduction (56.11%) against *Helicoverpa armigera* (Hubner) on chickpea.

M.P. Gupta (2006) [5] reported promising effect of quinolphos 25 EC 0.05% against *Helicoverpa armigera* (Hubner) on chickpea.

Sarode and Sonalkar (2000) [10] evaluated the efficacy of NPV against *Helicoverpa armigera* (Hubner) on chickpea and reported that two applications of NPV 250 LE/ha resulted in lowest pod damage (7.41 and 6.1%) and highest reduction in larval density (77.9 and 79.5%) respectively recorded at 7 and 14 days after virus application. These findings are in confirmation with the present investigations. The treatment *Beauveria bassiana* 10^8 conidia/ml 2ml/l (54.64%) and neem oil + detergent powder 2% (46.14%) were found on par with each other.

Tambe *et al*. (2003) [12] in the bioassay studies reported that, *Beauveria bassiana* 4.14 x 10^4, 2.34 x 10^5 and 4.07 x 10^6 spore/ml were effective against *Helicoverpa armigera* (Hubner) on chickpea.

Yadav *et al*. (2004) [14] tested the efficacy of biopesticides against *Helicoverpa armigera* (Hubner) on chickpea and found that beauveria bassiana 1 kg/ha reduced the larval population from 2.63/plant to 2.22, 1.54 and 1.43/plant on 3, 7 and 14 days after spraying. These findings are in agreement with our observation which indicated remarkable larval population reduction. The treatment azadirachtin 1500 ppm 2.5 ml/l (41.63 %) and treatment neem seed extract 5% (41.17 %) were found on par with each other as compared to control (14.16 %).

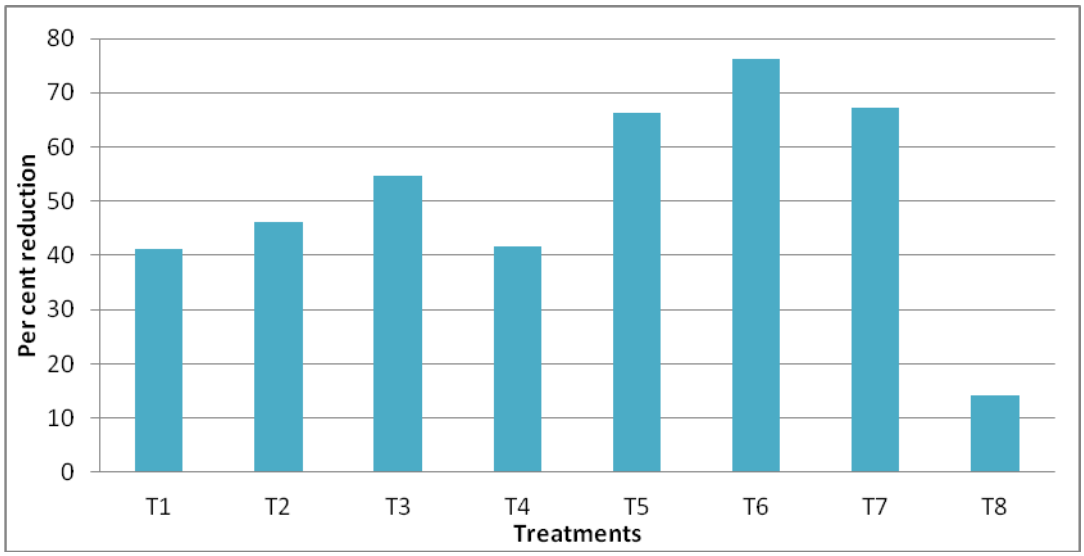

Fig 2: Effect of treatments on average per cent reduction in the larval population of *Helicoverpa armigera* (Hubner) on 14 days after spraying

1.4. Cumulative effect of treatments on larval population reduction.

The cumulative effect of various treatments on larval population reduction on 14 days after spraying explained in (Table-2) exhibited that the microbial insecticide spinosad 45 SC 0.01 % shown encouraging results in larval population reduction to the extent of 76.17 per cent. Singh *et al*. (2013) [11] observed bioefficacy of spinosad 45 SC @ 100 g a.i./ha against *Helicoverpa armigera* (Hubner) on chickpea and reported 81.2 per cent reduction in larval population over control.

Table 3: Cumulative effect of treatments on larval population reduction.

Treat. No.	Treatment	Average per cent reduction in larval population of *Helicoverpa armigera* (Hubner)			
		3 DAS	5 DAS	10 DAS	14 DAS
T1	Neem seed extract 5%	36.93 (37.41)	43.13 (41.04)	37.77 (37.91)	41.17 (39.90)
T2	Neem oil + detergent powder 2%	42.36 (40.58)	47.18 (43.37)	44.36 (41.74)	46.14 (42.77)
T3	*Beauveria bassiana* 10^8 conidia/ml 2ml/l	29.12 (32.65)	49.13 (44.50)	53.87 (47.22)	54.64 (47.66)
T4	Azadirachtin 1500 ppm 2.5 ml/l	38.71 (38.44)	40.18 (39.30)	39.14 (38.69)	41.63 (40.15)
T5	HaNPV 500 LE/ha 1ml/l	40.12 (39.29)	54.17 (47.39)	62.24 (52.09)	66.23 (54.48)
T6	Spinosad 45 SC 0.01%	72.23 (58.45)	71.80 (58.16)	73.15 (59.06)	76.17 (61.17)
T7	Quinolphos 25 EC 0.05%	58.16 (49.71)	57.19 (49.14)	64.12 (53.23)	67.24 (55.13)
T8	Control (water spray)	16.62 (24.01)	9.88 (18.28)	14.82 (22.60)	14.16 (22.06)
	'F' test	Sig.	Sig.	Sig.	Sig.
	S. E.(m) ±	1.81	1.83	1.92	2.05
	CD at 5%	5.49	5.55	5.83	6.23

*Figures in parentheses are corresponding arcsine transformed values.

This findings are in support of our present investigation. Similarly the treatment HaNPV 500 LE/ha 1 ml/l also recorded maximum population reduction to the extent of 66.23 per cent,and found on par with spinosad 45 SC 0.01% (76.17%) and quinolphos 25 EC 0.05% (67.24%). Sarode and Sonalkar (2000) [10] evaluated the efficacy of NPV against *Helicoverpa armigera* (Hubner) on chickpea and reported that two applications of NPV 250 LE/ha resulted in lowest pod damage (7.41 and 6.1%) and highest reduction in larval density (77.9 and 79.5%) respectively recorded at 7 and 14 days after virus application.

The chemical insecticidal treatment quinolphos 25 EC 0.05% was effective and reduced larval population to the extent of 67.24 per cent. Thus the performance of spinosad 45 SC 0.01 % proved superior and the effect of HaNPV 500 LE/ha 1 ml/l is encouraging in comparison with chemical insecticidal treatment quinolphos 25 EC 0.05 %. For the confirmation of result this experiment needs to be repeated for further confirmation.

Conclusion

From the above results it is concluded that, the performance of spinosad 45 SC 0.01 % proved superior and the effect of HaNPV 500 LE/ha 1 ml/l is encouraging in comparison with chemical insecticidal treatment quinolphos 25 EC 0.05 %. For the confirmation of results this experiment needs to be repeated for further confirmation.

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