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Bio-pesticidal alternative to manage sunflower capitulum borer

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Abstract

Experiment was conducted in randomised block design during *Kharif* 2009-2011 at Experimental Farm, Oilseeds Research Station Latur, Maharashtra to study the bio-efficacy of the different six bio pesticides and one chemical check spray along with one untreated control. The study brought out the significant difference among the effect of biopesticide against capitulum borer indicated that all the insecticides were found to be significantly superior in recording minimum infestation of capitulum borer over untreated control. Among different treatment Profenophos50 EC @ 0.05% was found effective and was at par with the treatment of *HaNPV* @ 2 x 10⁸ POBs/ml revealed that the highest yield was recorded by the treatment of Profenophos 50 EC @ 0.05% (i.e. 1467 kg/ha) followed by the treatment of *HaNPV* @ 2 x 10⁸ POBs/ml (1416 kg/ha) and both of these treatments were at par with each other. Although the highest net return was recorded (Table 7) for the treatment of Profenophos50 EC @ 0.05% (Rs. 22532), and was followed by treatment of *HaNPV* @ 2 x 10⁸ POBs/ml (Rs. 21520) & NSKE 5% (Rs. 19197), highest IBCR was recorded with the treatment of *HaNPV* @ 2 x 10⁸ POBs/ml (1:15.07), and was followed by treatment of NSKE 5% (1:14.32) and Profenophos50 EC @ 0.05% (1:11.93) at same time Profenophos @ 0.05% was found most toxic to natural enemies and having reduced visits of honey bees in comparison with the treatments of bio-pesticides.

Keywords: Sunflower, Bio-efficacy, bio-pesticide, capitulum borer, Natural enemy and Honey bees

Introduction

Sunflower (*Helianthus annuus*) is native to North America, where it was domesticated by Indigenous peoples as early as 3000 BC and perhaps first domesticated in Mexico around 2600 BC, with early archaeological finds in Tennessee by 2300 BC. Spanish explorers brought it to Europe in the early 1500s, from where it spread to Russia, where in the 18th and 19th centuries, it became the focus for oilseed breeding—especially in the Voronezh region, where a scalable oil-extraction technology was invented. Russia and Ukraine later played pivotal roles in worldwide commercialization of sunflower as an oil crop. Sunflower reached India in the 1960s and was adopted as a dependable oilseed suited to rainfed agriculture. However, in India this oilseed crop is a recent introduction and is reported to be first grown in the southern part of the country in the year 1969 and later to boost the productivity hybrids were introduced in 1980. It thrived in the agro-climatic zones of Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Tamil Nadu and Telangana. By 2009–10, sunflower covered approximately 1.85 million hectares in India, with production reaching 1.35 million tonnes and average productivity around 730 kg/ha. In recent seasons, sunflower cultivation occupies roughly 1.48 million hectares nationwide, with an average yield of about 900 kg/ha (0.6 tonne/acre), around 80% of which is rainfed (Anonymous 2025a) ^[1]. Karnataka leads production with around 304,000 tonnes from 794,000 ha, followed by Andhra Pradesh, Maharashtra, Bihar, Odisha, and Tamil Nadu; Bihar and Tamil Nadu achieve superior yields (1,400 and 1,329 kg/ha, respectively) due to irrigation. Maharashtra ranks among the top three states for sunflower area and production. Data for 2009–10 show Maharashtra had about 193,000 ha under sunflower, yielding 152,000 tonnes with a productivity around 789 kg/ha; in Latur district during the rabi season, productivity was approximately 697 kg/ha, with irrigated farmers earning higher returns (output–input ratios of 1.64 under drip vs 1.45 under flood irrigation) (Anonymous 2025b) ^[3].

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Drought tolerance, photo-insensitivity, short duration, wider adaptation to diverse soil, climate and agro-ecological situation, higher productivity are some of the reasons that make sunflower a popular crop among the farmers. Under the changing climatic scenario, where crop diversification is increasingly considered as an important adaptation strategy, sunflower has tremendous potential in the diversification of different traditional cropping pattern and cropping systems of the country. Sunflower has been proved to be as a highly promising crop under different agro-climatic regions of India, because of thermo-insensitive and high production potential (Tomar *et al.*, 1997) [12].

Maharashtra has also developed several high-performing cultivars tailored to its dryland and Vidarbha regions. Notable examples include SS-56 and Phule Bhaskar (SS-0808), which yield 800–1,000 kg/ha and 1,800 kg/ha respectively under rainfed conditions. icar-iior.org.in. Despite this progress, sunflower productivity in India—and particularly Maharashtra—lags behind the world average (1,320 kg/ha), constrained by abiotic stresses (drought, erratic rainfall, nutrient deficiencies) and a complex of insect pests and diseases managed through integrated approaches. Sunflower is being cultivated in India over an area of 0.47 mha with a production of 0.33 mt and the productivity is 697 kg/ha. Karnataka, Maharashtra, Andhra Pradesh, Haryana and Tamil Nadu are the major sunflower growing states in our country. Karnataka with the production of 0.17 mt and productivity of 503 kg/ha, in an area of 0.33 mha stands as the leading state (Anonymous, 2016) [1].

The production of this crop is quite low despite the release of several high yielding varieties and hybrids. Various biotic and abiotic stresses are responsible for lower productivity in this crop. Crop attacked by large number of insect pests (biotic stress) at different stages of crop growth is an alarming feature for lesser productivity. Sunflower acts as a host for wide array of insect pests, as many as 251 insect species use this crop as food across the world. The major insect pests include the tobacco caterpillar (*Spodoptera litura*), which completes 6–8 generations annually, skeletonizing foliage and feeding on capitula. The head borer (*Helicoverpa armigera*), like wise 6–8 generations/year, tunnels into developing seed heads. Sap-sucking pests—leafhoppers (*Amrasca biguttula*), thrips, whiteflies—cause chlorosis and sticky honeydew. Additional pests include semiloopers (*Thysanoplusia spp.*), hairy caterpillar (*Spilosoma obliqua*), cutworms (*Agrotis spp.*), termites, and sunflower beetles. (Rajamohan, 1976) [9]. Adoption of integrated pest management (IPM) in India integrates cultural tactics (crop rotation, intercropping, border and trap crops, optimal planting dates), mechanical control (egg mass removal, trap and light traps), biological measures, seed treatments and judicious, threshold-based chemical use can only solve the problem.

Sunflower's journey from North American domestication to a vital Indian oilseed crop reflects its adaptability and global significance. While Karnataka, Maharashtra and Andhra Pradesh remain core production centers, yield remains subdued by rainfed cultivation and pest–disease pressures. Yet, targeted cultivar development, IPM adoption, and improved agronomic techniques have enabled significant gains, particularly in Maharashtra, pointing to a pathway for closing the productivity gap. In this line current study was

aimed to find biocotrol alternative for the management of *Helicoverpa armigera*.

Material and Methods

An experiment to evaluate the biopesticides against head borer in Sunflower was carried out in randomized block design with eight treatments and three replication during Kharif 2009, Kharif 2010 & Kharif 2011. the observations on pest incidence and predators were recorded one day before imposing treatment and one three and seven days after imposing the treatments from five randomly selected plants of each plot. The observations on honey bee visits were recorded during the peak period of their activity one day before imposing treatment and one three and seven days after imposing the treatments.

Data so collected was subjected to statistically analysed and results were interpreted.

Table 1: The details of Experiment

A] Design	RBD
B] Replications	Three
C] Treatments No. & Treatments details	Eight, T ₁ - <i>B. bassiana</i> @ 5g/litre T ₂ - <i>Bacillus thuringiensis</i> @ 2.5 gm/litre T ₃ - <i>HaNPV</i> @ 2 x 10 ⁸ POBs/ml T ₄ - PSE 5% T ₅ - NSKE 5% T ₆ - Commercial neem formulation 0.5% T ₇ - Profenophos 50EC @ 0.05% T ₈ - Control
D] Plot size	Gross: 4.2 m x 4.5 m. Net: 3.0 x 3.9 m.
E] Spacing	60X30 cm
F] Variety	Morden
G] Year of experiment & Corresponding Sowing date	Kharif 2009-10 -21.07.2009, Kharif 2010-11-17.07.2010 & Kharif 2011-12-20.07.2011.
H] Seed rate and irrigation	As per recommendation

Results

Management of sunflower capitulum borer

Efficacy of different insecticides against Sunflower capitulum borer after first and spray are mentioned in the table 2. Pre-treatment larval count varied from 2.00 to 4.17 larva/plant one day before spraying. Data in the table shows that one day after spraying profenophos 50 EC was found to be highly effective with the minimum larval count of 0.30 larva/plant and followed by *HaNPV* @ 2 x 10⁸ POBs/ml (Rs. 21520) & NSKE 5% it was noticed to be on par with each other. They were followed *B. bassiana* @ 5g/litre, *Bacillus thuringiensis* @ 2.5 gm/litre, PSE 5% and Commercial neem formulation 0.5%. Next best treatments were *B. bassiana* @ 5g/litre, *Bacillus thuringiensis* @ 2.5 gm/litre and PSE 5% were found to be on par with one another (1.55 and 1.57 larva/plant). Commercial neem formulation 0.5% with larval count of 1.71 larva/plant was noticed to be less effective. Data recorded on three days after spraying depicts that all treatments effectively reduced larval population over untreated control. Among these treatments profenophos 50 EC was highly effective in reducing the larval population to 0.45 larva/plant. *HaNPV* @ 2 x 10⁸ POBs/ml 0.75 larva/plant & NSKE 5% 1.14 larva/plant which was on par with each other. These two treatments were followed by *Bacillus thuringiensis* @ 2.5 gm/litre, Commercial neem formulation 0.5%, PSE 5% and

B. bassiana @ 5g/litre. Profenophos 50EC 0.45 larva/plant, *HaNPV* @ 2×10^8 POBs/ml 0.75 larva/plant & NSKE 5% 1.14 larva/plant With the maximum larval control of was found to be most effective and *B. bassiana* @ 5g/litre with larval count of 1.64 larva/plant was least effective among biopesticidal treatment and control recorded highest population of capitulum borer larvai.e. 2.22 larva/plant. It is evident from the data that on 14 days after spraying profenophos 50 EC was highly effective in reducing the larval population to 0.40 larvae/plant and emerged as best treatment. It was very closely followed by *HaNPV* @ 2×10^8 POBs/ml 0.60 larva/plant & NSKE 5% 0.84 larva/plant. The next best treatments were *Bacillus thuringiensis* @ 2.5 gm/litr, *B. bassiana* @ 5g/litre, PSE 5% and Commercial neem formulation 0.5% and treatment control recorded highest population with 2.08 larva/plant. The data presented in the Table 1 to 5 revealed that the highest yield was recorded by the treatment of Profenophos50 EC @ 0.05%(i.e. 1467 kg/ha) followed by the treatment of *HaNPV* @ 2×10^8 POBs/ml (1416 kg/ha) and both of these treatments were at par with each other. Although The highest net return was recorded (Table 4) for the treatment of Profenophos50 EC @ 0.05%(Rs. 22532),and was followed by treatment of *HaNPV* @ 2×10^8 POBs/ml (Rs. 21520) & NSKE 5% (Rs. 19197),highest IBCR was recorded with the treatment of *HaNPV* @ 2×10^8 POBs/ml (1:15.07),and was followed by treatment of NSKE 5%(1:14.32) and Profenophos50 EC @ 0.05% (1:11.93) at same time Profenophos @ 0.05%was found most toxic to natural enemies and having reduced visits of honey bees in comparison with the treatments of bio-pesticides. The present findings are more or less also parallel to Jagadish *et al.*, (2010) [6] reported the superior efficacy of

neem based formulations against sunflower head borer and mentioned that while, neem oil formulation (300 ppm Azadirachtin) reduced the borer population by 34.1 percent, NSKE (5%) minimised the larval load by 57.4 percent. According to Mane *et al.*, (2013) [10] Azadiractin 1500 ppm @ 2ml/lit lowers the larval population of *H. armigera* in sunflower crop at Akola, Maharashtra. Further Sajjad Ali *et al.*, (2014) [11] reported that after 4th spray, mean reduction of *H. armigera* damage in sunflower, was highest in Neem seed kernal extracts (42.06%) followed Neem oil (31.40%). Kumar *et al.*, (2015) [8] also recommended that application of 5% neem seed kernel extract at 10 days interval protects the sunflower crop from the head borer damage. Gautam *et al.*, (2018) [5] found that Neem seed oil @ 5ml/l was considerably superior in regulating the population of *H. armigera* at Kumarganj, Faizabad. Mane *et al.*, (2013) [10] studied the efficacy of different bio-pesticides against *H. armigera* and reported that *Bt* @ 2 g per liter of water was effective in reducing the larval population on sunflower. While evaluating the efficacy of biorationals and botanical formulations against *Helicoverpa armigera* Hub. in sunflower, Basavaraj *et al.*, (2014) [4] observed that foliar application of *Bt* @ 5g per litre of water caused 67.5% reduction of larval population over the untreated control at 7 days after the second spray. Kumar and Kaur (2017) [7] have reported that *Beauveria bassiana* @ 2 g per liter of water and *Bt* @ 2.5 g per liter of water are the potential candidates that can be used for early season suppression of *Helicoverpa armigera* on sunflower and are safe to natural enemies as well. These biopesticide and entomopathogens may be useful components of Integrated Pest Management (IPM) strategy in sunflower.

Table 2: Evaluation of Bio-pesticides for the control of capitulum borer in Sunflower (Pooled data 2009-2011)

Treatments	Average Head borer larvae/ plant 1 day before spray				Average Head borer larvae/ plant 1- day after spray				Average Head borer larvae/ plant 3- day after spray			
	2009-10	2010-11	2011-12	Pooled mean	2009-10	2010-11	2011-12	Pooled mean	2009-10	2010-11	2011-12	Pooled mean
T ₁ - <i>B. bassiana</i> @ 5g/liter	3.90	2.30	2.87	2.27	3.00	1.00	2.20	1.55	2.60	1.10	2.87	1.64
	2.10	1.70	1.83	1.66	1.87	1.20	1.64	1.43	1.76	1.20	1.83	1.46
T ₂ - <i>Bt</i> @ 2.5 g/liter	3.80	2.30	2.73	2.21	2.93	1.20	2.13	1.57	2.40	1.20	1.60	1.30
	2.07	1.70	1.80	1.65	1.85	1.30	1.62	1.44	1.70	1.30	1.45	1.34
T ₃ - <i>HaNPV</i> @ 2×10^8 POBs/ml	3.66	2.30	2.67	2.16	2.20	0.90	1.53	1.16	1.00	1.00	1.00	0.75
	2.04	1.70	1.78	1.63	1.64	1.20	1.43	1.29	1.22	1.20	1.22	1.12
T ₄ -PSE 5 %	4.00	2.50	2.67	2.29	2.67	1.30	2.40	1.59	2.60	1.40	2.13	1.53
	2.12	1.70	1.78	1.67	1.78	1.30	1.70	1.45	1.55	1.40	1.62	1.43
T ₅ -NSKE 5 %	3.80	2.40	2.73	2.23	2.47	1.00	1.73	1.30	1.40	1.10	2.07	1.14
	2.07	1.70	1.80	1.65	1.72	1.20	1.49	1.34	1.38	1.20	1.60	1.28
T ₆ -Commercial Neem formulation 0.05%	4.17	2.60	2.73	2.38	2.80	1.50	2.53	1.71	2.30	1.50	2.27	1.52
	2.16	1.80	1.80	1.70	1.82	1.40	1.74	1.49	1.67	1.40	1.66	1.42
T ₇ -Profenophos 50 EC @ 0.05%	3.80	2.20	2.60	2.15	0.93	0.20	0.07	0.30	0.80	0.40	0.60	0.45
	2.07	1.60	1.76	1.63	1.18	0.80	0.75	0.89	1.14	0.90	1.05	0.97
T ₈ -Control	3.87	2.00	2.73	2.15	4.07	2.20	3.00	2.32	3.50	2.50	2.87	2.22
	2.09	1.60	1.80	1.63	2.13	1.60	1.87	1.68	2.00	1.70	1.83	1.65
SE	NS	NS	NS	NS	0.51	0.10	0.06	0.04	0.06	0.10	0.06	0.04
CD					0.15	0.30	0.18	0.12	0.17	0.30	0.18	0.12
CV					5.04	13.10	6.73	6.74	7.00	11.50	6.77	7.31

Figures in bold are square root transformed values.

Table 2: Continued

Treatments	Average Head bore larvae/ plant 7 day after spray				Average yield kg/ha			
	2009-10	2010-11	2011-12	Pooled mean	2009-10	2010-11	2011-12	Pooled mean
T ₁ - <i>B. bassiana</i> @ 5g/liter	2.16	1.30	1.13	1.15	894	1054	1607	1185
	1.63	1.30	1.28	1.28				
T ₂ -Bt @ 2.5 g/liter	2.20	1.40	0.93	1.13	1015	969	1647	1210
	1.64	1.40	1.20	1.28				
T ₃ - <i>HaNPV</i> @ 2 x 10 ⁸ POBs/ml	1.13	0.80	0.47	0.60	1189	1083	1977	1416
	1.28	1.20	0.98	1.05				
T ₄ -PSE 5 %	2.00	1.60	1.47	1.27	1088	940	1561	1196
	1.58	1.40	1.40	1.33				
T ₅ -NSKE 5 %	1.43	1.20	0.73	0.84	1121	997	1835	1318
	1.39	1.30	1.11	1.16				
T ₆ -Commercial Neem formulation 0.05%	2.36	1.70	1.47	1.38	930	883	1470	1094
	1.69	1.50	1.40	1.37				
T ₇ -Profenophos 50 EC @ 0.05%	0.70	0.70	0.20	0.40	1198	1140	2063	1467
	1.10	1.10	0.84	0.95				
T ₈ -Control	3.30	2.90	2.13	2.08	862	627	1447	979
	1.95	1.80	1.62	1.61				
SE	0.513	0.1	0.08	0.05	65.00	89.9	78.16	45.24
CD	0.155	0.3	0.24	0.13	196	266.8	236.73	125.39
CV	6.000	13.8	11.47	9.585	11.00	16.4	7.95	11.004

Figures in bold are square root transformed values.

Table 3: Bio-sefaty of bio-pesticides to the predators on Sunflower (Pooled data 2009-2011)

Treatments	Average predators/ plant 1 day before spray				Average predators/ plant 3days after spray				Average predators/ plant 7 days after spray			
	2009-10	2010-11	2011-12	Pooled mean	2009-10	2010-11	2011-12	Pooled mean	2009-10	2010-11	2011-12	Pooled mean
T ₁ - <i>B. bassiana</i> @ 5g/liter	1.66	2.30	1.40	1.10	1.66	1.10	0.93	0.95	1.66	1.33	1.27	1.06
	1.46	1.70	1.38	1.26	1.47	1.20	1.20	1.20	1.47	1.35	1.33	1.25
T ₂ -Bt @ 2.5 g/liter	1.66	2.30	1.47	1.12	1.66	1.20	1.07	1.01	1.33	1.00	1.27	0.99
	1.46	1.70	1.40	1.27	1.47	1.30	1.25	1.23	1.35	1.22	1.33	1.22
T ₃ - <i>HaNPV</i> @ 2 x 10 ⁸ POBs/ml	1.66	2.30	1.47	1.11	1.33	1.00	1.27	1.02	1.00	1.67	1.40	0.97
	1.43	1.70	1.40	1.27	1.35	1.20	1.33	1.23	1.22	1.47	1.38	1.21
T ₄ -PSE 5 %	1.66	2.50	1.53	1.12	1.00	1.40	0.60	0.63	1.33	0.93	0.93	0.85
	1.46	1.70	1.43	1.27	1.22	1.40	1.05	1.06	1.35	1.20	1.20	1.16
T ₅ -NSKE 5 %	1.33	2.40	1.47	0.99	1.66	1.10	0.73	0.88	1.00	1.33	1.13	0.85
	1.35	1.70	1.40	1.22	1.47	1.20	1.11	1.17	1.22	1.35	1.28	1.16
T ₆ -Commercial Neem formulation 0.05%	1.33	2.60	1.40	1.01	1.33	1.50	0.40	0.66	1.33	0.80	0.80	0.80
	1.35	1.80	1.38	1.23	1.35	1.40	0.95	1.08	1.35	1.14	1.14	1.14
T ₇ -Profenophos 50 EC @ 0.05%	1.33	2.20	1.53	1.06	0.70	0.40	0.27	0.29	0.70	0.53	0.60	0.33
	1.35	1.60	1.43	1.25	1.09	0.90	0.88	0.89	1.09	1.02	1.05	0.91
T ₈ -Control	1.33	2.00	1.53	1.05	1.66	2.50	1.33	1.13	1.66	2.27	1.93	1.30
	1.35	1.60	1.40	1.25	1.47	1.70	1.35	1.28	1.47	1.66	1.56	1.34
SE	NS	NS	NS	NS	0.14	0.10	0.04	0.05	0.12	0.06	0.09	0.05
CD					0.43	0.30	0.13	0.15	0.38	0.18	0.29	0.15
CV					18.42	11.50	6.64	14.93	16.76	8.08	12.67	13.73

Figures in bold are square root transformed values.

Table 4: Benefit Cost ratio of bio-pesticides [Based on three years pooled yield (2009-11)]

Treatments Detail s	Mean Cost of cultivation excluding Plant Protection	Qty. of insecticides for single spray (lit/ha or kg/ha)	Mean Price of insecticides (Rs. / lit or kg)	Mean Cost of insecticide for single spray (Rs./ ha)	Mean Application cost insecticides Rs./ ha for single spray	Total cost of Imposing the Treatment	Total cost of cultivation (Rs. /ha)	Seed Yield (kg/ha)	Gross returns (Rs./ha)	Net returns (Rs. /ha)	B:C Ratio	Incremental cost (Rs. /ha)	Incremental Benefit (Rs. /ha)	Incremental Benefit: cost ratio (IBCR)
T ₁ - <i>B. bassiana</i> @ 5g/litre	13200	2.5	242	604	220	824	14024	1185	29625	15601	2.11	824	4326	5.25
T ₂ -Bt @ 2.5 gm/litre	13200	1.25	263	350	220	570	13770	1210	30250	16480	2.20	570	5205	9.13
T ₃ - <i>HaNPV</i> @ 2 x 10 ⁸ POBs/ml	13200	0.5	920	460	220	680	13880	1416	35400	21520	2.55	680	10245	15.07
T ₄ -PSE 5 %	13200	25	77	1917	220	2137	15337	1196	29900	14563	1.95	2137	3288	1.54
T ₅ -NSKE 5 %	13200	25	13	333	220	553	13753	1318	32950	19197	2.40	553	7922	14.32
T ₆ -Commercial neem formulation 0.05%	13200	2.5	473	1183	220	1403	14603	1094	27350	12747	1.87	1403	1472	1.05
T ₇ -Profenophos 50EC@ 0.05%	13200	0.5	1447	723	220	943	14143	1467	36675	22532	2.59	943	11257	11.93
T ₈ -Control	13200						13200	979	24475	11275	1.85			

B:C Ratio= Per ha Gross Returns / Per ha Cost of cultivation, IBCR= Incremental Benefits / Incremental Costs & Mean Av. Market Price of Sunflower Rs. 2500/Q.

Table 5: Bio-safety of treatments to Honey bees activity (2011-12)

Sr. No.	Treatments	Average honey bees visits			
		BS	1DAS	3 DAS	7 DAS
1	<i>B. bassiana</i> @ 5 g/liter	1.33	1.00	1.33	1.67
		1.35	1.22	1.35	1.47
2	Bt @ 2.5 gm/liter	1.33	0.67	1.00	1.53
		1.35	1.08	1.22	1.43
3	<i>HaNPV</i> @ 2 x 10 ⁸ POBs/ml	1.67	1.40	1.67	2.00
		1.47	1.38	1.47	1.58
4	PSE 5 %	2.00	0.67	0.93	1.33
		1.58	1.08	1.20	1.35
5	NSKE 5 %	1.67	0.33	1.33	1.47
		1.47	0.91	1.35	1.40
6	Commercial neem formulation	1.67	0.47	0.80	1.27
	0.5 %	1.47	0.98	1.14	1.33
7	Profenophos 50 EC @ 0.05%	2.00	0.13	0.53	0.80
		1.58	0.80	1.02	1.14
8	Control	2.00	2.33	2.27	2.53
		1.58	1.68	1.66	1.74
	S.E. _±		0.09	0.06	0.07
	CD (P=0.05)	NS	0.26	0.18	0.21
	CV (%)		13.15	8.08	8.54

Figures in bold are square root transformed values.

Conclusion

The data presented in the Table 1 to 5 revealed that the highest yield was recorded by the treatment of Profenophos50 EC @ 0.05% (i.e. 1467 kg/ha) followed by the treatment of *HaNPV* @ 2×10^8 POBs/ml (1416 kg/ha) and both of these treatments were at par with each other. Although The highest net return was recorded (Table 7) for the treatment of Profenophos50 EC @ 0.05% (Rs. 22532), and was followed by treatment of *HaNPV* @ 2×10^8 POBs/ml (Rs. 21520) & NSKE 5% (Rs. 19197), highest IBCR was recorded with the treatment of *HaNPV* @ 2×10^8 POBs/ml (1:15.07), and was followed by treatment of NSKE 5%(1:14.32) and Profenophos50 EC @ 0.05% (1:11.93) at same time Profenophos @ 0.05% was found most toxic to natural enemies and having reduced visits of honey bees in comparison with the treatments of bio-pesticides.

Therefore Spraying of *HaNPV* @ 2×10^8 POBs/ml and NSKE 5% was found economic & safe to natural enemies and honey bees and effective for the management of Sunflower capitulum borer, hence it can be recommended as biocontrol alternative for management of capitulum borer.

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