



Evaluation of Organic Extracts against Bollworm Complex of Cotton

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ABSTRACT: An experiment was conducted to evaluate organic extracts against cotton bollworm complex at research farm of Department of Entomology, Dr. PDKV, Akola during *Kharif*, 2019. Experiment was laid in Randomized Block Design with seven organic extracts viz., Bramhastra extract @ 2 lit, Panchpatre extract @ 2.5 lit, Garlic–Chilli extract @ 2.5 lit, Broad-spectrum formulation @ 1.6 lit, Dr. PDKV Entomology formulation @ 2.5 lit, Neem seed extract @ 10 lit and Cow urine @ 12.5 lit per 100 lit of water along with a untreated control treatment. These treatments were applied thrice at 10 days interval. The observations on damage of bollworm complex were recorded at an interval of 3, 7 and 10 days after spraying while, damage by pink bollworm larva was recorded at 110 and 125 days after emergence of crop. Damage of bollworm complex on open boll was observed at each picking. Finally seed cotton yield was recorded from each treatment plot. According to the present study Dr. PDKV-Entomology formulation was more effective in minimizing the bollworm complex damage in green fruiting bodies. Untreated control showed maximum bollworm damage. Significantly minimum bollworm damage was recorded in treatment Dr. PDKV-Entomology formulation at harvesting. Cow urine was less effective in controlling bollworm damage and found statistically at par with untreated control. Highest seed cotton yield was obtained with Dr. PDKV-Entomology formulation. Brahmashttra extract was found most economical treatment with highest incremental cost benefit ratio (ICBR) followed by Dr. PDKV-Entomology formulation and Panchpatre extract. Results of present experiment indicated that the organic extracts can efficiently protect the cotton crop from bollworm complex.

Keywords: Bollworm complex, Bramhastra extracts, Dr. PDKV-Entomology formulation, Panchpatre extract, Garlic-Chilli extract.

INTRODUCTION

Cotton is a most important fiber and cash crop in India. It plays an important role in the textile industries and economy of the nation, it contributes 1/3rd of total foreign exchange earning of India (Mayee and Rao 2002). But, continuous cultivation of hybrid cotton in large areas increases its vulnerability to bollworms viz., American bollworm, *Helicoverpa armigera* (Hubner), spotted bollworm, *Earias vittella* (Fabricius), pink bollworm, *Pectinophora gossypiella* (Saunders) attack in different growth stages of cotton. Insect pest management in cotton has traditionally been relied upon synthetic insecticides. The indiscriminate use of chemical pesticides is resulting in environment and land pollution (Gill and Garg 2014). The chemical pesticides kill non-target and beneficial insects, leading to outbreaks of secondary pests. Awareness about harmful effects of chemical pesticides has attracted many farmers towards organic farming. Use of more biodegradable pest control material with greater selectivity might help to reduce the adverse effects on the non-target organisms and other environmental risks (Wondafraash *et al.*, 2012). The deleterious effects of crude plant extracts on insects are manifested in several

ways including toxicity, feeding inhibition and growth inhibitors (Wheeler and Isman 2001). Various plants has been identified with insecticidal properties viz., Neem, Custard apple, garlic, *Lanatina camara*, datura, tobacco, *Ipomoea carnea*, chilli, Kanheri which are effective against *Helicoverpa armigera*, cotton leaf worm, *Spodoptera littoralis*, pink bollworm, *Pectinophora gossypiella*, *Spodoptera littoralis*, sap sucking insect pests (Upadhyay and Singh 2012; Paul and Chaudhary 2016; Rajput *et al.*, 2017; Moustafa *et al.*, 2018; Nassar *et al.*, 2018; Pareek *et al.*, 2018). Cow urine has the ability to inhibit the bollworm complex on cotton plants (Shalaby *et al.*, 2018).

Many organic farmers and Non-Governmental Organizations (NGOs) have developed number of innovative formulations which can be effectively used in control of various pests (Yadav, 2012). But, limitations such as lack of immediate effect of organic extract on insect pests, seasonal availability of plants used in organic extract, time consuming preparations of organic extracts, lack of knowledge about preparation of organic extracts and its use at individual level rather than in community or village level lower down the adaptation and use of organic extract by farmers. Hence, a study needs to be carried out to provide data

on efficacy of organic extract against insect pests at field condition. Keeping in mind the above facts an investigation was undertaken to evaluate the efficacy of organic extracts against bollworm complex on cotton crop.

MATERIAL AND METHODS

An experiment was conducted at Research farm, Department of Entomology, Dr. PDKV, Akola, during Kharif season in July-December, 2019. Experiment was laid in Randomized Block Design with seven organic extracts and one control treatment (water spray) which replicated thrice. Cotton variety AKH-9916 was sown on the plot size of 4.80 m × 4.20 m for each treatment with row to row spacing of 60 cm and plant to plant spacing of 60 cm. All the agronomic practices were followed as per the recommendations of Dr. PDKV, Akola in raising cotton crop. Five plants were selected randomly from each plot for recording observations. As soon as the level of bollworm infestation reached at 5 per cent green fruiting bodies damage, schedule of spraying was initiated. The pre-treatment observations were recorded 24 hours before spraying. The post-treatment observations were recorded on 3rd, 7th and 10th days after spraying. The subsequent spraying was given at 10 days interval.

Table 1: Details of treatment used against bollworms.

Tr. No.	Treatments	Dose / 100 liter of water
T1	Brahmashtra extract	2 L
T2	Panchpatre extract	2.5 L
T3	Garlic-Chilli extract	2.5 L
T4	Broad-spectrum formulation	1.6 L
T5	Dr. PDKV-Entomology formulation	2.5 L
T6	Neem seed extract	10 L
T7	Cow urine	12.5 L
T8	Untreated control	-

Total fruiting bodies (squares, flowers and bolls) and bollworms damaged fruiting bodies were counted from randomly selected five plants in each plot and per cent

bollworm complex damage in green fruiting bodies was worked out. The damage caused by *Earias* sp. and *H. armigera* on squares, flowers and bolls were considered together for the estimation of total fruiting bodies damage due to bollworms by using following formula
% Bollworm damage in fruiting bodies =

$$\frac{\text{Number of damaged fruiting bodies}}{\text{Total number of fruiting bodies}} \times 100$$

Incidence of pink bollworm was recorded at 110 and 125 days after crop emergence by plucking twenty matured green bolls from border rows from each plot. These bolls were dissected and observed for pink bollworm larvae and damage. At the time of dissecting bolls for larval count, the number of bolls damaged by pink bollworm was counted. Per cent green boll damage by pink bollworm was calculated by using following formula

% Green boll damage by pink bollworm =

$$\frac{\text{No. of green boll damage due to pink bollworm larvae}}{\text{Total no. of green bolls observed}} \times 100$$

Yield of seed cotton in q/ha was calculated in order to compare the effect of different treatments. As per Gomez and Gomez (1984) the data obtained during the present course of investigation was converted to appropriate transformations and was subjected to statistical analysis to test the level of significance.

RESULTS AND DISCUSSION

Pre-treatment count on fruiting bodies damage due to bollworms complex (*Earias* sp. and *H. armigera*) was recorded in range of 5.55 to 8.10 per cent. Cumulative data calculated after three sprays revealed that Dr. PDKV-Entomology formulation was more effective treatment with least bollworm complex damage in green fruiting bodies *i.e.* 4.09 per cent. However, this treatment was found at par with Brahmashtra extract (4.28%) and Panchpatre extract (4.69%). Broad-spectrum formulation (5.83%), Neem seed extract (5.86%), Garlic-Chilli extract (6.23%) and Cow urine (8.04%) appeared as next best treatments. The maximum percentage of bollworm damage was recorded in untreated control *i.e.* 10.13% damage (Table 2).

Table 2: Effect of organic extracts on bollworm complex damage in green fruiting bodies.

Tr. No.	Treatments	Dose/100 liter of water	Bollworm complex Damage (%)			Mean
			3 DAS	7 DAS	10 DAS	
1	Brahmashtra extract	2 L	4.58 (2.11)	4.11 (2.00)	4.15 (1.99)	4.28 (2.03)
2	Panchpatre extract	2.5 L	4.87 (2.19)	4.59 (2.14)	4.60 (2.11)	4.69 (2.15)
3	Garlic-Chilli extract	2.5 L	6.53 (2.55)	6.04 (2.45)	6.13 (2.46)	6.23 (2.49)
4	Broad-spectrum formulation	1.6 L	6.02 (2.44)	5.71 (2.38)	5.76 (2.38)	5.83 (2.40)
5	Dr. PDKV- Entomology formulation	2.5 L	4.42 (2.06)	3.87 (1.95)	3.97 (1.94)	4.09 (1.98)
6	Neem seed extract	10 L	6.26 (2.50)	5.62 (2.35)	5.70 (2.37)	5.86 (2.41)
7	Cow urine	12.5 L	8.04 (2.82)	8.09 (2.83)	8.00 (2.82)	8.04 (2.82)
8	Untreated control	-	9.95 (3.15)	10.11 (3.18)	10.34 (3.21)	10.13 (3.18)
	F test		Sig	Sig	Sig	Sig
	SE (m) ±		0.11	0.12	0.12	0.12
	CD @ 5%		0.34	0.36	0.36	0.35
	CV (%)		7.91	8.51	8.50	8.30

Note: Figures in parentheses are corresponding square root transformed values.

Mean data of two sprays of organic extract on pink bollworm damage in green bolls revealed that Neem seed extract and Dr. PDKV- Entomology formulation with least damage of 18.67 and 21.15 per cent respectively were most effective treatments. Maximum green boll damage by pink bollworm was recorded in the untreated control plot (47.17%). Overall damage was ranged between 18.67 to 47.17 per cent in the plots treated with different organic extracts (Table 3). At harvesting, minimum bollworm damage in open bolls was observed in plots treated with Dr. PDKV-

Entomology formulation (25.17 per cent) which was found at par with Brahmasthra extract (28.33%) and Panchpatre extract (34.00%). Broad-spectrum formulation (40.67%), Neem seed extract (45.50%) and Garlic-Chilli extract (50.00%) found moderately effective in this respect. Cow urine was found comparatively less effective with 65.67 per cent open boll damage. Whereas, highest per cent open boll damage was recorded in untreated control *i.e.* 68.33 % (Table 4).

Table 3: Effect of organic extracts on pink bollworm damage in green bolls.

Tr. No.	Treatments	Dose / 100 liter of water	Pink bollworm damage		
			110 DAE	125 DAE	Mean
1	Brahmasthra extract	2 L	27.00 (30.93)	19.00 (25.69)	23.00 (28.31)
2	Panchpatre extract	2.5 L	43.33 (40.72)	39.85 (38.30)	41.59 (39.51)
3	Garlic-Chilli extract	2.5 L	44.67 (41.02)	42.33 (39.42)	43.50 (40.22)
4	Broad-spectrum formulation	1.6 L	43.00 (39.83)	41.00 (38.86)	42.00 (39.35)
5	Dr. PDKV-Entomology formulation	2.5 L	24.67 (29.65)	17.62 (24.59)	21.15 (27.12)
6	Neem seed extract	10 L	20.00 (26.45)	17.33 (24.27)	18.67 (25.36)
7	Cow urine	12.5 L	46.67 (42.88)	43.00 (40.05)	44.84 (41.47)
8	Untreated control		49.33 (44.39)	45.00 (41.09)	47.17 (42.74)
	F test		NS	NS	NS
	SE (m) ±		4.22	4.62	4.42
	CD @ 5%		-	-	-
	CV (%)		19.78	23.50	21.64

Figures in parentheses are corresponding Arc Sin transformed values DAE-Days after Emergence

Present findings are in confirmation with previous researchers such as Singh *et al.* (2014) who reported use of neem leaves extraction (5 lit of solution/ 200 lit of water) and asafoetida solution (100gm/ 150-200 lit of water) by farmers for the control soybean pests, *Helicoverpa* spp, *Melonoagromyza obtusa* and Girdle beetle. Patel and Yadav (2017) revealed that the highest mortality of *Spodoptera litura* obtained in 5 per cent concentration of *Parthenium hysterophorus* leaf extract at 24 hrs (53.33%), 48 hrs (66.67%), 72 hrs (80%) and 96 hrs (80%) after application. They concluded that the *P. hysterophorus* leaf extract possesses antifeedant, larvicidal and growth inhibiting activity against *Spodoptera* spp. Rajput *et al.* (2017) observed maximum reduction in pink bollworm larval population (13.17%) in non-Bt cotton due to tobacco extract (@ 37.19 ml/ 2 lit of water), followed by neem extracts (8.76%) and datura extract (5.85%) (@ 37.19 ml/ 2 lit of water. Moustafa *et al.* (2018) reported 70.7 and 63.6

per cent reduction in bollworm larvae by cow's urine-dung extract (1:1) and cow's urine-dung extract: water (1:4) respectively. While in cow's urine-dung extract with neem oil in 1:1:50 and 1:4:50 ratio reported reduction of 80 and 71 per cent larval population respectively. Cow's urine-dung extract was found more effective on bollworm complex with ability to inhibit the bollworm complex on cotton from the beginning of flowering to the boll maturity. Yousef *et al.* (2018) evaluated 70 per cent hydroethanolic extracts of *Nerium oleander* (leaves, stems and flowers) against 1st instar larvae of pink bollworm and reported increased toxic effect of this extract with the increasing concentration. Joshi *et al.* (2020) showed feeding inhibition of bioformulations *viz*: Neemastra, Agniastra, Brahmastra, Dashparni ark and garlic + ginger + mint mixture at 1.5% to 24% concentrations against fourth, fifth and sixth instar larvae of *Agrotis ipsilon*.

Table 4: Effect of organic extracts on open boll damage due to bollworm complex at harvesting.

Tr. No	Treatments	Dose/100 liter of water	Open boll damage (%)			Mean
			RI	RII	RIII	
1	Brahmasthra extract	2 L	20.00 (26.57)	30.00 (33.21)	35.00 (36.27)	28.33 (32.02)
2	Panchpatre extract	2.5 L	25.00 (30.00)	32.00 (34.45)	45.00 (42.13)	34.00 (35.53)
3	Garlic-Chilli extract	2.5 L	35.00 (36.27)	70.00 (56.79)	45.00 (40.13)	50.00 (45.06)
4	Broad-spectrum formulation	1.6 L	30.00 (33.21)	50.00 (45.00)	42.00 (40.40)	40.67 (39.54)
5	Dr. PDKV-Entomology Formulation	2.5 L	24.00 (29.33)	20.00 (26.57)	31.50 (34.14)	25.17 (30.01)
6	Neem seed extract	10 L	40.00 (39.23)	50.00 (45.00)	46.50 (42.99)	45.50 (42.41)
7	Cow urine	12.5 L	57.00 (49.02)	70.00 (56.79)	70.00 (56.79)	65.67 (54.20)
8	Untreated control	-	65.00 (53.73)	75.00 (60.00)	65.00 (53.73)	68.33 (55.82)
	F test		Sig	Sig	Sig	Sig
	SE (m) ±		-	-	-	2.52
	CD @ 5%		-	-	-	7.64
	CV (%)		-	-	-	10.43

Figures in parentheses are corresponding Arc Sin transformed values

According to data Dr. PDKV- Entomology formulation with highest seed cotton yield of 12.10 q/ha was most effective treatment. The next effective treatments were Brahmasthra extract and Panchpatre extract which recorded seed cotton yield of 9.50 and 8.30 q/ha, respectively. Whereas, plots treated with Broad-spectrum formulation and Neem seed extract recorded seed cotton yield of 7.80 and 7.10 q/ha, respectively and proved moderately effective. Garlic-Chilli extract

and Cow urine treatment showed seed cotton yield of 6.20 and 5.50 q/ha, respectively and both treatments were found statistically at par with untreated control (5.20 q/ha) (Table 5). Data on incremental cost benefit ratio showed Brahmasthra extract more economically viable treatment with highest ICBR of 1:5.4. It was followed by Dr. PDKV-Entomology formulation (1:4.7) and Panchpatre extract (1:3.2). Cow urine was most uneconomical with ICBR of 1: -0.7 (Table 6).

Table 5: Effect of organic extracts on seed cotton yield.

Sr. No.	Treatments	Dose/100 liter of water	Seed cotton yield (q/ha)			
			RI	RII	RIII	Mean
1	Brahmashtra extract	2 L	8.80	9.30	10.40	9.50
2	Panchpatre extract	2.5 L	7.30	8.60	9.00	8.30
3	Garlic-Chilli extract	2.5 L	7.20	5.20	6.20	6.20
4	Broad-spectrum formulation	1.6 L	7.50	8.30	7.60	7.80
5	Dr. PDKV-Entomology formulation	2.5 L	12.70	11.60	12.00	12.10
6	Neem seed extract	10 L	8.10	6.90	6.30	7.10
7	Cow urine	12.5 L	5.40	6.10	5.00	5.50
8	Untreated control	-	5.10	4.80	5.70	5.20
	F test	-	Sig	Sig	Sig	Sig
	SE (m) ±	-	-	-	-	0.45
	CD @ 5%	-	-	-	-	1.36
	CV (%)	-	-	-	-	10.10

Figures in parentheses are corresponding Arc Sin transformed values

Table 6: Incremental cost benefit ratio for organic extract.

Sr. No.	Treatments	Quantity of organic extract (Dose/ 100 liter of water)	No. of sprays	Cost of organic extract (Rs/ha)	Labour and sprayer charges (Rs/ha)	Cost of plant protection (Rs/ha) (A)	Yield of seed cotton (q/ha)	Increase in yield over control (q/ha)	Value of increased yield over control (Rs/ha) @ Rs. 5100 (B)	Net gain over control (C) (B-A)	ICBR	Rank
1	Brahmashtra extract	2 L	3	1890	1530	3420	9.50	4.30	21930	18510	1:5.4	I
2	Panchpatre extract	2.5 L	3	2190	1530	3720	8.30	3.10	15810	12090	1:3.2	III
3	Garlic-Chilli extract	2.5 L	3	3090	1530	4620	6.20	1.00	5100	480	1:0.1	VI
4	Broad-spectrum formulation	1.6 L	3	2089.44	1530	3619.44	7.80	2.60	13260	9640.56	1:2.6	IV
5	Dr. PDKV-Entomology formulation	2.5 L	3	4657.5	1530	6187.5	12.10	6.90	35190	29002.5	1:4.7	II
6	Neem seed extract	10 L	3	1440	1530	2970	7.10	1.90	9690	6720	1:2.3	V
7	Cow urine	12.5 L	3	3750	1530	5280	5.50	0.30	1530	-3750	1: -0.7	VII
8	Untreated control	-	-	-	-	-	5.20	-	-	-	-	-

1) Labour charges for one spray/ha. @ Rs. 230/Labour/day 2. spray pump charges/ha. Rs. 50/day/pump 3. price of seed cotton Rs. 5100/ql.
2) Cost of organic extract: Brahmashtra extract @ Rs. 630/ha, Panchpatre extract @ Rs. 730/ha, Garlic-Chilli extract @ Rs. 1030/ha.
3) Broad- spectrum formulation @ Rs. 696.48/ha, Dr. PDKV- Entomology formulation @ Rs. 1552.5/ha, Neem seed extract @ Rs. 480/ha and Cow urine @ Rs. 1250/ha

Earlier researchers such as Anitha and Nandihalli (2008) reported effectiveness of biorationals viz. NSKE 5%, neem oil 2%, pongamia oil 2%, azadirachtin 5%, *Vitex negundo* 5% and mycopathogens against sucking pest complex of okra. NSKE proved most economical with highest yield of 40.21 q/ha and net returns of Rs. 6,418/ha and highest C: B ratio of 1:8.56. Malinga (2012) reported tobacco as most promising bio-pesticide against American bollworm (*H. armigera*) and spiny bollworm (*E. insulana*) larvae on cotton with significantly higher yields (37.50 q/ha) than the garlic, *Allium sativum* (30.60 q/ha), khaki weed, *Tagetes minuta* (27.01q/ha) and thorn apple, *Datura stramonium* (28.70 q/ha). Patel *et al.* (2017) reported highest seed cotton yield (27.74 q/ha) from the plots treated with Brahmastra @ 20 per cent followed by Agniastra @ 20 per cent (25.12 q/ha) and Neemastra @ 20 per cent (23.99 q/ha). Untreated control had lowest seed cotton yield *i.e.* 15.72 q/ha.

CONCLUSIONS

Dr. PDKV-Entomology formulation was most effective with least bollworm complex damage in green fruiting bodies *i.e.* 4.09 per cent. Neem seed extract and Dr. PDKV- Entomology formulation reported least pink bollworm damage of 18.67 and 21.15 per cent in green bolls respectively. At harvesting minimum bollworm damage on open bolls was observed in plots treated with Dr. PDKV-Entomology formulation (25.17%) which was found at par with Brahmashtra extract (28.33%) and Panchpatre extract (34.00%). Dr. PDKV-Entomology formulation showed highest seed cotton yield of 12.10 q/ha. Brahmashtra extract emerged as the most economically viable treatment by giving the highest Incremental cost benefit ratio (ICBR) of 1:5.4.

FUTURE SCOPE

Present study will be helpful in providing botanical pesticides as a safer option for bollworm complex control on cotton crop. These eco-friendly pesticides

will eventually conserve natural enemies and will contribute as one of the important component of Integrated Pest Management in cotton crop.

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Conflict of Interest. None.

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