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RESEARCH **P**APER

Bioefficacy of wild plant extract for biological control of insect pests of Bt cotton

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Wild plant fruit extract such as hinganbet, *Balanites roxburghii*, ritthaa/soap nut, *Sapindus trifoliatus*, shikekaaee, *Acacia concinna*, Neem, *Azadirachta indica*, Karanj, *Pongamia pinnata* and vekhand, *Acorus calamus* L. were evaluated to screen their efficiency for the control of sucking pests of Bt cotton during *Kharif* 2009 to 2012 at Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. All the organic pesticide treatments were superior over untreated control. Among the evaluated organic pesticides the treatment with 5 per cent hingan bet extract @ 2 litre per hectare was observed to be effective in reducing pest population in which aphids, jassids, thrips and whiteflies of 22.68, 8.16, 14.53 and 10.97 per three leaves, respectively, were recorded with the seed cotton yield of 20.77 quintal per hectare. However, this treatment was statistically at par with 5 per cent ritthaa extract @ 2 litre per hectare. The treatment with 5 per cent ritthaa extract recorded aphids, jassids, thrips and whiteflies of 23.16, 9.87, 15.34 and 12.65 per three leaves, respectively, with the seed cotton yield of 20.09 quintal per hectare. The treatment with 5 per cent NSE @ 2 litre per hectare recorded 28.96, 12.61, 17.71 and 15.18 aphids, jassids, thrips and whiteflies per three leaves, respectively, with the seed cotton yield of 12.31 quintal per hectare. The phytotoxicity studies on leaf injury on tips and leaf surface, wilting, vein necrosis, epinasty and hyponasty showed that there was no phytotoxic effect of the evaluated pesticides on cotton crop at the evaluated doses. The counts on natural enemies in the treatments with hinganbet and ritthaa extract were more or less similar to those recorded in untreated control. This clearly indicated that there was no adverse effects on natural enemies due to spraying of hinganbet and ritthhaa extract at evaluated doses.

Key words : Bt cotton, *Kharif*, Sucking pests, Organic pesticide, Hingan bet, *Balanites roxburghii*, Soap nut, *Sapindus trifoliatus*, Phytotoxicity

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INTRODUCTION

In agriculture and horticulture, insect pests are a very important factor of loss. As an average, they account for 20-30 per cent loss of production, but in some cases they provoke a total loss. In addition, more than 550 species of insect pests have developed resistance against most current insecticide groups. So many scientists in industry and academia are currently trying to obtain useful compound from plants as, natural insecticides. A possibly interesting class of molecules is the saponins, a group of steroid or triterpenoid secondary plant metabolites with divergent biological activities. Saponins are known to have various biological properties. They have membrane-permeabilising, haemolytic, antioxidant, anti-inflammatory, immunostimulant and anticarcinogenic activities, they affect feed intake, growth and reproduction in animals and they can be used as fungicides, molluscicides and pesticides, as well as against some bacteria and viruses (Francis *et al.*, 2002; Sparg *et al*., 2004; Avato *et al.*, 2006 and Tava and Avato, 2006).

Saponins give rise to increased mortality levels,

lowered food intake, weight reduction, retardation in development, disturbances in development and decreased reproduction in insect pests (Ellen *et al*., 2007). The mechanism underlying these actions is, however, still largely unkown, but it is likely that saponins have multiple activities. The main hypotheses are that saponins could either make food less attractive to eat (repellent/deterrent activity), bear digestive problems cause moulting defects or have toxic effects on cells.

Apart from working on the insect gut saponins can also affect the micro flora living in there. For most herbivore insects (invertebrates) the digestion of leaf material is mediated by symbiotic micro-organisms that reside in the hindgut (Waterman, 1993). Any compound that kills off a reasonable amount of these supporting bacteria could undermine the insects digestive capabilities. The predators and parasitoids were not affected in field. Therefore, saponin insecticides have potential for use in integrated pest management programmes because of their insecticidal activity. The present study was aimed at determining the potential of plant saponins against sucking pests in Bt cotton under field conditions with effect on NEs and yield.

RESEARCH METHODOLOGY

The present study was carried out at Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri to screen the efficiency of wild plant extract for the control of sucking pests of Bt cotton. The field experiment was laid out during *Kharif* 2009 to 2012 in a Randomized Block Design (RBD) with eight treatments including control, each replicated thrice. The plot size was 7.2 x 5.4 m^2 with 90 x 90 cm row to row and plant to plant distance, respectively.

The crop was sown in the first week of June during all years. Fertilizers and other cultural practices were followed as per the recommendations in the package of practices. There were seven plant extracts including neem products. Based on economic threshold level, three sprays of these botanicals were given initiating the first at 50 days after sowing. The data on sucking pest population were recorded from randomly selected five tagged plants per plot. Pre-treatment count was made just before the application of botanicals and post treatment count after 3, 5 and 10 days of application of botanicals. The values were then transformed to square root transformation for analysis as per Randomized Block Design. At the crop harvest cotton yield was recorded in kg/plot and then transformed to quintal/ha. The data were analyzed as per Randomized Block Design for interpretation.

Besides this, the observations on number of natural enemies *viz.*, *Coccinellids* and *Chrysoperla* were recorded on ten randomly selected plants in each plot. In case of phytotoxicity, the observations were recorded at 1, 3, 5, 7 and 10 days after spray on leaf injury on tips and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty on 10 randomly selected plants. The total number of leaves and those showing phytotoxicity, if any, were counted and data converted into percentage and extent of phytotoxicity were recorded on the basis of score.

Table A : Treatment details

Sr. No.	Treatments	Dose/ha
1.	Neem oil, *Azadirachta indica*	2 lit.
2.	5% Hingan bet extract, *Balanites roxburghii*	2 lit.
3.	Vekhand powder, *Acorus calamus*	2 kg
4.	Shikekaaee powder, *Acacia concinna*	2 kg
5.	5 % Ritthaa/ soap nut extract, *Sapindus trifoliatus*	2 lit.
6.	Karanj oil, *Pongamia pinnata*	2 lit.
7.	5 % NSE, *Azadirachta indica*	2 lit.
8.	Untreated control	----

RESEARCH FINDINGS AND ANALYSIS

The pooled data (2009 to 2012) presented in Table 1 revealed that all the organic pesticide treatments were significantly superior over untreated control. Among the evaluated organic pesticides, the treatment with 5 per cent hingan bet extract @ 2 lit./ha observed to be most effective against sucking pests of Bt cotton by recording 22.68, 8.16, 14.53 and 10.97 aphids, jassids, thrips and whiteflies per three leaves, respectively. This treatment was statistically at par with 5 per cent ritthaa extract @ 2 lit./ha, in which aphids, jassids, thrips and whiteflies of 23.16, 9.87, 15.34 and 12.65/3 leaves were recorded, respectively. This was followed by treatment with neem oil @ 2 lit./ha, Karanj oil @ 2 lit./ha, shikekaee extract 5 per cent, vekhand powder extract and 5 per cent NSE. The treatment with 5 per cent NSE recorded 28.96, 12.61, 17.71 and 15.18 aphids, jassids, thrips and whiteflies/3 leaves, respectively. The untreated control recorded higher population of sucking pests *viz.*, aphids (54.14),

Table 1 : Bioefficacy of botanical insecticides against major pests on cotton (Pooled 2009 to 2012)

Sr. No.	Treatments	Dose / ha	Average sucking pest population/3 leaves				Predators / 10 plants		Yield (q/ha)
			Aphids	Jassids	Thrips	Whitefly	Chrysopa	Coccinellids	
1.	Neem oil *Azadirachta indica*	2 lit	25.51 (5.10) *	10.52 (3.32)	16.89 (4.17)	13.50 (3.74)	7.27 (2.79)	8.53 (3.00)	18.67
2.	5% Hingan bet extract *Balanites roxburghii*	2 lit	22.68 (4.81)	8.16 (2.94)	14.53 (3.88)	10.97 (3.39)	8.13 (2.94)	9.27 (3.13)	20.77
3.	Vekhand powder *Acorus calamus*	2 kg	37.29 (6.15)	16.59 (4.13)	20.23 (4.55)	18.74 (4.39)	5.93 (2.54)	6.80 (2.70)	14.22
4.	Shikekaaee powder *Acacia concinna*	2 kg	29.45 (5.47)	13.24 (3.71)	15.88 (4.05)	15.48 (4.00)	6.07 (2.56)	8.20 (2.95)	17.13
5.	5 % Ritthaa/ soap nut extract, *Sapindus trifoliatus*	2 lit	23.16 (4.86)	9.87 (3.22)	15.34 (3.98)	12.65 (3.63)	9.60 (3.18)	10.93 (3.38)	20.09
6.	Karanj oil *Pongamia pinnata*	2 lit	26.67 (5.21)	12.64 (3.62)	17.72 (4.27)	15.68 (4.02)	5.73 (2.50)	6.80 (2.70)	18.62
7	5 % NSE** *Azadirachta indica*	2 lit	28.96 (5.43)	12.61 (3.62)	17.71 (4.27)	15.18 (3.96)	3.41 (1.98)	4.77 (2.30)	12.31
8.	Untreated control	----	54.14 (7.39)	20.69 (4.60)	35.89 (6.03)	26.49 (5.20)	10.53 (3.32)	12.00 (3.54)	9.47
	S.E. ±	----	0.11	0.14	0.10	0.15	0.23	0.24	0.47
	C.D. (P=0.05)	----	0.32	0.42	0.31	0.45	0.70	0.73	1.42
	CV %	-----	9.48	11.27	10.34	8.20	9.74	10.70	10.14

*(Figures in parenthesis are √x+0.5 transformed values for numbers) ** NSE = Neem Seed Extract

Table 2 : Rating criteria for phytotoxicity symptoms

Score	Per cent crop health affected
0	No adverse effect
1	1-10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

jassids (20.69), thrips (35.89) and whitefly (26.49) per three leaves, respectively. The results are in agreement with those of Jat *et al.* (1992), Lekha and Jat (2004) who reported that neem based products were least effective against aphid on coriander and mustard.

The results showed that seed cotton yield under all the treatments were significantly superior over control. The highest seed cotton yield of 20.77 q/ha was obtained from the plots treated with hingan bet extract followed by ritthaa extract and 5 per cent NSE which gave 20.09 and 12.31 q/ha, respectively. The present findings are in conformity with that of Lekha and Jat (2004) who reported that increase in yield in different insecticide treatment

Table 3 : Phytotoxicity effect of botanical insecticides on injury on leaf injury on tips and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty

Sr. No.	Treatments	Dose/ha	Observations before and after spray					
			Before spray	1 DAS*	3 DAS	5 DAS	7 DAS	10 DAS
1.	Neem oil, *Azadirachta indica*	2 lit	0	0	0	0	0	0
2.	5% Hingan bet extract, *Balanites roxburghii*	2 lit	0	0	0	0	0	0
3.	Vekhand powder, *Acorus calamus*	2 kg	0	0	0	0	0	0
4.	Shikekaaee powder, *Acacia concinna*	2 kg	0	0	0	0	0	0
5.	5 % Ritthaa/ soap nut extract, *Sapindus trifoliatus*	2 lit	0	0	0	0	0	0
6.	Karanj oil, *Pongamia pinnata*	2 lit	0	0	0	0	0	0
7.	5 % NSE, *Azadirachta indica*	2 lit	0	0	0	0	0	0
8.	Untreated control	----	----	----	----	----	----	----

*DAS= days after spraying

over control against aphid, whereas it was minimum in neem based products.

The counts of *Coccinellids* and *Chrysoperla* in different insecticide treatment presented in Table 2, clearly indicated that the counts of natural enemies were more or less similar to those recorded in untreated control. This indicates that there was no adverse effect of these botanicals on natural enemies at evaluated doses. The studies on phytotoxicity effects of these botanicals (Table 3) revealed that none of the insecticide treatment showed phytotoxic symptoms like leaf injury on tips and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty on cotton crop at evaluated doses. The neem based product neem oil and NSE were found less effective than saponins. The present findings are in conformity with findings of Jat *et al.* (1992), Lekha and Jat (2004) and Jat *et al.* (2009) who reported that neem based products were least effective against aphid.

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