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EVALUATION OF SOAP SOLUTION FOR MANAGEMENT OF COTTON SUCKING PESTS AT DIFFERENT LOCATIONS OF BANGLADESH

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ABSTRACT

Experiments were conducted to determine the efficacy of soap water solutions against sucking pests of cotton viz. white fly, jassid and aphid at three locations namely Dinajpur, Jessore and Gazipur of Bangladesh. All the tested concentrations viz. 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0% were evaluated on the yield and benefit cost ratio. Results showed that soap water solutions significantly reduced the incidence of sucking pests and increased cotton yield. The benefit cost ratio indicated that spray soap water solution is a profitable method and may to be as an environmental friendly tool for management of cotton sucking pests.

Key words: *Cotton, sucking pests, soap solution*

INTRODUCTION

Cotton is a highly valued commercial crop and is prone to pest attack at all the stages of growth. About 162 insect pests attack cotton of which 15 are considered as major (Anonymous, 1999). White fly (*Bemisia tabaci*), jassid (*Amrasca biguttulla*) and aphid (*Aphis gossypii*) are important sucking pests and cause heavy losses (Kulkarni *et al*., 2003). White fly sucks sap usually from the under surface of the leaves and excrete honey dew. Infested leaves become less vigor, wilt and turn yellow (Bohmfalk *et al*., 1996). Jassid, which is commonly known as leaf hopper suck sap from the leaves and cause phytotoxic symptoms known as "hopper burn" which results in complete desiccation of plants (Narayan and Singh, 1994). Cotton aphids are commonly found at lower leaf surface on the terminal and other parts of cotton plants. They feed by sucking sap from phloem tissue. The accumulation of honey dew causing the appearance of sticky and shiny leaf surfaces often indicates the presence of this pest. Severe infestations seriously stunt plants and reduce yields. Honey dew secretions on open bolls may result in lint staining or sticky cotton (Bohmfalk *et al*., 1996). Cotton growers usually spray insecticides throughout the season to protect their crops from pest attack. But this kind of control strategy creates complications in the ecosystem (Frisbie, 1984), which is directly toxic to the beneficial insects (Goodland *et al*., 1985). Soaps have been used to control insects for over 200 years. Soaps are inexpensive and act strictly as contact insecticides, with no residual effect (Abbasi *et al*., 1984). As a result, recently there has been a great increase in interest and use of these products. Therefore, this investigation was done to test the efficacy of soap water solution for the control of sucking pests of cotton.

MATERIALS AND METHODS

Cultivation of crop: The experiment was conducted in randomized complete block design with the cotton variety CB-9 during August to December 2005 and 2006 at three regional cotton research, training and seed multiplication farm namely Dinajpur, Jessore and Gazipur. The plot size was 10 × 10 m. The spacing between block-to-block and plot-to-plot were 1.5 and 1m and respective footpath was 2 m. At all the location, seeds were sown on 1st week of August 2005 and 2006, at the rate of 15 kg / ha in a north-south row. The seeds were sown by hand keeping a distance of 45 cm from plant to plant and row-to-row distance was 90 cm. Necessary intercultural operations such as mulching, weeding, irrigation and application of fertilizer were done properly.

Application of soap solution: The experiment was conducted with 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0% soap water solution @ 1, 2, 3, 4, 5 and 6 kg soap powder per hectare area. An untreated

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observation was performed for control treatment. Spraying was done on the basis of threshold level of the pests by using a knapsack sprayer. Field evaluation of soap water solution was assessed by the incidence of pest (number of insect/ plant) and economic return of the crop. To estimate the incidence of pests, sampling was carried out from the cotton field in the entire cotton growing season (August to November). It was done by weeklyscouting taking 5 plants randomly from each replication. Plants were examined for white fly, jassid and aphid. The presence of aphid was estimated on a scale 0 - 4 ('0' no aphid, '1' few aphids, '2' one leaf or growing point infested, '3' more than one leaf or growing point infested, '4' entire plant heavily infested). Newly growing parts with two fully expanded leaves were examined for aphid and white fly. A scouting form was used during estimation of the pests.

Data analysis: Variable cost and net return was calculated as per Tague and Shelstad (1981). The benefit cost ratio was calculated by dividing the net return by total variable cost. Data of the different parameters were analyzed by analysis of variance and the mean values were separated by Duncan's Multiple Range Test (DMRT).

RESULTS

At Dinajpur station, different concentrations of soap water solution showed significantly lower incidence of white fly and aphid compared to control (Table 1). But the effects of soap water concentrations were statistically indifferent. The incidence of white fly and aphid grade varied from 1.27 - 3.01 and 0.50 - 3.50, respectively. Soap water solution did not effect on the incidence of jassid. The incidence of jassid ranged from 0.27 - 0.50. Soap water solution showed significant effect on the production of yield compared to control, and the highest amount (1250 kg / ha) of yield (seed cotton) was produced when 3% solution was applied.

Table 1. Effect of soap water solution on the mean incidence of sucking pests and yield of cotton at Dinajpur station for the year 2005 and 2006

Concentration	No. of	Dose	Number of insect/plant		Aphid	Yield
(%)	spray	(Kg/ha)	White fly	Jassid	grade	(kg/ha)
0.5	9	1	1.60 b	0.44 a	1.20 b	720 b
1.0	8	2	1.58 b	0.43 a	1.00 b	815 b
1.5	7	3	1.49 b	0.38 a	0.90 b	860 b
2.0	7	4	1.39 b	0.32 a	0.80 b	1000 a
2.5	6	5	1.33 b	0.31 a	0.65 b	1100 a
3.0	6	6	1.27 b	0.27 a	0.50 b	1250 a
Control	-	-	3.01 a	0.50 a	3.50 a	250 c

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

Table 2 showed the results obtained from Jessore station where the solutions were applied 6 to 10 times. At this station, soap water solutions showed significantly lower incidence of sucking pests compared to control. The incidence of white fly, jassid and aphid varied from 1.35 - 5.02, 1.45 - 4.50 and 0.60 - 3.75, respectively. Table 2 showed that soap water solutions have significant effect on the production of yield and the highest (1195 kg / ha) amount of yield was attained by 3% soap water solution. Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$). At Gazipur station (Table 3), soap water solutions showed significantly lower incidence of sucking pests compared to control. But results obtained from different concentrations were statistically indifferent. The incidence of white fly, jassid and aphid varied from 1.27-4.05, 1.02-3.27 and 0.66-3.39, respectively. Soap water solution showed significant effect on the production of yield. The highest (1200 kg/ha) and lowest (275 kg/ha) amount of yield were gained by the treatments 3% soap water solution and control, respectively.

Table 2. Effect of soap water solution on the mean incidence of sucking pests and yield of cotton at Jessore station for the year 2005 and 2006

Concentration (%)	No. of spray	Doses (Kg/ha)	Number of insect/plant		Aphid grade	Yield (kg/ha)
			White fly	Jassid		
0.5	10	1	1.85 b	2.04 b	1.30 b	800 b
1.0	9	2	1.76 b	1.90 b	1.15 b	900 b
1.5	9	3	164 b	1.75 b	0.95 b	1050 a
2.0	8	4	1.55 b	1.60 b	0.80 b	1125 a
2.5	7	5	1.48 b	1.50 b	0.72 b	1156 a
3.0	6	6	1.35 b	1.45 b	0.60 b	1195 a
Control	-	-	5.02 a	4.50 a	3.75 a	260 c

Table 3. Effect of soap water solution on the mean incidence of sucking pests and yield of cotton at Gazipur station for the year 2005 and 2006

Concentration (%)	No. of spray	Doses (Kg/ha)	Number of insect/plant		Aphid grade	Yield (kg/ha)
			White fly	Jassid		
0.5	9	1	1.75 b	1.64 b	1.15 b	850 b
1.0	8	2	1.60 b	1.45 b	1.02 b	920 b
1.5	8	3	1.55 b	1.28 b	0.92 b	1090 a
2.0	7	4	1.48 b	1.20 b	0.83 b	1105 a
2.5	6	5	1.35 b	1.12 b	0.72 b	1160 a
3.0	5	6	1.27 b	1.02 b	0.66 b	1200 a
Control			4.05 a	3.27 a	3.39 a	275 c

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

Benefit cost ratio of soap water solution used for controlling sucking pests at Dinajpur station in the year 2005 and 2006 have presented in table 4. Results showed that total variable cost ranged from 1710 - 2340 Tk., and net return varied from 18450 - 32660 Tk, and that were accounted from the treatments 0.5 and 3% solutions, respectively. These treatments also showed lowest (10.79) and highest (13.95) benefit cost ratios.

Table 4. Polled benefit cost ratio of soap water solution used at Dinajpur station for the year 2005 and 2006

Concentration (%)	No. of spray	Variable cost (Tk)			Return (Tk)		Benefit cost ratio
		Soap powder	Labor	Total	Gross	Net	
0.5	9	360	1350	1710	20160	18450	10.79
1.0	8	640	1200	1840	22820	20980	11.40
1.5	7	840	1050	1890	24080	22190	11.74
2.0	7	1120	1050	2170	28000	25830	11.90
2.5	6	1200	900	2100	30800	28700	13.66
3.0	6	1440	900	2340	35000	32660	13.95
Control	-	-	-	-	-	-	-

Soap powder: 40 Tk / Kg, Seed cotton: 28 Tk / Kg, Labor: 2 labor / spray / ha (75Tk / labor)

Table 5 comprising the polled benefit cost ratio obtained from Jessore station stated that total variable cost ranged from 1900 - 2480 Tk, and were obtained from the treatments 0.5% and 2.0% soap solution, respectively. The highest (31120 Tk) and lowest (20500 Tk) net return obtained from the treatments 3% and 0.5% solution, respectively. The highest (13.30) and lowest (10.79) benefit cost ratios were obtained by these treatments, respectively.

Table 5. Polled benefit cost ratio of soap water solution used at Jessore station for the year 2005 and 2006

Concentration (%)	No. of spray	Variable cost (Tk)			Return (Tk)		Benefit cost ratio
		Soap powder	Labor	Total	Gross	Net	
0.5	10	400	1500	1900	22400	20500	10.79
1.0	9	720	1350	2070	25200	23130	11.17
1.5	9	1080	1350	2340	29400	26970	11.53
2.0	8	1280	1200	2480	31500	29020	11.70
2.5	7	1400	1050	2450	32368	29918	12.21
3.0	6	1440	900	2340	33460	31120	13.30
Control	-	-	-	-	-	-	-

Soap powder: 40 Tk / Kg, Seed cotton: 28 Tk / Kg, Labor: 2 labor / spray / ha (75Tk / labor)

Polled benefit cost ratio obtained from Gazipur station presented in Table 6. Table showed that total variable cost ranged from 1710 - 2170 Tk, and these amounts were accounted from the treatments 0.5 and 2.0% solution, respectively. Net return increased with increasing concentration of solution and ranged from 22090 - 31650 Tk. Benefit cost ration also increased with increasing concentration of solution and varied from 12.91 - 16.23.

Table 6: Polled benefit cost ratio of soap water solution used at Gazipur station for the year 2005 and 2006

Concentration (%)	No. of spray	Variable cost (Tk)			Return (Tk)		Benefit cost ratio
		Soap powder	Labor	Total	Gross	Net	
0.5	9	360	1350	1710	23800	22090	12.91
1.0	8	640	1200	1840	25760	23920	13.00
1.5	8	960	1200	2160	30520	28360	13.14
2.0	7	1120	1050	2170	30940	28770	13.26
2.5	6	1200	900	2100	32480	30380	14.47
3.0	5	1200	750	1950	33600	31650	16.23
Control	-	-	-	-	-	-	-

Soap powder: 40 Tk / Kg, Seed cotton: 28 Tk / Kg, Labor: 2 labor / spray / ha (75Tk / labor)

DISCUSSIONS

In this study, six different concentrations of soap solutions viz. 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0% were sprayed for controlling white fly, jassid and aphid of cotton at three locations of Bangladesh. The treatments were sprayed on the basis of the economic threshold level of the pests which varied in different locations. The results obtained from different locations stated that soap water solutions significantly effect on the incidence of sucking pests which interrupted the yield and benefit cost ratio. Soaps are most effective against small and soft-bodied arthropods, such as aphids, young scales, whiteflies, psyllids, mealy bugs, and spider mites (Fournier and Brodeur, 2000). Soap disrupted the cell membranes of insects and removed the protective waxes that cover the insect,

causing death through excess loss of water. Daniel (2002) applied different concentrations viz. 0.05, 0.1, 0.25, 0.5, 1.0, 2.0, 3.0, 4.0 and 5.0% of soap water solution on German cockroach, *Blattella germanica* and reported that soap concentrations of 3% or greater resulted in 100% unresponsiveness after 3 minutes and eventually resulted in 100% mortality within 72 h for all adults and nymphs treated. Nurindah and Bondra (1988) stated that the insecticides have adverse effects on predator insects. The beneficial insect fauna were adversely affected when insecticides were applied to kill the cotton pests (Khattak *et al*., 2004). Soaps may act as nerve toxicants that result in paralysis and death of the insect. Other mode-of-action theories include spiracle blockage, cellular disruption, and cuticle desiccation (Olkowski *et al*. 1991), but these modes of action would not result in such rapid death. Soap solutions, due to their low mammalian toxicity, have potential for use in pest management programmes. The result in this study is not only an effective, but also an economical pest management option. While soap solutions may not completely replace the currently used pesticidal sprays, they may have a place as environmental safe pest management tool for sucking pests of cotton.

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