

COMPARATIVE EFFECT OF NEEM (*AZADIRACHTA INDICA* A. JUSS) OIL, NEEM SEED WATER EXTRACT AND BAYTHROID TM AGAINST WHITEFLY, JASSIDS AND THRIPS ON COTTON

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ABSTRACT

Neem oil and neem seed water extract at different levels of concentration were compared with Baythroid TM for its effects against some sucking insect pests of cotton at cotton research section, Agriculture Research Institute, Dera Ismail Khan. Neem oil at 2% and neem seed water extract at 3% significantly reduced the population of whitefly, jassids and thrips on cotton up to 168 hours after spray but lost their efficacy up to 336 hours after spray. Reduction in the test insects population 24 hours after spray at 1.5 % and 2% neem oil and 3% neem seed water extract increased 168 hours after spray which may be because of the anti-feedant and deterrent effect of neem which had forced the test insects to leave the locality or chronic effect of the neem compounds. The synthetic chemical (Baythroid TM) at recommended dose ranked 1st in reducing the test insect population and also remained effective up to 336 hours after spray.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) in Pakistan is a major source of foreign exchange. Millions of workers are engaged in the production, trade and industry of cotton. Besides, providing lint to domestic textile industry, it contributes 69.5% share in national oil production (Awan, 1994). Moreover, cotton seed cake is a good concentrated feed of cattle. In Pakistan, it is grown over an area of 3.0 million hectares with an annual production of over 10 million bales (170 kg) each (Kifayatullah, *et al.*, 2005). The yield per hectare is very low as compared to other agro technically advanced cotton growing countries. The low yield per unit area could be because of the lack of quality seed, non technical approach of farmers and the attack of insect pests complex which cause 15-20% loss in cotton yield (Zahidullah, 1992).

Among these insect pests, whitefly, jassids and thrips are of a great importance. These sucking insect pests not only reduce the quantity but the quality of the crop as well.

These insect pests are mainly controlled by synthetic chemicals but because of their several ill effects, plant derivatives are being tried by the farmers. These plant derivatives are safe to man and other non target organisms and friendly to the environment. At least 46 families of flowering plants have insecticidal activities (Feinstein, 1952). Among these plants, neem tree provide a good source for the control of these insect pests in the form of neem oil extracts and even seed water extracts (Jacobson, 1988). Its safe nature makes neem superior to the other synthetic chemicals. The most important compounds in neem are Azadirachtin, Salanin, Nimbin and Malentrolil which have feeding

deterrence, repellent, ovipositional inhibiting and growth regulating activities against a great variety of insects (Jacobson, 1988).

The insecticidal activities of neem against different insect pests have also been evaluated by Sharma and Ansari (1994), Khattak *et al.* (2000), Okonkwo and Okoya (1996).

MATERIALS AND METHODS

EFFECT OF NEEM DERIVATIVES AND BAYTHROID TM ON SUCKING INSECT PESTS OF COTTON

An experiment was conducted at Agriculture Research Institute Ratta Kulachi, D. I. Khan to test the effect of neem derivatives on Whitefly, Thrips and Jassids on cotton during kharif 2005. Cotton variety CIM-476 used in these trials was obtained from the cotton research section of the said institute. The experiment was designed in Randomized Complete Block (RCBD). There were eight treatments, each treatment was replicated three times. Plot size was 5 x 4.5 m per treatment. Two to three seeds per hill were sown using dibbling method. Plant to plant distance was kept 30 cm and row to row distance was kept 75 cm, respectively. At three to four leaves stage thinning was done leaving one healthy seedling per hill. Recommended doses of fertilizer were applied as and when required. All other standard agronomic practices including irrigation were given at proper time.

For the assessment of insect pests of cotton a diagonal method was used. To assess population of sucking insects data were recorded early in the morning by counting number of whiteflies, thrips, and jassids through use of magnifying lens on three randomly selected plants per treatment. Three leaves per plant were

observed randomly and alternatively from top, middle and lower portion of the plants.

The crop was sprayed four times at an interval of 20 days. The first spray was carried out when the pest attack reached at Economic Threshold Level. The threshold level for sucking insects is as follows:

- Whiteflies 4-5 Adults/Crawlers per leaf
- Thrips 8-10 Adults/Nymphs per leaf
- Jassids 1-2 Adult/Nymph per leaf

Each neem derivative and pesticide was sprayed with knapsack hand operated sprayer. Pre-treatment data was recorded 24 hours before spray and post treatment data was recorded 24 hours, 168 hours and 336 hours after spray to determine the effect of above mentioned chemicals.

The mean populations of sucking insect pests from sprayed plots were considered to be an indirect reflection of efficacy of different insecticides, thus a lower mean value of population of insect pests after spray reflected on a higher efficacy or toxicity of an insecticide and vice versa. Percent population change was calculated by using modified Abbot's formulae (Fleming and Retnakaran, 1985) as below:

$$\% \text{ population change} = \left\{ 1 - \left(\frac{\text{Post treat. pop. in treatment}}{\text{Pre treat. pop. in check}} \div \frac{\text{Pre treat. pop. in treatment}}{\text{Post treat. Pop. in check}} \right) \right\} \times 100$$

Thus the final data were analyzed with Analysis of Variance (ANOVA) and means separated using Least Significant Different (LSD) test.

Preparation of Neem Oil Concentrations

Neem seed was collected from the local farmers of D. I. Khan and Bhakhar District. Neem oil from the neem seed was expelled by neem seed oil expeller. Different concentrations of the crude oil were prepared to be used in these trials.

Preparation of Neem Water Extracts

Two kilo grams dried neem seed collected from the local farmers was grinded. The grinded seed was tied in a cotton cloth in the form of a bag and dipped in five liter of water at 80 °C for 16 hours. In this way concentrated solution of 20% was obtained and diluted to 1% 2 % and 3% for spray in the trials.

Lay Out Plan of Experiment

R1	R2	R3
T4	T2	T1
T6	T5	T4
T3	T8	T6
T7	T3	T2
T5	T4	T5
T2	T1	T8
T8	T7	T3
T1	T6	T7

Detail of Treatments

T1	Neem oil 1%
T2	Neem oil 1.5%
T3	Neem oil 2%
T4	Neem seed water extract 1%
T5	Neem seed water extracts 2%
T6	Neem seed water extracts 3%
T7	Insecticide
T8	Control

RESULTS

EFFECT OF NEEM DERIVATIVES AND BAYTHROID TM ON THE INFESTATION OF:

Whitefly

Neem oil at 1% and neem seed water extract at 1% and 2% did not show any significant decrease in the whitefly population 24 hours after spray. However, a slight increase in the population reduction at 2% neem seed water extract, though, statistically similar was more than that in the control. The 42.31% and 28.19% population reduction at 2% neem oil and 3% neem seed water extract, respectively, was significantly better than the other treatments except the treatment of insecticide, which showed the highest (85.35%) population reduction of the test insect (Table-1).

The overall increase in the mean percent reduction in Whitefly population 168 hours after spray may be because of the neem antifeedant and deterrent effect, besides its toxicity to this insect at higher concentrations. A slight significant effect of neem oil 24 hours after spray at 1.5% concentration increased to 45.64% up to 168 hours after spray. The insecticide (Baythroid TM), 366 hours after spray resulted into 31.27% mortality of the test insect, where neem oil and neem seed water extract showed no significant reduction of the test insect population 336 hours after spray.

Similar results were obtained in the 2nd, 3rd and 4th sprays (Table-2, Table-3 and Table-4). Neem oil and neem seed water extract significantly reduced the test insect population at higher concentrations up to 168 hours after spray but lost their effectiveness up to 336 hours after spray. A slight reduction in the population of test insect at 2% neem seed water extract was also similar as it was

in the first spray. Though, there was a gradual decrease in the efficacy of insecticide used in this study against the test insect, it remained effective up to 336 hours after spray; as 22.42%, 26.33%, and 29.27% population reduction in 2nd, 3rd and 4th spray was statistically better than the other treatments.

Table-1: Effect of neem derivatives and Baythroid TM on the infestation of whitefly on cotton (1st spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24hours after spray	168hours after spray	336hours after spray	
1%	7.2	5.59E (6.57)	3.27E (6.81)	-0.12CD (7.03)	
1.5%	7	9.90D (6.22)	45.64C (3.93)	1.60C (6.7)	
2%	7.03	42.31B (3.93)	55.06AB (2.83)	7.00C (6.54)	
Neem Seed Water Extracts					
1%	6.16	6.50E (5.57)	1.96E (6.17)	-3.36D (6.24)	
2%	5.13	7.16DE (4.60)	10.31D (4.68)	1.35CD (4.94)	
3%	7.83	23.92C (5.76)	51.26BC (3.92)	2.38BC (7.46)	
Insecticide	6.33	85.35A (0.89)	60.51A (2.90)	31.27A (4.24)	
Control	8.43	4.5E (8.05)	-5.83E (8.52)	4.4CD (8.14)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-2: Effect of neem derivatives & Baythroid TM on the infestation of whitefly on cotton (2nd spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24hours after spray	168hours after spray	336hours after spray	
1%	(6.53)	2.78C (5.82)	2.60D (6.08)	-3.04D (6.53)	
1.5%	(8.96)	4.58C (7.74)	38.29B (5.29)	1.79BC (8.52)	
2%	(7.33)	32.05B (4.50)	53.45A (3.31)	3.04C (6.89)	
Neem Seed Water Extracts					
1%	(5.76)	-1.75C (5.29)	2.94D (5.67)	-3.29D (5.76)	
2%	(6.06)	-0.61C (5.60)	13.08 (5.25)	-0.17C (5.98)	
3%	(8.03)	24.46B (5.47)	40.17B (3.08)	2.88C (7.54)	
Insecticide	(5.4)	87.87A (.59)	58.10A (2.94)	22.42A (4.05)	
Control	8.5	9.64C (7.68)	5.41C (8.12)	-1.33C (8.23)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-3: Effect of neem derivatives and Baythroid TM on the infestation of whitefly on cotton (Third spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24hours after spray	168hours after spray	336hours after spray	
1%	5.53	3.40C (5.02)	3.62CD (5.27)	-2.12E (5.56)	
1.5%	6.36	6.72C (6.17)	36.34B (5.32)	2.34BCD (5.95)	
2%	8.43	36.16B (4.89)	57.62A (2.87)	4.56B (6.76)	
Neem Seed Water Extracts					
1%	6.56	-0.72C (6.47)	-0.99D (6.39)	-1.08DE (6.53)	
2%	6.00	2.61C (5.76)	8.91C (4.98)	1.29BCDE (5.71)	
3%	6.86	28.42B (4.55)	42.27B (3.82)	3.46BC (8.15)	
Insecticide	6.66	87.28A (1.06)	57.80A (3.37)	26.33A (3.59)	
Control	7.7	-0.12C (7.71)	-3.14D (7.96)	3.64CDE (7.68)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-4: Effect of neem derivatives and Baythroid TM on the infestation of whitefly on cotton (Fourth spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24hours after spray	168hours after spray	336hours after spray	
1%	(5.33)	-1.28EF (4.81)	-4.80D (4.81)	-3.58D (5.11)	
1.5%	(5.63)	2.79D (4.20)	31.65B (3.05)	-2.05CD (5.37)	
2%	(7.33)	37.70B (3.99)	54.79A (2.66)	2.16B (5.39)	
Neem Seed Water Extracts					
1%	(5.63)	-4.17F (5.14)	-12.25E (5.21)	-2.31CD (5.34)	
2%	(4.96)	2.33D (4.31)	6.28C (3.64)	-2.74D (4.75)	
3%	(6.06)	32.13C (3.59)	51.21A (2.36)	1.12BC (6.76)	
Insecticide	(5.16)	82.48A (0.80)	56.39A (1.81)	29.27A (3.40)	
Control	(7.26)	13.97DE (6.37)	10.01D (5.79)	-10.92BCD (6.5)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Thrips

Neem derivatives at higher concentration greatly affected the test insect population, as neem oil at 2% and neem seed water extract at 3% reduced 33.7% and 29.1%

thrips population, respectively, 24 hours after spray which were statistically better than the population reduction in the control (Table-5). However, Baythroid TM with 77.79% reduction ranked first in its efficacy. The insecticide, although, gradually lost its efficacy, it significantly control the test insect up to 336 hours. Neem oil at 1.5%, although, did not show any toxic effect against thrips 24 hours after spray, it significantly affected the test insect population 168 hours after spray. The increase in the percent reduction of the insect population not only at 1.5% but also at 2% neem oil and 3% seed water extract 168 hours after spray may be because of the antifeedant and deterrent effect of neem at these concentrations which had forced the insect to leave the locality; However, these treatments lost their efficacy up to 336 hours. Against thrips, neem seed water extract at 2% also showed a slight statistically better reduction of the test insect population than in the control.

All these treatments in the other applications behaved in similar fashion, as they did in the first application against the test insect. The synthetic insecticide ranked first in its efficacy and remained effective up to 336 hours after spray. The neem derivatives effected the insect population 168 hours after spray at higher concentrations but completely lost their effect up to 336 hours after spray (Table-6, 7, 8).

Table-5: Effect of neem derivatives and Baythroid TM on the infestation of thrips on cotton (First spray)

TREATMENTS		MEAN PERCENT EFFICACY		
Neem oil	24 hours before spray	24hours after spray	168hours after spray	336hours after spray
1%	13.93	-1.93C (13.44)	-2.83E (12.94)	-8.49D (14.00)
1.5%	13.1	3.12C (11.72)	28.32C (8.65)	0.75BC (12.07)
2%	13.03	33.73B (8.26)	57.43B (5.14)	2.37B (11.23)
Neem Seed Water Extracts				
1%	10.7	-2.21C (10.4)	-6.48E (10.47)	-7.50CD (10.65)
2%	9.63	-0.21C (8.99)	13.61D (7.72)	-3.27BCD (9.27)
3%	10.23	29.10B (6.87)	51.82B (4.13)	1.85B (9.39)
Insecticide	10.46	77.79A (2.20)	66.75A (3.23)	33.88A (6.40)
Control	12.56	5.36C (11.92)	2.84E (11.59)	-0.25BCD (11.62)

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$.

Table-6: Effect of neem derivatives and Baythroid TM on the infestation of thrips on cotton (Second spray)

TREATMENTS		MEAN PERCENT EFFICACY		
Neem Oil	24 hours before spray	24hours after spray	168hours after spray	336hours after spray
1%	10.46	-1.39D (10.23)	-3.88DE (10.12)	-3.63C (10.58)
1.5%	12.5	3.25C (11.72)	29.50B (8.2)	0.85BC (12.08)
2%	11.0	35.22B (6.88)	60.97A (4.00)	1.93B (10.53)
Neem Seed Water Extracts				
1%	10.04	-2.51C (9.93)	-7.33E (10.03)	-3.83C (10.17)
2%	10.43	2.28C (9.84)	6.13C (9.18)	-2.30BC (10.43)
3%	10.00	32.77B (6.47)	57.06A (4.01)	1.68B (8.94)
Insecticide	10.23	82.77A (1.72)	62.02A (3.62)	32.44A (5.99)
Control	10.16	3.25C (9.84)	3.14CD (9.54)	-4.21BC (9.96)

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-7: Effect of neem derivatives and Baythroid TM on the infestation of thrips on cotton (Third spray)

TREATMENTS		MEAN PERCENT EFFICACY		
Neem Oil	24hours before spray	24 hours after spray	168hours after spray	336 hours after spray
1%	10.49	-4.05F (10.7)	-7.81E (9.61)	-13.58E (10.62)
1.5%	12.53	1.56D (11.37)	29.89B (7.45)	-5.56CD (11.80)
2%	10.35	38.26B (5.88)	58.60A (3.29)	1.91B (7.72)
Neem Seedwater Extracts				
1%	10.44	-3.10EF (9.96)	-10.87E (9.87)	-9.80DE (10.27)
2%	10.26	0.74D (9.39)	8.64C (7.95)	-1.89BC (9.32)
3%	10.3	31.80C (6.47)	55.87A (3.9)	1.46B (9.05)
Insecticide	9.4	85.64A (1.24)	58.66A (3.62)	28.24A (6.01)
Control	11.23	8.39DE (10.36)	8.70D (9.53)	-4.89B (10.02)

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-8: Effect of Neem derivatives and Baythroid TM on the infestation of thrips on cotton (Fourth spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours Before spray	24 hours after spray	168 hours after spray	336 hours after spray	
1%	11.78	-1.15D (11.27)	-9.34E (11.39)	-8.62D (11.81)	
1.5%	11.37	2.17D (10.53)	32.21B (6.85)	0.58B (10.60)	
2%	11.34	35.73B (6.91)	54.95A (3.44)	1.89B (10.33)	
Neem Seed Water Extracts					
1%	10.40	-1.21D (9.93)	-9.72E (10.1)	-5.55CD (10.13)	
2%	9.62	1.53D (8.66)	9.01C (7.43)	-1.17BC (9.02)	
3%	11.25	31.01C (7.34)	54.35A (4.56)	1.67B (10.23)	
Insecticide	8.63	86.24A (1.12)	56.91A (4.34)	29.17A (5.65)	
Control	13.4	5.76D (12.67)	6.64D (11.88)	-4.27B (12.41)	

Each value is a mean of 3 replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$.

Jassids

Neem derivatives at higher concentrations and Baythroid TM at recommended dose were as effective against jassids as these were effective against whitefly and thrips (Table-9). Neem oil at 2% and neem seed water extract at 3% reduced 37.89% and 31.31% insect population, respectively, 24 hours after spray. Neem oil at 1.5%, although, did not target the pest population 24 hours after spray, it significantly reduced the test insect pest population up to 168 hours after spray. The increase in the efficacy was also apparent in the 2% neem oil and 3% neem seed water extract 168 hours after spray. As mentioned earlier, this increase would be because of the antifeedant and deterrent effects of neem derivatives at these concentration which had compelled the insect to leave the area. Baythroid TM as usual significantly reduced the test insect population up to 336 hours after spray. Neem seed water extracts at 1% and 2% and neem oil at 1% were statistically similar to figures in the control, however, neem seed water extract at 2% slightly affected the test insect population as it did in the other trials against whiteflies and thrips.

All these treatments when applied 2nd, 3rd, and 4th times each after 20 days interval showed identical efficacy to jassids; as they showed in the first application of the treatments. Baythroid TM was more toxic at higher

concentrations and stayed toxic to the test insect for longer period. Neem derivatives lost their efficacy up to 336 hours after spray even at higher concentrations Table 10, 11, and 12

Table-9: Effect of neem derivatives and Baythroid TM on the infestation of jassid on cotton (First spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24 hours after spray	168 hours after spray	336 hours after spray	
1%	1.20	-0.73DE (1.14)	-3.52FG (1.13)	-2.39D (1.23)	
1.5%	1.52	2.88D (1.35)	31.31D (0.94)	-0.44BCD (1.52)	
2%	1.73	37.89B (1.00)	58.15B (0.65)	0.70BC (1.71)	
Neem Seed Water Extracts					
1%	1.53	-2.56E (1.48)	-5.17G (1.46)	-2.20CD (1.56)	
2%	1.39	1.54DE (1.28)	6.98E (1.17)	-1.68BCD (1.41)	
3%	1.62	31.31C (1.03)	53.72C (0.67)	1.05B (1.58)	
Insecticide	1.3	85.67A (0.17)	64.05A (0.42)	29.02A (0.92)	
Control	1.46	5.79DE (1.38)	4.54F (1.32)	-9.58BCD (1.46)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-10: Effect of neem derivatives and Baythroid TM on the infestation of jassid on cotton (Second spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24 hours after spray	168 hours after spray	336 hours after spray	
1%	1.82	-0.68CD (1.67)	-6.51F (1.76)	-6.00D (1.86)	
1.5%	1.66	1.62CD (1.50)	33.03C (1.02)	-0.49BCD (1.63)	
2%	1.69	30.29B (1.11)	53.70B (0.71)	2.01B (1.32)	
Neem Seed Water Extracts					
1%	1.66	-2.45D (1.54)	-7.11F (1.60)	-5.00CD (1.69)	
2%	1.41	2.54C (1.25)	9.11D (1.17)	-1.04BCD (1.38)	
3%	1.2	30.54B (0.76)	49.03B (0.56)	1.36BC (1.2)	
Insecticide	1.09	88.46A (0.11)	62.05A (0.38)	27.09A (0.78)	
Control	2.63	8.23CD (2.43)	0.82E (2.41)	-6.22BCD (2.57)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-11: Effect of neem derivatives and Baythroid TM on the infestation of jassid on cotton (Third spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24 hours after spray	168 hours after spray	336 hours after spray	
1%	1.74	-0.23D (1.67)	-5.88G (1.62)	-2.70C (1.72)	
1.5%	1.73	2.61D (1.61)	36.49D (1.27)	0.12BC (1.66)	
2%	1.93	37.17B (1.16)	58.32B (0.70)	0.32BC (1.85)	
Neem Seed Water Extracts					
1%	1.55	0.22D (1.47)	-9.78G (1.49)	-3.32C (1.52)	
2%	1.35	1.23D (1.28)	8.86E (1.10)	-2.02BC (1.34)	
3%	1.38	29.39C (0.93)	47.92C (0.64)	2.71B (1.30)	
Insecticide	1.39	91.92A (0.10)	63.17A (0.45)	30.67A (0.95)	
Control	2.13	4.41D (2.04)	7.36F (1.9)	-7.76BC (2.06)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

Table-12: Effect of neem derivatives and Baythroid TM on the infestation of jassid on cotton (Fourth spray)

TREATMENTS		MEAN PERCENT EFFICACY			
Neem Oil	24 hours before spray	24 hours after spray	168 hours after spray	336 hours after spray	
1%	1.46	-1.25DE (1.38)	-8.37F (1.39)	-3.94DE (1.44)	
1.5%	1.63	2.37D (1.48)	29.52C (1.01)	-2.12CD (1.58)	
2%	1.65	38.99B (0.95)	56.35A (0.63)	0.99BC (1.56)	
Neem Seed Water Extracts					
1%	1.71	-3.92E (1.65)	-12.22F (1.66)	-6.83E (1.72)	
2%	1.750	1.95DE (1.60)	6.48D (1.43)	-1.39BCD (1.69)	
3%	1.58	31.31C (1.01)	48.79B (0.70)	2.45B (1.46)	
Insecticide	1.53	83.16A (0.28)	58.16A (0.56)	29.03A (1.01)	
Control	2.18	7.38DE (2.03)	6.84E (1.90)	-8.21BCD (2.07)	

Each value is a mean of three replications. Means followed by the same letters are not significantly different at $\alpha = 0.05$

DISCUSSION

Neem oil at 1.5% and 2%, neem seed water extract at 3%, and Baythroid TM at its recommended dose significantly reduced the mean percent infestation of cotton by whitefly, jassid and thrips. In Bangladesh, Islam (1983) found that the hexane extract of neem significantly deterred the feeding of brown plant hopper and rice hispa. An ether and hexane extract of

neem seed reduced feeding activities by rice hispa and egg deposition by brown plant hopper in young rice seedling. Gupta and Sharma (1997) noted that in spray schedule in which neem was used alternately with *Bacillus thuringiensis* and synthetic pyrethroid successfully managed *Bemisia tabaci* without its resurgence. Neem seed extract and neem oil significantly reduced the adult and nymphal populations of *Bemisia tabaci*.

Neem derivatives at all concentrations lost their effectiveness upto 336 hours after spray, while Baythroid TM remained effective upto 336 hours after spray. Saxena *et al.* (1981a) demonstrated that neem derivatives degrade faster in sunlight than in storage environment and therefore, could provide satisfactory protection to stored grains against insect pests without requiring repeated application. Khattak *et al.* (2000) investigated that the detrimental effect of the 1000ppm neem oil treatment lost by 30 days after treatment but the 10,000ppm treatment effectively retained its antifeedant and deterrent effects against maize weevil on corn kernels. Khan *et al.* (2002) demonstrated that neem extracts and insecticidal combinations significantly reduced the population of thrips and bollworms on cotton 17 days after spray. However, they showed gradual decrease in their toxic effect against the test insects.

Neem derivatives showed more reduction of the test insect population 168 hours after spray as compared to the reduction 24 hours after spray. This most probably be due to the antifeedant and deterrent effect of neem which would forced the whiteflies, thrips and jassids to leave the locality. Sexana *et al.* (1981b) found that neem oil was good antifeedant for the control of rice brown hopper. Hoppers generally avoided the rice plants sprayed with 3%, 6% and 12% crude emulsified neem oil.

ACKNOWLEDGEMENTS

The Principal author is highly indebted to Higher Education Commission, Islamabad for full financial support of the studies, which for sure is in the interest of this nation. Thanks to Mr. Sultan Masood, In-charge Cotton Section, Agriculture Research Institute, Ratta Kulachi for providing research field for these trials.

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