

Efficacy of Plant Extracts on Some Cotton (*Gossypium hirsutum*) Pests: *Amrasca bigutulla bigutulla* Ishida and *Thrips tabaci* Lindeman

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Abstract. Jassids (*Amrasca bigutulla bigutulla* Ishida) and thrips (*Thrips tabaci* Lindeman) have become major pests in subcontinent due to invasion of Bt cotton. Insecticidal resistance by these pests is another threat, keeping in view these facts five plants derivative viz., Lemon oil, Bittergourd (*Momordica charantia* L) extract, bakain (*Melia azadirachta*) leaf extract, Neem (*Azadirachta indica*) oil and Neem (*A. indica*) leaf extract, each at a 5% concentration were tested for their repellency and phagodeterrent effects against jassid and thrips with three applications upon emergence of pest population. The variety CIM-496 was sown during 2008 at experimental area of the department of Agriculture, Entomology, University of Agriculture, Faisalabad. Six treatments including control were maintained following Randomized Complete Block Design with three replications. The plant derivatives were applied three times at the interval of 20 days. Data were recorded at 24, 48, 72 hrs, and 7 days intervals after application of each treatment. Results revealed that lemon oil proved to be the most effective plant derivative against jassid followed by neem oil, bakaine, bitter gourd and neem leaf extract in all three applications. In case of thrips all plant derivatives controlled thrips population significantly. Bakain leaf extract, neem oil and neem leaf extract showed comparatively higher mortality of the thrips as compared to other plant derivatives. Studies concluded that plant derivatives can be good alternatives to chemical pesticides to control sucking pests complex especially jassids and thrips in Pakistan

Key words: Plant derivatives, *Amrasca bigutulla bigutulla*, *Thrips tabaci*, cotton.

INTRODUCTION

Jassid (*Amrasca bigutulla bigutulla* Ishida) and thrips (*Thrips tabaci* Lindeman) are the most important pests of cotton proving most destructive in the era of Bt cotton in sub-continent south east Asia. They affect the foliage by sucking the cell sap and reducing the photosynthetic area of the plant. Jassid (*A. bigutulla*) is considered to be a very serious pest of cotton in sub-continent. Both nymphs and adults cause damage to the crop by injecting its toxic saliva into tissues. Further investigation has found that extreme damage during mid season reduce yield and if the same amount of damage occurs late in season yield is heavily reduced (Borah, 1995; Patel and Patel, 1998; Rafique and Shah, 1998; Sudhakar *et al.*, 1998).

Thrips (*T. tabaci*) attack cotton crop early in the season, but high population densities can be seen during second fortnight in September (Ali *et al.*, 1993; Gupta *et al.*, 1997; Khan *et al.*, 2008). Both

nymph and adult stages of thrips damage the tissue and destroy leaves by sucking the cell sap. Due to the attack of this pest, leaves curl up and in case of severe attack, plants remain stunted at initial stage. The indiscriminate and continuous use of large quantities of synthetic insecticides, besides creating health hazards to human and animal life, as well as environmental pollution, has also resulted in the crop failure in different parts of the world (Razaq *et al.*, 2006; Naik *et al.*, 1993). To avoid losses due to insect pests, the entire reliance has always been on chemical pesticides as a control measure for which foreign exchange worth of millions of rupees is being spent every year. To mitigate the hazards of chemical insecticides, the present study has been conducted to evaluate the efficacy of plant extract like (Neem, Neem oil, Bittergourd, lemon oil and Bakain) were screened against jassid and thrips.

MATERIALS AND METHODS

The experiment was conducted at Research area of Department of Agricultural Entomology, University of Agriculture, Faisalabad. The different plant derivatives were tested against

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thrips and jassids on cotton variety CIM-496 during 2008. There were six treatments (*viz.*, neem oil, neem leaf extract, bakain leaf extract, bitter gourd extract and lemon oil, control treatment) with three replicates (three spatial blocks of each treatment) in a Randomized Complete Block Design. The data were recorded early in the morning from 15 leaves selected at random from 15 plants by counting number of thrips and jassids through use of magnifying lens on 15 leaves per replicate from upper, middle and lower leaves from each treatment.

Preparation of plant extracts

Neem oil

Neem seeds were collected from wild neem tree in Faisalabad district. Seeds were dried in sun shine for about 10 days. After dehulling, oil extraction was carried out from dried seed kernels by hydraulic press and Soxhlet apparatus using n-hexane as a solvent (Anwar *et al.*, 2005). The 5% solution was prepared in ethanol which was used for efficacy trial.

Neem leaf extracts

One kg of fresh leaves of *A. indica* were plucked from neem trees from University of Agriculture, Faisalabad. The leaves were dried in an oven at 80°C for the period of 72 h. The dried leaves were ground separately into a fine powder with the help of pestle in a mortar. The leaf powders were sieved into a particle size of 150 µm with a standard sieve and 50 g powder of each was weighed into 1 litre round bottom flask before a 400 ml ethanol (b.p. 56°C) was added into it. The mixtures were thoroughly shaken with mechanical shaker for 24 h and allowed to settle overnight and later decanted. The decanted solutions were then filtered using Whatman No.1 filter paper and evaporated in a rotary film evaporator to get the solute (Oladimeji and Kannike, 2010).

Bakain extract

One kilo grams fresh bakain (*Melia azadarach*) leaf were collected from the wild trees University of Agriculture Faisalabad, sun dried, grinded in pestle recheck and mortar, 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 5% (Salijoqi *et al.*, 2006).

Bitter gourds extracts

One kilo grams dried bitter gourd (*Memordica charantia*) seed collected from the University of Agriculture Faisalabad, grinded, tied in a cotton cloth bag, dipped in five liter of water at 80°C for the period of 16 hours. Concentrated solution of 20% was obtained and diluted to 5% (modified Gasperi-Company *et al.*, 1980).

Lemon oil

Lemon seed were collected from citrus fruits and collected seeds were ground in electric grinder. Powder was put in Soxhlet apparatus for extraction of oil by steam distillation method (Vogel, 1998) using diethyl ether as a solvent. 5% solution was prepared from stock solution using Murugan 2007. This is modified method as used by Akram *et al.* (2010).

Data collection and statistical analysis

For the assessment of sucking insect pests of cotton a diagonal method was used, data were recorded early in the morning by counting number of thrips (LIVE) and jassids through use of magnifying lens on fifteen leaves per replicate from upper middle and lower leaves from each treatment.

The crop was sprayed three times at an interval of 20 days. The first spray was carried out on 3rd of August when the pest attack reached the economic threshold level and then the second and the third spray were carried out after 20 days interval. Pre-treatment data were recorded 24 hours before spray and post treatment data were recorded 24 h, 48 h and 72 h and 7- days after spray to determine the effect of plant extracts. Percent corrected mortality was determined using Abott formula (1925)

$$\% \text{ corrected mortality} = \frac{\text{observed mortality} - \text{control mortality}}{100 - \% \text{ control mortality}} \times 100$$

Final data were analyzed with MSTAT- C

(Anonymous, 1986), Analysis of Variance (ANOVA II) and means were separated by Tukey honestly significant difference at 0.05. The mean populations of sucking insect pests from sprayed plots were considered to be an indirect reflection of efficacy of different botanicals.

RESULTS

The data regarding percent mortality of *Amrasca bigutulla bigutulla* and *Thrips tabaci* recorded 24, 48, 72 h and 7 days interval after application of botanicals are described in Table I and Table II. The data revealed that lemon oil proved to be the most effective botanical extract followed by bitter gourd, bakain leaf extract, neem oil and neem leaf extract in all three applications and Lemon oil killed 55.24% of jassid population at 24 h, 55.79% at 48 h, 54.85% at 72 h and 54.85% at 168 h after first spray. After a second spray lemon oil killed 49.76%, 39.68%, 44.01% and 36.69% of jassid population, respectively, after 24, 48, 72 and 168 h interval. In third spray the percent mortality of jassid population was 37.33, 37.33, 37.66 and 38.33 after 24, 48, 72 and 168 h intervals (Table I, Fig. 1).

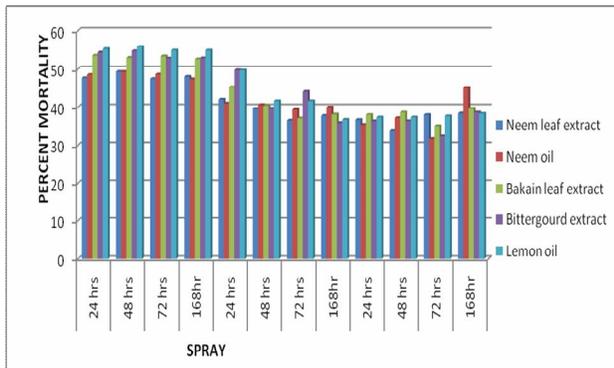


Fig. 1. Efficacy of plant derivatives against cotton jassid *Amrasca bigutulla bigutulla* Ishida.

Bitter gourd (*Memodica charantia*) extract reduced jassid population 54.32% in 24 h, 54.68% after 48 h, 52.80% after 72 h and 52.88% after 168 h interval. In second spray it reduced jassid population 49.76%, 39.68%, 44.01%, 35.81% after 24, 48, 72, and 168 h interval, respectively. In third spray it

Table I.- Efficacy of plant derivatives against cotton jassid (*Amrasca bigutulla bigutulla* Ishida).

Plant Derivative	Dose / acre	First spray				Second spray				Third spray			
		24 h	48 h	72 h	168 h	24 h	48 h	72 h	168 h	24 h	48 h	72 h	168 h
Neem leaf extract	5%	47.65 c	49.33 a	47.44 b	48.00 a	42.00 a	39.64 a	36.48 c	37.74 ab	36.66 ab	33.66 a	38.00 a	38.40 a
Neem oil	5%	48.50 bc	49.33 a	48.62 ab	47.36 a	41.00 a	40.62 a	39.36 bc	39.99 a	35.33 b	37.16 a	31.67 a	45.00 b
Bakain leaf extract	5%	53.50 abc	52.95 a	53.33 ab	52.59 a	45.18 a	40.41 a	37.08 c	38.13 ab	38.00 a	38.66 a	35.00 a	39.66 ab
Bittergourd extract	5%	54.32 ab	54.68 a	52.80 ab	52.88 a	49.76 a	39.68 a	44.01 a	35.81 b	36.33 ab	36.33 a	32.33 a	38.66 b
Lemon oil	5%	55.24 a	55.79 a	54.85 a	54.85 a	49.75 a	41.61 a	41.61 ab	36.69 b	37.33 ab	37.33 a	37.66 a	38.33 a
THSD	0.05	1.22	1.79	1.420	1.55	1.96	1.34	0.91	0.48	0.48	1.11	1.44	1.08
S.E		4.49	9.70	6.05	7.21	7.20	11.57	5.42	2.50	0.70	3.70	6.22	3.50
F		8.20	2.77	5.08	4.47	7.17	0.17	5.48	3.01	4.39	2.80	4.14	6.91
P		0.006	0.102	0.024	0.034	0.009	0.948	0.020	0.086	0.036	0.100	0.042	0.010

reduced jassid population 36.33%, 36.33%, 32.33% and 38.66 % after 24, 48, 72 and 168 h interval, respectively (Table I, Fig. 1).

Neem seed kernel oil (NSKE) reduced jassid population 48.50% in 24 h, 49.33% in 48 h, 48.62% after 72 h and 47.36% after 168 h interval. In second spray it reduced jassid population 41.00%, 40.62%, 39.36%, 39.99% after 24, 48, 72 h and 7 days interval. In third spray it reduced jassid population 35.33%, 37.16%, 31.67% and 45.00% after 24, 48, 72 and 168 h interval, respectively (Table 1, Fig. 1).

Result of present study documents that Neem oil reduced mortality 48.5, 49.33, 48.62 and 47.36% after 24, 48, 72 and 168 h. In second spray Neem oil reduced mortality 41.0%, 40.6% and 39.9% 24, 48 and 168 h after spray. There was no significant difference in mortality after exposure thus it is meant that neem oil remained effective in whole 7 days and effectively suppressed jassid population.

Neem leaf extract reduced jassid population 47.6% in 24 h, 49.3% after 48 h, 47.44% after 72 h and 48.0% after 7 days interval. In second spray it reduced jassid population 42.0%, 39.6%, 36.4%, 37.7% after 24, 48, 72, and 7 days interval. In third spray it reduced jassid population 36.6%, 33.6%, 38.0% and 38.4% after 24, 48, 72, and 7 days interval respectively (Table I, Fig. 1).

On *Thrips tabaci* Lindeman bitter gourd extract proved most effective insecticide followed by lemon oil, Bakain leaf extract, neem leaf extract and neem oil.

Bitter gourd extract controlled thrips population from 42.87% in 24 h, 44.46% in 48 h, 44.84% in 72 h and 44.52% in 7 days. In 2nd spray, it controlled thrips population 36.89% to 35.1% in all seven days exposure time while in third spray it reduced population from 35.0% to 39.6%. The mortality ranged between 40-42% in all applications (Table II, Fig. 2).

Lemon oil killed thrips population in first spray 41.3% after 24 h, 42.6% after 48 h, 46.2% after 72 h and 45.5% after 7 days. In second spray lemon oil killed jassid population 37.0%, 40.6%, 39.9% and 36.6% respectively after 24, 48, 72 h, and 7 days interval. In third spray thrips population was reduced to 35.3%, 33.6%, 37.3% and 37.3% after 24, 48, 72 h and 7 days interval (Table II, Fig. 2).

Table II.- Efficacy of plant derivatives against *Thrips tabaci* Lindeman.

Plant derivative	Dose /acre	First spray			Second spray			Third spray			
		24 h	48 h	72 h	24 h	48 h	72 h	24 h	48 h	72 h	168 h
Neem leaf extract	5%	40.62 a	41.35 a	40.86 a	35.07 a	36.31 ab	37.26 a	39.00 a	41.66 a	39.00 a	40.33 a
Neem oil	5%	40.33 a	40.19 a	41.80 a	37.18 a	35.00 b	38.13 a	37.66 a	41.66 a	37.66 a	35.00 a
Bakain leaf extract	5%	41.52 a	42.27 a	42.54 a	37.19 a	37.66 ab	35.57 a	35.66 a	39.66 a	35.66 a	38.00 a
Bittergourd extract	5%	42.87 a	44.46 a	44.84 a	36.89 a	38.66 ab	36.24 a	36.33 a	37.33 ab	36.33 a	39.66 a
Lemon oil	5%	41.35 a	42.66 a	46.21 a	37.00 a	40.66 a	39.92 a	35.33 a	33.66 b	37.33 a	37.33 a
THSD		1.50	2.09	1.69	0.52	1.11	1.09	0.91	0.97	1.69	1.81
S.E		6.80	13.20	0.24	0.80	3.70	2.51	2.80	4.70	2.20	3.70
F		0.43	0.57	1.72	3.04	3.83	3.47	2.48	7.29	2.25	3.57
P		0.78	0.69	8.57	0.084	0.050	0.063	0.127	0.009	0.153	0.059

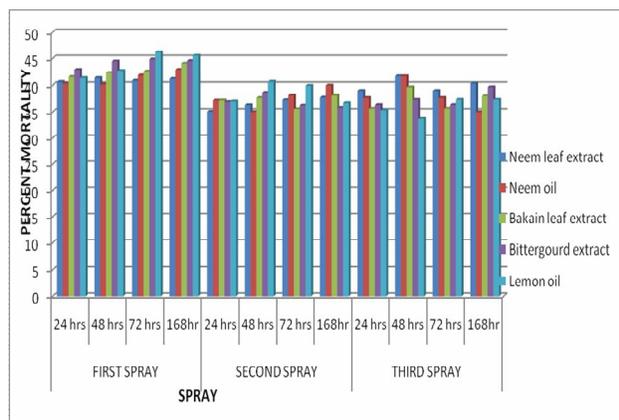


Fig. 2. Efficacy of plant derivatives against onion Thrips *Thrips tabaci* Lindeman.

Neem leaf extract controlled thrips population from 40.62% to 41.19% in all seven days in 1st spray, 35.0% to 37.7% in 2nd spray, 39.0% to 40.3% in third application (Table II, Fig. 2).

Neem oil killed thrips population from 40.3% to 42.8% in first spray in all 7 days interval. In second spray it reduced mortality from 37.1% to 39.9%. In third spray it reduced population from 37.6% to 35.0% in all 7 days exposure time (Table II, Fig. 2).

Bakain leaf extract, on the other hand, controlled thrips population from 41.5% after 24 h, 42.2% after 48 h, 42.5% after 72 h, 44.03% after 7 days in first application. Mortality ranged between 30-40% in all applications (Table II, Fig. 2).

The present study clearly documents that botanicals can be good alternative to insecticides with less residue action, environmentally safe, eco friendly and being toxic to target pests.

DISCUSSION

The present studies on the effects of different concentration of neem, *Azadirachta indica* A. on cotton against jassid and thrips was carried out during June, 2008. Non-traditional botanical pest control materials comprising neem derivatives, viz., neem leaf extracts, neem oil, (5% Azadirachtin), Bakain extracts (5%), lemon oil extracts (5%) and bitter gourd leaf extracts (5%) were applied including a control on a field grown crop of cotton.

The results of the investigation showed that

all the neem derivatives, viz., 5% each of neem leaf extract (39%) and 5% neem oil (37%), gave significantly high mortality in population of jassid at different post treatment intervals as compared to control. These findings are in agreement with those of Dreyer (1986) who reported that simple neem products like aqueous extracts of neem kernel powder, neem oil and ground neem kernels gave good control of vegetable pest and other field crop including cicadellids, *Jacobiella facials* and several Lepidoptera on aubergines (brinjal).

Siddiq (1986) also reported effective control of jassid can be achieved with the application of neem extracts and ground fruits.

Jotwani and Srivastava (1981) have reviewed Neem leaf extract proved to be effective for the control of cicadellid (Jassid) as it gave 58.13% (at 4% conc) and 47.60% (at 3% conc) mortality of the pest. The work done on the effectiveness of neem, *Azadirachta indica* showed that neem derivatives were effective not only against biting and chewing pests but also against sucking Hemiptera, and cicadellids. Present studies are quite in conformity with those of Schumtterer (1984) who also reported that aqueous extracts, oil and enriched extracts of plants such as *Azadirachta indica* and *Melia azadirach*, particularly, Triterpenoids are suitable for use as pesticides because of their effectiveness against a wide range of pests such as Heteroptera, Homoptera and Agromyzidae. Our findings further tally with the results reported by Shahid (1993) who got the best control of homopterous pests on cowpea (*Vigna unguiculata*).

The present studies revealed that the application of neem leaf extract gave effective control of jassid. These findings partially agree with those of Ratanoara *et al.* (1994), Patel and Patel (1998), Perveez *et al.* (1998), Ramaraju and Babu (1989), Naqvi *et al.* (1989), Natarajan and Sundaramurthy (1990) who applied neem leaf extract for the control of mustard aphid, *Nephotettix* sp., *Sogatela furcifera*, pod sucking bug and thrips (*Thripidae*). In the present studies neem oil 5% yielded, 68.67% reduction of Jassid population after 7 days of third application.

Many workers like Akbar *et al.* (1993), Ahmed *et al.* (1993), Khan *et al.* (1993) and Gupta *et al.* (1990) carried out investigation on neem plant

materials against insect pests what type of pests other than those included in present study. Many of these workers reported encouraging results.

Hasan *et al.* (1996) studied the efficacy of neem samples, neem oil, Fenoxycarb and KN-1-35-120 under controlled conditions in the field as well as in laboratory for control of sucking insect pest of cotton. Neem sample showed effective results against Jassids, thrips and aphids.

Santos and Cost (2004) reported that due to over use of chemicals, botanicals are used as alternative technique for the control of sucking insect pest (Jassid and thrips). The aqueous neem extract is applied against sucking insect pest which cause mortality at nymph and adult stage.

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REFERENCES

- ABBOTT, S.W., 1925. A method of computing the effectiveness of an insecticide. *J. econ. Ent.*, **18**: 265-267.
- AHMED, F., KHAN, F.R., SHAHID, M.I. AND AHMED, M., 1993. Field efficacy on different formulation and concentration of neem (*Azadirachta indica* A. Juss) against major insect pests of brinjal (*Solanum melongena*). *Pak. Entomol.*, **15**: 11-15.
- AKBAR, S., AHMED, S., IQBAL, M. AND ISHTIAQ, A., 1993. Comparative efficacy of synthetic insecticides and Neem extract against insect pests of Brinjal. *Pak. Entomol.*, **15**: 99-102.
- AKRAM, W.H.A., KHAN, A., HAFEEZ, F., BILAL, H., KIM, Y.K. AND LEE, J.J., 2010. Potential of citrus seed extracts against dengue fever mosquito, *Aedes albopictus* (SKUSE) (Culicidae: Diptera). *Pak. J. Bot.*, **42**: 3343-3348.
- ALI, A., BHATTI, M.A. AND AHMED, K.J., 1993. Role of weather in fluctuating the population of *Amrasca biguttula biguttula* (Dist.) and *thrips tabaci* (Lind.). *Proc. Pakistan Congr. Zool.*, **13**:133-139.
- ANONYMOUS, 1986. MSTAT-C. *Microcomputer statistical programme*. Michigan State University, Michigan Lansing, USA.
- ANWAR, M., ASHFAQ, M., HASSAN, M. UL. AND ANJUM, F.A., 2005. Efficacy of *Azadirachta indica* L. on bagging materials against some insect pests of wheat stored in ware houses at Faisalabad. *Pak. Entomol.*, **27**: 89-94.
- BORAH, R. K., 1995. Insect pest complex in brinjal (*Solanum melongena* L.). *Ann. Agric. Res.*, **16**: 93-94.
- DREYER, M., 1986. Field and laboratory trials with simple neem products as protectants against pests of vegetables and field crops in Togo. "Proc. 3rd Int. Neem conf., Nairobi, Kenya, 10-15 July: 431-447.
- GASPERI-CAMPANI, A., BARBIERI, L., MORELLI, P. AND STIRPE, F., 1980. Seed extracts inhibiting protein synthesis *in vitro*. *Biochem. J.*, **186**: 439-441
- GUPTA, M.P., PARSAI, S.K. AND GUPTA, D.P., 1990. Bioefficacy and economics of certain insecticides and vegetable oils against gram pod borer on chickpea. *Ind. J. Pl. Prot.*, **18**: 207-211.
- GUPTA, M.P., SANDEEP, S., SHRIVASTAVA, S.K. AND SHARMA, S., 1997. Population buildup of some sap sucking insects on cotton in Madhya Pradesh. *J. Insect Sci.*, **10**: 153-156.
- HASAN, M., AHMED, F., ALI, A. AND AHMED, M., 1996. Some studies on the effect of synthetic growth regulators and Neem plant material against sucking insect pest of cotton. *Pak. Entomol.*, **18**: 24-27.
- JOTWANI, M.G. AND SRIVASTAVA, K.P., 1981. Neem Insecticide of the future. II-Protection against field pests. *Pesticides, India*. 15(11): *Rev. appl. Ent.*, **70**: 40-47.
- KHAN, F., AHMED, R.F., SHAHID, M.I. AND AHMAD, M., 1993. Field efficacy studies of different formulations and concentration of Neem (*Azadirachta indica* A. Juss) against major insect pests of brinjal (*Solanum melongena*). *Pak. Entomol.*, **13**: 79-81.
- KHAN, M.A., KHALIQ, A., SUBHANI, M.N. AND SALEEM, M.W., 2008. Incidence and development of *thrips tabaci* and *Tetranychus urticae* on field grown cotton. *Int. J. Agric. Biol.*, **10**: 232-234.
- MURUGAN, K., MURUGAN, P. AND NOORTHEEN, A., 2007. Larvicidal and repellent potential of *Albizia amara* Boivin and *Ocimum basilium* Linn. against dengue vector, *Aedes aegypti*. *Biores.Technol.*, **98**: 198-201.
- NAIK, B.G., VERMA, S. AND PHADKE, K.G., 1993. Occurrence of pest in relation to degradation of insecticides in brinjal crop during summer and Kharif season. *Pestic. Res. J.*, **5**: 94-103.
- NAQVI, S.N.H., NURULAIN, S.M., AZMI, M.A. AND ASDAQUE, T., 1989. Effect of neem fractions and malathion against whiteflies, *Aleuroloous barodensis* on brinjal crop (*Solanum melongena*). *Sarhad J. Agric.*, **56**: 25-28.

- NATARAJAN, K. AND SUNDARAMURTHY, V.T., 1990. Effect of neem oil on cotton whitefly (*Bemisia tabaci*). *Indian J. agric. Sci.*, **60**:290-291.
- OLADIMEJI, A. AND KANNIKE, M.A., 2010. Comparative studies on the efficacy of neem basil leaf extract and synthetic insecticides, lambda_cyhalothrin, against *Podogria* spp. on okra. *African J. Microbiol. Res.*, **4**: 33-37.
- PARVEZ, A.W., SHAH, A. AND MANAN, A., 1998. Some studies on the efficacy of Neem (*Azadirachta indica* A. Juss.) extracts on okra against cotton Jassid (*Amrasca biguttula biguttula*). *Pak. Entomol.*, **20**: 11-13.
- PATEL, Z. AND PATEL, J.R., 1998. Re-surveyed of Jassid (*Amrasca biguttula biguttula*) in brinjal. *Indian J. Ent.*, **60**: 152-164.
- RAFIQUE, M.A. AND SHAH, H.A., 1998. Cotton pest scouting of farmers fields at Multan during 1996. *Pak. Entomol.*, **20**: 40-42.
- RATANOARA, A., SHEKH, M., PATEL, J.R. AND PATEL, N.M., 1994. Effect of weather parameters on brinjal Jassid, (*Amrasca biguttula biguttula*). *Ishida Gujrat Agric. Univ. Res. J.*, **19**: 39-43.
- RAZAQ, M., ASLAM, M. AND SUHAIL, A., 2006. Synergism of pyrethroids with piperonyl butoxide (PBO) in jassid, *Amrasca devastans* (dist.) (Homoptera: cicadellidae) from Pakistan. *Pak. Entomol.*, **28**: 51-56
- SALIJOQI, A.U.R., AFRIDI, M.K., KHAN, S.A. AND RAHUMAN, S., 2006. Effect of six plant extracts on rice weevils *Sitophilus oryzae* L. in the stored wheat grains. *J. Agric. Biol.*, **1**: 1-5
- SANTOS, T.M.D. AND COSTA, N.P., 2004. Effect of Neem extract on the cotton aphid. *Pesq. agropec. Bras.*, **39**: 1071-1076.
- SCHUMTTERER, H., 1984. Possibilities for using plant compounds for the control of pests. *Mitteil. Biol. Bundesan Land ForstwirtSch.. Rev. appl. Ent. Berlin*, **13**: 223-333.
- SHAHID, M.I., 1993. *Some studies on the efficacy of different formulations and concentrations of neem (Azadirachta indica A. Juss) against major insect pests of brinjal (Solanum melongena L.)* M.Sc. thesis, Deptt. of Agricultural Entomology, University of Agriculture, Faisalabad.
- SIDDIQ, S.A., 1986. A proposed pest management program including neem treatments for combating potato pests in the Sudan. *Proc. 3rd Int. Neem Conf. Nairobi, Kenya*, 10-15 July: pp. 449-459.
- SUDAHKAR, K., PUNNAIAH, K.C. AND KRISHNAWA, P.C., 1998. Efficacy of certain selected insecticides on the sucking pest complex on Brinjal. *Ind. Entomol.*, **60**: 214-244.
- VOGEL, A.I., 1978. In: *Text book of practical organic chemistry*. The English Language Book Society and Longman, London, pp. 1368.

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Table I.- Efficacy of plant derivatives against cotton jassid (*Amrasca bigutulla bigutulla* Ishida).

Plant Derivative	Dose / acre	First spray				Second spray				Third spray			
		24 h	48 h	72 h	168 h	24 h	48 h	72 h	168 h	24 h	48 h	72 h	168 h
Neem leaf extract	5%	47.65 c	49.33 a	47.44 b	48.00 a	42.00 a	39.64 a	36.48 c	37.74 ab	36.66 ab	33.66 a	38.00 a	38.40 a
Neem oil	5%	48.50 bc	49.33 a	48.62 ab	47.36 a	41.00 a	40.62 a	39.36 bc	39.99 a	35.33 b	37.16 a	31.67 a	45.00 b
Bakain leaf extract	5%	53.50 abc	52.95 a	53.33 ab	52.59 a	45.18 a	40.41 a	37.08 c	38.13 ab	38.00 a	38.66 a	35.00 a	39.66 ab
Bittergourd extract	5%	54.32 ab	54.68 a	52.80 ab	52.88 a	49.76 a	39.68 a	44.01 a	35.81 b	36.33 ab	36.33 a	32.33 a	38.66 b
Lemon oil	5%	55.24 a	55.79 a	54.85 a	54.85 a	49.75 a	41.61 a	41.61 ab	36.69 b	37.33 ab	37.33 a	37.66 a	38.33 a
THSD	0.05	1.22	1.79	1.420	1.55	1.96	1.34	0.91	0.48	0.48	1.11	1.44	1.08
S.E		4.49	9.70	6.05	7.21	7.20	11.57	5.42	2.50	0.70	3.70	6.22	3.50
F		8.20	2.77	5.08	4.47	7.17	0.17	5.48	3.01	4.39	2.80	4.14	6.91
P		0.006	0.102	0.024	0.034	0.009	0.948	0.020	0.086	0.036	0.100	0.042	0.010

Table II.- Efficacy of plant derivatives against *Thrips tabaci* Lindeman.

Plant derivative	Dose /acre	First spray				Second spray				Third spray			
		24 h	48 h	72 h	168 h	24 h	48 h	72 h	168 h	24 h	48 h	72 h	168 h
Neem leaf extract	5%	40.62 a	41.35 a	40.86 a	41.19 a	35.07 a	36.31 ab	37.26 a	37.74 a	39.00 a	41.66 a	39.00 a	40.33 a
Neem oil	5%	40.33 a	40.19 a	41.80 a	42.86 a	37.18 a	35.00 b	38.13 a	39.99 a	37.66 a	41.66 a	37.66 a	35.00 a
Bakain leaf extract	5%	41.52 a	42.27 a	42.54 a	44.03 a	37.19 a	37.66 ab	35.57 a	38.13 a	35.66 a	39.66 a	35.66 a	38.00 a
Bittergourd extract	5%	42.87 a	44.46 a	44.84 a	44.52 a	36.89 a	38.66 ab	36.24 a	35.81 a	36.33 a	37.33 ab	36.33 a	39.66 a
Lemon oil	5%	41.35 a	42.66 a	46.21 a	45.56 a	37.00 a	40.66 a	39.92 a	36.69 a	35.33 a	33.66 b	37.33 a	37.33 a
THSD		1.50	2.09	1.69	1.81	0.52	1.11	1.09	0.91	0.91	0.97	1.69	1.81
S.E		6.80	13.20	0.24	9.87	0.80	3.70	2.51	2.50	2.80	4.70	2.20	3.70
F		0.43	0.57	1.72	0.85	3.04	3.83	3.47	3.01	2.48	7.29	2.25	3.57
P		0.78	0.69	8.57	0.53	0.084	0.050	0.063	0.087	0.127	0.009	0.153	0.059