Management of Sucking Complex in Bt Cotton Through the Application of Different Plant Products

M. Hamayoon Khan*, N. Ahmad, S.M.M. Rashdi , I. Rauf, M. Ismail and M. Tofique
Nuclear Institute of Agriculture, Tandojam-70060, Pakistan

*Corresponding author: entomologist170@yahoo.com

ABSTRACT
The effect of different plant extracts (neem oil, garlic, eucalyptus and datura) on the population of jassid, *Amrasca devastans* (Dist.), whitefly, *Bemisia tabaci* (Genn.) and thrips, *Thrips tabaci* (Lind.) were tested in Bt cotton under field conditions. All the plant products showed varying toxicity against sucking complex of Bt cotton 24, 72, 168 and 240 hours after application. Datura proved to be the most effective bringing about significant reduction in the pest population followed by neem oil. Garlic and eucalyptus also produced significant results compared to untreated check. However, the two times application of plant products revealed garlic and eucalyptus significantly less effective than Datura and neem.

Keywords: Sucking complex, Bt cotton, botanical pesticides, infestation

Introduction

Cotton is one of the most important cash crops and commercial fiber crop of Pakistan contributing about 68 percent to export earnings of the country [1]. It is infested by a wide range of insect pests at various stages of growth compared to any other crop [2]. Cotton crop is susceptible to the attack of 96 insect and mite pests [3]. Bt cotton can easily withstand the attack of bollworms because of toxins but it has no resistance against sucking pests. Among these, jassid, *Amrasca devastans* (Dist.), whitefly, *Bemisia tabaci* (Genn.) and thrips, *Thrips tabaci* (Lind.) are very serious. Jassids are reported to cause 19 percent reduction in cotton yield [4]. Whitefly causes great damage indirectly to cotton by secreting honeydew and transmitting viral diseases [1].

A huge number of synthetic pesticides are used annually for the control of these pests. No doubt agrochemicals have a major role in improving yields in food production; however, concern has arisen about the negative impact of such chemicals on human health and environment [5]. Some pesticides have active ingredients that act as hormone disruptors and may cause infertility, carcinogenesis and mutagenesis. The widespread application of agrochemicals to most crops has meant that pesticides are present in the ecosystems, aquifers and water systems of most agricultural areas. In the long term this could have repercussions on both environment and human health. Therefore there is an urgent need to

replace pesticides with alternative means of control that are safe, low in cost, local in production and also environment friendly [6]. Historically, some of the insecticides first used in agriculture and forestry were derived from plants such as nicotine from tobacco (*Nicotiana tabacum*, Solanaceae) leaves; rotenone, from the roots of ‘‘timbo’’ (*Derris* spp.), ‘‘chaperno’’ (*Lonchocarpus* spp.), yam bean (*Pachyrhizus* spp.) and other leguminous plants; quassinoids, from bitterwood (*Quassia amara*, Simaroubaceae), azadirachtin, from neem (*Azadirachta indica*, Meliaceae) and pyrethrum, from *Chrysanthemum cinerariifolium* (Asteraceae). Other plants well known for having substances with insecticidal properties include ryania (*Ryania speciosa*, Flacourtiaceae) and ‘‘sabadilla’’ (*Schoenocaulon officinale*, Lilliaceae). However, their use in agriculture and even in traditional tropical systems vanished in the 1950s, as a result of the appearance and widespread use of synthetic insecticides as their rather simple molecules lend themselves for these materials to be manufactured at an industrial scale and a relatively low cost [7]. Botanical insecticides are promising alternatives in insect pest management system because they are naturally occurring compounds derived from plant sources. Botanicals are selective in action and degrade easily in sunlight, air, and moisture by detoxifying enzymes [8].

The use of plants, insecticidal allelochemicals appears to be promising. Aromatic plants, and their essential oils, are among the most efficient botanicals. Their activities are manifold. Therefore, present studies were conducted to find out and compare efficacy of different botanical pesticides against sucking pests in Bt cotton under field conditions.

Materials and Methods

To study the effect of different plants products (Neem oil, Garlic, Eucalyptus and Datura) on sucking pests in Bt cotton (IR-FH-901), an experiment was designed in randomized complete block with four replications. Bt cotton IR-FH-901was sown under natural field conditions with row to row and plant to plant distance of 0.75 and 0.25 m, respectively. The experimental area was divided into 20 plots by keeping 1.0m distances between the treatments and 1.5m between replications. Normal agronomic practices were followed for raising the crop. The field was regularly visited and observed for any pest attack. Data collection was started with attack of pests. The plant products (Neem oil, Garlic, Eucalyptus and Datura) were used at 2% concentration. Neem oil was purchased from the local market. Leaves of Eucalyptus, Datura (fruit and leaves) and Garlic bulbs were collected from field. 20 g of crushed leaves of eucalyptus, datura and grinded garlic bulbs with a little detergent were put separately in muslin cloth and added to one liter of water and kept for 24 hours which gave us 2% solution of each botanical [9]. These plant products were applied two times when the pests reached at economic threshold level. The surveillance of cotton crop was initiated at the seedling emergence and continued up to the mid October on weekly basis. The population of insect pests was recorded 24 hours, 72 hours, one week and 10 days after both the sprays. Economic threshold levels (ETL) used in this experiment for the pests in question i.e. jassids, white-flies and thrips were 1-

1.5, 4-5 and 8-10 per leaf, respectively [10]. The surveillance of cotton crop was initiated at the seedling emergence and continued up to the mid of October on weekly basis. The standard plant inspection method was used for sampling and the populations of three major sucking pests (whiteflies, jassids & thrips) were recorded early in the morning by observing the three leaves (one each from top, middle and bottom) from randomly selected five plants and transformed on per leaf basis. The plant extracts were applied on the crop in the form of spray with the help of knapsack hand sprayer having 20 liters capacity fitted with hollow cone nozzle. The control plots were sprayed with water only. All agronomic practices followed were uniform in whole cotton field under trial. The toxicity of various plant extracts was considered to be an indirect reflection of pest population i.e. lower population of insect pest would represent higher toxicity and vice versa [11]. The data were analyzed by using computer software Statistix. Significance of difference in mean population of insect pests was sorted out with LSD (5% significance level).

Results and Discussion

Cotton Jassids

The infestation of jassids was recorded above ETL at the time of first spray and varied significantly among various treatments 24 hours, 72 hours, 168 and 240 hours after application of plant products (table 1). Neem oil and datura were found effective and non significantly different in minimizing jassid infestation 24, 72, 168 and 240 hours after application. Significant reduction in the over all mean population of jassid (0.31) was recorded with datura application followed by neem oil (0.37). Garlic and eucalyptus also produced significant results compared to untreated check however eucalyptus was found less effective in suppressing jassid infestation. The same pattern was also true for the 2nd spray where jassid attack was successfully suppressed by datura and neem (table 2).

Cotton Thrips

The population of thrips was significantly different among various treatments 24, 72, 168 and 240 hours after application of plant products though datura and neem were found statistically at par (table 3 & 4). The overall means population of the thrips also demonstrated similar trend. The mean per leaf population of thrips was significantly reduced in the neem treated plots (2.80) followed by Datura treated plots (2.85). Garlic and eucalyptus though produced significant results compared to untreated check however garlic extract was less effective in suppressing thrips population (table 3). In the 2nd spray of botanical pesticides datura proved more lethal to thrips showing lowest per leaf infestation of 2.0 followed by neem (2.41) thereby minimizing the pest infestation (table 4).

Cotton Whiteflies

Results showed significant differences of pest population recorded in treatments after observed 24, 72, 168 and 240 hours of 2 sprays of tested botanical pesticides (table 5 & 6). In the first spay, the over all mean population of whiteflies per leaf was the lowest in datura treated plots (0.50) which was

Table 1. Mean population of jassids after application of plant extracts (First spray).

Treatments	jassids/leaf				Mean
	24 hrs	72 hrs	168 hrs	240 hrs	
Neem	0.33 c	0.28 d	0.35 c	0.54 c	0.37 c
Garlic	0.66 b	0.70 c	0.93 b	0.82 b	0.77 bc
Eucalyptus	0.74 b	1.60 b	1.89 a	0.63 bc	1.21 b
Datura	0.25 c	0.24 d	0.30 c	0.46 c	0.31 c
Control	2.95 a	2.39 a	2.11 a	2.19 a	2.41 a

Means followed by similar letters are not significantly different ($P \leq 0.05$)

Table 2. Mean population of jassids after application of plant extracts (2nd spray).

Treatments	jassids/leaf				Mean
	24 hrs	72 hrs	168 hrs	240 hrs	
Neem	0.38 d	0.42 b	0.54 bc	0.63 c	0.49 c
Garlic	0.76 c	0.92 a	0.82 b	0.94 b	0.86 b
Eucalyptus	1.11 b	1.14 a	1.16 a	1.19 ab	1.15 ab
Datura	0.25 d	0.30 b	0.43 c	0.56 c	0.38 c
Control	1.95 a	1.10 a	1.18 a	1.27 a	1.37 a

Means followed by similar letters are not significantly different ($P \leq 0.05$)

Table 3. Mean population of thrips after application of plant extracts (First spray).

Treatments	thrips/leaf				Mean
	24 hrs	72 hrs	168 hrs	240 hrs	
Neem	2.68 c	2.75 c	2.90 d	2.88 c	2.80 c
Garlic	4.94 b	5.52 b	7.76 b	7.96 b	6.54 b
Eucalyptus	4.38 b	4.88 b	5.33 c	3.56 c	5.53 b
Datura	2.75 c	2.84 c	2.88 d	2.93 c	2.85 c
Control	10.26 a	12.23 a	11.10 a	13.22 a	11.7 a

Means followed by similar letters are not significantly different ($P \leq 0.05$)

Table 4. Mean population of thrips after application of plant extracts (2nd spray).

Treatments	thrips/leaf				Mean
	24 hrs	72 hrs	168 hrs	240 hrs	
Neem	2.47 d	2.22 d	2.32 d	2.66 d	2.41 d
Garlic	5.11 b	5.18 b	7.58 b	8.60 b	6.61 b
Eucalyptus	3.58 c	3.88 c	4.23 c	3.86 c	3.88 c
Datura	1.85 d	1.70 d	2.12 d	2.33 d	2.0 d
Control	12.74 a	12.36 a	11.15 a	13.12 a	12.34 a

Means followed by similar letters are not significantly different ($P \leq 0.05$)

Table 5. Mean population of white flies after application of plant extracts (First spray).

Treatments	whiteflies/leaf				Mean
	24 hrs	72 hrs	168 hrs	240 hrs	
Neem	0.40 bc	0.66 c	0.48 c	0.50 c	0.51 c
Garlic	0.64 b	1.25 b	1.64 b	1.44 b	1.24 b
Eucalyptus	0.52 b	1.55 b	1.52 b	1.62 b	1.30 b
Datura	0.24 c	0.78 c	0.34 c	0.65 c	0.50 c
Control	3.04 a	4.11a	5.04 a	5.13 a	4.33 a

Means followed by similar letters are not significantly different ($P \leq 0.05$)

Table 6. Mean population of white flies after application of plant extracts (2nd spray).

Treatments	white flies/leaf				Mean
	24 hrs	72 hrs	168 hrs	240 hrs	
Neem	0.38 bc	0.52 c	0.58 c	0.50 d	0.49 c
Garlic	0.61 b	1.13 b	1.71 b	1.33 c	1.19 b
Eucalyptus	0.49 bc	1.42 b	1.69 b	1.77 b	1.34 b
Datura	0.21 c	0.61 c	0.34 c	0.54 d	0.42 c
Control	3.14 a	3.71 a	4.13 a	4.26 a	3.81 a

Means followed by similar letters are not significantly different ($P \leq 0.05$)

statistically at par with that of neem treated plots (0.51). In the 2nd spray of plant extracts, the trend was again same and significant reduction of whiteflies was achieved with the application of datura (0.42 per leaf) followed by 0.49 with that of neem. The two times application of plant products revealed that garlic and eucalyptus, although minimized pest infestation in comparison to control, were significantly less effective compared to datura and neem.

The sucking insect pests sometimes cause serious damage to many crop plants. Unfortunately this particular class of insects can not be controlled by *Bacillus thuringiensis* insect control protein. Use of chemical insecticides is unsafe because of a number of ill effects. In this regard, *Datura alba* has been suggested to be an ideal candidate for the control of insect pests of Bt cotton. In the present experiment datura efficiently suppressed the sucking pest infestation. These results are in agreement with Kuganathan *et al*. [12] who investigated lethal effects of *Datura alba* on ants and aphids. Similarly Liyanage *et al.* [13] tested effect of datura leaves on different insect pests under laboratory conditions and found similar results. Neem was found at par with datura and produced significant results in minimizing pests attack showing acute toxicity at recommended dose against sucking pests. Khan and Atta [14] compared the effect of Imidacloprid and extracts of neem and datura on whitefly population. Their study revealed neem extract much safer, environment friendly and effective in suppressing whitefly population. However unlike our findings they found datura extract ineffective in controlling whitefly population. Similarly Aslam and Naqvi [15] compared the efficiency of neem product with perfekthion

(dimethoate) against sucking pests (jassid, aphid, thrips, and whitefly) and found neem very useful in minimizing attack of these sucking pests. The same was also found very effective by Faria and Kleeberg [16] for the control of sucking insects like white flies, leaf miners and spider mites on ornamental plants. Eucalyptus leaves extract also produced significant results against sucking pests compared to control thereby causing considerable reduction in the pest population. Early workers, Thakur and Sankhyan [17] and Kurowska *et al*. [18], tested the toxicity of eucalyptus against *Rhizopertha dominica* (Coleoptera: Bostrychidae) and observed significant reduction in the population of the pest. In our studies the garlic extract had lethal effects on the sucking pests of Bt cotton compared to untreated check although it was found less effective in suppressing thrips population. Bandyopadhyay *et al.* [19] reported detrimental effect of purified garlic leaf lectin (ASAL), on growth and survival of two important homopteran insect pests, *Lipaphis erysimi*, (aphids) and *Dysdercus cingulatus* (red cotton bug).

Conclusion

It can be concluded from the present research findings that plant extracts, datura and neem at 2% concentrations were superior in reducing the population of jassids, *A. devastans* (Dist.), thrips, *T. tabaci* and whiteflies, *B. tabaci* thereby enhancing the yield. Therefore both can be used for the efficient management of sucking complex of Bt cotton and higher cotton yield. Integration of such botanicals in insects' management package would also be helpful to reduce the need for conventional chemical uses.

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