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Response of *Azadirachta indica* against *Bemisia tabaci* Gennadius (Homoptera: Aleyrodidae) and *Amrasca biguttula* Ishida (Homoptera: Cicadellidae) on Cotton Cultivars

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AA designed and conducted research, MIU helped in data anaylsis and interpretation, MWH supervised research, SK, YI and MA helped in preparation and review of manuscrip, JMO critically revised the manuscript.

Key words
Whitefly, Jassid, Cotton, Neem seed extract.

ABSTRACT

The study was conducted to evaluate the effectiveness of neem seed extract (NSE) for the management of *Bemesia tabaci* Gennadius, (Homoptera: Aleyrodidae) and *Amrasca biguttula* Ishida, (Homopter: Cicadellidae) infesting *Bt* and non-*Bt* cotton cultivars. Foliar application of neem seed, *Azadirachta indica* extract was applied upon reaching economic threshold levels of *B. tabaci* and *A. biguttula*. The insect pest population was recorded 24 hours before and 24h, 72h and 168h after spray. Maximum reduction of 60.20% of *B. tabaci* on *Bt* cotton was recorded at 6% NSE while at 2% concentration of NSE after 148 hrs, 39. 16% reduction was observed. While maximum reduction on non-*Bt* cotton at 6% recorded as 66.60% and minimum at 2% concentration recorded as 48.72% of neem seed extract against *B. tabaci*. In case of *A. biguttula*, maximum reduction in population was observed at 6% concentration of NSE (64.94%) and minimum at 2% concentration (44.50%) on *Bt* cotton. While maximum reduction of *A. biguttula* was observed at 6% concentration (69.05%) and minimum at 2% concentration (48.48%) on non-*Bt* cotton.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an economically important fiberous crop of Pakistan. Many factors like floods, heavy monsoon, infestation of sucking insect pests and cotton leaf curl virus (CLCV) disease has resulted a decline in 13.4% of cotton area during the years 2010-11 (Economic Survey of Pakistan, 2011). While during cropping season of 2009-10, an area of 3105.64 thousand hectares of cotton were sown with an average yield of 11560.1 thousand bales (Economic Survey of Pakistan, 2011). In Pakistan, there is a need to increase the per hectare yield than many other cotton growing countries. In Punjab province of Pakistan *Bt* (*Bacillus thuringiensis*) cotton was introduced in 2001 (Rao, 2006). Non *Bt* varieties of cotton had resulted with less quality seed, high pest attack (bollworms), lower yield, high pesticide applications usage and less resistance to drought conditions (Qaim and Zilberman, 2003). *Bt* cotton is frequently sown due to its advantageous features of increased yield of 7-12% than non-*Bt* (Bryant *et al*., 1999). Transgenic cotton confers a substantial benefit compared with non-transgenic due to higher yield and less use of the chemicals against the insect pest populations (Qaim and Janvry, 2004). This has resulted in overall decrease in expenses with maximum production with minimum inputs for transgenic cotton as compared to non-transgenic cotton and increased net revenue (Huang *et al*., 2002).

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Although *Bt* cotton is resistant against bollworms but sucking insect pests are reported to attack and damage the *Bt* cotton (Sharma and Pampapathy, 2006). Cotton is threatened by many insect pests which are associated with this crop from vegetative growth to the harvesting (Abudulai *et al*., 2007). Cotton whitefly, *Bemisia tabaci* Genn. harm the crop by frequently sucking the cell sap which results in an estimated 50% reduction in cotton bolls. It also secretes honey dew that serve as a potential substrate for sooty mold to grow (Ahmad *et al*., 2002). The sucking insect pests like jassid are also more destructive to cotton. Due to the damage of jassid, 19% dropping of fruits has been reported in cotton with decreased yield (Ali, l992). Besides this, a complex of sucking insect pests *viz., Amrasca biguttula biguttula* (Ish.), *Thrips tabaci* (Lin.), *Aphis gossypii* (Gl.) and *Bemisia tabaci* (Gen.), are recognized to have engaged foremost damaging pest ranking (Mamoon-ur-Rashid *et al*., 2016).

Synthetic insecticides are broadly used for the management of cotton insect pests. Extensive use of synthetic pesticides has resulted in environmental complications (Abdel Bagi *et al*., 2006). Resistance of pest against pesticides has also increased expenses of crop which enlightened the negative impacts on the production (Assad *et al*., 2006). There is an increasing trend of shifting from synthetic pesticides to non-synthetic pesticides. Botanicals are valued for their insecticidal purpose that has proved beneficial against insect pest populations (Prakash and Rao, 1996). Now a days, botanicals are also widely used against cotton insect pests due to their more safety to the environment and plants. Among botanical, neem based insecticides are produced and used for the management of many insect pests (Joseph *et al*., 2010). Neem based pesticides contain azadirachtin as active ingredient that is used to produce neem based biopesticides (Subbalakshmi *et al*., 2012). Due to the germicidal and anti-bacterial properties neem oil and seed extracts are well known plant protectants for the plants against different kinds of pests (Vethanayagam and Rajendran, 2010). Neem-based pesticides do not leave any residues on the plants which is one of the most important advantage for the plant health (Subbalakshmi *et al*., 2012).

MATERIALS AND METHODS

The experiment was conducted at the farm area the Islamia University of Bahawalpur, Pakistan to test efficacy of three concentrations of neem seed extract against *Bemesia tabaci* and *Amrasa biguttula* in *Bt* (IR-370) and no-*Bt* (BH-167) cotton cultivars. There were 8 treatments including control, 3 rows of each treatment and three replications with randomized complete block design (RCBD) under split plot arrangement. The plot size was kept as 2.4 x 4.6 m^2, plant to plant distance was maintained at 30 cm and row to row distance was 75cm. The neem seeds were obtained from the nursery of University College of Agriculture and Environmental Sciences at the Islamia University of Bahawalpur. The covering of neem seed was removed and seed was gently ground in an electric grinder. Neem seed powder of 400g was soaked in 4 liters of water in a jar. The jar mouth was covered with the string and was left for 3 days. The jar solution was stained after 3 days to get clear extract. A 100 gm of surf was added as surfactant, stirred it well and then was sprayed in the field when the population of pest were reached at economic threshold level (ETL) (Fiaz *et al*., 2012; Schmutterer, 1988, 2002). The ETL for whitefly is five adults or nymphs per leaf and for the jassid it was a single adult or nymph per leaf. The application was carried out with hand operated knapsack sprayer having capacity of 20 liters fitted with hollow cone nozzle. The control treatments were treated with water only. Knapsack sprayer was calibrated prior to application of neem solution. Nine random plants were selected per plot for the observation of pest population early in the morning. Upper, middle and lower portions of plants were observed for the pest activity (both nymphs and adults) through every survey. To evaluate the efficacy of different concentrations, population of whitefly and jassid was observed 1, 3 and 7 days after application of neem seed extract concentrations. Statistical analysis was carried out using (ANOVA) and means were separated using LSD test. Percent change in population was determined using modified Abbot's formula (Flemings and Ratnakaran, 1985):

$$\% \text{ Population change} = \left\{1 - \frac{\text{Post treatment population in treatment}}{\text{Pre treatment population in treatment}} \times \frac{\text{Pre treatment population in control}}{\text{Post treatment population in control}}\right\} \times 100$$

RESULTS AND DISCUSSION

For non-transgenic cotton, the results showed maximum reduction in whitefly populations (29.02±0.3%) was at 6% concentration after 24 h of application. While after 72 and 168 h at same concentration, the reduction was 43.25±0.38% and 66.60±0.79%, respectively. For Bt- cultivar, 6% concentration application has resulted in a decrease in whitefly population of 16.07±0.17%, 25.49±0.59% and 60.20±0.42% after 24, 72 and 168 h, respectively (Table I).

Table I.- Percent population reduction (SE±) of whitefly and jassid at different time intervals and at various concentrations of neem seed extract (NSE) on *Bt* and Non-*Bt* cotton cultivars.

Treatments	Cultivar	24HAT	72HAT	168HAT
Whitefly				
6% Water	*Bt* (IR-370)	16.07±0.17c	25.7±0.59d	60.2±0.42b
6% Water	N-*Bt* (BH-167)	29.02±0.28a	43.25±0.38a	66.6±0.79a
4% NSE*	*Bt* (IR-370)	10.75±0.50d	28.49±0.44c	51.87±0.49cd
4% NSE	N-*Bt* (BH-167)	18.7±0.37b	26.97±0.39cd	55.62±0.57c
2% NSE	*Bt* (IR-370)	7.72±0.32e	19.58±0.36e	39.16±0.21e
2% NSE	N-*Bt* (BH-167)	11.43±0.15d	33.35±0.44b	48.72±0.48d
0% NSE	*Bt* (IR-370)	2.7±0.34f	2.75±0.37f	4.09±0.11f
0% NSE	N-*Bt* (BH-167)	3.88±0.09f	1.94±0.06f	5.82±0.11f
Cultivars x Concentrations	P < 0.05	0.0000	0.0000	0.0300
CV	-	2.1034	2.0785	3.6012
Jassid				
6% Water	*Bt* (IR-370)	27.5±0.28c	45.32±0.80b	64.94±0.62b
6% Water	N-*Bt* (BH-167)	34.49±0.57b	50.25±0.74a	69.05±0.67a
4% NSE*	*Bt* (IR-370)	28.63±0.33c	39.55±0.75c	60.82±0.48c
4% NSE	N-*Bt* (BH-167)	41.74±0.59a	53.24±0.73a	65.67±0.47b
2% NSE	*Bt* (IR-370)	15.03±0.22d	22.26±0.52d	44.5±0.58e
2% NSE	N-*Bt* (BH-167)	11.63±0.52d	24.24±0.30d	48.48±0.42d
0% NSE	*Bt* (IR-370)	6.39±0.15e	9.59±0.18e	12.89±10.25f
0% NSE	N-*Bt* (BH-167)	3.19±0.10e	9.59±0.18e	6.39±0.15g
Cultivars x Concentrations	P < 0.05	0.0000	0.0029	0.0001
CV		1.9541	4.5605	2.7832

HAT, hours after treatment; *NSE, neem seed extract.

The findings of current study are like that of Abdalla *et al*. (2010) who stated the 6% and 12% of the neem seed extract gave significant mortality of sucking insect pests (whitefly and jassid) as compared the control. The present experiment results are in accordance with Venkatesh *et al*. (1998), who showed the results that alternative application of neem seed kernel extract at 4 % reduced leaf curl virus by whitefly in chilies. Neem seed extract at various concentrations resulted in reduction of egg hatching (29%) and larval mortality (90%) (Coudriet *et al*., 1985), 93.7% nymphal mortality (Jayaraj *et al*., 1986), reduction of *Bemisia tabaci* (Gen.) in field experiment with neem water extract (Serra and Schmuttere, 1993) and reduction of whitefly and jassid up to 12 days (Khattak *et al*., 2001).

After 24, 72 and 168 h of treatment, neem seed extracts (NSE) at 4% and 6% concentration caused maximum reduction in jassid population on non Bt cotton cultivar BH-167. While on Bt cotton cultivar IR-370, the same concentrations after similar interval of time in the maximum reduction of jassid populations (Table I). The results of our study are in accordance with the findings of Jotwani and Srivastva (1981) which depicted that neem extracts proved to be effective against sucking pests. Ahmad *et al*. (1993) and Dhanalakshmi (2006) also found maximum reduction in jassid population after seven days and minimum after two days of treatment (Khattak *et al*., 2006).

Neem has been proved safer than synthetic chemicals for coccinellids and predatory spiders (Samiayyan and Chandrasekharan, 1998; Sakthivel and Qadri, 2010; Joseph *et al*., 2010). Kundu *et al*. (1998) reported neem formulation of Nimbecidine @ 5 ml/l safer to *Chrysoperla carnea* in cotton. Similarly, Sahayaraja and Karthickraja (2003) found 46% of hatching ability along with 98.8% of predatory potential of *Rhynocoris marginatus*, a predator of cotton aphid, when applied neem product; Nivaar demonstrated. Babu *et al*. (1998) assessed the efficacy of neem formulations for the control of jassid and brown plant hopper of rice and reported neem products were safer to predatory mirid bug, *Cyrtorhinus lividipennis* and predatory spiders.

CONCLUSION

To conclude population reduction for whitefly and jassid was maximum at 6% concentration of neem seed extract for *Bt* and non-*Bt* cotton after 168 h of spray. Similarly, population reduction after 24 h and 72 h of spray were maximum either at 4% and 6% concentrations for both varieties of cotton.

Statement of conflict of interest

Authors have declared no conflict of interest.

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