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INTEGRATED MANAGEMENT OF COTTON APHID, *APHIS GOSSYPII* ON ROOF-PLANTED EGGPLANT, *SOLANUM MELONGENA*

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Abstract: Prevalence and integrated management of cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) were studied on four varieties of roof planted eggplant (*Solanum melongena* L.) Along the sixteen weeks study period highest incidence of aphids (1959.17.17±172.44/plant) on eggplant variety of Blackboy were recorded at 16th week (last week of February, 2013) and the lowest incidence (12.83±8.68/plant) was recorded on the eggplant variety Singnath at 13th week (first week of February, 2013). The treatment having combination of 2g Neem seed kernel extract (NSKE) + ½gm detergent+100ml water) was most effective followed by a treatment of 2g NSKE+100ml water and 1g NSKE+100ml water in reducing the rate of aphid infestation. Eggplant variety Green round showed comparatively higher resistance in all aspects (from leaf and fruit infestation) followed by variety Muktakeshi and Black boy.

Keywords: *Aphis gossypii, Solanum melongena*, Neem extract Rooftop garden

INTRODUCTION

Cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) are small, soft-bodied insects ranges in color from light yellow to dark green and in many cases are almost black. *A. gossypii* has been recorded infest over 320 plant species worldwide, and they belong to about 46 families (Blackman and Eastop 2000). Eggplant (*Solanum melongena* L.) is cultivated during Rabi and Kharif seasons in Bangladesh and are attacked by a dozen of insect pests among which the most serious and destructive one is cotton aphid *A. gossypii.* The incidence of the pest occurs either sporadically or as outbreak every year throughout the country wherever the eggplants are grown (Alam 1969). As a result of its attack, considerable damage occurs every year affecting adversely the quality and yield of the crop. The cotton aphid suck sap from the underside of leaves (Karim *et al.* 2001). High infestation of the aphid can reduce the vigor of the host plant and make it susceptible to other pests (Yarahmadi *et al.* 2011).

The control measures adopted for the cotton aphid in Bangladesh were mainly based on chemical insecticides (Satar *et al.* 2005). The application of broad-spectrum insecticide for control of this pest, has destroyed natural enemy populations and contributed to cotton aphid outbreaks (Slosser *et al.* 1989), both loss of pesticides' effectiveness as well as damage to the environment and human health (Rashid *et al.* 2004).

Neem (*Azadirachta indica)* belongs to the order Rutales and the family Meliaceae (Panhwar 2005). Neem extracts contain azadirachtin are usually safe for beneficial organisms, such as bees, predators and parasitoids, mammals, and for the environment (Tang *et al.* 2002). The triterpenoid azadirachtin was

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first isolated from the seeds of the tropical neem tree. The extract of this plant reduces the population of several aphid species in many crops, causing high mortality and decreasing fecundity, as well as inhibit population growth (Tang *et al.* 2002). The neem extracts reduce adult longevity, survival rate, fecundity, and life table parameters of aphid species (Ahmed *et al.* 1985).

The present study was carried out to assess the incidence of cotton aphid, *A gossypii* on different varieties of eggplant (*Solanum melongena* L.) planted on the roof top. The impact of climatic factors (temperature and relative humidity) on the incidence of this pest population and the efficacy of neem seed kernal extract (NSKE) and soap detergent solution against this pest species for the management of this pest species was also studied.

MATERIAL AND METHODS

Study site: The experiment was carried out at the rooftop garden of Zoology Department, Jagannath University (23°42′37″ N 90°24′40″E), Dhaka during November 1, 2012-February 26, 2013 and November 1, 2013-January 15, 2014.

Experimental layout: The experiment was laid out in a randomized complete block design (RCBD) with two replications as described by Rashid *et al.* (2004). The experimental field was divided into three blocks each consisted of four varieties, namely- Variety 1 (Black boy), Variety 2 (Singnath), Variety 3 (Green round), and Variety 4 (Muktakeshi)

Treatments:

Treatment-1: 1 gm neem seed kernel extracts (NSKE) + 1000ml water

Treatment-2: 2 gm NSKE + 1000ml water

Treatment-3: ½ gm detergent + 1000ml water

Treatment-4: 2 gm NSKE + ½ gm detergent/100ml water

Treatment-5, Control: Untreated control (an equal volume of water)

There were three replications under each treatment and treatments were applied at three days interval. The experiments was conducted for a period of six weeks (01.11.2013 to15.01.2014)

Aphid sampling: The sampling was done by counting the aphid number on different plants which were selected randomly. Counting started two weeks after transplanting. Aphid populations were monitored twice weekly and by leaf count method. The sampling was done at the same time (8:00 am – 11:00 am) in each collection. The average number of insects were counted each time and was computed for each treatment.

Fruit Infestation: Harvesting was done at an interval of 10 days. Percent fruit infestation at each harvest was calculated using the following formula:

% fruit infestation by number= Number of infested fruits/ Number of total fruits × 100

% fruit infestation by weight= Weight of infested fruits/Total weight of fruits × 100

% reduction in fruit infestation= % fruit infestation in control - % fruit infestation in treatment/% fruit infestation in control × 100

Climatic data: Humidity and temperature data were obtained from the meteorological department of Dhaka city.

Data analysis: The data were analyzed using Microsoft office Excel program.

RESULTS

The prevalence of aphid population in different varieties of eggplants at 16 consecutive weeks of study is shown in the Figure 1. The highest incidence of aphid was recorded at 16th week (23.02.2013) (1959.17.17±172.44/plant) in eggplant variety Blackboy) and the lowest incidence was at 13th week (03.02.2013) (12.83±8.68/plant) in eggplant variety Singnath 666). The occurrence of aphid population was increased gradually from 1st week to 4th week and at 5th week aphid number was decreased and then again increased at 6th week in all cases except variety 2 and 3. After that the number of aphid population was declined up to 14th week. From the beginning of 14th week, the aphid incidence again commenced to increasing the number. Monthly, the highest frequency of aphid population was recorded in February and the lowest number in January.

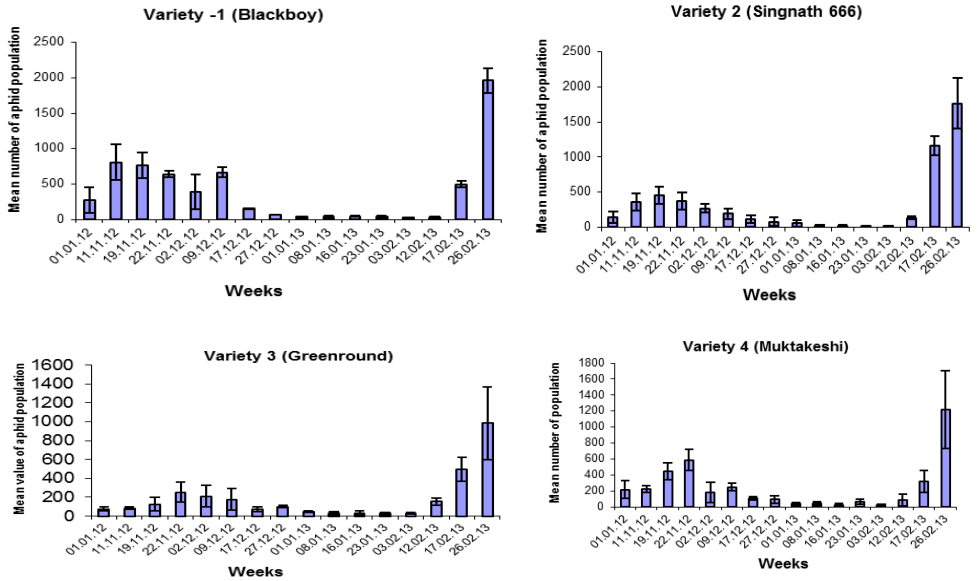

Figure 1. Occurrence of *Aphis gossypii* population during 16 consecutive weeks on different varieties of eggplants.

Climatic Interaction: The *A. gossypii* population has a positive correlated with temperature (Figure 2a) in all the eggplant varieties (R^2 = 0.3007 for variety 1, R^2 = 0.1409 for variety 2, R^2 = 0.1 for variety 3 and R^2 = 0.3135 for variety 4). On the otherhand *A. gossypii* population has a negative correlation with relative humidity (Figure 2b) in all the eggplant varieties. (R^2 = 0.054 in variety 1; R^2 = 0.171 in variety 2; R^2 = 0.230 in variety 3 and R^2 = 0.113 in variety 4).

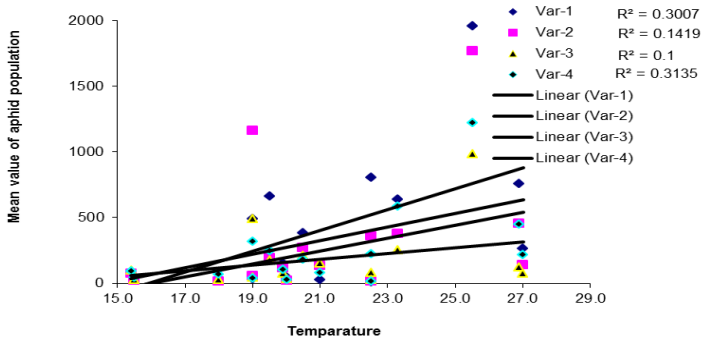

Fig. 2a. Correlation of *Aphis gossypii* population with temperature different on varieties of eggplant

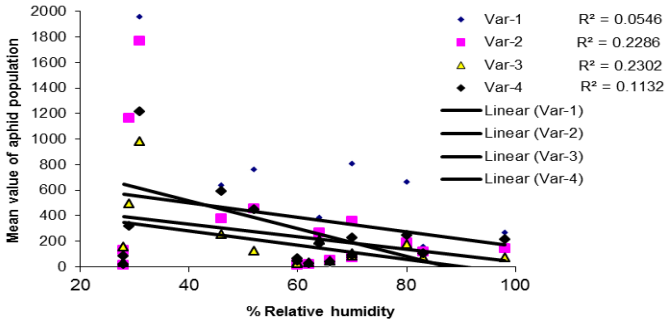

Fig. 2b. *Aphis gossypii* population with relative humidity on different varieties of eggplant

Effect of treatments: Effect of different treatments on aphid control of the different eggplant varieties are shown in the Figure 3. In cases of all varities highest aphid incidence was seen in the treatment 5 at the 6th week. *viz.,* 15808±404.30/plant for variety 1(Blackboy), 9918±1389.32/ plantfor variety 2 (Singnath), 23940±2011.84/plant for variety 3 (Green round), and 44172 ± 1105.24/ plant for variety 4 (Muktakeshi). On the other hand treatment 4 had the maximum controlling effects on different varieties of eggplants resulted with lowest aphid infestation. The result indicates that a gradual decrease of aphid population in the later weeks on treatment 1to 4 but gradual increases in treatment 5 (control) in all the varieties.

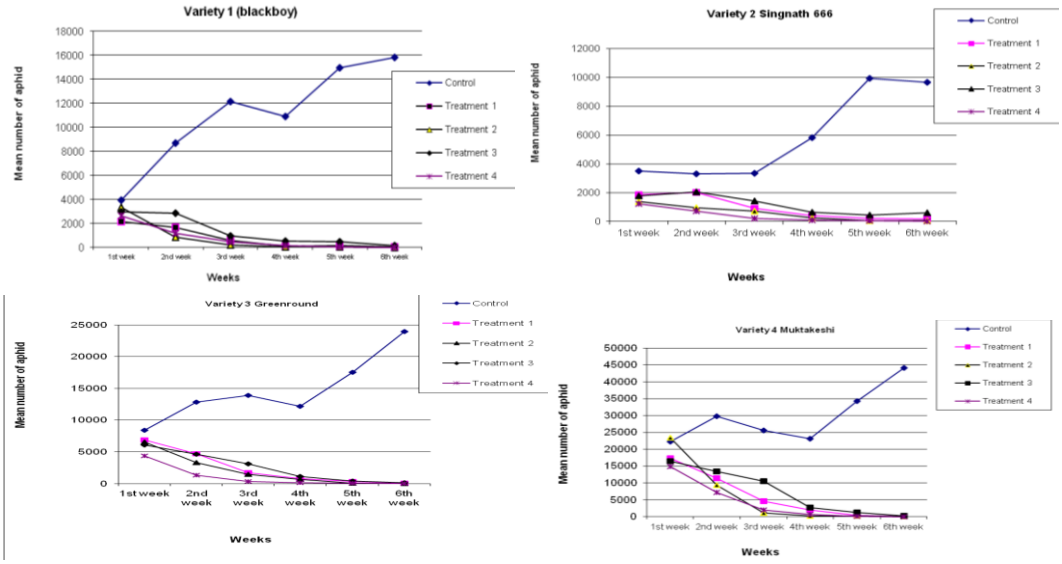

Figure 3. Number of aphids on varieties of eggplants after different weeks of treatments

Screening of eggplant varieties: On the basis of gradation for rate of infestation of different eggplant varieties, the levels of percentage of fruit infestation by *A. gossypii* were categorized by number and weight (Table 1). The percentage of fruit infestation on eggplant by number varied in 2012-2013 and 2013-2014 cultivation years. The rate of infestation of different varieties ranged from 28.57% (in variety 3) to 38.46% (in variety 2) in 2012-2013 and 4.17% (in vareity 3) to 6.67% (in variety 2) in 2013-2014. The percentage of cotton aphid infestation by weight also varied in 2012-2013 and 2013-2014 cultivation years. The level of percent infested fruits ranged from 21.62% (in variety 3) to 28.65% (in variety 1) in 2012-2013 and 4.12% (in variety 2) to 5.08% (in variety 4) in 2013-2014. From the level of percentage of the infestation by weight it was observed that all varieties were tolerant (T) after application of different treatment.

Table 1. Screening of susceptible eggplant variety from sight of fruit infestation by number and weight

Varieties	Percentage infestation of fruits				Relative grading of susceptibility	
	Number		Weight (g)		Number	Weight (g)
Black boy	33·33	5.56	28·65	4.26	S	T
Singnath	38·46	6.67	28·00	4.12	S	T
Green round	28·57	4.17	21·62	5.01	T	T
Muktakeshi	30·76	4.76	21·86	5.08	T	T

Legend (After Lal *et al*, 1976): T=Tolarant (21-30% infestation) S=Susceptibility (31-40% infestation), HS-Highly susceptible (above 41% infestation).

DISCUSSION

The study of the population dynamics of the cotton aphid *A. gossypii* on eggplant established a basis for the development of future cotton aphid management. The result reveals that the highest frequency of aphid population was recorded in February and the lowest number in January. Result of this experiment partially similar to the findings of Rondon *et al. (*2005) and Sreedevi *et al. (*2007) who have reported that the aphid population gradually developed attaining the maximum during February. Banerjee and Raychaudhuri (1986) reported the incidence of *A. gossypii* in July, August, and November on okra, chili and eggplant respectively that is partly supported by the present observation. Maiti *et al.* (1989) observed that *A. gossypii* prevailed on okra from early December to late February.

The incidence of *A. gossypii* population in eggplant was mostly affected by temperature and humidity during the study period (November 2012 to February 2013). In this period air temperature and relative humidity was 18-28ºC, 29-74% respectively. There was a positive correlation between aphid population and temperature in all varieties. This result confirms the study of Campbell *et al. (*1974) who have indicated that peak of aphid population was positively correlated with a moderate increase in temperature. The study contrasts with the findings of Karim *et al.* (2001) who found that *A. gossypii* favors January with temperature.

During the study, the aphid population increased in number as humidity decrease (in February 2013 monthly average RH 29%) and decreased in number as humidity increase (in January 2013 monthly average RH 62%). However the result of this experiment partially similar to the findings of Mall *et al. (*1992) who have noted that the survivability of the pest to be uppermost when maximum temperature and average relative humidity were between 20-25ºC and 50-72% respectively. The present result conflicts with those observed by Araujo and Sales (1985) who studied the population of *A. gossypii* on cotton in Brazil.

The study was conducted for 6 weeks (late November to mid-January) to evaluate the efficacy of different treatments, against *A. gossypii* in eggplant, that are prepared from neem derived insecticides in isolated form, in mixture with detergent and from isolated detergent. Azadirachtin, a chemical complex found in seeds of neem, is known to act synergistically with other chemical and biological pesticides by Mohan *et al.* (2007) The most fascinating finding of the present study is that treatment 4 attained superiority to treatment 2, treatment 1 and treatment 3. The result reveals that treatment 4, prepared from aqueous neem seed kernel extract and detergent, showed synergistic or additive effects. Fei *et al.* (2012) have reported different joint actions for the mixture of destruxins and botanical insecticides. Morgan (2009) noted that the synergistic action of azadirachtin includes killing, deterring, antifeedant and disrupting the growth of pest *A. gossypii.*

From the sight of fruit infestation by number the rate of infestation of different eggplant varieties ranged from 28.57% to 33.33% in 2012-2013 and 4.17% to 6.67% in 2013-2014. The result showed that all the varieties showed highly resistant to the aphid infestation after treatment application whereas they showed tolerant grade of infestation before applying treatments. In the present study, the percentage of fruit infestation by weight in variety 2 (Singnath) was 28% in 2012-2013. The results are in partial agreement with the findings of Ahmed *et al.* (1985) who noted that the percentage of fruit borer infestation was 23.47% in Singnath long.

Results ensured the feasibility of using neem seed kernel extracts in combination with detergent and also in isolated form in higher concentration (2gm/1000ml). Finally results concluded that neem based insecticides should be introduced as alternative to chemical insecticides; that reduced both leaf and fruit infestation and may meet the demand of vegetables for ever-increasing world's population, can conserve the world's beneficial organism and ensure the sound health of earth best creature.

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