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Population Dynamics of *Aphis gossypii* Glover (Homoptera: Aphididae) at Rajshahi, Bangladesh

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Abstract: Population of *A. gossypii* Glover on *Solanum melongena* L. was studied. Monthly data were collected from 5 plants along with their natural enemies. Mean monthly temperature, relative humidity, dew point, rainfall, soil temperature and photoperiod were also collected. Correlation coefficient was calculated. Aphid population started growing from August, became highest in January and vanished in April. Multiple correlation coefficient was also highly significant.

Key words: *A. gossypii*, aubergine, plant population dynamics, Bangladesh

Introduction

The study of numerical changes in population of living organisms in time, space and of the processes which cause such variations may be regarded as population dynamics. The term population dynamics is applied to the forces affecting changes in population density (Huffaker and Messenger, 1964). Some author emphasized the role of biotic factors among the forces which control the abundance of organisms. Recently a number of more or less intensive discussion on insect population dynamics have attempted to put the entire subject into perspective (Clark *et al.*, 1967; Huffaker *et al.*, 1971; Bartlett and Hiorns, 1973; Varley *et al.*, 1973).

The objectives of population dynamics is to identify the causes of numerical change in population studies and to explain how these causes act and interact to produce the observed pattern of numbers (Hughes, 1972). Hence, the project was conducted to have a picture of their abundance and causes of population fluctuation.

Materials and Methods

In order to study the population dynamics of *A. gossypii* infesting aubergine plant, *Solanum melongena* L. var. muktakeshi, a moderate size (50 x 30- yard^2) of field was selected around Rajshahi University Campus. Every week five aubergine plants (4 from 4 corners and 1 from middle) were chosen from the field randomly and the number of infested leaves by *A. gossypii* and total number of leaves of each plant were counted. Percentage of infested leaves, total number of aphids and the average aphids per plant were calculated along with number of natural enemies on them.

When the aubergine plants of the said field was uprooted, a second field was selected and sampling was done by the aforesaid procedure. In this way percentage of infested leaves by *A. gossypii* and their average number per plants were calculated. Daily temperature, relative humidity, dew point, rainfall, soil temperature and photoperiod were recorded during the course of study.

Results and Discussion

Weekly percentage of infested leaves and average number of *A. gossypii* per plant along with temperature, relative humidity, dew point, rainfall, soil temperature and photoperiod for different month from September, 1992 to August 1995 were shown in the Fig. 1. ANOVA for monthly mean number of aphid poipulation was calculated (Table 1).

Data were analysed to inspect the relationship between monthly mean physical factors of the environment and natural enemies with monthly mean aphid population. The 'r' values were calculated separately and are provided in Table 2. Regression lines were drawn in case of significant relationship. The negative slope of the equations for temperature, dew point, rainfall (1993-94) and soil temperature showed inverse relationship with aphid population. The positive slope of the equation for natural enemies with aphid population showed direct relationship. The predators of *A. gossypii* were *Coccinella septempunctata* L., *Coccinella transversalis* Fab., *Menochilus 6-macaulatus* Fab., *Micraspis discolor* Fab., *Scymnus pyrocheilus* Mulsant, *Paragus crenulatus* (Thomson), *Ischiodon scutellaris* (Fabr.).

Multiple regression of aphid population was calculated with software SPSS/PC from Statistics Department, Rajshahi University. Relationship between temperature (x_1), relative humidity (x_2), dew point (x_3), rainfall (x_4), soil temperature (x_5) and photoperiod (x_6) with aphid population (y) was calculated. R-value was 0.96302 ($P<0.001$). F-value was 51.102 ($P<0.01$). Regression equation was $y=77.264 - 2.881x1 - 0.0015x2 - 0.055x3 - 0.392x4 + 0.426x5 + 0.495x6$. The negative slope of the equation shows that temperature, relative humidity, dew point and rainfall are inversely proportional to aphid population. The positive slope of the equation showed that soil temperature and photoperiod influenced directly.

In fact aphid population dynamics are strongly influenced by climatic conditions and cool spring and fall of temperature augment aphid numbers (Hajek and Dahlsten, 1988). The abundance of aphid is dramatically affected by changes in weather, a major distribution factor. Aphid nunmbers are regulated by a hierarchy of different density-dependent processes controlling population growth at various levels of abundance. Natural enemies of aphids can reduce their rate of increase dramatically, and the use of hymenopterous parasites in biological control of a few aphid pests would appear to have been successful (Dixon, 1985). Behura (1963) reported that this aphid is available in the field round the year. In Egypt, Khalifa and Sharaf El-Din (1964) observed that *A. gossypii* first appeared in mid-November on the American cotton, but the Egyptian cotton was free from infestation.Khalid and Al-Zarari (1982) *A.gossypii* as a main pest of cotton. The abundance of aphid populations in 1979 as related to prevailing temperature and relative humidity was recorded. There was a negative correlation between aphid population and temperature. Trumble *et al.* (1983) observed the population of *A. gossypii* on strawberries in California along with other aphids. They found that the population reached maximum in January and February (1980-81) period and vanished in May, but again they become highest in January (1981-82) period, gradually

Table 1: Analysis of variance between the monthly mean population of *A. gossypii* per brinjal plant for the year 1992, 1993, 1994 and 1995

Month	Mean				Total	Average
	1992	1993	1994	1995		
January	----	39.79	36.30	38.24	114.33	38.11
February	----	36.11	35.11	26.63	97.85	32.61
March	----	19.85	22.15	16.35	58.35	19.45
April	----	7.39	6.95	5.15	19.49	6.49
May	----	0.00	0.00	0.00	0.00	0.00
June	----	0.00	0.00	0.00	0.00	0.00
July	----	0.00	0.00	0.00	0.00	0.00
August	----	5.98	8.60	9.27	23.85	7.95
September	10.00	7.09	18.25	----	35.34	11.78
October	14.38	9.85	21.41	----	45.64	15.21
November	17.65	14.43	27.81	----	59.89	19.96
December	25.85	27.95	35.18	----	88.98	29.66
Total	67.88	168.44	211.76	95.64	543.72	

Variance ratio (F). Between month. 60.09*, Between year 7.09*

LSD value = 11.02. Only January and February differs from other months.

DMRT value does not differ. HSD value (36.917) does not differ. * = P < 0.01.

Table 2: Impact of temperature, relative humidity, dew point, rainfall, soil temperature and photoperiod on the population of *A. gosspyii* from September, 1992 to June, 1995

Year	Variables		Correlation coefficient	Regression equation
1992-93	Temperature (°C)	and APP	-0.897***	y = 81.670 - 2.606x
	Relative humidity (%)	and APP	-0.026	---------
	Dew point	and APP	0.780**	y = 54.697 - 1.979x
N = 10				
Df = 8	Rainfall (mm)	and APP	0.510	--------
	Soil temperature (°C)	and APP	-0.931**	y = 84.625 - 2.577x
	Photoperiod (hour)	and APP	0.166	--------
	Natural enemy	and APP	0.774**	y = -5.426 + 13.449x
1993-94	Temperature (°C)	and APP	-0.964**	y = 89.185 - 2.919x
	Relative humidity (%)	and APP	-0.268	--------
	Dew point	and APP	-0.911**	y = 67.675 - 2.480x
N = 12				
Df = 10	Rainfall (mm)	and APP	-0.609	y = 20.932 - 2.108x
	Soil temperature (°C)	and APP	-0.973**	y = 93.084 - 2.911x
	Photoperiod (hour)	and APP	0.437	--------
	Natural enemy	and APP	0.765**	y = 1.387 + 11.933x
1994-95	Temperature (°C)	and APP	-0.931**	y = 86.517 - 2.725x
	Relative humidity (%)	and APP	-0.093	--------
	Dew point	and APP	-0.835**	y = 60.041 - 2.151x
N = 12				
Df = 10	Rainfall (mm)	and APP	-0.551	--------
	Soil temperature (°C)	and APP	-0.901**	y = 87.177 - 2.605x
	Photoperiod (hour)	and APP	0.445	--------
	Natural enemy	and APP	0.963**	y = 0.979 + 13.324x

APP = Aphid population per plant. * = P < 0.05, ** = P < 0.01

decreased in February and vanished in May.

Araujo and Sales (1985) studied the population of A.gossypii on cotton in Brazil. They found that the population dynamics were not affected by the minimum, maximum or mean temperature, the relative humidity or velocity of wind, the evaporation rate, rain or the number of mature bolls. However, increase in population were favoured by the presence of flower buds and by sunshine. Banerjee and Raychaudhuri (1985) observed the growth of *A. gossypii* on aubergine crop and found that the growth curves showed a modified sigmoid form where the upper asymptote level was marked during late November (Kharif) and late February (rabi), when the plants were fully mature. Roy and Behura (1979) noticed that at Bhubaneswar *A. gossypii* are found throughout the year on aubergine plants, heaviest infestation occurring during either September - November or March - April depending on early or late crops. *A. gossypii* favour winter with low temperature and optimum relative humidity.

Banerjee and Raychaudhuri (1986) recorded the incidence of

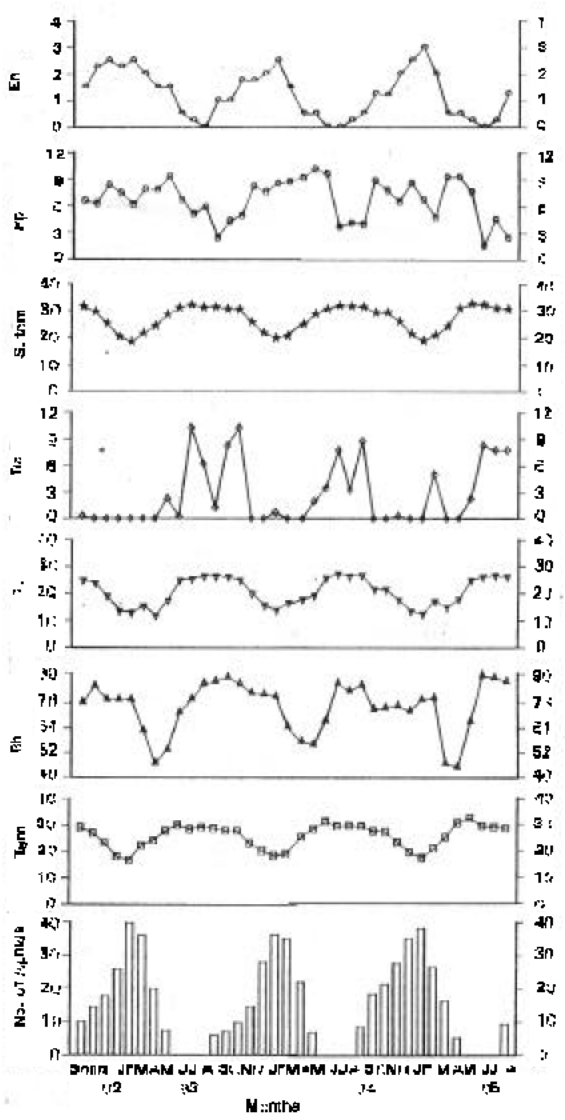

Fig. 1: Mean number of A. Gossypii infesting brinjal plant along with corresponding physical factors of the environment
(Tem=Temperature, Dp=Dew point, Rh=Relative humidity, Ra=Rainfall, S.tem=Soil temperature, Pp=Photoperiod, En=natural enemy).

A. gossypii maximum in July, August and November on okra, chilli and aubergine respectively. Highest incidence was always on older leaves. Banerjee and Raychaudhuri (1987) also observed *A. gossypii* on aubergine plant that in older leaves the number decreases gradually and increases in young leaves towards harvest. Banerjee *et al.* (1986) recorded 30 to 35% as maximum infestation of aubergine plants by *A. gossypii* on aubergine plant in West Bengal during 1980-81 and 1981-82. In the first year population was maximum in January, then dropped slightly and again raised in February and began to decline afterwards upto March. In the second year counting began in October, become highest in December and declined in February.

Growth of *A. gossypii* in the warmer region of Japan was observed Nozato (1988). In the field the aphid was found on *Veronica persica* from early December to late May and on *Carratia japonica* from late May to early December. Crops (potatoes, aubergines and cucumbers) were infested from early summer (May-June) and in autumn (October-November), but few aphids were found in mid-summer.

Maiti *et al.* (1989) observed that the same aphid prevailed on okra from early December to late February (at 18 to 24°C, 62 to 71% RH) and from early March to late May (at 27 to 34°C, 65 to 85% RH). Slosser *et al.* (1992) observed that populations of *A. gossypii* increased rapidly during August only in June-planted cotton, which suggests that time of year interacts with plant age to influence population development. Karim *et al.* (1994) observed the maximum number of aphids during January 93, followed by December 92. Aphid appeared during October 92 and disappeared during March 93. Temperature, rainfall, dew point and photoperiod showed negative effect, the former two was significant. Only relative humidity showed insignificant positive effect. *A. gossypii* were always collected as parthenogenetic viviparous females. A few were found in one of the bushy aubergine plant in mid July'97 in Rajshahi College Campus, which indicates that this aphid leads an anholocyclic life cycle in this geographical belt throughout the year. Above a certain fairly small group size, however, the performance of the aphids starts decreasing, with gradually smaller, and therefore less fecund, aphids being produced. The rate of population increase in turn slows down as a result of increasing competition for food and space and increased production of emigrant alates. These sensitive changes in aphid performance and morph production as a result of competition can be seen due to adaptations to the highly variable and consequently changing quality and quantity of these particular aphids food resources.

Each species of aphid is a part of complex system of interacting factors, and detailed studies, often involving simulation models, should be undertakne to unravel the interactions of aphids with their natural enemies, host plants, and weather. These studies give a good understanding of the system and often allow the development of more easily applied, simple decision rules, for example, in those aphids that overwinter viviparously, the severity of winter and early spring is of paramount importance in determining the abundance of the aphids.

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