BIOLOGICAL AND ECOLOGICAL STUDIES ON THE COTTON APHID *Aphis gossypii* Glover

(Hemiptera :Aphidae)

By

Philip Riad Shawki

B.Sc. (Agriculture)

A Thesis Submitted in Partial Fulfilment of the Requirements

for the Degree of

Master of Science

(Entomology)

Faculty of Agriculture

Ain Shams University

1968

This Thesis for the M.Sc. Degree

has been approved by: M. S. Zoheiry

Date: Feb. 8, 1969

Acknowledgements

The author feels indebted to Dr. A. Habib, head of the Crop Protection Dept., Ain-Shams University, for the facilities and encouragements he kindly offered throughout the course of this investigation.

The author also wishes to express his deep gratitude to both Dr. M.M. Hosny, Prof. of Insect Ecology and Dr. E.A. El-Kady, Associate Prof. of Entomology at the same Department, for suggesting the problem and for supervising the work.

====

CONTENTS

PART I.

G E N E R A L

Section I

INTRODUCTION

The cotton aphid "Aphis gossypii Glover" is distributed throughout most of the countries between latitudes 60° N. and 30° S. Its importance is greatly connected with the damage it causes to some economic plants. According to Willcocks & Bahgat (1937), A.gossypii is found everywhere in Egypt and is most abundant in the lower and middle parts of the country. According to Hall (1924), Eguchi (1937), Takahasi (1950), Talhouk (1954) and others, the adults and nymphs of this serious pest cause considerable losses to a variety of important field and vegetable crops, especially those belonging to the families Malvaceae and Cucurbitaceae as well as to several fruit shrubs and trees. Theobald (1926) stated that this aphid species occur on cotton, melon, gauva, carrot and tobacco as well as on more than fifty different other plants belonging to various families including vegetables, fruit trees and field crops.

A.gossypii which is commonly known as the "melon aphid" or "cotton aphid" usually injures the cotton plants during the seedling stage, after fruiting and occasionally, just before harvesting. The resulting damage is due to inserting the mouth parts of the nymph and adults into the plant tissues and sucking the cell's juice. The readily observed evidence of aphid's injury is the excretion of the honey dew which falls on the upper surface of the leaves that lie beneath the

infested ones. The growth of the black fungus and the distortion and discoloration of the leaves are further evidences. Ultimate defoliation and shedding of bolls and spoiling of lint are among the inflicted damages. The grade of the staple may be lowered, if the honey dew falls on open bolls, since it provides a favourable medium for fungal growth.

Besides the direct damage resulting from aphid-feeding, these insects may also act as vectors of several plant diseases and play an important role in transmitting and distributing the pathogens of these diseases. Cater (1962) reported that aphids are capable of transmitting 44 different virus-causing symptoms of cotton anthocnosis, potato virus Y, luttuce, maize and pea mosaics .... etc.

Section II

Review of Literature:

A. Annual Generations of Aphids:

Paddock (1920), in Texas, observed that during a single year, 51 generations of A.gossypii were completed. Eguchi (1937), said that the maximum number of annual generations of aphids in Korea was about 33 and 28 on hibiscus and cotton respectively. In Egypt, Hassan (1956) stated that it could have 54 generations a year.

B. Seasonal Abundance of Aphids:

In U.A.R., A.gossypii may be found all the year round. However, it is more abundant during two main periods:

a) Spring and early summer (from the beginning of March till June) mainly on cotton seedlings.

b) Late summer, autumn and early winter (July - October).

Cotton plants are rarely attacked during July, but they are likely to be heavily infested during August and September. However, Willcocks & Bahgat (1937) claim that in the Giza Province and, northwards, throughout the whole of the Delta, the cotton aphid attack cotton plants heavily during the months of July and August. They also added, that in the northern provinces, the attack may last till September. In October, a sharp decline in the population takes place, coinciding with the dryness of its hosts leaves.

C. General Description of Aphids:

The adult aphid is a small soft-bodied insect, about 1.5 mm. long. Considerable variations in body size are quite common. Its colour is often blackish or very dark olive-green. Frequently, the body colour is pale white, yellow or green according to the host. The spring forms tend to be much longer than those of the late summer and autumnal forms. Both wingless and winged forms occur.

D. Biological Aspects:

Nassar et al. (1959), studied the biology of the cotton aphid under controlled conditions of temperature and humidity. They also determined the effect of crowding on wing production. Their results show that the rise of temperature affected the pre-reproduction and reproductive periods while the post-reproductive period was not influenced by the rise

of temperature up to 30°C. They also found that the reproductivity of aphids is expected to be greater at moderately low temperature than at fairly high ones, and the longevity of the adults tended to decrease with the rise of temperature. They observed that A.gossypii completes four nymphal instars of approximately equal durations at any given temperature. The high temperature affected the size of the insects, while humidity expressed no effect on either the total duration of the nymphal period or wing-production.

The above review infers that while the morphology and biology of A.gossypii has been extensively studied, yet little field-ecological work has been carried out on this pest. It was thus the main object of the present study to cover part of the latter aspect in U.A.R. Accordingly, the effect of nitrogenous fertilization, irrigation, plant spacings and sowing dates on the population density of A.gossypii on certain cotton varieties were investigated in the present work.

MATERIALS, METHODS AND TECHNIQUE

The present study on the cotton aphid "A.gossypii" was carried out during the cotton-growing seasons of 1964 and 1965 in three "ecologically-different" localities, though fairly close to one another (5-20 miles apart). The first locality was the experimental field attached to the Faculty of Agriculture Ain-Shams University at Shoubra El-Kheima,

3.5 x 5.0 m. Sowing took place on 25th March 1964 and in order to enhance germination, the seeds were soaked, prior to sowing, in plain water for 24 hours. Irrigation followed sowing directly on the same day. The common practice of "thinning down" the number of growing seedlings to only 2 per hill was applied on the 18th day after sowing, just before the second irrigation.

Fertilization Rates:

Calcium nitrate $[Ca(NH_3)_2]$ 15% was added to the different treatments of cotton at the 3 rates of 75, 150 and 225 kg. per feddan (i.e. 11.25; 22.50 and 33.75 kg. of nitrogen respectively). The fertilizer was added in the following manner:

i) Each of treatments A (75 kg./feddan), B (150 kg./feddan) and C (225 kg./feddan) received the first batch of the fertilizer when the plants were one month old, at the rate 75 kg. per feddan.

ii) Two weeks later, the plants of treatments B and C only, received a similar amount of the fertilizer, thus getting, so far, 150 kg. per feddan each.

iii) After another two weeks, a further amount of the fertilizer (at the same rate of 75 kg./feddan) was added to the plants of treatment C alone. Thus, treatment C received a total amount of 225 kg.; treatment B, 150 kg. and treatment A, 75 kg. per feddan.

Irrigation of the whole experimental field was synchronized on the dates of fertilization.

Except for the differences in the rates of chemical fertilization, all treatments received, equally, all the other usual agricultural practices such as hoeing, weeding, hand picking of the cotton leaf worm egg masses ..... etc. In the mean time, chemical control of cotton pests had to be totally avoided in the experimental field, in spite of the occasional necessity of such measures especially against cotton boll worms.

Sampling Technique:

The growing cotton plants were kept under close observation as from the beginning of May. When aphids started to invade the plots of any treatment, regular weekly counts of the aphids (apterous forms) were taken. The weekly records were obtained by simply examining 6 plants, chosen at random from any replicate-plot, on every sampling date. From each sampled plant, 3 leaves were examined thoroughly. This technique of sampling was recommended by Branson & Floyed (1946). Sampling was usually carried out between 8 a.m. and 1 p.m., and the sampling season extended until the end of September.

Separate averages per leaf for every cotton variety on each sampling date were calculated and variance analysis using F test was conducted, to differentiate between their rates of susceptibility at each of the tested rates of fertilization.

Calculations of the Graphical Areas:

The surface areas denoting the size of aphid infestation on the different varieties of cotton at different rates of fertilization were calculated from the graphs, by simply using the "Trapyzoidal rule's method" according to the following formula:

$$\text{Area} = \left[\frac{Y_1 + Y_n}{2} + y_2 + y_3 \ldots\ldots + y_{(n-1)} \right] h$$

where

Y_1 Denotes the average number of aphids per leaf on the first sampling-date in millimeters (from the graph) or the first trapezium length ;

Y_n Denotes the corresponding average for the last sampling-date or last trapezium base length ;

Y_{n-1} Denotes the last but one ..... etc. ; and

h Denotes the standard height of trapezia, i.e. the scaled distance between each two successive sampling dates on the graph (1 cm. in the present case).

The values of the calculated areas for the different varieties and at the tested rates of fertilization are tabulated and, in the meantime, are inserted in the graphs.

Section IV

The Abou-Zabal Experiment:

It has been stated earlier that the large-scale field experiments (of 1964 & 1965) were carried out in the experimental farm of the Faculty of Agriculture, Ain-Shams University at Abou-Zabal. The purpose of the 1964 experiment was the study of the following points:

1) Comparing the relative susceptibility to aphid infestation of five cotton varieties viz. "Giza 66"; "Giza 67"; "Giza 68"; "Giza 47" and "Monoufi".

2) Determining the effect of 3 different sowing dates on the infestation levels of aphids attacking the above-outlined cotton varieties.

3) Testing the effect of 3 planting spacings (i.e. plant densities) on the rates of aphid infestation.

4) The relationship of 3 rates of nitrogenous fertilization to aphid infestation.

A total area of about six feddans was divided into 3 equal blocks of two feddans each. Every main block was divided, in turn, into 135 plots. The plot measured 7 x 6 m. (i.e. $\frac{1}{100}$th feddan each), and included 12 rows, 60 cm. apart and 6 m. long. Each of the three main blocks was assigned for one of the three tested planting dates (main treatments). The 135 plots within any block (planting-date) was divided into 3 equal groups of 45 plots each; and each group was assigned for one of the three tested fertilization rates (sub treatments). Later on,