Chapter 5. HOST-PATHOGEN INTERACTION AND BREEDING FOR RESISTANCE

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RESISTANCE OF CERTAIN CUCUMBER VARITIES TO THE MELON APHID, *APHIS GOSSYPII* (GLOVER)

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Abstract

Certain cultivars of the cucumber, *Cucumis sativus* L., were tested for resistance to the melon aphid, *Aphis gossypii* (Glover), under greenhouse conditions. The obtained results showed that the melon aphid reared on 'Beth alpha F1' had a longer productive period and produced fewer and smaller individuals than that reared on the other cultivars. The alate aphids on 'Beth alpha F1' gave only 9.81% of the total progeny compared with the other three cultivars. However, alate aphids on 'Beit alpha MR', F1 hybrid 'Beit alpha MR' and 'Rawa-F1RS', produced 24.07%, 24.57% and 41.55% of the progeny, respectively. Significant differences were observed in the reproductive period, total longevity, the number of nymphs per aphid and the number of nymphs per one reproductive aphid. The life table studies indicated that the population of 10 females of A. gossypii could increase to become 40, 59, 62 and 69 aphids on 'Beth alpha F1', 'Beit alpha MR', 'Rawa-F1RS' and F1 hybrid 'Beit alpha MR', respectively, within one week.

Key words: melon aphid, life table, plant resistance, cucurbits variety.

Introduction

The melon aphid *Aphis gossypii* (Glover) is a serious pest of cucumber plants in Egypt. This aphid causes economic damage to cucumber plants by inducing direct injury to the plants or indirectly as a vector of virus diseases.

At present, insecticides are relied upon for cucumber aphid control. The growing of resistant varieties has been a major successful control tactic against the vegetable pests, because of the difficulty of using pesticides on these edible plants. Chambliss and Jones (1966), Da Costa and Jones (1971a), Kooistra (1971) and Howe et al. (1976) supported this view.

This investigation was undertaken to evaluate the effects of the resistance in cucumber cultivars on the bionomics of the melon aphid. Moreover, the variations in the population size of the aphid on these cultivars were studied by using life table

parameters /Birch, 1948; Strong, Sheldahl, 1970; Gutierrez et al., 1971; Mueller, Stern, 1973; El-Dessoki et al., 1976; Dixon, 1987; Patrick, Gutierrez, 1995/.

Materials and Methods

The cucumber cultivars, ʻBeit alpha MR', ʻBeth alpha F1', F1 hybrid ʻBeit alpha MR' and ʻRawa-F1-RS' were grown in small pottery pots and were treated weekly with a complete fertiliser to maintain vigorous growth. The experiments were conducted under natural day light when the daily greenhouse temperature fluctuated between 21 and 32^{o} C.

Aphids were obtained from a stock colony of *A. gossypii* maintained on cucumber plants. Reproduction and survival of alate adult aphids were studied by confining then individually in micro cages similar to those designed by Pruthi and Samuel /1937/. The cage was fixed to the lower surface of a leaf of the means of wire clip. In order to avoid any injury to the leaf surface, a disc of sponge was inserted between the surface of the leaf and the wire clip. The experimental aphids were aspirated as pre-reproductive adults from the walls of the stock colony and transferred to the leaf cages with a camel hair brush. These aphids were observed daily and all offspring were counted until they all died. Ten aphids were used on each cucumber cultivar. The greenhouse tests encountered completely randomized experimental designs. The data were subjected to analysis of variance with mean separation by multiple range test /Snedecor, Cochran, 1971/. The results were also used to calculate the fecundity table parameters according to Birch (1948).

Results and Discussion

I. Greenhouse studies: Table 1 summarizes the data of the four cucumber cultivars tested for resistance to the melon aphid, *A. gossypii*. It may be obvious from these data that no significant difference was observed between various cultivars in the durations of the pre- and post-reproductive periods or in the percentage of reproducing aphids. The significant difference occurred between the reproductive activity, the total longevity, the number of nymphs per aphid and the number of nymphs per reproductive individual. The alate aphids on ʻBeth alpha F1' produced only 9.81% of the total progeny, while they produced 24.07%, 24.57% and 41.55% of the total progeny on ʻBeit alpha MR', F1 hybrid ʻBeit alpha MR' and ʻRawa-F_1-RS', (Table 1) respectively. The low reproduction could be attributed to the fewer progeny per aphid per day on 'Beth alpha F_1' than on the other cultivars (Figure), but not due to differences in survival or in the number of reproduced aphids. This finding is not in contrast with the observation of Kennedy and Kishaba (1976) on cantaloupe, in which the low populations of *A. gossypii* on resistant plants resulted from both the reduced rate of reproduction (i. e. fewer progeny/reproductive aphid/day) and the greater mortality during the reproductive period of the aphids.

II. Life table parameters: The intrinsic rate of increase (rm), net reproduction rate (Ro), finite rates of increase *(λ)* and mean generation time (T) of *A. gossypii* on various cucumber cultivars are shown in Table 2.

Table 1. Means of development, reproduction, and longevity of the adult alate, *A. gossypii* on four cucumber cultivars under greenhouse conditions

Biological reproductive activities	Mean duration in days on various cultivars			
	Vl	V2	V3	V4
Pre-reproductive period	*1.8 a	2.3 a	1.2 a	1.3 a
Reproductive period	10.0 b	5.8 a	9.7 b	16.9 c
Post-reproductive period	1.1 a	0.9 a	1.9 a	1.9 a
Total longevity	13.7 a	9.6 a	12.5 a	20.2 b
% aphids reproducing	80.0 a	80.0 a	90.0 a	100.0 a
X No. nymphs/aphid	29.2 b	11.9 a	29.9 b	50.4 c
X No. nymphs/repr. aphid	36.5 b	14.8 a	33.11 b	50.4 c
% produced progeny out of the resulted progeny	24.07 b	9.81 a	24.57 b	41.55 c

* Means within the same row, followed by the same letter are not significantly different at 0.05 level of probability, multiple range test.

Vl = ʻBeit alpha MRʼ V2= ʻBeth alpha F1ʼ

V_3 = F1hybrid ʻBeit alpha MRʼ V_4= ʻRawa-F1-RS'.

Table 2. The intrinsic rate of increase (rm), net reproduction rate (Ro), finite rates of Increase *(λ)* and mean generation time (T) of *A. gossypii* reared on four cucumber cultivars

Cucumber cultivars	rm	Ro	T	***X***
ʻBeit alpha MRʼ	0.253	25.57	12.81	1.29
ʻBeth alpha F1ʼ	0.197	9.83	11.63	1.22
F1 hybrid ʻBeit alpha MRʼ	0.276	27.82	12.03	1.32
ʻRawa-F1-RSʼ	0.262	49.78	14.93	1.30

1. Net reproduction rate (Ro): It is evident from Table 2 that Ro increased from 9.83 on ʻBeth alpha F1ʼ to 49.78 on ʻRawa-F1-RSʼ cultivar. The population of this species could be increased about five times in the course of one generation on ʻRawa-F1-RSʼ as compared to that reared on ʻBeth alpha F1ʼ cultivar.

2. Intrinsic (rm) and finite rates of increase (λ): As shown in Table 2, the values of rm increased markedly on the three cultivars, ʻBeit alpha MRʼ, F1 hybrid ʻBeit alpha MRʼ and ʻRawa-F1-RSʼ more than on ʻBeth alpha F1ʼ. The respective values of rm were 0.253, 0.276, 0.262 and 0.197. The data also showed that the rm value on the cucumber cultivars ʻBeit alpha MRʼ, F1 hybrid ʻBeit alpha MRʼ and ʻRawa-F1-RSʼ were approximately 1.28, 1.40 and 1.33 times higher than that on ʻBeth alpha F1ʼ.

The figures also indicated that F1hybrid ʻBeit alpha MRʼ and ʻRawa-F1-RSʼ cultivars were the most suitable among the tested cultivars as they showed the maximal rm value. The intrinsic rate of increase (rm) was used in a comparative manner to estimate the degree of fitness of various genotypes to their environment /Birch et al., 1963; Ohba, 1967; Ayaia, 1968/. When the values of the intrinsic rate of increase (rm)

were converted into finite rate of increase (λ); it was clear that the population of *A. gossypii* had the capacity to multiply about 1.29, 1.22, 1.32 and 1.30 times per female per day on ʻBeit alpha MR', ʻBeth alpha F1', F1hybrid ʻBeit alpha MR' and ʻRawa-F1-RS', respectively (Table 2). This finding indicated that a population of 10 females of *A. gossypii* could increase in a week to become 40, 59, 62 and 69 individuals on ʻBeth alpha F1', ʻBeit alpha MR', ʻRawa-F1-RS' and F1hybrid ʻBeit alpha MR', respectively.

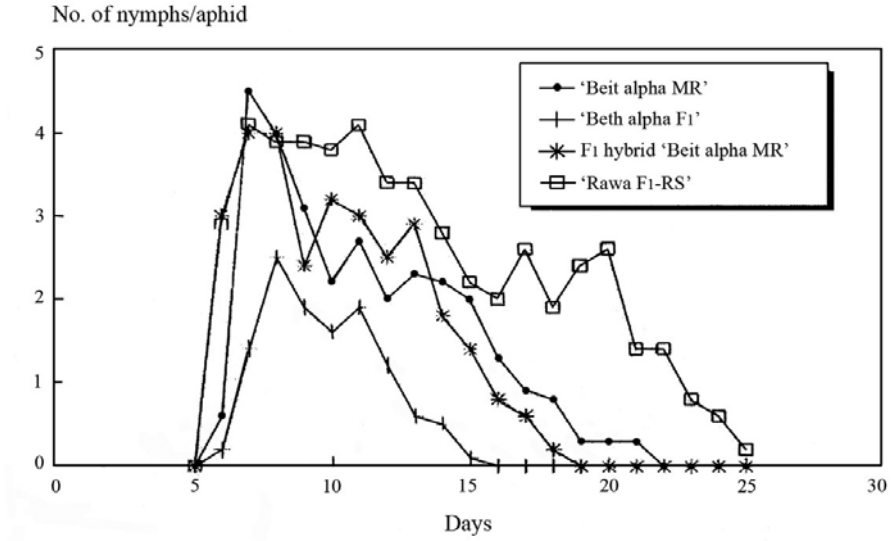

Figure. Age-spesific fertility of *A. gossypii* on cucumber cultivars under greenhouse conditions

Conclusions

From the obtained results it could be concluded that the length of the pre-reproductive period of aphids and their reduced fecundity may be attributed to the presence of antibiosis in ʻBeth alpha F', cultivar (Table 2). Similar results on the turnip aphid have been reported by Kennedy and Abou-Ghadir /1979/. They stated that the population of the turnip aphid *Lipaphis erysimi* (Kaltenbach) reared on ʻPTWG' (susceptible turnip cultivar) was 3x larger than that on ʻShogoin' (resistant turnip cultivar). The greenhouse studies indicated that this difference was due primarily to reduced reproduction by the turnip aphid on ʻShogoin', although a significantly longer pre-reproduction period on the resistant cultivar also was involved. The presence of cucurbitacins has been associated with the toxic effect of cucumber leaves, which proved that cucurbitacins evolved in wild cucurbits as a mechanism to protect them from generalized herbivores such as *Tetranychus urticae* (Koch) /Andeweg, De Bruyin, 1959; Da Costa, Jones, 1971b/.

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