THE EFFECT OF DIFFERENT CUCUMBER (*CUCUMIS SATIVUS L.*) VARIETIES ON GROWTH AND DEVELOPMENT TIME OF *APHIS GOSSYPII* GLOVER (HEMIPTERA: APHIDIDAE)

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Abstract

The biological response of *Aphis gossypii* Glover (Hom. Aphididae) was investigated on the effects of seven cucumber varieties (Cucumis sativus L.) such as Kitir, Muhika, Ayda, Beit, 14-F1, Ruzgar, and Ptk in the laboratory condition at 24±1°C, 65±5% relative humidity (RH) and a photoperiod of 16:8 (L: D) hour. The results were related that the developmental time of A. gossypii at the nymphal stages were presented significant difference only on the first instar stage. From the lowest to the highest respectively, 0.98 days on ruzgar to 1.18 days on Kitir, the second nymphal stage 0.98 days to Beit alfa, 1.08 days on Muhika, the third from 0.94 days to Kitir, from 1.16 days to 14-F1, and the last instar 1.22 days on Ptk, 1.48 days on Kitir were investigated. The total development time was evaluated at 4.46 days Beit on alfa 4.72 days on kitir. Offspring number 60.42/aphids on ayda, 83.72/aphids on muhika, their significant differences based on one way Anova (Tukey test). The lifetime of *A. gossypii* was recorded 19.10 days on Kitir, 27.64 days on Ptk. The results showed that cucumber cultivars were affected by the biological life of *A. gossypii*. The combination of this study with the other methods of the IPM tactics can serve as the best strategy for controlling this pest on cucumber varieties into the greenhouse.

Keywords: Cucumber cultivars, fecundity, intrinsic rate, mortality, resistance

Résumé

La réponse biologique d'*Aphis gossypii* Glover (Hom. Aphididae) a été étudiée sur les effets de sept variétés de concombre (Cucumis sativus L.) telles que Kitir, Muhika, Ayda, Beit, 14-F1, Ruzgar et Ptk dans des conditions de laboratoire à 24 ± 1 °C, 65 ± 5 % d'humidité relative (HR) et une photopériode de 16 :8 (L : D) heure. Les résultats ont été liés à une différence significative dans le temps de développement d'*A. gossypii* aux stades nymphaux uniquement au premier stade. Du plus bas au plus haut respectivement, 0,98 jour sur ruzgar à 1,18 jour sur Kitir, le deuxième stade nymphal 0,98 jour à Beit alfa, 1,08 jour sur Muhika, le troisième de 0,94 jour à Kitir, de 1,16 jour à 14-F1, et le dernier stade 1,22 jour sur Ptk, 1,48 jour sur Kitir ont été étudiés. Le temps de développement total a été évalué à 4,46 jours Beit sur alfa 4,72 jours sur kitir. Le nombre de descendants est de 60,42/pucerons sur ayda, 83,72/pucerons sur muhika, leurs différences significatives étant basées sur une Anova à un facteur (test de Tukey). La durée de vie d'A. gossypii a été enregistrée à 19,10 jours sur Kitir, 27,64 jours sur Ptk. Les résultats ont montré que les cultivars de concombre étaient affectés par la vie biologique d'*A. gossypii*. La combinaison de cette étude avec d'autres méthodes de lutte intégrée pourrait constituer la meilleure stratégie pour lutter contre ce ravageur sur les variétés de concombres cultivées en serre.

Mots-clés : cultivars de concombre, fécondité, taux intrinsèque, mortalité, résistance

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1. Introduction

Aphids are the global pest of numerous agriculture crops and are presented by their efficient development with a high reproduction rate. From these species, the cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae) is a polyphagous largely spread in tropical, subtropical and temperate regions. Worldwide, A. *gossypii* can colonize more than 60 plant species including cucurbits, citrus, vegetable and ornamental plants (Behdad et al., 1982; Leclant and Beguine, 1994). Among them, cucurbit is an important host plant for *A. gossypii*. A *gossypii* seriously causes the direct damage in sucking sap for feeding that may provoke deformation foliar and indirect damage on two ways by the honeydew secretion on the leaves can reduce the process of photosynthesis of plants and then known as virus vector transmissions (Kocourek, 1994). This pest is the vector for more than 60 virus diseases largely identified on the plants. (Eastop, 1983).

The cotton aphid was long considered as a minor pest in the eastern Mediterranean region of Turkey in the greenhouse cucumber (Satar et al., 1999). The last control tactics on this pest such as chemical control, of course, biological control and resistance of varieties have been showing the important issues in the last two decades. (Kersting et al., 1999). For these disastrous situations, a lot of research has increasingly been conducted to identify alternative measures to reduce its damages. For example, the relative resistance to *Aphis gossypii* has been found in several cotton cultivars, and during field experiments, its population increased on certain cultivars, whereas it decreased significantly on other cultivars (Mojeni et al., 1997). In this case, the host resistance is an interesting approach to control this pest, then it is not detrimental to the environment and also reduces the expenses for growers. (Razmjou et al., 2006).

The most of repeat strategies for the cotton aphid focus on application of aphidicides. Its consequences are not only worst for our ecosystem, which are greatly threaten human health, atmospheric pollution and also, the elimination of beneficial insects, increasing resistance to pesticides, the change of nutritional, and bioclimatic factors are reunited to create more favourable conditions to *A. gossypii* (King and Philips, 1989; Slosser et. al. 1989; Barber et al.1999; Foster et al., 2002). In this case, there is a lot of suitable technical, in which would be to use all possible methods to reduce pesticide application by using resistance plants as an entity in integrated pest management (IPM) program.

A lots researchers have recorded the impacts of host plants on the percentage of development time, fecundity, survival, and prolificacy of the cotton aphid in the papers (Kennedy & Kishaba, 1976; Liu & Perng, 1987; Kocourek et al., 1994; Vansteenis, 1992; Vansteenis & El-khawass, 1995; Guldemond et al., 1995; Kersting et al., 1999). In this case, a better understanding of the phenological stages of development and growth of *A. gossypii* could be helped in the involving in the board of pest management programs for cucumber cultivars.

In this study, we obtained developmental time, reproduction period, and life span, pre and post-reproduction and adult longevity of *A. gossypii* to find resistance among cucumber cultivars in laboratory condition. Understanding these parameters will help in the development of a comprehensive pest management program for cotton aphid. In summary, based on our outcomes, and application of apart from resistance cucumber cultivar and with other methods of IPM practices could play an important buster role in monitoring against aphid cotton in cucumber plantation.

2. Methods and Materials

A. gossypii was collected from eggplant plantation into the greenhouse of plant protection department at Balcalı in Adana/Saricam in the east Mediterranean region of Türkiye. The use of seven varieties of cucumber (*Cucumis sativus* L.*)* seeds in their trading names such as Kitir, Ruzgar, F14, Beit alfa, Ayda, Ptk, and Muhika. The plants are grown under controlled conditions at 24±1°C, 65±10% relative humidity (RH) and a photoperiod around 10000 Lux 16h of artificial light.

The insect cultured was reared in the laboratory for five generations before their use in the experiment. In which randomly selected some apterous females from the packaging culture and were transferred to the prepared cotton leaf discs (5 cm in diameter). After 24h, the Newborn Nymphs of *A.gossypii* were transferred individually on cucumber leaf discs in Petri dishes. The wet cotton wool in the Petri dishes (0.5 cm thick) was placed under the leaf to keep it against drying with a daily water supply. And around 3-5 days, the aphids were transferred on new cucumber leaf discs for better feeding. The use of leaves in the experiment was taken from Room condition of citrus pest laboratory at Çukurova University around 5-6 weeks of age.

The experiments were conducted on the effects of seven cucumber varieties such as Kitir, Ruzgar, F14, Beit alfa, Ayda, Ptk, and Muhika into the bod incubators under a respective temperature of at 24 ±1°C, 65±5 % relative humidity (RH), and a photoperiod of 16h (L: D) h of artificial light 5000 Lux. The nymphal instars were recorded every 24h until the mature age. The exuviae were counted to determine the developmental time. After the adult stage, the newborn nymphs produced were counted and removed from the Petri dishes daily on each variety until death.

Figure 1. (a) the culture of seven cucumber varieties, (b) the incubator for regulating of temperature, c. plant home with weather conditions (d) sample of ten on excised cucumber leaf dics at 24 ±1°c, 65±5 % relative humidity (RH) and a photoperiod of 16:8 (L:D) time, 24 h day.

2.1 Data analysis

Differences classification of variables, developmental time and reproductive performance were subjected to descriptive statistical analysis (one way-ANOVA) for example; the different phenological stages of A. gossypii, including development times for nymphal molts, reproduction time and determining lifetime of adults on each variety. Furthermore, the mention of the calculation of parameters on seven cucumber cultivars. In this work, the completely randomized design (CRD). Eventually, the multiple comparison data of averages were done in testing the significant difference when they are existed using Turkey's HSD multiple range test (P>05) the

calculations were realized in using Microsoft excel, infosat student version, and Spss. Population growth rates were computed from the equation of Lotka (23):

$$1 = \Sigma\ e\text{-}r*x\ 1x * mx \quad (1)$$

In which: x = age in days, r = intrinsic rate of increase,

1x= age-specific survival, mx = age-specific number of female offspring. After "r" was computed for the original data (rall), differences among rm-values were tested for significance by estimating variances through the jackknife method (24). The jackknife pseudo-value "rj" was calculated for the "n" samples using the following equation:

$$rj = n * rall - (n-1) * ri \quad (2)$$

The mean of "n" jackknife pseudo-values for each treatment was subjected to analysis of variance. The scheffé test was used to compare mean growth rates for different host plants (p = 0.01). Because low probability levels were used, there was no concern about inflation of experiment-wise error rates (25). Each of the abovementioned analyses were conducted using the Statgraphics software package.

3. Results and discussion

3.1 Nymphal, total development, death ratio and pre-reproduction period

The mean duration of each nymphal stage for A. *gossypii* on the effect of seven cucumber varieties are summarized (Table 1*)*. The nymphal development time was ranged from the lowest 0.98 days on Ruzgar to the highest 1.48 on Kitir. Consequently, only we can observe the differences between the four varieties. The total development time of *A. gossypii* was not affected by the varieties as well; from lowest 4.46 on Beit alfa days Beit alfa to highest 4.72 days on Muhika. The mortality rate of nymphs during development time occurred from lowest %0 on Ptk to highest %16 on Muhika and Beit Alfa (Table.3). The pre-reproduction period of *A. gossypii* was significantly different among some varieties. Its results ranged from 0.56 days on Ptk to 0.88 days on Muhika at 24 ±1°C of constant temperature.

The survival adult stage was significantly different between some varieties ranged from the lowest 14 days on Kitir to the highest 23 days on Ptk. The mentioned outcomes do not indicate any significant differences between Beit alfa at 21.16 days on Muhika and 22.34 days and 14-F1 at

24.32 days. The span life showed significantly different extended from 19 days on Kitir to 28 days on Ptk. The daily number of nymphal reproduction of *A. gossypii* was significantly different on varieties found in this interval from 8.54 on Ayda to 12.16 on Ptk. The post-reproduction the period also was presented significant differences among varieties ranging from 4.32 days on Kitir to 10.92 on Ptk. The outcomes of number offspring were significantly differenced among cucumber cultivars varied from 59.84 Aphids on Kitir to 83.72 aphids on Ptk. Life span was statistically showed some significant differences under the varieties arranged from 19 days on Kitir to 28 days on Ptk at a constant temperature of 24 ± 1°C, 65±5 % relative humidity and photoperiod of 16h (L: D) 24h day (Table.2).

Table 1. Total developmental time of (mean± SE) *Aphis gossypii* on seven cucumber variety at 24 ±1°C constant temperature, relative humidity Rh of 65±5 % and photoperiod 16:8 (L: D) Time, 24 hours.

Parameters (days)	Beit Alfa	Ayda	Ruzgar	Kitir	14-F1	PTK	Muhika
Instar I	1.1±0.05abc	1.2±0.05c	0.9±0.05a	1.2±0.05bc	1.0±0.05ab	1.1±0.05abc	1.1±0.05abc
Instar II	0.9±0.05	1.0±0.05	1.0±0.05	1.7±0.05	1.0±0.00	1.1±0.05	1.2±0.05
Instar III	1.1±0.06	0.9±0.06	1.1±0.06	1.0±0.06	1.2±0.06	1.2±0.06	1.1±0.06
Instar IV	1.3±0.08	1.4±0.08	1.4±0.08	1.5±0.08	1.4±0.08	1.2±0.08	1.4±0.08
T. development	4.5±0.12	4.6±0.12	4.5±0.12	4.7±0.12	4.7±0.12	4.6±0.12	4.7±0.12

Means with a common letter are not significantly different by Tukey's HSD multiple test ($p > 0.05$)

Table 2. Pre-reproduction, post-reproduction, reproduction and number offspring. of (mean± SE) *Aphis gossypii* on seven cucumber variety at 24 ±1°C constant temperature, relative humidity Rh of 65±5 % and photoperiod 16:8 (L:D) Time, 24 hours.

Parameters (days)	Beit Alfa	Ayda	Ruzgar	Kitir	14-F1	PTK	Muhika
Pre-production	0.7±0.07ab	0.8±0.07ab	0.7±0.07ab	0.8±0.07ab	0.7±0.07ab	0.6±0.07b	0.9±0.07a
Reproduction	9.8±0.77ab	8.5±0.77b	11.8±0.77a	10.1±0.77ab	10.6±0.77ab	12.2±0.77a	10.3±0.77ab
Post-reproduction	6.9±1.03ab	7.5±1.03ab	10.2±1.03a	4.3±1.03b	9.4±1.03b	10.9±1.03a	7.4±1.03ab
Adult longevity	16.7±1.52ab	16.0±1.52ab	21.9±1.52bc	14.4±1.52c	20.0±1.52abc	23.1±1.52a	17.6±1.52abc
N. offspring	69.2±4.51ab	60.4±4.51b	69.2±4.51ab	76.5±4.51ab	81.9±4.51a	69.7±4.51ab	83.7±4.51a

Life span	21.2±1.55abc	20.7±1.55ab	26.4±1.55bc	19.1±1.55c	24.3±1.55abc	27.6±1.55a	22.3±1.55abc

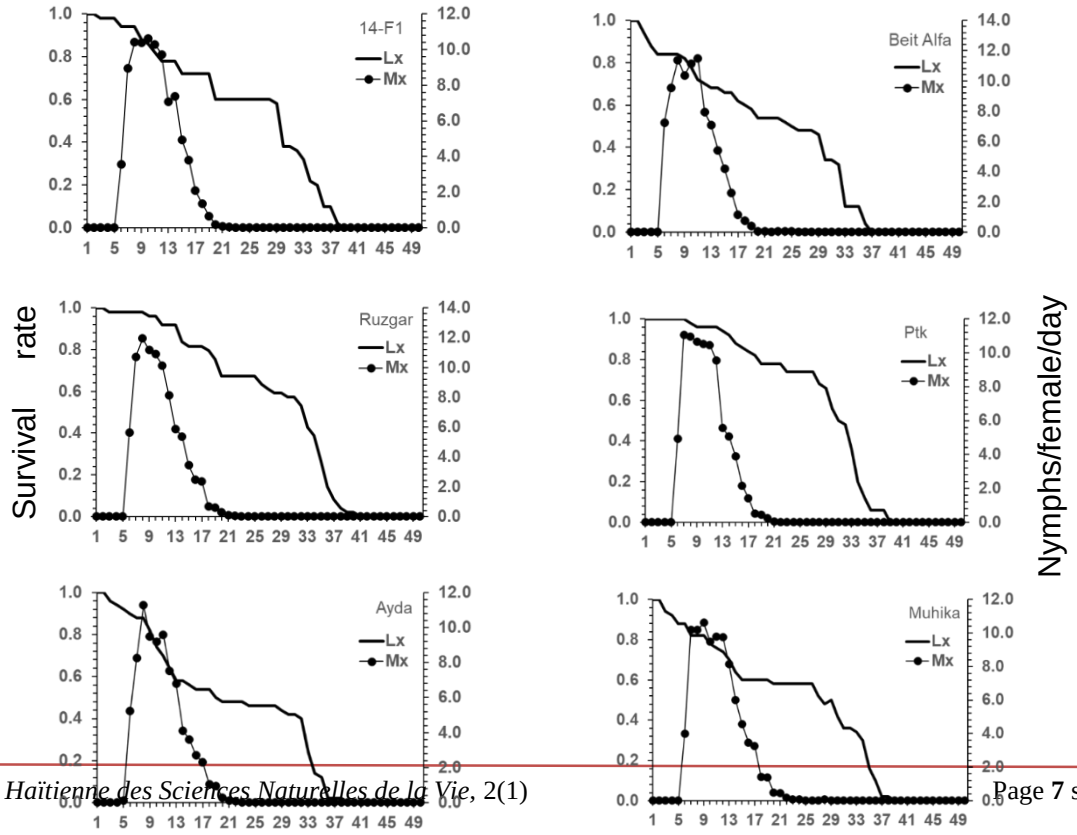
Means with a common letter are not significantly different by Tukey's HSD multiple test ($p > 0.05$).

3.2 Life statistic table of intrinsic rate parameters

The intrinsic parameters per day (*rm*) and the survival rate (*lx*) of *A. gossypii* are plotted in (Table.3). After, the reproduction net (Ro) of the nymph from the 59.88 Aphids on Kitir to the highest 83.63 Aphids on Ruzgar. The generation time resulted in an interval of 10.09days on Kitir and 10.76 days on Muhika (Table.2).

Table 3. Generation time (T_o), net reproduction rate (R_o), rate of population of growth (r_m) and nymphal mortality rate of *A. gossypii* reared on seven cucumber variety leaves at 24 ±1°C constant temperature, 65±5 % relative humidity (RH) and a photoperiod 16:8 (L:D) Time, 24 hours.

Parameters	n	Ayda	Beit Alfa	14-F1	Ruzgar	Muhika	Ptk	Kitir
Intrinsic rate of increase(r_m)	50	0.47	0.49	0.47	0.50	0.46	0.50	0.47
Reproduction net(R_o)	50	60.42	69.22	76.54	83.63	69.58	83.72	59.88
Generation time(T_o)(days)	50	10.13	10.13	10.71	10.26	10.76	10.28	10.09
Death ratio (%)	50	12	16	6	2	16	0	6



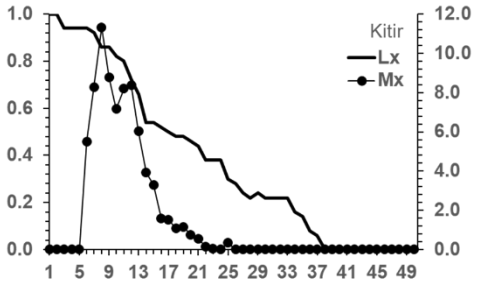


Figure.4. Age-specific survival rate (l_x) and age-specific fecundity (m_x) of *A.gossypii* reared on seven cucumber variety leaves at 24 ±1°C constant temperature, relative humidity Rh of 65±5 % and photoperiod 16:8 (L: D) Time, 24 hours.

4. Discussion

The current researches revealed the severe effects of the cucumber varieties on growth and development parameters of *A. gossypii* at different temperatures. Although our research, its outcomes reported on total nymphal development period were, first; 4.64 days on Ayda, the second; 4.46 on Beit, the third; 4.46 days on Ruzgar, fourth; 4.66 on 14-F1, fifth; 4.72 days on Ptk, the sixth 4.66 days on muhika and at the end 4.57 days on Kitir. However, the total nymphal development period on cucumber was 4.98 days, (MollaShahi & TahMaSeBi., 2009), (Akram et al., 2016) on Zomorod variety (4.90 days) and (KerStinG et al., 1999) related the value of 4.51 days for nymphal development period on cotton plants and focused on outcomes to 4.60 days for *A.gossypii* which is near to 4.46 on Beit alfa to 4.66 days on muhika in our study and also on 5 varieties of cucumber, 5.20 days sepehr, 4.75 days on salar, 4.58 days on Sina, 4.43 days on zohal, 4.90 days on zomorod and 4.40 days on Homa have been registered by (Akram et al.,2016) and more hollyhock, cotton, okra 5.6, 5.5 and 6 days listed, orderly (Satar et al., 1999, 2008) which are mentioned the host effect on the biology of *A. gossypii*, nymphal developmental period for three cotton cultivars comprising cucumber, there before, there isn't too much difference between the ancient works compared to ours.

The life span of *A. gossypii* on cucumber in vitro was 26.98 days (MollaShahi & Tahmasebi., 2009) and 26.09 days (Rahsepar et al., 2016) close to our experiment with 26.38 days on ruzgar at the temperature of 24 °C and at 25°C the life span of royal cucumber variety was 21.9 days and the Storm variety lasted for 21.6 days (Haji Ramezani et al. 2012) and, 21.74 days on zomorod

(Rahsepar et al., 2016) which is near to ayda, beit alfa, and muhika 20.68, 21.16 and 22.32 days in this study. The life span of *A. gossypii* Glover was 25.69 days on cucumbers, 14.06 days on the pumpkin 15.37 days on squash which the minimum life span was on the cucumber and lowest life cycle referred to the pumpkin (Shirvani & Husseini nave 2004) that the difference between host plants was observed. Generally, in our study ranged from the minimum life span 19.10 days to the maximum 27.64 days on Ptk.

These contrast indicated an accessible effect of different plant species, tactics and, materials of the researches on the development of *A. gossypii*, for example, the life span in some cotton varieties such as Bakhtegan, Sahel, Silandr, Ciukra, and Varamin were recorded 21.6, 20.5, 16.4, 18.2 and 21.2 days, respectively (razMjou et al. 2006) thus and on the other hand as forementioned showed on Sepehr, Salar, Sina, Zohal, Zomorod, and Homa, respectively 18.18 days, 26.09, 23.75, 27.34, 21.74 and 23.95 days (Rahsepar et al., 2016).

Comparing with other experiments, we can conclude that the host plants have a great impact on the life of *A. gossypii*, especially the cucumber varieties showed that more adaptation for it but on the other hand the secretory and non-secretory of trichomes represent as a physical obstacle for its growth and development for that reason they consider as an antibiosis (Van Dam, N. M., 2017). The ecosystem has a lot of factors including abiotic and biotic they are consequently affected the biological life of the insects. In our study, we were accentuated on the resistance varietal effect only and the rest of the parameters were rejected, concerning the resistance and non-resistance, both of them have not satisfied with this study but the found results showed the most effective variety was ptk and the less one is Kitir.

These results of this experiment bring out some essential informations on the growth and development time from the first nymph stage to offspring number of Aphis gossypii on cucumbers. They can be combined with other ecological strategies such as cultural rotation and biological control that can able to utilize for avoiding the increasing of *Aphis gossypii* on the cucumber varieties and then can represent a great added value in the monitoring and implementation of pest management programs. This study can also help all those who work in the field of scientific researches, particularly in the cucumber production industries for all kinds of vital needs.

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