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Impact of Neem and Extracts of Some Plants on Development and Fecundity of *Aphis Gossypii* Glover (Homoptera: Aphididae)

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Abstract

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Cotton farmers in the Mediterranean region, Turkey, have used synthetic insecticides against the cotton aphid for many decades. The plant extracts and neem clearly reduced adult longevity, survival rate, fecundity, and life table parameters. The highest survival rate was obtained for the control aphid, following on treated with Red gum (67.62 %), and with California pepper tree (87.64 %), while the aphid treated with neem this rate was zero. Fecundity always tended to be higher in untreated of the aphid than in the treated with plant extracts. Production of offspring from treated adult aphid was lower than that of the control aphid.
Key words: Aphis gossypii, neem, plant extract, fecundity

Introduction

Cotton aphid, *Aphis gossypii* Glover, is a polyphagous pest and causes extensive damage to cotton in the world. Nymph and adult of the cotton aphid feed that causes direct and indirect damage. The cotton aphid, *Aphis gossypii* Glover, has been identified as one of the major pests in cotton areas in Turkey (Ozgur and Sekeroglu, 1986; Kersting et al., 1999) as now in many production area of the world (Akey and Butler, 1989; dos Santos et al., 2004).

Synthetic insecticides have been used against the cotton aphid for many decades

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by cotton farmers in the Mediterranean region, Turkey. Especially, use of synthetic insecticides frequently leads to a destabilization of the ecosystem and to enhanced resistance to insecticides in pests (Dittrich et al., 1990). New techniques for controlling pests are needed. Many researchers have been working alternative methods against chemical methods. Also, one of the alternative methods is biopesticide. The neem tree, *Azadirachta indica* A. Juss, and its products have the potential to help in this situation (Schmutturer, 1995; Lowery et al., 1993; Basedow et al., 2002). Several works have been carried out on the effect of neem insecticides on aphids (Schauer, 1987; Stark and Rangus, 1994; Lowery and Isman, 1995, 1996; Losch et al., 1998; Ulrichs et al., 2001; El Shafie and Basedow, 2003).

There were little works on botanical pesticides against pests in Turkey (Tuncer and Aliniazee, 1998; Baspinar et al., 2000; H?ncal et al., 2000; Madanlar et al., 2000; Ulusoy and Bayhan, 2002; Durmusoglu et al., 2003; Bulut and Madanlar, 2004; Akca et al., 2005, Kivan, 2005).

The aim of this work was to evaluate the effects of some plant extracts and neem on the development and fecundity of *A. gossypii* on cotton. It was also the objective of this research to determine if some plants extracts have potential on effect development and fecundity of the cotton aphid.

Materials and Methods

Plants. The host plants were reared at 25 °C, a relative humidity 65 ± 5 %, and light regime (16 L : 8 D) in laboratory conditions. Seeds of cotton (cv. Cukurova 1518) were sown in 12 x 22 cm pot in soil in the laboratory conditions. Plants were watered once a week. At 4-6 week of age, when the plants had acquired several true leaves, the plants were used in this study.

Insects. *A. gossypii*, originally obtained from on cotton (cv. Cukurova 1518) fields in Adana, Turkey, was colonized on cotton (cv. Cukurova 1518) at 25 °C, 65 ± 5 % relative humidity, and 16 L: 8 D light regime in a climatic room. The aphids had been reared in laboratory conditions for about 10 month before individuals were used in the experiments.

Chemicals. The extracts of *Schinus molle* L. and *Eucalyptus camaldulensis* Dehnh. leaves were used in laboratory studies. The extracts were prepared by cut in to parts and soaking the leaves for 24 hours. The concentration was 200 gr. Leaves/1000 ml water for each plant species. NeemAzal T/S® (NA) (Trifolio-N, GmbH, Lahnau, Germany) was prepared as recommended (0.5 %) in trials. NeemAzal-T/S was used at 5 ml/1 l of water. In order to evaluate the effect of neem on the cotton aphid, the extracts were prepared beforehand, 2 hours prior to laboratory experiments.

Laboratory experiments. All experiments were carried out on cotton plants 65 ± 5 % relative humidity, and a light-dark cycle of 16 L: 8 D h in a climatic cupboard. Leaf discs (5 cm in diameter) were cut out from the center of cotton leaves, cv. Cukurova 1518, from the plant rearing room plants, which were dipped in 0.5 % NeemAzal T/S® (hereafter named NA) (standard treatment), California pepper tree, *Schinus molle* L. extract (hereafter named CPT) (200 gr. leaves/1 l water), and Red gum, *Eucalyptus camaldulensis* Dehnh. extract (200 gr. lea-

ves/1 l water) for 30 second. Then, they placed on each petri-dish and were used after they were allowed to air-dry for 45 min at laboratory conditions. Also, the cotton leaf discs dipped in distillated water were used as the untreated control.

Randomly selected apterous females from the stock culture were transferred separately onto an treated cotton leaf disc, placed upside down on wet filter paper in each Petri dishes. The nymph born within 24 h from the Petri dish was transferred individually to each of the fresh-cut treated cotton leaf discs in a Petri dish (6 cm diameter x 1.5 cm deep) with a small camel's-hair brush, and placed in a climatic cupboard under constant temperature of 25 C, with 65 ± 5 % R.H., in 16 : 8 (L : D) photoperiod. The filter papers in the Petri dishes were wetted daily. Every four days the cotton leaf discs were changed to the new leaf discs were not treated with plant extracts and neem treatments. The nymph on each petri-dish was checked under a stereoscopic microscope, and this was recorded as observed on daily basis. The presence of the discarded exuviae were used to determine when molting had occurred. Daily observations were made on the number of molts undergone by the cotton aphids, including those individuals that died before reaching adult stage and the survival period was evaluated. Also, we determined that the developmental time of immature stage, mortality rate, and fecundity were measured. These studies were replicated three times for each treatment including each replication containing fifty leaf discs and compared with untreated controls.

Data Analysis. Effects of different neem and some plant extracts on biology of the cotton aphid were assessed by constructing a life table, using age-specific survival rates (l_x) and fecundity (m_x) for each age interval (x) per day. Net reproductive rate (R_0)= $\Sigma\, l_x.m_x$, mean generation time

(T_0)= $\Sigma\, (x.l_x.m_x)\, /\Sigma\, l_x.m_x$, and growth potential of a population under a given set of laboratory conditions

$\Sigma e^{-r.x}\ l_x.m_x$ were calculated (Birch, 1948). In addition, life table parameters of *A. gossypii* were calculated from the data collected by a computer program TWOSEX (Chi 1997).

$T_o = \Sigma(x.l_x .m_x)/ \Sigma\, l_x.\mathrm{m}_x$ (1)

$R_o = \Sigma\, l_x.m_x$ (2)

$1 = \Sigma\, e^{-rx}\ .l_x.m_x$ (3)

x= each age interval per day

l_x = using age-specific survival rates

m_x = nymphs per female per day (female/female/day),

R_o = net reproductive rate

T_o = mean generation time

r_m = intrinsic rate of increase

Data on nymphal development times, adult life span, fecundity, and daily reproduction at 4 constant temperatures were analyzed SPSS and treatment differences were determined by Tukey's Tests. Differences at probability level ($P < 0.05$) were considered significant.

Results and Discussion

A. gossypii nymphs exposed to plant extracts showed to have longer developmental times than the aphid nymphs submitted to the control treatment (Table 1). Our data show that *A. gossypii* nymphs were highly susceptible to NA (Table 1). When the 1st nymph feeds on cotton leaf discs treated NA, no survival except 1st nymphs was observed (Table 1). Nymphs treated with NA survived only until the first

Table 1

Developmental times (days) of immature stages of *Aphis gossypii* on cotton treated with neem (NeemAzal T/S) and plant extracts at 25 °C, laboratory condition

	Instar duration				Nymhal period
	1st	2nd	3rd	4th	
NeemAzal T/S	1.98 ± 0.064 c	-	-	-	-
NeemAzal T/S Red gum	1.58 ± 0.085 a	1.38 ± 0.084 a	1.11 ± 0.056 a	1.94 ± 0.040 a	6.00 ± 0.094 b
CPT	1.86 ± 0.052 b	1.20 ± 0.061 a	1.13 ± 0.052 a	1.81 ± 0.058 a	6.02 ± 0.082 b
Control	1.57 ± 0.072 a	1.19 ± 0.050 a	1.06 ± 0.036 a	1.80 ± 0.058 a	5.59 ± 0.072 a

Within columns, means with the same letters are not significantly different at P<0.05 (Tukey's range test).

Table 2

The survival rate, adult longevity, biological cycle, and fecundity of *Aphis gossypii* on cotton treated with neem (NeemAzal T/S) and plant extracts at 25 °C, laboratory condition

	Survival rate, %	Adult longevity	Biological cycle	Fecundity
NeemAzal T/S	-	-	-	-
Red gum	67.62	20.08 ± 0.431 a	26.05 ± 0.430 a	43.20 ± 1.072 b
CPT	87.64	19.90 ± 0.290 a	25.90 ± 0.265 a	37.09 ± 0.952 a
Control	94.26	22.02 ± 0.183 b	27.61 ± 0.181 b	46.51 ± 0.774 c

Within columns, means with the same letters are not significantly different at P<0.05 (Tukey's range test).

Table 3

Life table parameters of *Aphis gossypii* on cotton treated with neem (NeemAzal T/S) and plant extracts at 25 °C, laboratory condition

	r_m	R_o	T_o
NeemAzal T/S	-	-	-
Red gum	0.2965	29.04	13.94
CPT	0.3223	32.6	13.55
Control	0.3475	43.72	14.30

instar and after this stage 100 % mortality was observed (Table 1).

The total immature developmental times of nymphs feeding on cotton leaves discs

treated with plant extract were higher than that of the control group (Table 1).

The plant extracts and neem clearly reduced adult longevity, survival rate, fecundity, and life table parameters (Table 1-2-3). The first, second, third, and fourth nymphs calculated on control leaves average 1.6, 1.2, 1.0, and 1.8 days, respectively (Table 1). These results are similar to those found by Xia et al. (1999), Michelloto (2002), and dos Santos et al. (2004). The total immature developmental time of the cotton aphid on non treated leaves lasted 5.59 days that is close those obtained by Akey and Butler Junior (1989), Kersting et al. (1999), Tang et al. (2002) and dos Santos et al. (2004) for *A. gossypii* reared on cotton at 25 °C.

The highest survival rate was obtained for the control aphid, following on treated with Red gum (67.62 %), and with CPT (87.64 %), while the aphid treated with neem this rate was zero (Table 2). There was a very significant difference in fecundity capacity of the cotton aphid treated and non-treated (Table 2). Fecundity always tended to be higher in untreated of the aphid than in the treated with plant extracts (Table 2). In our study, the plant extracts and neem reduced both the fecundity and life table parameters (r_m, R_o, and T_o) of the cotton aphid. Production of offspring from treated adult aphid was lower than that of the control aphid. The similar results were also observed the treatment with neem on *Aphis fabae* (Dimetry and Schmidt, 1992), on *Myzus persicae*, *Nasonovia ribisnigri*, *Rhopalosiphum padi* (Lowery and Isman, 1996), *Myzocallis coryli* (Tuncer and Aliniazee, 1998), Brevicoryne brassicae (Pavela et al., 2004), and *A. gossypii* (dos Santos et al., 2004).

We obtained our data that rm was higher in control aphid than in treated plant extract aphid. The highest rm was obtained for adult in the control with 0.3475, while the aphid treated with neem this rate was zero (Table 3). Our rm data obtained in control aphid was similar to this obtained by Kersting et al. (1999).

Conclusions

Because of increasing problems associated with the use of acutely toxic synthetic insecticides, there is a pressing need for the development of safer, alternative crop protectants such as botanical insecticides. Neem is efficient against the cotton aphid in alternative control methods. The plant extracts in this study influence the survival rate, adult longevity, biological cycle, and fecundity of *Aphis gossypii*.

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