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Evaluation of some melon lines for their resistance against melon aphid, *Aphis gossypii* Glover

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Abstract: The melon aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae), which has a very wide host range including cucurbit species, causes serious direct and indirect damage to many crops. In both greenhouse and open field melon cultivation in Antalya (in southwestern Turkey), the control of this pest generally depends on the use of chemical insecticides, resulting in a rapid increase in resistance to a wide range of insecticides. In the present study, a total of 23 melon lines (22 indigenous and 1 exotic) belonging to 2 varieties (*Cucumis melo* var. *inodorus* and *C. melo* var. *reticulatus*) were evaluated for resistance to the pest. The study consisted of 2 consecutive work packages; in the first stage, 23 melon lines were evaluated for resistance to *A. gossypii* by using the antixenosis test method under growth chamber conditions at 26/20 °C (day/night temperatures, respectively), with a photoperiod of 16:8 h (light:dark); in the second stage, the most resistant 4 lines (PI-414723, ÜNLÜ, TK15, and ŞÜKRÜBEY) were evaluated once more for resistance against the pest by using the choice-test method in climate chambers at 26 °C and continuous light. N3, which was found to be the most susceptible line in the first stage of the study, served as the control. Counts were made 30 min, 1, 2, 4, and 8 h after the aphids were introduced into the test arena (a 15-cm diameter Petri dish) including leaf discs (2.5 cm diameter) belonging to the 5 lines. The results of the choice test showed that the aphids preferred the PI-414723 line (2 aphids/disc after 8 h) less than the 3 other resistant lines. Additionally, aphids preferred to settle on the susceptible control (N3) (6 aphids/disc after 8 h) during the experiment. Overall, the results suggest that first PI-414723 and then ŞÜKRÜBEY, TK15, and ÜNLÜ may be used for the management of *A. gossypii*.

Key words: Antalya, *Aphis gossypii*, melon aphid, melon lines, resistance

1. Introduction

The melon aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae), is a major pest of melons in tropical and temperate regions throughout the world except for the northernmost areas (Tabacian et al., 2011). The pest feeds on the underside of leaves, or on growing tip of sprouts, sucking nutrients from the plant, and the foliage may become chlorotic and die prematurely. This feeding also causes a great deal of distortion and leaf curling, hindering the photosynthetic capacity of the plant. Additionally, the pest secretes a great deal of honeydew, which provides a substrate for growth of sooty mold; thus, the quality of fruit may be impaired and the photosynthetic capacity of foliage further hindered (Capinera, 2001). This aphid species effectively transmits potyviruses in cucurbits. Cucumber mosaic virus, watermelon mosaic virus, and zucchini yellow mosaic virus are transmitted by this aphid even despite intensive insecticide applications, probably because the viruses can be transmitted within a very short time—e.g., 15 s (Pitrat and Lecoq, 1980; Blackman and Eastop, 2000; Ng and Perry, 2004).

In Turkey, this pest has a very wide range of hosts and is most harmful to cucurbit vegetables and cotton, producing a large number of offspring over the year (Satar et al., 2009; Ulusoy et al., 2018). The management of *A. gossypii* generally relies on insecticide application. Depending on local conditions, 3–5 applications are made each year. Even in Antalya Province (in the southwestern part of Turkey), where greenhouse melon-growing is frequently practiced, the number of insecticide applications throughout the growing period is sometimes over 10. This makes it possible for the pest to develop resistance to many insecticides quickly (Devonshire, 1989). Development of resistance results in the failure of repeated application of many insecticides, even though doses higher than the label rates are being used (Tabacian et al., 2011).

The use of resistant or tolerant plant varieties in the management of melon aphid is an important method of

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pest control for preventing economic losses (Martín and Fereres, 1997). For this purpose, a total of 23 melon lines belonging to 2 varieties (*Cucumis melo* var. *inodorus* and *C. melo* var. *reticulatus*) were tested for their resistance to *A. gossypii*.

2. Materials and methods

2.1. Plant material

In the present study, a total of 23 melon lines belonging to 2 varieties (*Cucumis melo* var. *inodorus* and *C. melo* var. *reticulatus*) were tested for their resistance to *A. gossypii* using the antixenosis test method under greenhouse conditions and the choice-test method under laboratory conditions. All of the lines tested had previously been obtained from different parts of Turkey within the scope of the Batı Akdeniz Agricultural Research Institute (BATEM, Antalya) Melon Breeding Project (Table 1). In the present study, the use of antixenosis and choice-test methods for assessment of plant resistance to melon aphid was based on previous studies indicating that these two methods may be effectively used to assess aphid resistance in cucurbits (Pitrat and Lecoq, 1984; Shinoda and Tanaka, 1987; Martín and Fereres, 2003). All plants used in the experiments were grown in a soil substrate and vermiculite mixture in separate pots under growth chamber conditions at 26/20 °C (day/night temperatures, respectively), 65% ± 5% relative humidity (r.h.), a photoperiod of 16:8 h L:D, and I00 μE m^{-2} s^{-1} light intensity.

2.2. Insect material

The insects used in this study were obtained from the *A. gossypii* colony established from a single virginoparous aptera collected on melon at Serik (Antalya) in 2016. The colony was reared on melon plants (*Cucumis melo* var. *inodorus*, line N3, which was found to be the most susceptible line in preliminary studies) within plexiglass cages (40 × 50 × 70 cm) at 22 ± 1 °C and 65 ± 10 RH, under a 16:8 h L:D photoperiod. Young (7–8 days old) apterae adults were used in all experiments. To obtain young adults of the same age, a method defined by Garzo et al. (2002) was used throughout the study. According to this method,

Table 1. Melon lines tested for resistance to *Aphis gossypii* in the present study.

Line	Variety	Origin (in Turkey)
N2	*Cucumis melo* var. *inodorus*	Çeşme (İzmir)
N3	*Cucumis melo* var. *inodorus*	Kırkağaç (Manisa)
N16	*Cucumis melo* var. *inodorus*	Çengeltatar (Balıkesir)
N18	*Cucumis melo* var. *inodorus*	Kırkağaç (Manisa)
N21	*Cucumis melo* var. *inodorus*	Kuşcular (Akhisar, Manisa)
N22	*Cucumis melo* var. *inodorus*	Burdur
N24	*Cucumis melo* var. *inodorus*	Akhisar (Manisa)
N41	*Cucumis melo* var. *inodorus*	Çamköy (Milas, Muğla)
N43	*Cucumis melo* var. *inodorus*	Balıkesir
N54	*Cucumis melo* var. *inodorus*	Akçeşme (Akhisar, Manisa)
N72	*Cucumis melo* var. *inodorus*	Midyat (Mardin)
N77	*Cucumis melo* var. *inodorus*	Menemenli (Kırkağaç, Manisa)
MLN9	*Cucumis melo* var. *inodorus*	Çukurova (Adana)
MLN16	*Cucumis melo* var. *inodorus*	Çukurova (Adana)
MLN20	*Cucumis melo* var. *inodorus*	Çukurova (Adana)
TK15	*Cucumis melo* var. *inodorus*	Acıpayam (Denizli)
TKU3	*Cucumis melo* var. *reticulatus*	BATEM pure line
TF37	*Cucumis melo* var. *reticulatus*	BATEM pure line
TF29	*Cucumis melo* var. *reticulatus*	BATEM pure line
ÇA	*Cucumis melo* var. *inodorus*	BATEM pure line
PI-414723	*Cucumis melo* var. *inodorus*	Plant Gene Expression Centre (USDA/ARS)
ÜNLÜ	*Cucumis melo* var. *inodorus*	BATEM pure line
ŞÜKRÜBEY F1	*Cucumis melo* var. *inodorus*	VATAN Tohum (Commercial line)

groups of 10 apterae were collected from the *A. gossypii* colony in cages with the help of a fine brush (No. 000), and placed inside plastic boxes (8 × 4 cm) on melon leaves for a 48-h period. The nymphs born during this period were kept inside the boxes, and all adults were removed. The nymphs were maintained in a growth chamber at a constant temperature of 26 ± 1 °C and a photoperiod of 16:8 h L:D. Melon leaves were kept turgid by introducing the petiole inside an Eppendorf tube filled with water. Leaves were changed every 3–4 days to encourage aphid development; 7–8 days later, young apterae adults of the same age were available for experiments.

2.3. Antixenosis tests

For these tests, 20 test plants from each melon line, at the 7–8-leaf stage, were placed on trays so as not to touch each other. Then, 10 apterae adults of *A. gossypii* (7–8 days old) were transferred onto each test plant (a total of 200 aphids for each melon line tested) by using a moistened fine brush. The trays were then transferred to a growth chamber at 24/14 °C (day/night temperatures, respectively) with a photoperiod of 16:8 h L:D. The number of aphids remaining on each test plant was counted 24 and 72 h later (Martin and Fereres, 2003).

After 24 h, plants with 0–7 aphids were considered resistant; those with 8–10 aphids, susceptible (Pitrat and Lecoq, 1980). After 72 h, plants with 0–5 aphids were considered resistant, and plants with more than 5 aphids on their leaves or stem susceptible (Martin and Fereres, 2003). The resistance rate was obtained by dividing the number of resistant plants by the total number of plants in each line.

2.4. Choice tests

These tests were conducted to assess the response of *A. gossypii* individuals when offered a choice between leaves of susceptible and resistant plants (Garzo et al., 2002; Martín and Fereres, 2003). For this purpose, 1 susceptible (N3, which was found to be the most susceptible line in the antixenosis tests) and 4 resistant (PI-414723, ÜNLÜ, TK15, and ŞÜKRÜBEY, which were determined to be the most resistant lines, with a resistance rate between 80% and 90%) melon lines were selected. For each line, 15 plants were grown in pots and used when they were at the 2–3 expanded-leaf stage to obtain 3 leaf disks (2.5-cm diameter) per plant. A 15-cm Petri plate (2 cm height) has been previously covered with moistened filter paper and divided into 6 identical pie sections. Leaf disks obtained from resistant (PI-414723, ÜNLÜ, TK15, or ŞÜKRÜBEY) and susceptible (N3) lines were placed alternately on each section so that there were 3 resistant and 3 susceptible leaf disks per plate. Ten Petri dishes were prepared (i.e. 10 plants and 30 leaf disks for each melon line). Melon aphids were synchronized to obtain individuals of the same age as described above (Insect material section). Twenty-four young apterae adult aphids (7–8 days old) were selected from the colony and starved for 1 h. They were then released with the help of a moistened fine brush at the center of each plate. All plates were sealed with Parafilm tape to avoid aphid escape and then transferred to a growth chamber at a constant temperature of 26 °C and with continuous light. The number of aphids located on each leaf disk was counted at 30 min, 1, 2, 4, and 8 h after the aphids were released.

2.5. Leaf trichome density, leaf thickness, and essential elements (NPK)

To estimate leaf trichome density, we counted the number of trichomes on the abaxial leaf surface in a 1-mm^2 area using a compound microscope (Gonzales et al., 2008).

A digital micrometer was used to measure thickness of the leaves, with care taken to ensure constant pressure by using the instrument's ratchet clutch, and the leaflet mid- and lateral ribs were avoided in measurements (White and Montes, 2005).

The levels of nitrogen (N), potassium (K), and phosphorus (P) were measured according to the methods of Olsen (1954) and Jackson (2005), respectively. All tests were done in Batı Akdeniz Agricultural Research Institute.

2.6. Statistical analysis

In the antixenosis tests, the number of aphids settled on each melon line was subjected to an ANOVA after transformation by square root, and mean comparisons were made according to Fisher's least significant difference (LSD) test using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA).

ANOVA was also used to compare the density of trichomes between genotypes; in this case, Tukey's test was used to evaluate differences between groups using SPSS.

The average numbers of aphids settled on leaf disks of the resistant and susceptible lines in the choice test experiments are given in graphical form for the different assessment times. The mean number of aphids per disk (n = 30 disks for each line) was compared statistically by means of the Mann–Whitney U-test.

3. Results

3.1. Antixenotic effect of tested melon lines

When the 24 and 72 h results of the antixenosis trials were evaluated together, the most resistant melon lines were PI-414723, ŞÜKRÜBEY, ÜNLÜ, TK15, and ÇA, which showed resistance rates ranging from 80% to 90% (Table 2). Eleven lines (N43, MLN9, MLN20, N16, N72, N2, N18, N22, N41, N77, and N54) were found to be resistant, with a resistance rate between 75% and 65%. One (N3) of the 23 melon lines was the most susceptible line to *A. gossypii*, with a zero resistance rate (0%) at both 24 and 72 h after exposure in the antixenosis experiments. The second most susceptible line was TKU3, which exhibited little (5%) and

Table 2. Number (N) and proportion (%) of plants showing resistance in the antixenosis tests at 24 (criteria of Pitrat and Lecoq, 1980) and 72 h (criteria of Martin and Fereres, 2003) (n = 20).

Melon lines	At 24 h		At 72 h	
	N	%	N	%
N3	0	0	0	0
TKU3	1	5	0	0
N24	3	15	2	10
TF37	2	10	1	5
TF29	2	10	1	5
N21	7	35	9	45
MLN16	6	30	9	45
N18	13	65	14	70
N16	14	70	14	70
ÇA	14	70	16	80
N22	13	65	14	70
MLN9	13	65	15	75
N43	14	70	15	75
N41	13	65	14	70
N72	14	70	14	70
ŞÜKRÜBEY	14	70	17	85
PI414723	15	75	18	90
TK15	13	65	16	80
ÜNLÜ	14	70	16	80
N77	12	60	14	70
N54	12	60	13	65
N2	13	65	14	70
MLN20	13	65	15	75

no (0%) antixenotic effect at 24 and 72 h, respectively, after the release of the aphids.

The results given in Table 3 indicate that the mean number of aphids per plant was significantly lower on the PI-414723 melon line than on the other lines after both 24 and 72 h of exposure in the antixenosis tests ($P < 0.05$). This line also exhibited higher antixenotic effect at 72 h compared to 24 h, which resulted in a reduction in the mean number of aphids per plant (3.10 and 1.95 aphids at 24 and 72 h, respectively). After PI-414723, the highest antixenotic effect at both 24 and 72 h was recorded for ŞÜKRÜBEY (3.75 aphids per plant at both time intervals). The other melon lines with high antixenotic effect were ÜNLÜ and TK15, in which the average number of aphids per plant decreased from 4.05 at 24 h to 3.95 at 72 h and from 5.10 at 24 h to 3.90 at 72 h, respectively. At both 24 and 72 h, the greatest number of aphids settled on N3 (8.90 and 8.60 aphids per plant, respectively), followed by TKU3 (8.45 and 8.20 aphids per plant, respectively).

3.2. Settling of melon aphid in the choice tests

In the choice tests, the aphids moved actively over the filter paper surface immediately after being released onto the Petri dishes. Most of the released aphids contacted leaf disks within a few minutes and started to probe them. Very few aphids were present on the filter paper layers 30 min later; most of them were situated on the leaf disks.

The figure shows changes over time in the number of aphids that settled on the resistant-line disks versus the susceptible-line disks. From the beginning of the trial onwards, the number of aphids choosing susceptible-line disks was markedly higher than the number choosing the resistant-line disks. The mean values obtained at all time intervals differ significantly from the susceptible control (N3) according to the Mann–Whitney U test ($P = 0.05$). When aphids were given a choice, significantly lower numbers of aphids were counted on the PI-414723 leaf disks at all time points compared to the other resistant lines tested ($P = 0.05$).

3.3. Effect of some plant factors on settling of melon aphid

The data for measured plant factors are summarized and illustrated in Table 4. There was no significant difference among the genotypes with respect to leaf thickness and NPK contents, but significant differences in the leaf trichome density were observed. The highest trichome density was recorded for PI414723 ($49.690 \pm 3.756/mm^2$).

4. Discussion

Although populations of melon aphid can be managed by synthetic insecticides, cultural practices, biological agents, etc., the use of resistant plant varieties has top priority as an environmentally friendly approach for sustainable agriculture. In the present study, we tested a total of 23 (22 indigenous and 1 exotic) melon lines belonging to 2 varieties (*C. melo* var. *inodorus* and *C. melo* var. *reticulatus*) from different parts of Turkey for antixenosis to *A. gossypii* by assessing feeding deterrence and aphid settling in a choice test. Our results showed that 5 (PI-414723, ŞÜKRÜBEY, ÜNLÜ, TK15, and ÇA) of the 23 melon lines tested showed a resistance rate ranging from 80% to 90% against *A. gossypii*. Of these 5 melon lines, ŞÜKRÜBEY, ÜNLÜ, TK15, and ÇA, which are rumoured to be resistant or tolerant to *A. gossypii* in Turkey, were experimentally detected for the first time in this study as highly melon aphid-resistant lines (Table 3 and Figure). The line PI-414723 had previously been detected as a melon aphid-resistant line in India (Kishaba et al., 1976; Klingler et al., 2001).

Table 3. Average number of aphids present on each plant after 24 and 72 h of exposure in the antixenosis experiment (n = 20) and status of melon lines tested (resistant, R; susceptible, S).

Melon lines	At 24 h		At 72 h	
	Mean ± SE	Status	Mean ± SE	Status
N3	8.90 ± 0.18 h	S	8.60 ± 0.22 e	S
TKU3	8.45 ± 0.23 gh	S	8.20 ± 0.22 de	S
N24	7.85 ± 0.41 fgh	R/S	6.75 ± 0.45 cd	S
TF37	8.05 ± 0.42 fgh	S	6.75 ± 0.34 cd	S
TF29	8.15 ± 0.39 gh	S	6.65 ± 0.39 cd	S
N21	6.65 ± 0.62 defg	R	5.30 ± 0.59 b	S
MLN16	7.05 ± 0.63 efg	R/S	5.10 ± 0.17 b	S
N18	5.95 ± 0.50 cde	R	4.05 ± 0.57 b	R
N16	4.70 ± 0.68 abcd	R	4.15 ± 0.49 b	R
ÇA	4.75 ± 0.64 abcd	R	4.40 ± 0.52 b	R
N22	5.15 ± 0.64 bcde	R	4.60 ± 0.65 b	R
MLN9	5.35 ± 0.62 bcde	R	4.10 ± 0.53 b	R
N43	5.50 ± 0.58 bcde	R	4.30 ± 0.57 b	R
N41	4.80 ± 0.69 abcd	R	4.40 ± 0.59 b	R
N72	4.75 ± 0.68 abcd	R	4.55 ± 0.57 b	R
ŞÜKRÜBEY	3.75 ± 0.68 ab	R	3.75 ± 0.53 ab	R
PI-414723	3.10 ± 0.72 a	R	1.95 ± 0.34 a	R
TK15	5.10 ± 0.69 bcd	R	3.90 ± 0.50 ab	R
ÜNLÜ	4.05 ± 0.71 abc	R	3.95 ± 0.60 ab	R
N77	6.30 ± 0.50 def	R	4.35 ± 0.58 b	R
N54	6.05 ± 0.48 de	R	4.75 ± 0.59 b	R
N2	5.55 ± 0.58 bcde	R	4.55 ± 0.59 b	R
MLN20	5.80 ± 0.57 cde	R	4.05 ± 0.60 b	R

Analysis of variance

Source	Dependent variable	Sum of squares	df	Mean square	F	P (Significance)
Melon lines	At 24 h	1080.748	22	49.125	7.372	0.000*
	At 72 h	1015.474		46.158	8.396	0.000*

*Significant at $P < 0.05$ (LSD test).

Prior to this study, a number of melon lines had already been screened for resistance to melon aphid. Screening of melon lines for resistance to *A. gossypii* began before the 1970s (Kishaba et al., 1971; Bohn et al., 1973). Later, Garzo et al. (2002) evaluated 3 melon lines (PI-161375, PI-414723, and TGR-1551) for resistance to melon aphid and indicated that TGR-1551, a new *C. melo* line from Zimbabwe, was a very promising new source to breed for resistance against *A. gossypii*. Recently, Doryanizadeh et al. (2017) conducted a choice test to evaluate antixenotic resistance of 8 melon lines (Hormozgan, Bushehr, Guilan, Girtap, Negeen, Sepehr, Pouya, and Armenian cucumber) against melon aphid, and reported that the greatest overall antixenotic effect to melon aphid was observed in Bushehr, while Sepehr and Negeen exhibited little or no antixenosis.

As for the test methods for assessing resistance to the melon aphid, antixenosis and choice tests, which were also used in the present study, are commonly used to determine plant resistance to aphids (Pitrat and Lecoq, 1984; Shinoda and Tanaka, 1987). Martín and Fereres (2003) reported that antixenosis and choice tests are fast and simple methods to screen plant material for resistance to aphids. They also indicate that choice test is a potential new method for assessing antixenotic effects; the results

Table 4. Means (± SE) of some measured features of *Cucumis melo* genotypes.

Genotypes	N (%)	P (%)	K (%)	Thickness (mm)	Trichome density
					(mm^{-2})
N3	4.150 ± 0.111	0.390 ± 0.020	3.950 ± 0.550	0.365 ± 0.025	26.340 ± 2.340 j
TKU3	3.960 ± 0.151	0.485 ± 0.025	4.600 ± 0.600	0.395 ± 0.031	27.350 ± 3.256ıj
N24	3.615 ± 0.285	0.410 ± 0.120	4.350 ± 0.250	0.410 ± 0.023	32.200 ± 1.890 fghı
TF37	4.015 ± 0.165	0.480 ± 0.010	5.150 ± 0.350	0.430 ± 0.035	30.410 ± 2.652 ghıj
TF29	3.095 ± 0.280	0.455 ± 0.040	4.650 ± 0.150	0.380 ± 0.030	30.093 ± 3.785 hıj
N21	4.250 ± 0.115	0.395 ± 0.035	4.100 ± 0.170	0.420 ± 0.028	33.956 ± 2.350 efgh
MLN16	4.075 ± 0.240	0.420 ± 0.075	4.550 ± 0.250	0.390 ± 0.032	33.733 ± 1.654 efgh
N18	3.890 ± 0.110	0.445 ± 0.015	3.650 ± 0.350	0.350 ± 0.011	36.000 ± 3.456 defg
N16	4.310 ± 0.600	0.500 ± 0.040	3.850 ± 0.150	0.285 ± 0.027	35.310 ± 2.954 defgh
ÇA	4.320 ± 0.180	0.395 ± 0.060	3.150 ± 0.450	0.355 ± 0.031	40.693 ± 2.231 bcd
N22	3.740 ± 0.370	0.510 ± 0.150	3.350 ± 0.150	0.430 ± 0.026	34.256 ± 2.099 efgh
MLN9	4.150 ± 0.200	0.450 ± 0.075	4.155 ± 0.350	0.410 ± 0.032	34.713 ± 1.890 efgh
N43	3.555 ± 0.125	0.435 ± 0.065	3.200 ± 0.300	0.350 ± 0.027	37.386 ± 2.354 cdef
N41	4.290 ± 0.120	0.365 ± 0.025	4.250 ± 0.550	0.385 ± 0.035	35.026 ± 2.926 defgh
N72	4.120 ± 0.455	0.390 ± 0.045	4.700 ± 0.300	0.425 ± 0.028	34.500 ± 3.142 efgh
ŞÜKRÜBEY	4.355 ± 0.125	0.485 ± 0.035	4.650 ± 0.450	0.357 ± 0.030	45.863 ± 2.566 ab
PI414723	4.275 ± 0.320	0.510 ± 0.015	3.750 ± 0.650	0.415 ± 0.023	49.690 ± 3.756 a
TK15	3.900 ± 0.155	0.470 ± 0.025	3.250 ± 0.250	0.375 ± 0.021	42.303 ± 1.253 bc
ÜNLÜ	4.150 ± 0.120	0.495 ± 0.020	4.100 ± 0.550	0.425 ± 0.032	45.506 ± 4.250 ab
N77	2.970 ± 0.080	0.470 ± 0.035	3.800 ± 0.400	0.373 ± 0.024	34.376 ± 3.455efgh
N54	3.850 ± 0.350	0.450 ± 0.045	4.450 ± 0.300	0.485 ± 0.022	38.360 ± 3.943cde
N2	4.150 ± 0.250	0.495 ± 0.015	5.250 ± 0.150	0.405 ± 0.012	36.803 ± 4.352 cdef
MLN20	4.010 ± 0.125	0.315 ± 0.045	4.350 ± 0.600	0.367 ± 0.035	35.133 ± 3.145 defgh
P	0.141	0.252	0.526	0.189	< 0.05*

Abbreviations: N: nitrogen; P: Phosphorus; K: potassium.
Means in a column followed by the same letters are not significantly different (Tukey's test at 5% significance level).
*: Significant P < 0.05.

obtained have been promising. Similarly, the present study demonstrated that the differences in the response of aphids to the resistant and susceptible melon lines in both antixenosis and choice test methods were extremely rapid and clearly apparent from the beginning of the trials.

Although the mechanisms of resistance have not been studied here, some previous studies indicate that resistance of plants to insect pests is based on some genetic attributes that cause a genotype/line/accession of one cultivar or species to be less damaged by insects than susceptible ones which lack these qualities (Klingler et al., 2001; Kamel and El-Gengaihi, 2009). In addition, there are some works on antixenosis of cucurbits against melon aphid. Vat gene has been identified in melon lines that confer both antibiotic and antixenotic melon resistance to *A. gossypii* (Bohn et al., 1972; Pitrat and Lecoq, 1984). Bohn et al. (1972) expressed that Vat-mediated resistance is exhibited as a combination of antibiosis (delayed growth and development with reduced fecundity) and antixenosis (host nonpreference and plant tolerance to aphid colonization). In a more recent study, Chen et al. (1996) reported that the Vat resistance in melon is detected early by the aphid during stylet penetration, and is strongly reinforced during phloem feeding. They also reported that the presence of extractable chemical factors in phloem sap discriminating the genotypes and 2 small peptides are significantly modified when the Vat gene is present. However, the mechanism of resistance is not fully understood at the molecular level.

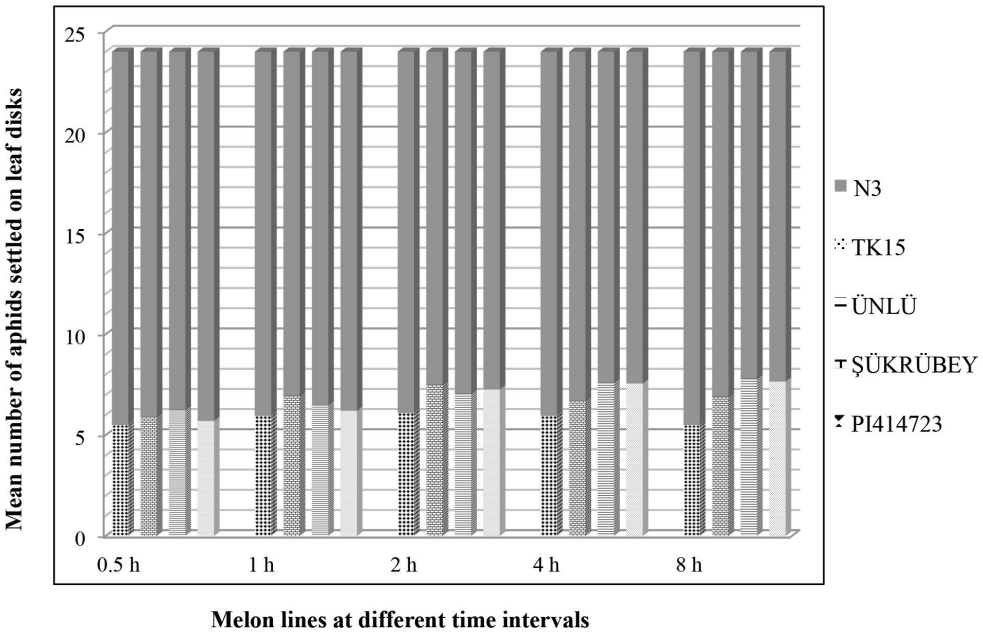

Figure. Mean number of aphids located on resistant and susceptible melon line leaf-disks at different assessment times in the choice tests. The values obtained at all time intervals differ significantly from the susceptible control (N3) according to the Mann–Whitney U test (P = 0.05).

Additional studies need to be carried out about that. In addition, Smith (2005) indicates that some morphological or chemical plant factors alter aphid behavior, causing the selection of an alternate host plant in antixenosis. He also declares that allelochemicals can be a stimulant or deterrent for the aphids. Gonzales et al. (2008) indicate that leaf trichomes, in general, have the role of water control and resistance against herbivorous insects in plants. Some previous studies have also found that leaf trichomes act as mechanical barriers that hinder insect movement and/or feeding (Levin, 1973; Smith, 2005; Le Roux et al., 2008). In a recent study, Doryanizadeh et al. (2017) reported that antixenotic effect in melon lines was positively correlated with leaf trichome density. Of the 23 melon lines tested in this study; 4 local lines (ŞÜKRÜBEY, ÜNLÜ, TK15, and ÇA) that showed the highest antixenotic effect against *A. gossypii* after PI-414723 had a higher leaf trichome density than the remaining melon lines. In this respect, our results are consistent with previous findings on leaf trichomes. Similar to the results of Doryanizadeh et al. (2017), our findings showed that NPK and leaf thickness had no significant effect on aphid resistance.

In conclusion, our results demonstrated that there were differences between the melon lines tested in terms of preference and choice. Such findings can be helpful in IPM programs for melons, in combination with information on other resistance mechanisms.

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