International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS
International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2018; 5(4): 01-03
Received: 01-05-2018
Accepted: 02-06-2018

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The determination of the relationship between cotton leaf hairy and sucking pest on cotton

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Abstract
Studies have been conducted in cotton fields of the Southeastern Anatolia Region, Kızıltepe District of Mardin Province and Akçakale District of Şanlıurfa Province. Cotton types with different number of hairs in leaves were used in the study. Similar results were obtained in the study at both locations. Very close association has been found between the sucking insects and number of hairs on cotton leaves. While the *Thrips tabaci* Lind. And *Bemisia tabaci* Genn. Developed better in varieties with leaves having hairs, they developed less in varieties with leaves that did not have hairs. In contrast, *Asymmetrasca decedens* (Paoli) and *Empoasca decipiens* (Paoli) have produced population that was 19 folds more abundant in varieties with leaves that did not have hairs as compared to varieties with leaves having hairs.

Keywords: Southeast Anatolia region, Cotton, Leaf hairy, sucking pests

Introduction
Cotton is an important agricultural plant in Turkey. It is cultivated on a land of about 501.853 da hectares (TUIK, 2017) [17]. The cotton plant has lots of pests. Sucking insects have an important place among these. The resistance of the plant is important for the struggle against pests of the cotton plant. Sucking insects weaken the resistance of the plant and cause serious damages (Abro *et al*., 2004) [1]. Among sucking insect pests, *Bemisia tabaci* (Genn.), *Aphis gossypii* (Glover), *Thrips tabaci* (Lind.) and *Amrasca bigutella* (Dist.) can cause serious damages in the harvest (Nizamani *et al*., 2002; Amjad and Aheer, 2007; Miyazaki et. al., 2013) [10, 2, 7]. Improvement scientists exert efforts to develop varieties durable against pests. These efforts are based on the fact that wild plants are resistant and on the idea of developing such wild varieties. IPM programs in struggle against pests require full or partial resistance. Therefore, determining the durability statuses of cotton varieties is important. Several studies have been conducted on this subject. Plant's endurance against pests can also be expressed as the population of the pest being affected by the hosting plant (Van Emden, 1974) [18]. Mound, 1965 [18] and Sippell *et al*., 1983 [14], have stated that abundance of hairs on cotton leaves allowed development of a greater *B. tabaci* population. *B. tabaci* has a wide host range (Berlinger, 1986) [4]. Adults and larvae of *B. tabaci* feed on plants. Many morphologic characteristics of plants affect the development of *B. tabaci.* Among these, hairiness of leaves is important. Presence of hairs on cotton leaves plays a very important role on endurance against *B. tabaci*. While *B. tabaci* in smaller numbers developed in cotton lines with smaller number of leaf hairs per cm^2, greater numbers of *B. tabaci* developed in lines with greater number of hairs on leaves (Sippell *et al*., 1987) [12]. While *T. tabaci* and *B. tabaci* has developed in lesser numbers on cotton varieties with lesser number of hairs on leaves, they have developed in greater numbers on cotton varieties with greater number of hairs on laves. In contrast, while Jassids developed in greater numbers in varieties with less hairy leaves, Jassids developed less with varieties with more hairy leaves (Syed at al., 2003) [16]. Butter and Vir., 1989 [13], have stated in their study that some varieties have greater endurance against *B. tabaci*. In the recent years, leafhopper has started to act as a pest in cotton fields in India and has caused significant damages. Studies have shown that hairiness of leaves is very important for durability against this pest (Murugesan and Kavitha, 2010) [9]. Hairs on cotton plant significantly affect the development of *Thrips tabaci* (Arif et. al., 2004) [3]. The number of hairs on cotton plant affect the development of *B. tabaci*. *B. tabaci* had displayed better development in cotton varieties with a mean hair number of 92 per cm^2 (Salim *et al*. 2013) [11].

Small numbers of hairs on leaves result in poorer development of *B. tabaci* (Stiller, W. N., Wilson, 2013) [15]. It has been found that the number of hairs in cotton plant was positively correlated with *B. tabaci* and *T. tabaci*, while it was negative correlated with Jassid (*Amrasca bigutella* Dist.). *B. tabaci* and *T. tabaci* developed more in cotton varieties with hairy leaves and developed less in varieties with less hairy leaves. Jassid (*A. bigutella*), in contrast, developed less in varieties with hairy leaves and developed better in varieties with less hairy leaves (Khalil *et al*., 2017) [6]. This study has been conducted in the Southeastern Anatolia Region that cotton is cultivated intensely. It was attempted in the study to determine the correlation between the number of hairs on leaves and sucking insects.

Material and Method

Six cotton varieties were used in the study. The study was established with six characters and four repeats based on the randomized blocks experimental design on June 2 in in Kızıltepe District and on May 30 in Akçakale. Parcel sizes were adjusted as 8 lines and 12 meters od length. Counts were commenced at the bifoliate phase after pullulation. Counts were carried out on 10 plants of each parcel on three leaves of each plant, one in the upper, one in the middle part and one in the lower part of the plant, totaling to 30 leaves in each parcel. While the counts of *T. tabaci*, *A. decedens*, *E. decipiens* adults were carried out in the plants of the field, *B. tabaci* larvae and pupae were counted in the laboratory using a stereoscopic microscope. Counts of pest species were carried out throughout the season and were assessed based on the total numbers. Five leaves emerging from main stem in the middle part of the plant were included in counts in each parcel. These leaves were carried to the laboratory within an icebox and hairs in each cm^2 were counted under stereoscopic microscope.

Findings and Discussion

Significant differences were found between the varieties as regards the number of hairs in the study conducted in Akçakale location. The biggest number of hairs was found in variety no. 1 with 515.25 hairs/cm^2. The smallest number of hairs, however, was found in variety no. 2 with 7.45 hairs/cm^2. The biggest count of *T. tabaci* was found in the variety 6 with 14.87 individuals/leaf, while the smallest number was found in the variety 3 with 1.7 individuals/leaf. *A. decedens* and *E. decipiens* were the most abundant with 54.75 individuals/leaf in variety no. 3, the same were the least frequent in variety no. 6 with 3.4 individuals/leaf. *B. tabaci*, however, was found the most abundantly in variety no. 1 with 9.05 individuals/leaf, and the least frequently in variety no. 3 with 0.65 individual/leaf (Table 1). The relation between the number of hairs in varieties and *T. tabaci* was found as r: 0,937 for *A. decedens* and r: -0,748 and *E. decipiens* while r: 0,981 for *B. tabaci*.

In the study conducted in Kızıltepe, the number of hairs were similar to those in Akçakale. While the biggest number of hairs was found again in variety no. 1 with 595 hairs/cm^2, the smallest number was found in variety no. 3 with 7.45 hairs/cm^2. T. tabaci was the most abundant in variety no. 1 with 21.17 individuals/leaf, it was the least frequent in variety no. 5 with 4.10 individuals/leaf. Number of *A. decedens*, *E. decipiens* was the biggest with 38.40 individuals/leaf in variety no. 3, and the smallest in variety no. 4 with 2.02 individuals/leaf. *B. tabaci* number was the biggest in variety no. 1 with 25.32 individuals/leaf, while it was the smallest in variety no. 3 with 1.52 individuals/leaf (Table 2). The correlation between the number of hairs and number of pests in Kızıltepe was r:0.974 for *T. tabaci* and r:-0.974 for *A. decedens*, *E. decipiens* and r:0.974 for *B. tabaci*. When both locations were evaluated together, it was seen that *T. tabaci* and *B. tabaci* developed more in cotton varieties that leaves were hairy, and they developed less in varieties with less hairy leaves. The contrary was seen in the development of *A. decedens*, *E. decipiens* population. Population development was very less in varieties with hairy leaves, the same was about 19 folds in hairless varieties in Kızıltepe location, and about 15.8 folds in Akçakale location. Mound (1965) [18] and Sippell *et al*. (1983) [14] have stated that *B. tabaci* population developed the most in case the number of hairy in cotton leaves were greater in number. Correlations between the number of hairy in leaves and development of *B. tabaci* were r:0.981 and r: 0.974, respectively. Sippell *et al*. (1987) [12] have stated that B. tabaci developed more on varieties with greater number of hairs per cm^2 on cotton leaves, and correlation was r: 0,63. Syed *et al*. (2003) [16] have stated in their study that *T. tabaci* developed less in cotton plants with less hairy leaves, it developed more in varieties with hairier leaves; Jassids however, developed more in varieties with less hairy varieties. Similar results were also obtained in our study. Murugesan and Kavitha, 2010 [9], however, have stated that hairiness of leaves was important for durability against Leafhopper. Salim *et al*. (2013) [11] reported in their study that B. tabaci developed more in varieties with hair numbers exceeding about 92 per cm^2 in leaves; in our study however, *B. tabaci* developed more in varieties with hair numbers exceeding about 400 per cm^2.

A very close relationship was found between the number of hairs in cotton leaves and development of sucking insects. While *T. tabaci* and *B. tabaci* developed better in varieties with markedly hairy leaves, while *A. decedens*, *E. decipiens* developed more in varieties with less hairy leaves. It is considered that the above-mentioned situations will be taken into consideration when cultivating cotton in the area.

Table 1: Numbers of hairs on cotton leaves per cm^2 in Kızıltepe District and population developments of sucking insects.

Variety no	df	Hairy		*T. tabaci* (Adet/yaprak)		*Empoasca* spp. (Adet/yaprak)		*B. tabaci* (Adet/yaprak)	
		f	p	f	p	f	p	f	p
		215.85	**0.000**	**100.24**	**0.000**	**129.38**	**0.000**	**185.51**	**0.000**
1	5,18	515.25±37.54d*		12.77±0.66b		5.85±0.94a		9.05±c	
2	5,18	7.45±1.03a		2.02±0.22a		52.12±4.08c		0.97±a	
3	5,18	8.90±1.28a		1.27±0.30a		54.75±2.57c		0.65±a	
4	5,18	37.60±4.03b		1.92±0.35a		48.37±1.41c		0.97±a	
5	5,18	11.72±1.04ab		1.40±0.14a		13.52±1.22b		0.55±a	
6	5,18	4.01±5.44c		14.87±1.28c		3.4±0.34a		6.2±b	

*Values within a column followed by the same letter do not differ singnificantly at p:0.05

Table 2: Numbers of hairs on cotton leaves per cm^2 in Kızıltepe District and population developments of sucking insects.

variety	df	Hairy		*T. tabaci* (Adet/yaprak)		*Empoasca* spp. (Adet/yaprak)		*B. tabaci* (Adet/yaprak)	
		f	p	f	p	f	p	f	p
		1146.663	**0.000**	**258.39**	**0.000**	**83.23**	**0.000**	**25.72**	**0.000**
1	5,18	595±15.01d		21.17±0.90c		2.80±0.60a		25.32±1.79c	
2	5,18	16.25±3.63a		4.82±0.46a		27.20±1.89c		3.65±0.39a	
3	5,18	7.45±1.01a		5.32±0.21a		38.40±3.00d		1.52±0.11a	
4	5,18	58±4.01b		6.95±0.62b		27.17±1.74c		4.17±0.28a	
5	5,18	15.2±31.4a6		4.10±0.04a		9.42±0.59b		1.67±0.41a	
6	5,18	445±9.94c		20.47±0.22c		2.02±0.34a		20.00±1.89b	

*Values within a column followed by the same letter do not differ singnificantly at p:0.05

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