

## Susceptibility of Three Strawberry Cultivars to the Infestation of the Most Important Pests in Qalubia Governorate.

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### Abstract

Experiments were conducted during the two seasons of 2018-2019 and 2019-2020 in Qalubia Governorate, Egypt, to evaluate the susceptibility of three cultivars of strawberry (Fertona, Felorida and Festival) to the infestation of red spider mite, white fly, aphid and thrips. Also the relation of anatomic characters of three strawberry cultivars leaves in relation to the infestation of *Tetranychus urticae* and *Bimicia tabaci* was also studied. The obtained results showed that the highest mean number of *T. urticae* (egg & movable stages) was recorded on Fertona var, being 187.2 and 123.36 individuals/10 leaves and 75.7 & 53.89 eggs/10 leaves during the two studied seasons, respectively. On the other hand, the lowest infestation was recorded on Florida, it was 14.4 and 53.8 individuals /10 leaves, and 35.6, 56.6 eggs during the two tested successive seasons, respectively. A significant difference were detected between the anatomical characteristics and the mean numbers of pests where the cultivars have higher thickness attract low number of pests.

**Keywords:** strawberry, *Tetranychus urticae*, *Bimicia tabaci* anatomical characteristics

### Introduction

Strawberry (*Fragaria x ananassa* Duch.) is one of the most important crop of the family Rosaceae. It has become one of the most economic vegetable crops in Egypt. Strawberry is a vegetable crop rich in minerals, vitamins C, A, B and potassium, calcium, magnesium, iron, sulfur and phosphorus. Strawberries, are rich source of phytochemicals (ellagic acid, anthocyanins, quercetin, and catechin), have been highly ranked among dietary sources of polyphenols and antioxidant capacity (Basu *et al.*, 2014). Strawberry plants infested by many pests which are responsible for considerable quantitative and qualitative losses in the fruit yield. It is attractive to the more important insects and other pests which attack strawberry plants. These pests can cause serious economic loss by markedly reducing crop yields and quality (Gamila *et al.*, 2018).

The aim of this work is to study the susceptibility of three strawberry cultivars to infestation of the most important pests and the relationship of their infestation with the anatomical characteristics of these cultivars leaves in order to choose the best cultivars that attract the lowest numbers of these pests and had the best anatomical characteristics.

### Materials and Methods

#### 1-Susceptibility of three strawberry cultivars to infestation of the most important pests:

Seedlings of three strawberry cultivars (Felorida, Fertona and Festival (*F. x ananassa*) were chosen and transplanted at Qalubia Governorate to determine their susceptibility to infestation of *B. tabaci*, aphids (*aphis gossypii*), *T. tabaci* and

*T. urticae*. This experiment was conducted throughout two successive seasons, 2018-2019 and 2019-2020. The whole area of 1050 m<sup>2</sup> divided into 9 replicates were arranged in a randomized complete block design with 3 replicates for each cultivar. Seedlings of the three tested cultivars were transplanted at 17<sup>th</sup> in the two studied seasons. Experimental area received normal agricultural practices and kept free from any pesticide treatments. Weekly randomized samples of 10 leaves from each replicate were taken after one month of transplanting and continued until the end of crop in two studied seasons. Weekly samples were picked at early morning, visual count of the previous tested pests was done and recorded. The collected sample leaves were transferred to the laboratory in paper bags where the observed studied pests were counted by using aid stereomicroscope.

#### 2-Determination of anatomical characters of the tested strawberry cultivars leaves:

Samples of each cultivar leaves were picked up and fixed in FAA solution (5ml formalin, 5ml glacial acetic and 90 ml ethyl alcohol 70%). Leaves were taken and washed in 50% ethyl alcohol, dehydrate in series of ethyl alcohol (70, 90, 95% and absolute alcohol) and filtrated in xylene, embedded in paraffin wax of melting point 60-15c, longitudinal sections sectioned to thickness of (10-15) microns were prepared and handled with the same procedures of paraffin method, and double stained with fast green and safranin, cleared in xylene and mounted in Canada balsam (Jackson, 1976)

The different measurements (in micron) of the thickness of cuticle (upper and lower), epidermis, (upper and lower), palisade tissue, thickness of spongy tissue and No. of spongy layers were

determined by using of Compu Eye, Leaf and Symptom Area Program by **Bakr (2005)**.

#### 4-Data analysis:

Statistical analysis for ANOVA was carried out by using **SAS (2003)** Portable. Whereas the means were compared through L.S.D (tests, least significant differences) at  $P=0.05$  level.

### Results and Discussion

#### 1- Susceptibility of three strawberry cultivars for red spider mite, white fly, aphid and thrips infestation.

##### 1. The red spider mites (*Tetranychus urticae*)

The obtained results in Tables (1 and 2) indicated that there were a significant differences between the mean numbers of *T. urticae* (egg & movable stages) among the three tested cultivars, during first season (2018-2019) table (1), as F values and L.S.D values were 3.70 and 6.55 & 72.02 and 22.32 for mean numbers of eggs and movables stages, respectively but there are insignificant differences between the mean numbers of eggs on the three tests cultivars and there was significant difference in case of movable stages during the second season (2019-2020).

The highest mean number of *T. urticae* (egg & movable stages) was recorded on Fertona cultivar; it was 187.23 and 123.36 individuals/10 leaves, 75.71 & 53.89 eggs/10 leaves during the two successive seasons, respectively. The lowest infestation was recorded on Felorida, it was 14.43 and 53.82 individuals /10 leaves, 35.64 and 56.61 eggs during the two tested successive seasons, respectively.

##### 2- whitefly (*B. tabaci*)

The obtained results indicated that there were insignificant differences between the mean numbers of *Bemisia tabaci* (egg & nymph) among the three tested cultivars. Except the mean numbers of eggs in the second seasons, as L.S.D value 1.05.

The highest infestation of *B. tabaci* eggs and nymphs was recorded on Felorida cultivar in the two

studied seasons, as the mean numbers were 9.11 and 17.12 & 1.84 and 1.87, respectively. On contrast, the lowest population density was recorded on Fertona cultivar, showing 5.27 and 12.25 & 0.61 and 1.70 in the two studied seasons, respectively.

##### 3-Aphid (*A. gossypii*):

The obtained results indicated that aphid population appeared with few numbers throughout the two studied seasons and there was no significant difference between the population density of aphids on three tested cultivars in the first season, while, there was a significant difference in the second season. The highest mean number of aphids, 1.70 and 1.58 individuals/10 leaves recorded on Festival cultivar during two studied seasons, respectively, Tables 1 and 2.

##### 4-*T. tabaci*

As obtained in case of aphid infestation, *T. tabaci* population appeared with very few numbers and there were a significant difference between the population density of *T. tabaci* on three tested cultivars in the first season, but there was insignificant difference in the second season (Table 1 and 2). Felorida cultivars infested by the lowest numbers of *T. tabaci* in the two studied seasons, 0.19 and 0.14 individuals/10 leaves, respectively.

Several authors in different countries studied the susceptibility of some strawberry cultivars. **Abdelmaksoud (2021)** in Egypt stated that Fortuna was susceptible cultivar to infestation of *T. urticae*, among three strawberry cultivars, **Costa, A. F et al. (2018) in Brazil**, stated that Festival cultivar infested by the lowest numbers of *T. urticae* compared with other cultivars. **Hassan, S. M. (2004)**. Evaluated Fifteen excellent strawberry cultivars for pest infestation. All the cultivars were infested by whitefly (*B. tabaci*), two-spotted spider mite (*T. urticae*), aphids (*A. gossypii*) and thrips (*T. tabaci*). Results showed that Rosalinda was the most infested. The lowest population was found on Diamount.

**Table 1.** The infestation of three strawberry cultivars of the most important pests in Qalubia Governorate during 2018/2019 season.

Varieties	<i>T. urticae</i>		<i>B. tabaci</i>		<i>A. gossypii</i>	<i>T. tabaci</i>
	Egg	Moving stage	Egg	Nymph		
Felorida	35.64 <sup>b</sup>	14.43 <sup>b</sup>	9.11 <sup>a</sup>	17.12 <sup>a</sup>	0.73 <sup>a</sup>	0.19 <sup>b</sup>
Festival	71.62 <sup>b</sup>	23.92 <sup>b</sup>	5.77 <sup>a</sup>	16.43 <sup>a</sup>	1.70 <sup>a</sup>	0.42 <sup>a</sup>
Fertona	187.23 <sup>a</sup>	75.75 <sup>a</sup>	5.27 <sup>a</sup>	12.25 <sup>a</sup>	1.16 <sup>a</sup>	0.26 <sup>b</sup>
F value	3.7	6.55	12.76	15.42	1.36	2.25
L.S.D	72.023	22.32	3.9209	5.23	1.9218	0.2126

**Table 2.** The infestation of three strawberry cultivars of the most important pests in Qalubia Governorate during 2019/2020 season.

Varities	<i>Tetranychus urticae</i>		<i>Bemisia tabaci</i>		<i>aphis gossypii</i>	<i>Thrips Tabaci</i>
	Egg	Moving stage	Egg	Nymph		
Felorida	56.67 <sup>a</sup>	53.89 <sup>a</sup>	1.84 <sup>a</sup>	1.87 <sup>a</sup>	0.18 <sup>b</sup>	0.14 <sup>a</sup>
Festival	104.67 <sup>a</sup>	42.93 <sup>b</sup>	1.43 <sup>b</sup>	1.71 <sup>a</sup>	1.58 <sup>a</sup>	0.15 <sup>a</sup>
Fertona	123.36 <sup>a</sup>	53.89 <sup>a</sup>	0.611 <sup>b</sup>	1.7 <sup>a</sup>	0.47 <sup>b</sup>	0.18 <sup>a</sup>
F value	4.12	4.17	3.78	3.52	4.15	0.96
L.S.D	72.067	31.878	1.0469	1.1247	0.6508	0.1434

## 2- Effect of the anatomical characters of three strawberry cultivars leaves in relation to the infestation of tested pests.

From the obtained data, it is clear that there was a significant difference in all the tested layers among the three tested cultivars except for the upper cuticle layer which did not show any significant difference between the three studied cultivars.

Statistical analysis of obtained data in Table(4) indicated that the two studied pests *T.urticae* eggs and movable stages and *B. tabaci* eggs and nymphes affected by anatomical charactersitics of strawberry leaves.

Regarding to *T.urticae* eggs and movable stages ,the relationship between the seventh layers of strawberry leaf the population of these two stages were significantly positive with upper cuticle and lower epidermis (r = 0.97 and 0.96 & 0.13 and 0.16 respectively).

On the contrary , the population density of *T.urticae* eggs and movable stages correlated negatively with the five remaining layers , lower cuticle,upper epidermis , palisade tissue , spongy tissue and no.of spongy tissue (Table 4) .It is clear

from (Table 3),Felorida strawberry cultivars which had the highest layer of upper cuticle (14.40  $\mu$ ) and lower epidrems (33.30 $\mu$ ) infested by the lowest numbers of *T.urticae* eggs and movable stages , being 46.60.eggs/ 10 leaves and 17.10 individuals/ 10 leaves ,respectively.

Concerning *B.tabaci* eggs and nymphs the population density was positively correlated with upper cuticle (r= 0.23 and 0.99) and negatively with lower cuticle(r= -0.05 and -0.99) and No. of spongy layer (r =-0.81 and -0.69 for eggs and nymphs, respectively)

From the above mentioned results of the relationship between the population density of *B. tabaci* eggs and nymphs and anatomical characters of three cultivars leaves ,it is evident that ,Fertona cultivar which had a thickest layer of upper cuticle (13.94  $\mu$ ) and a thickest layers of palisad tissue(90.00  $\mu$ ), spongy tissue(103.50  $\mu$ ) and lowest no.of spongy layer(6.00 $\mu$ ) infested by the highest numbers of *B. tabaci* eggs and nymphs ,being 1.67 eggs / 10 leaves and 1.60 nymphs/10 leaves respectively.

**Table 3.** Relationship of anatomical characters in three strawberry cultivars for the infestation of *T. urticae B. tabaci* in Qalubia Governorate during 2019-2020 season.

Cultiva rs	Cuticle		Epidermis in micron		Palisa de tissue	Spon gy tissu	No.of Spongy layer	<i>Tetranychus urticae</i>		<i>Bemisia tabaci</i>	
	Upp er	Low er	Uppe r	Lowe r				eggs	movabl es	egg	nypm he
Ferton a	13.9 4 <sup>a</sup>	12.5 2 <sup>a</sup>	43.2 <sup>b</sup>	31.50 <sup>b</sup>	90 <sup>c</sup>	103.5 1 <sup>c</sup>	6 <sup>b</sup>	95.60 <sup>a</sup>	41.43 <sup>a</sup>	1.67 <sup>a</sup>	1.60 <sup>a</sup>
Festiva l	13.5 a	10. 81 <sup>b</sup>	29.74 <sup>c</sup>	22.50 <sup>c</sup>	103.50 <sup>b</sup>	109.8 0 <sup>b</sup>	10 <sup>a</sup>	79.41 <sup>b</sup>	32.60 <sup>b</sup>	1.40 <sup>a</sup>	1.61 <sup>a</sup>
Felore da	14.4 a	11.7 1 <sup>b</sup>	45 <sup>a</sup>	33.31 <sup>a</sup>	108 <sup>a</sup>	162 <sup>a</sup>	10 <sup>a</sup>	46.60 <sup>c</sup>	17.11 <sup>c</sup>	1.51 <sup>a</sup>	1.53 <sup>a</sup>
F value	2.02	4.72 *	740.9 **	334.8 **	877.5* *	53.33 **	10311.3 **	6232.13 **	1520.63 **	0.58	0.03
L.S.D	1.19 33	1.19	1.159 9	1.19	1.19	1.19	1.19	1.1931	1.1931	0.67 25	0.844 6

This results agree with **Tantawy.Maha(2006) in Egypt** indicated that the population density of aphids and white fly were positively corrected with lower & upper epidermis and negatively correlated with palisade an spongy tissues. **Abou Zaid(2013) in Egypt**. Stated that the population density of *T.urticae* infesting cucumber plants was negatively correlated with upper & lower epidermis and palisade layers and positive with spongy tissue layers.**Hanafy *et al.* (2014)** in Egypt, stated that anatomical characters play an important role in the infestation rates of thrips *Thrips tabaci*(Lind.), aphids, whitefly, *Bemisia*

*tabaci*(Genn.) and the two spotted spider mite, *Tetranychus urticae*(Koch, The population density of all pests had positive relationship and significant with palisade and spongy layers. While, this relation was significantly negative with upper and lower epidermis agents . **Klavins, L.; Klavins, M.(2020) in Switzerland** .Remained that the outer-most layer of plant surface, the cuticle, consists of epi- and intra-cuticular wax. It protects the plant from dehydration, extreme temperatures and UV radiation, as well as attacks from pests

**Table 4.** Correlation of anatomical characteristics and mean number of *T. urticae* *B. tabaci* / 10 leaves of three strawberry cultivars during 2019 – 2020 season.

Pests		Cuticle		Epidermis		Palisade tissue	Spongy tissu	No.of Spongy layer	
		Upper	Lower	Upper	Lower				
<i>T. urticae</i>	Egg	r	0.97	-0.91	-0.66	0.13	-0.08	-0.036	-0.88
		b	0.14	0.26	0.53	0.19	0.94	0.97	0.30
	M.stages	r	0.96	-0.9	-0.65	0.16	-0.06	-0.015	-0.89
		b	0.16	0.28	0.54	0.89	0.95	0.99	0.28
		r	0.23	-0.05	0.35	0.94	0.84	0.87	-0.81
		b	0.84	0.96	0.76	0.12	0.35	0.32	0.39
egg	r	0.99	-0.99	-0.87	-0.18	-0.403	-0.35	-0.69	
	b	0.06	0.057	0.32	0.87	0.73	0.76	0.51	
<i>B. tabaci</i>	Nymph	b	0.06	0.057	0.32	0.87	0.73	0.76	0.51



**Festival cultivar**



**Felorida cultivar**



**Fertona cultivar**

**Fig (1):** A Dissection structure of different strawberry leaves in. Fertona ,Feloreda and Festival at vegetative stage.

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قابلية إصابة بعض أصناف الفراولة للإصابة بأهم الآفات في محافظة القليوبية  
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تم اجراء التجربة في محافظة القليوبية خلال موسمين 2018-2019 و 2019-2020 . لدراسة قابلية إصابة ثلاث أصناف من الفراولة ( فلوريدا ، فرتونة ، فستقال) باهم الآفات الحشرية والحيوانية ( العنكبوت الأحمر ، الذبابة البيضاء ، المن والتريس) ، وكذلك دراسة علاقه بين الصفات التشريحية(سمك طبقة الكيوتكيل العلوى والسفلى وسمك طبقة البشرة العلوى والسفلى وسمك النسيج الإسفنجى وعدد طبقات النسيج الإسفنجى) لأوراق الثلاث أصناف الفراولة ومعدل الإصابة بالعنكبوت الأحمر والذبابة البيضاء ، وأظهرت النتائج أن الصنف فرتونه سجل أعلى معدل إصابة بالعنكبوت الأحمر 187.2 و 123.36 بيضه/ 10 أوراق، و 75.75 و 53.89 فرد / 10، خلال موسمى الدراسة ، بينما سجل الصنف فلوريدا اعلى تعدا د من الذبابة البيضاء بمعدل 9.11 و 1.84 بيضه /10 ورقا و 17.12 و 1.87 فرد/10 ورقا خلال الموسمين ، كما سجل أقل معدل إصابة بالعنكبوت الأحمر في الصنف فلوريد بينما كان تعداد كل من المن والتريس منخفضا خلال موسمى الدراسة. كما وجد أن هناك علاقه معنوية بين المكونات التشريحية للورقة سمك طبقة (الكيوتكيل العلوى والسفلى وسمك طبقة البشرة العلوى والسفلى وسمك النسيج الإسفنجى وعدد طبقات النسيج الإسفنجى).