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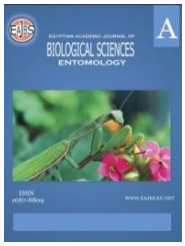

Effect of Infested Carnation Plants by *Haplothrips cottei* and *Bemisia tabaci* on the Annual Production of Flowers Under Glasshouse Conditions

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ABSTRACT

This study was carried out to study the effect of infested carnation plants (*Dianthus caryophyllus* L.) by Carnation Thrips, *Haplothrips cottei* (Vuillet) (Thysanoptera: Thripidae) and *Bemisia tabaci* (Gennadius) on the quantity of annual production of carnation flowers under glasshouse conditions at three locations (governorates), International Garden (Cairo Governorate), El-Orman Garden, (Giza Governorate) and International Garden (Alexandria Governorate) during successive season 2018, 2019.

Therefore, this study was divided into three parts, the first part studied population fluctuation of *H. cottei* and *B. tabaci* on the carnation plants during successive season. The second part studied the effect of infested carnation plants by the two insects on the quantity of annual production of carnation flowers at the three locations. And the third part studied the effect of insect infestation by the two insects on the internal components of carnation plants.

Results obtained showed that the infestation by *H. cottei* reduced the quantity of annual production of carnation flowers after picking more the infestation by *B. tabaci* compared to control (which non infested by the same insects). Also, results showed that the infestation by *H. cottei* reduced total sugar and total protein as the infested carnation flowers more than the infestation by *B. tabaci* compared to control.

INTRODUCTION

Carnation considers one of the most important cut flowers and ornamental plants in Egypt and all over the world which cultivated in the open field and under greenhouse conditions. Also, its cultivated area increased gradually during the last years, especially in the newly reclaimed areas for purposes of local consumption and exportation to the foreign markets. The human love to the dianthus due to their beautiful colors, style of flowers, smiles, and tolerant the inferable weather factors. Later dianthus flowers became one of the important components for international income for many countries all over the world through exporting these flowers to the different countries, Ali *et al*. (2008)

Carnation infested with a large scale of insects belongs to many orders and families such as *Haplothrips cottei* and *Bemisia tabaci* which are considered important pests of carnation flowers and many other flowers. Jaskiewicz (2010) reported that the strong infestation by *H.cottei* resulted in the deformation of stems, leaves, and flowers of canation plants. Derek (2013) in Australia who reported that *H. cottei and B. tabaci* are serious pests on carnation

plants, and they feed mainly on the young leaves and developing flower-buds of Carnation flowers.

This study was carried out to study the effect of infested carnation plants *(Dianthus caryophyllus* L.) by *H. cottei* and *B. tabaci* on the quantity of annual production of carnation flowers under glasshouse conditions at three locations, International Garden (Cairo Governorate) and El-Orman Garden, (Giza Governorate) and International Garden (Alexandria Governorate) during successive season 2018, 2019. Therefore this study divided into three parts, The first part studied population fluctuation of *H. cottei* and *B. tabaci* on the carnation plants during successive season 2018, 2019. The second part studied the effect of infested carnation plants by the two insects on the quantity of annual production of carnation flowers. And the third part studied the effect of insect infestation by the two insects on the internal components of carnation plants.

MATERIALS AND METHODS

Experimental Design:

This study was conducted on Carnation plants grown in three locations, International Garden (Cairo Governorate), El-Orman Garden, (Giza Governorate) and International Garden (Alexandria Governorate) under glasshouse conditions during successive season 2018, 2019. The glasshouse in each garden with an area of 27x45 m of each one was divided into three parts, first part left as control, the second part had artificially infestation by *Haplothrips cottei* and the third part had artificially infestation by *Tetranychus urticae*. Each part contains 5 plots (3x5 m^2) for each, and each part isolated completely from others. Carnation seedlings were planted in glasshouse conditions at the same time in November (the planting time of Carnation plants). All agricultural operations of irrigation and fertilization and others are completely identical in the two glasshouses were done without the application of any insecticide.

Artificially infestation was done by *H. cottei* in the first part and by *B. tabaci* in the second part with careful observation of the mean numbers of these pests during the plant growth period and especially during the flowering stage from February – August. At the end of the first growing season calculate a number of flowers per square meter from each part at the three locations.

Statistical Analysis:

In the experiments, effect on the insect infestation by *H. cottei* and *B. tabaci* on the quantity of annual production of the Carnation flowers. And the effect of the infestation by the same pests on the total soluble sugar and total protein of the Carnation flowers were subjected to analysis of variance (ANOVA) and the means were compared by L.S.D. test at 0.05 level, using SAS program (SAS Institute, 1988). The sugar and protein were analyzed by High-Pressure Liquid Chromatograph (HPLC).

RESULTS AND DISCUSSION

This study was carried out to study the effect of infested Carnation plants (*Dianthus caryophyllus* L.) by Carnation thrips, *Haplothrips cottei* and *Bemisia tabaci* on the quantity of annual production of Carnation flowers under glasshouse conditions at three locations (governorates), International Garden (Cairo Governorate), El-Orman Garden, (Giza Governorate) and International Garden (Alexandria Governorate) during successive season 2018, 2019. Therefore this study divided into three parts, the first part studied population fluctuation of the two insects on Carnation plants during successive season. The second part studied the effect of infested Carnation plants by the same insects on the quantity of annual

production of Carnation flowers. And the third part studied the effect of insect infestation by the two insects on the internal components of carnation plants.

Population fluctuation of *H. cottei* and *B. tabaci* on Carnation plants at the three locations (governorates) during season 2018:

Data tabulated from Table (1) show population fluctuation of *H. cottei* and *B. tabaci* on Carnation plants at the three locations (governorates) Cairo, Giza and Alexandria during season 2018, 2019. Data obtained showed that the mean number of *H. cottei* and *B. tabac* per leaf at Cairo Governorate were (13.2, 16.8), respectively. Whereas the mean number of *H. cottei* and *B. tabac* per leaf at Giza Governorate were (14.7, 18.2), respectively. And that the mean number of *H. cottei* and *B. tabac* per leaf at Alexandria Governorate were (11.9, 15.7), respectively.

These results agree with those obtained by Mirab (2015) in Iran who reported that were several species of Haplothrips are associated with flowers of Carnation plants and some other ornamental plants, and they cause serious damages to the stage of the flower. Jaskiewicz (2008) in Poland who reported the effect of the Carnation thrips, *H. cottei* and *B. tabaci* nymphs feeding on the flowering of Carnation and reported that *H. cottei*, when found in greater numbers, caused deformation of the leaf blades, shorting of shoots and petioles, as well as deformation of the flowers. Miles (2015) in Australia reported that in warm weather, *B. tabaci* nymphs walk-off buds of Carnation during a "critical period " coinciding with the opening of the sepals, and studies showed this behavior of pest feeding affected on the vase life period of these flowers after picking. Also, results obtained agreement with those obtained by Stone (2012) who studied the effect of infested Carnation flowers by three species of thrips on the vase life period of these flowers and estimated the damage on these flowers as a result of infestation by these insects.

Table 1: Population fluctuation of *H. cottei* and *B. tabaci* on Carnation plants at the three locations (governorates) during season 2018

Date	Population fluctuation/leaf					
	Cairo Governorate		Giza Governorate		Alex. Governorate	
	H. cottei	*B. tabaci*	*H. cottei*	*B. tabaci*	*H. cottei*	*B. tabaci*
1/11/2018	4.7	7.3	5.6	8.5	3.9	6.5
8/11/2018	5.3	9.5	7.1	10.8	4.6	8.2
15/11/2018	7.6	10.7	8.2	11.6	5.1	9.1
22/11/2018	8.2	11.4	9.5	12.9	7.6	10.4
29/11/2018	9.6	13.3	10.4	14.8	8.3	12.8
6/12/2018	11.3	15.6	12.6	16.3	10.5	14.6
13/12/2018	13.4	16.3	14.3	18.4	11.2	15.2
20/12/2018	15.3	18.4	17.1	19.6	13.8	17.6
27/12/2018	16.7	20.1	18.7	21.2	15.6	19.5
3/1/2019	17.6	22.6	19.2	23.1	16.3	20.3
10/1/2019	19.3	23.7	20.9	24.6	18.6	21.6
17/1/2019	20.6	24.6	22.3	26.7	19.6	23.7
24/1/2019	21.7	25.3	24.6	27.5	20.4	24.1
Total	**171.3**	**218.8**	**190.5**	**236.0**	**155.5**	**203.6**
Mean	**13.2**	**16.8**	**14.7**	**18.2**	**11.9**	**15.7**
F(0.05)	**245.78**	**355.65**	**275.98**	**312.45**	**212.75**	**385.45**
LSD	**1.045**	**1.032**	**1.085**	**1.072**	**1.035**	**1.082**

Means within columns bearing different subscripts are significantly different ($P< 0.05$)

Effect of Infested Carnation Plants by *H. cottei* and *B. tabaci* on the Quantity of Annual Production of Carnation Flowers:

This experiment was carried out to study the effect of infested Carnation plants by *H. cottei* and *B. tabaci* on the quantity of annual production of Carnation flowers at the three locations (governorates). Means of the quantity of annual production of Carnation flowers per square meter were calculated at the three locations for infested plants by the two insects compared to control (non-infested).

Data tabulated in Table (2) shows means of the quantity of annual production of the carnation flowers which infested by *H. cottei* and *B. tabaci* compared to control (non-infested) at the three examined locations (governorates) Cairo, Giza, and Alexandria. Data obtained showed the means of the quantity of annual production of carnation flowers in carnation plants which infested by *H. cottei* at Cairo governorate were 47.2 flowers/m^2 whereas means of the quantity of annual production of carnation flowers in carnation plants which infested by *B. tabaci* were 58.9 flowers/m^2, and mean of the quantity of annual production of carnation flowers in carnation plants which non-infested by any insects (control) were 75.5 flowers/m^2.

Whereas for Giza governorate means of the quantity of annual production of Carnation flowers in Carnation plants which infested by *H. cottei* were 54.5 flowers/m^2 whereas mean of the quantity of annual production of carnation flowers in carnation plants which infested by *B. tabaci* were 65.2 flowers/m^2, and mean of the quantity of annual production of carnation flowers in carnation plants which non-infested by any insects (control) were 82.4 flowers/m^2.

Lastly, for Alexandria governorate mean of the quantity of annual production of carnation flowers in carnation plants which infested by *H. cottei* were 49.5 flowers/m^2 whereas mean of the quantity of annual production of carnation flowers in carnation plants which infested by *B. tabaci* were 59.2 flowers/m^2, and mean of the quantity of annual production of carnation flowers in carnation plants which non-infested by any insects (control) were 78.8 flowers/m^2.

The static analysis shows highly significant differences between the quantity of annual production of carnation flowers which infested by *H. cottei* and *B. tabaci* compared to non-infested flowers (control) at both the three examined locations. Whereas F (0.05) value and LSD value for the three examined locations, Cairo, Giza and Alexandria governorates were (345.43, 1.032), (276.87, 1.053) and (264.21, 1.034) respectively.

Table 2: Effect of insect infestation by *H. cottei* and *B. tabaci* on the annual production of Carnation flowers after picking compared to control.

Location	Annual production of flowers/m^2			F(0.05)	LSD
	H. cottei	*B. tabaci*	Control		
Cairo	47.2 ^{c}	58.9 ^{b}	75.5^a	345.43	1.032
Giza	54.5 ^{c}	65.2 ^{b}	82.4^a	276.87	1.053
Alex	49.5 ^{c}	59.2 ^{b}	78.8^a	264.21	1.034

Means within columns bearing different subscripts are significantly different (P< 0.05)

Effect of Insect Infestation by *H. cottei* and *B. tabaci* on the Internal Components of Carnation Flowers:

1-Effect of Insect Infestation by *H. cottei* and *B. tabaci* on the Total Soluable Sugare:

Data tabulated in Table (3) show the total soluble sugar content in carnation flowers after infestation by *H. cottei* and *B. tabaci* compared to control. Whereas the total soluble sugar content at the carnation flowers which infested by *H. cottei* and *B. tabaci* compared to

control at the three examined locations were (25.75, 29.37, 35.25), (27.35, 32.63, 38.65), (26.65, 30.75, 36.25mg/g), respectively.

Statistical analysis in Table 3 shows highly significant differences between the total soluble sugar in carnation flowers which infested by *H. cottei* and *B. tabaci* compared to control at the three examined locations whereas F(0.05) value and L.S.D were (243.78, 1.045), (298.71, 1.067) and (367.93, 1.075), respectively.

Table 3: Determination of total soluble sugar (mg/g)

Location	Determination of total soluble sugar (mg/g)			F(0.05)	LSD
	H.cottei	*B. tabaci*	Control		
Cairo	25.75[a]	29.37[b]	35.25[a]	243.78	1.045
Giza	27.35[b]	32.63[a]	38.65[b]	298.71	1.067
Alexandria	26.65[c]	30.75[c]	36.25[c]	367.93	1.075

Means within columns bearing different subscripts are significantly different (P< 0.05

2-Effect of insect infestation by *H. cottei* and *B. tabaci* on the total protein:

Data tabulated in Table (4) shows the total soluble sugar content in carnation flowers after infestation by *H. cottei* and *B. tabaci* compared to control. Whereas the total soluble sugar content at the carnation flowers which infested by *H. cottei* and *B. tabaci* compared to control at the three examined locations were (22.35, 27.45, 31.65), (27.75, 31.68, 35.75), (24.45, 29.77, 33.25), respectively.

Statistical analysis in (Table 4) shows highly significant differences between the total soluble sugar in carnation flowers which infested by *H. cottei* and *B. tabaci* compared to control at the three examined locations whereas F(0.05) value and L.S.D were (345.97, 1.065), (361.75, 1.032) and (245.83, 1.092), respectively.

Table 4: Determination of total protein (mg/g)

Location	Determination of total protein (mg/g)			F(0.05)	LSD
	H.cottei	*B. tabaci*	Control		
Cairo	22.35[a]	27.45	31.65[a]	345.97	1.065
Giza	27.75[b]	31.68	35.75[b]	361.75	1.032
Alexandria	24.45[c]	29.77	33.25[c]	245.83	1.092

Means within columns bearing different subscripts are significantly different (P< 0.05

The obtained results are in agreement who those obtained by Galeotti *et al.* (2008) who studied the effect of *H. cottei* on the interior components of carnation flowers, he found that the total protein in the carnation petals reduced as to result to the infestation by *H. cottei.* Peng and Miles (2007) studied the changes in the internal components of Carnation flowers such as protein, sugar, and vitamins, which infested by two species of thrips, Carnation thrips (*H. cottei*) and *Franklinella tritici*. Becker and Apel (2016) reported that the decrease in total protein may be due to the decrease in carbohydrate content which acts as a carbon source in protein synthesis in carnation flowers due to the infestation by *T. urticae.* Atwal and Dhingra (2008) reported that the infestation by *H. cottei* was changed in the protein pattern in the carnation petals.

Also, the obtained results are in agreement with those obtained by

Nichols (2010) in France who studied the quantitative changes in soluble sugars (glucose, fructose, and sucrose) of carnation petals as a result of infestation by three species of thrips and estimated the damage. Decheva *et al.* (2001) in Bulgaria investigated the changes in the total sugar (glucose, fructose, and sucrose), starch, free amino acid and protein in buds of Carnation flowers, the level of 12 free amino acids identified decreased as a result of the infestation by two species of thrips.

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ARABIC SUMMARY

أثر إصابة نباتات القرنفل بحشرتى تربس القرنفل *Haplothrips cottei* والذبابة البيضاء *Bemisia tabaci* على كمية الإنتاج السنوى من الزهور تحت ظروف الصوب الزجاجية

أشرف صلاح إمام، مروة عبد المنعم محمد عبد الله ومحمد إسماعيل حسن
معهد بحوث وقاية النباتات - مركز البحوث الزراعية – الدقى – الجيزة – مصر

أجريت هذه الدراسة بغرض دراسة أثر إصابة نباتات القرنفل بحشرتى *Haplothrips cottei and Bemisia tabaci* على كمية الإنتاج السنوى من زهور القرنفل بعد القطف وذلك تحت ظروف الصوب الزجاجية.
أجريت هذه الدراسة فى ثلاثة مواقع مختلفة هى: الحديقة الدولية (محافظة القاهرة) وحديقة الأورمان (محافظة الجيزة) والحديقة الدولية (محافظة الإسكندرية) خلال عام ٢٠١٨, ٢٠١٩. وانقسمت هذه الدراسة إلى ثلاثة أجزاء:
الجزء الأول: دراسة التذبذبات العددية لكلا من حشرتى *H. cottei* and *B. tabaci* على نباتات القرنفل خلال موسم الدراسة.
الجزء الثانى: دراسة أثر الاصابة بكلتا الافتين *H. cottei* , *B. tabaci* على كمية الإنتاج السنوى من زهور القرنفل بعد القطف وذلك فى المواقع الثلاثة محل الدراسة.
الجزء الثالث: دراسة أثر الإصابة الحشرية بكلتا الحشرتين محل الدراسة على المكونات الداخلية لأزهار القرنفل مثل إجمالى السكريات وإجمالى البروتين.
وتوصلت النتائج إلى تزايد تأثير الإصابة بحشرة *H. cottei* على الإنتاج السنوى من زهور القرنفل أكثر من تأثير الإصابة بحشرة *B. tabaci* وذلك بالمقارنة بالإنتاج السنوى من الزهور فى نباتات القرنفل الخالية من الإصابة بكلتا الآفتين.
كما توصلت النتائج أيضا إلى تزايد تأثير الإصابة بحشرة *H. cottei* على المجموع الكلى للسكريات وكذلك البروتين الموجود فى أزهار القرنفل المصابة بدرجة أكبر من تأثير الإصابة بحشرة *B. tabaci* وذلك بالمقارنة بأزهار القرنفل الغير مصابة (الكنترول).