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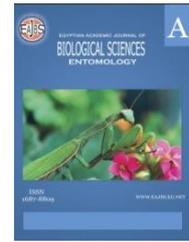
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Evaluation Efficiency of Sticky Traps on Attraction Greenhouse Whitefly, *Trialeurodes vaporariorum* (Westwood) infesting Carnation Flowers Under Glasshouse Conditions

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ABSTRACT

This study was carried out to evaluate efficiency sticky traps on attraction Greenhouse Whitefly, *Trialeurodes vaporariorum* (Westwood) (Homoptera: Aleyrodidae) infested Carnation flowers (*Dianthus caryophyllus* L.) under glasshouse conditions at two locations (governorates) El-Orman Garden (Giza governorate) and International Garden (Alexandria Governorate) during 2020 season. This study is divided into three parts, first part studied the evaluation efficiency color of the sticky trap on attraction *T. vaporariorum* through a comparison between five colors (yellow, blue, red, green and white). Results showed that the traps which have yellow color more efficiency than others which have (blue, red, green and white) color, respectively. The second experiment aimed to evaluate the efficiency height of the yellow sticky traps on attraction *T. vaporariorum* thorough comparison between four heights (2m, 1.5m, 1m and 0.5m) above the ground. Results showed that the trap which has 2m height above the ground more efficiency than others which have (1.5m, 1m and 0.5m) heights, respectively. The third experiment aimed to evaluate the efficiency orientation of the yellow sticky traps on attraction *T. vaporariorum* thorough comparison between four orientations (North, South, East and West). Results showed that had no clear effect of the trap orientation on attraction *T. vaporariorum* at both two locations.

INTRODUCTION

Carnation flowers (*Dianthus caryophyllus* L.) consider one of the most important cut flowers in Egypt and all over the world which cultivated in the open field and under glasshouse 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 its tolerant to the inferable weather factors, Ali *et al.* (2008)

Carnation plants infested with a large scale of insects belong to many orders and families such as Greenhouse Whitefly, *Trialeurodes vaporariorum* (Westwood) (Homoptera: Aleyrodidae) which consider one of the most important pests of Carnation flowers and many other flowers both in the open field and under glasshouse conditions, Loginova (1992) reported that the strong infestation by *T. vaporariorum* resulted in the

deformation of stems, leaves and flowers of Carnation plants. Gustavo *et al.* (2012) in Argentina reported that *T. vaporariorum* was a serious pest on Carnation flowers, and it feeds mainly on the young leaves and developing flower buds of Carnation flowers.

This study was carried out to evaluate efficiency sticky traps on attraction *T. vaporariorum* infested Carnation flowers *D. caryophyllus* under glasshouse conditions at two locations (governorates) El-Orman Garden (Giza governorate) and International Garden (Alexandria Governorate) during 2020 season.

MATERIALS AND METHODS

This study was carried out to evaluate efficiency sticky traps on attraction Greenhouse Whitefly, *Trialeurodes vaporariorum* (Westwood) (Homoptera: Aleyrodidae) infested Carnation flowers (*Dianthus caryophyllus* L.) under glasshouse conditions at two locations (governorates) El-Orman Garden (Giza governorate) and International Garden (Alexandria Governorate) during 2020 season. Carnation seedlings were cultivated in both two locations at the same time in a timely manner for the cultivation of Carnation plants in September month. In the two locations, each glasshouse is divided into three big parts to contain the three experiments.

Experimental Design:

The first experiment aimed to evaluate the efficiency color of the sticky traps on attraction *T. vaporariorum* through a comparison between five colors (yellow, blue, red, green and white). Glasshouses in both two locations were divided into equal five parts. Each part contains a different color of the sticky trap.

The second experiment aimed to evaluate the efficiency height of the yellow sticky trap on attraction *T. vaporariorum* thorough comparison between four heights (2m, 1.5m, 1m and 0.5m) above the ground. Glasshouses in both two locations are divided into equal four parts. Each part contains a different height of the yellow sticky traps.

The third experiment aimed to evaluate the efficiency orientation of the yellow sticky trap on attraction *T. vaporariorum* thorough comparison between four orientations (North, South, East and West). Glasshouses in both the two tested seasons are divided into equal four parts. Each part contains a different orientation of the yellow sticky traps.

Experiments were carried out at the same all the agricultural operations all over the two places. And checked up all the sticky traps in both two locations biweekly to calculate the mean numbers of *T. vaporariorum* and recorded the data biweekly.

Statistical Analysis:

The mean numbers of *T. vaporariorum* were analyzed statistically using a one-way analysis of variance. When ANOVA indicates that significant differences were found, ($P < 0.05$) means were separated by a Least Significant Differences Test (LSD), the simple correlation (r) and regression coefficient value (b) was adopted to clarifies the change in population due to change in each of the tested factors and the mean values compared with the Least Significant Differences (LSD) as well as, SAS program (SAS Institute 1988).

RESULTS AND DISCUSSION

This study was carried out to evaluate efficiency sticky traps on attraction Greenhouse Whitefly, *Trialeurodes vaporariorum* (Westwood) (Homoptera: Aleyrodidae) infested Carnation flowers (*Dianthus caryophyllus* L.) under glasshouse conditions at two locations (governorates), El-Orman Garden (Giza governorate) and International Garden (Alexandria Governorate) during 2020 season and this study was divided into three experiments:

First Experiment:

The first experiment aimed to evaluate the efficiency color of the sticky trap on attraction *T. vaporariorum* through a comparison between five colors (yellow, blue, red, green and white).

Data tabulated in Table (1) showed mean numbers and statically analysis of *T. vaporariorum* which caught by sticky traps which have different colors (yellow, blue, red, green and white) on Carnation plants at both of the two tested locations, El-Orman Garden (Giza governorate) and International Garden (Alexandria Governorate) during successive season 2020.

Table 1: Mean numbers of *T. vaporariorum* caught by sticky traps which have different colours on Carnation plants at both of the two tested locations during 2020 season.

Trap color	Mean numbers of <i>T. vaporariorum</i>	
	Cairo Governorate	Alexandria Governorate
Yellow	21 ^a	19 ^c
Blue	13 ^b	11 ^b
Red	10 ^c	8 ^a
Green	7 ^d	5 ^d
White	5 ^d	3 ^d
F _{0.05}	512.04	425.13
LSD	1.031	1.052

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

Results obtained showed that the traps which have yellow color more efficiency than others which have (blue, red, green and white), respectively. Whereas the mean numbers of *T. vaporariorum* which attracted to the different colors of the traps (yellow, red, blue, green and white) on Carnation plants at both of the two locations, Cairo Governorate and Giza Governorate were (21, 13, 10, 7 and 5), (19, 11, 8, 5 and 3) adults/trap, respectively

Statistical analyses showed that were highly significant differences between mean numbers of *T. vaporariorum* which attracted to the sticky traps which have different colors at both two locations. Whereas $F_{0.05}$ and LSD values at both of the two locations Cairo Governorate and Alexandria Governorate were (512.04, 1.031), (425.13, 1.052) respectively.

These results agree with those obtained by Suresh *et al.* (2013) who studied the attractive effects of different colors on Q-type *Bemisia tabaci* on Carnation flowers under greenhouse conditions, and they showed that *B. tabaci* was strongly attracted by yellow color traps compared with other colors (blue, orange) respectively. Shen and Ren (2003) in China reported that the best method to trap and control *B. tabaci* population in the Cucumber field was a yellow card. Soon *et al.* (2015) studied efficiency yellow and blue sticky traps on attractive western flower thrips and greenhouse whitefly and reported that the yellow sticky traps were more attractive to western flower thrips and greenhouse whitefly than blue sticky traps under greenhouses conditions. Wisler *et al.* (2008) found that the yellow traps had the best effect on alluring the insect in a period of 44 days, and the next was green color and red color, respectively.

Second Experiment:

The second experiment aimed to evaluate the efficiency height of the yellow sticky trap on attraction *T. vaporariorum* thorough a comparison between four heights (2m, 1.5m, 1m and 0.5m) above the ground.

Data tabulated in Table (2) showed mean numbers and statically analysis of *T. vaporariorum* which caught by yellow sticky traps which have different heights (2m, 1.5m, 1m and 0.5m) above the ground on Carnation plants at both of the two tested locations, El-Orman Garden (Giza governorate) and International Garden (Alexandria Governorate) during successive season 2020.

Table 2: Mean numbers of *T. vaporariorum* caught by yellow sticky traps which have different heights on Carnation plants at both of the two tested locations during 2020 season

Trap height	Mean numbers of <i>T. vaporariorum</i>	
	Cairo Governorate	Alexandria Governorate
2m	19 ^a	18 ^c
1.5m	12 ^b	10 ^b
1m	8 ^c	7 ^a
0.5m	5 ^d	4 ^d
F_{0.05}	431.52	523.18
LSD	1.021	1.052

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

Results obtained showed that the yellow traps which have a height of 2m above the ground more efficient than others which have a height of (1.5m, 1m and 0.5m), respectively. Whereas the mean numbers of *T. vaporariorum* which attracted to the different heights of the traps (2m, 1.5m, 1m and 0.5m) on Carnation plants at both of the two locations, Cairo Governorate and Giza Governorate were (19, 12, 8 and 5), (18, 10, 7 and 4) adults/trap, respectively

Statistical analyses showed that were highly significant differences between mean numbers of *T. vaporariorum* which attracted to the yellow sticky traps which have different heights at both of the two locations. Whereas $F_{0.05}$ and LSD values at both of the two locations were (431.52@ 1.021), (523.18 @ 1.052), respectively

These results were in agreement with those obtained by Shen and Ren (2003) in China who reported that the best method to trap *B. tabaci* adults using a yellow card in the squash field. And reported also that the best method was to hang the yellow card vertically between the rows of the squash plants, and the height of the yellow card is almost kept the same as the top of the squash plants. Maolin *et al.* (2008) reported that trap height showed significant influence on trap catches, which that trap height 1.5m above the ground more effective than which 0.5m above the ground, and reported also that the height of the trap was effective in controlling the adult population of *B. tabaci* on greenhouse Carnation. Ramon and Dolcet (2015) reported that the best height of yellow sticky cards was on top of the Carnation leaves about 10cm - 50cm higher than the top of the leaves and the best height of the yellow sticky cards were ranged from 1.5m – 2m above the ground. Also, Dan and Horowitz (2004) found that the efficiency of the yellow trap to catch whitefly was high whereas in the open air they flew >2m above the ground.

Third Experiment:

The third experiment aimed to evaluate the efficiency orientation of the yellows sticky traps on attraction *T. vaporariorum* through a comparison between four orientations (North, South, East and West).

Data tabulated in Table (3) showed mean numbers and statically analysis of *T. vaporariorum* which caught by yellow sticky traps which have different orientations (North, South, East and West) on Carnation plants at both of the two tested locations, El-

Orman Garden (Giza governorate) and International Garden (Alexandria Governorate) during successive season 2020.

Table 3: Mean numbers of *T. vaporariorum* caught by yellow sticky traps which have different orientations on Carnation plants at both of the two tested locations during 2020 season

Trap orientation	Mean numbers of <i>T. vaporariorum</i>	
	Cairo Governorate	Alexandria Governorate
North	20 ^a	18 ^c
South	18 ^b	17 ^b
East	19 ^c	19 ^a
West	17 ^d	16 ^d
F _{0.05}	612.023	525.13
LSD	1.033	1.051

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

Obtained results and statically analyses showed that were not clearly affect and significant differences between the mean numbers of *T. vaporariorum* which attracted to the yellow sticky traps which have different orientations in both the two tested locations.

These results were in agreement with those obtained by Maolin *et al.* (2008) who reported that the trap orientation had no effect on trap catches, but traps hanged vertically parallel to plant rows trapped slightly more efficiency to catch *B. tabaci* adults than those hanged horizontally, and those authors also studied the distribution and daily activities of *B. tabaci* adults in a greenhouse (East-West) oriented were investigated with yellow sticky traps, and they found that no significant differences between East and West orientation of the yellow sticky traps in the Cucumber greenhouse. Also, these results in agreement with those obtained by Xi *et al.* (2008) who studied the orientation of the yellow sticky traps on tomato plants in greenhouses, and reported that had no effect on the orientation of the traps (North, South, East and West) on attractive *B. tabaci* adults.

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ARABIC SUMMARY

تقييم فاعلية المصائد اللاصقة في جذب حشرة *Trialeurodes vaporariorum* (Westwood) التي تصيب أزهار القرنفل تحت ظروف الصوب الزجاجية

مرفت قاسم جبر الشربيني و يسرى إسماعيل عافيه

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقى - الجيزة - مصر

أجريت هذه التجارب بغرض تقييم فاعلية المصائد اللاصقة في جذب حشرة ذبابة القرنفل البيضاء *Trialeurodes vaporariorum* (Westwood) على نباتات القرنفل *Dianthus caryophyllus* L. تحت ظروف الصوب الزجاجية. كما أجريت هذه التجارب في موقعين (محافظتين) مختلفتين حديقة الأورمان (محافظة الجيزة) والحديقة الدولية (محافظة الإسكندرية) خلال عام 2020، حيث إنقسمت هذه الدراسة إلى ثلاثة تجارب: التجربة الأولى: أجريت هذه التجربة بغرض تقييم فاعلية لون المصائد اللاصقة في جذب حشرة ذبابة القرنفل البيضاء من خلال مقارنة خمسة ألوان مختلفة للمصائد اللاصقة وهي (الأصفر، الأزرق، الأحمر، الأخضر، الأبيض). وتوصلت النتائج إلى ارتفاع فاعلية المصائد اللاصقة ذات اللون الأصفر بالمقارنة بالمصائد ذات الألوان الأخرى (الأزرق، الأحمر، الأخضر ثم الأبيض) على الترتيب. كما أشار التحليل الإحصائي للنتائج إلى وجود فروق معنوية بين تعداد الحشرة موضع الدراسة التي تنجذب للمصائد اللاصقة ذات الألوان الخمسة المختلفة محل الدراسة. التجربة الثانية: أجريت هذه التجربة بغرض تقييم فاعلية ارتفاع المصائد الصفراء اللاصقة في جذب حشرة ذبابة القرنفل البيضاء من خلال مقارنة أربعة ارتفاعات مختلفة للمصائد الصفراء اللاصقة وهي (2م، 1.5م، 1م، 0.5م) عن سطح الأرض. وتوصلت النتائج إلى ارتفاع فاعلية المصائد الصفراء اللاصقة ذات الارتفاع 2م بالمقارنة بالمصائد ذات الارتفاعات الأخرى (1.5م، 1م، 0.5م) على الترتيب. كما أشار التحليل الإحصائي للنتائج إلى وجود فروق معنوية بين تعداد الحشرة موضع الدراسة التي تنجذب لكلا من المصائد الصفراء اللاصقة ذات الارتفاعات الأربعة المختلفة محل الدراسة. التجربة الثالثة: أجريت هذه التجربة بغرض تقييم فاعلية اتجاه المصائد الصفراء اللاصقة في جذب حشرة ذبابة القرنفل البيضاء من خلال مقارنة أربعة اتجاهات مختلفة للمصائد الصفراء اللاصقة وهي (الجنوب، الشرق، الغرب). وتوصلت النتائج إلى عدم وجود تأثير ملموس لإتجاه المصائد الصفراء اللاصقة على معدل أو فاعلية المصائد في جذب الحشرة موضع الدراسة. حيث كان معدل جذب المصائد الصفراء اللاصقة لذبابة القرنفل البيضاء متقاربا في الإتجاهات الأربعة وذلك في كلا من موقعي الدراسة. كما أشار التحليل الإحصائي للنتائج إلى عدم وجود فروق معنوية بين تعداد الحشرة موضع الدراسة التي تنجذب لكلا من المصائد الصفراء اللاصقة في كلا من الإتجاهات الأربعة المختلفة محل الدراسة.