EFFICACY OF DIFFERENT SAMPLING METHODS AND COLOUR'S TRAP FOR ESTIMATING THE POPULATION DENSITY OF *BEMISIA TABACI (*HOMOPTERA :ALEYRODIDAE) ON SQUASH PLANTS AT QALUBIYA GOVERNORATE

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Abstract

The population density and fluctuation of cotton whitefly, *Bemisia tabaci* (*Gennadius*) adult on squash plants (*Cucurbita pepo* L.) was studied during summer plantations of 2002 and 2003 using four sampling methods (Sticky coloured traps, coloured water pan traps, sweeping net and direct counting on plant leaves) at Qalubiya Governorate. The obtained results could be summarized as follows: the population of whitefly collected was the highest in number by the direct counts recording as total mean number of 732.7 and 2043.3 insects/5 leaves during the first and second season, respectively, followed the insects collected by sticky traps with 788.2&643.2 insect/4 traps and then by water pan trap methods with 322.4&228.6 insect/4 traps during the two seasons, respectively. On the other hand, the sweeping net was the lowest effective sampling method for estimating whitefly population in which the total collected insects were 84.00 and 60.00 insects/25 double strokes in average during the two tested seasons, respectively. In relation to the colour traps, the yellow colour plays an important role in trapping *B. tabaci* adults. The catches in the case of yellow traps were significantly higher than those recorded by using other colures, i.e., blue, green and red traps.

INTRODUCTION

Cucurbit vegetable plants e.g. squash plants are most popular vegetable crops used as food in Egypt. Recently, the cultivated area of this crop in Egypt has gradually increased in order to cover the rising demand for local consumption and export, these plants are usually infested with different insect pests such as whiteflies. Few investigations have been done to evaluate the population density, fluctuation and predicting of whiteflies using various methods and tools for insect sampling [El-Khidir (1965), El-Helaly *et al.,* (1981), Gerlind and Horowitz (1984), Abou-Ghadir and Al-Beshr (1992) and Salah El-Din (2004)]. So the need was necessary to evaluate efficiency of various sampling methods for estimating the population density and fluctuation of *Bemisia tabaci* on squash plants.

The aim of this work is to evaluate the efficiency of different sampling methods, trap colours and the effect of weather factors on population density obtained by these tested methods during plantation of summer seasons of 2002 and 2003 at Qalubiya Governorate.

MATERIALS AND METHODS

The present study was carried out at the experimental farm of Faculty of Agriculture, Benha University at Moshtohor, Qaluobia governorate on squash field during the summer plantation of the experimental years 2002 and 2003.

Four sampling methods have been experimented to compare their efficiency in trapping cotton whitefly, these methods included sticky coloured traps, water coloured pans, sweeping net finally direct counting on leaves.

The experimental area was 5 Kerates divided to 24 plots (36.50 sq. m/replicate) that for fixing one trap/plot (3 for each colour) including the sticky traps and the water ·pan traps. For sweeping net and direct counting techniques 3 kerats for each were divided to three plots as replicates.

EXPERIMENTAL DATES AND PORTIONS

Item	1st exp. Year 2002	2nd exp. Year 2003
Sowing	17-3	1-4
Complete germination	26-3	11-4
Fixing traps	5-4	11-4
First inspection	13-4	18-4
Last inspection	29-6	27-6
Number of inspections	12	11
Variety of squash	*Eskandrany*	*Eskandrany*

a) Sticky coloured traps

Four colures red (6400 Ang.), yellow (5770 Ang.), green (5461 Ang.) and blue (4358 Ang.) were evaluated. Board of traps 20X 15 cm^2 made of polyvinyl material covered with strongly diluted, sticky past base (poly isobutene), so the surface was tacky, but not thickly as recommended by Gerling and Horowitz (1984) the 4 coloured traps (3 replicates for every colour) were placed vertically on the top of wooden stalks 15 cm above the plants, fitted by wooden large clips in the center of each plot. Traps were collected weekly and examined in the laboratory by using pocket lens. Stereomicroscope was used for examining the collected insect specimens, which were counted and preserved for identification.

b) The coloured water pans

(The same four examined colours) are in vials each of them 30 cm diameter with wall highest 7 cm filled with about 500 cm^3 water was put at 15 cm above the plants on carton fixed on wood pars in the center of each plot, continuously examined every three days by taking water pan caught insects, then the insects removed,

recognized and recorded (total of two sequenced inspections to be weekly), each colour was represented by 3 traps (replicates).

c) Sweeping net technique

Sweeping net (30 cm diameter and 55 cm deep made from muslin cloth with wood hand 70 cm) was used to collect insects from squash fields. Weekly 25 double storks were taken as sample by walking diagonally in each plot (3 plots as replicates). The collected insects were emptied into a labeled paper bag after killing by Calcium Cyanide in tight jar and transferred into the laboratory to examine by stereoscope microscope. Number of individuals of each sp. per sample was sorted, identified, counted and recorded.

d) Direct counting technique

The adult insects were counted on 5 randomly leaves/plot early in the morning. Samples of 5 leaves of squash plants were picked up weekly at random from each experimental plot. Leaves kept in paper bags until they were examined in laboratory by using stereoscope microscope on both lower and upper surfaces of the leaves and immature individuals were counted and recorded then collected specimens were preserved for later identification.

2. Statistical analysis

The data as mean numbers of collected insects by different methods were subjected to statistical analysis of variance (F-test) (SAS, 1988). The differentiation between the mean numbers of whitefly insects were separated by the calculated L.S.D. value of analysis of variance test, the method of duncan

RESULTS AND DISCUSSION

I. Efficiency of various sampling methods for estimating the population density of *Bemisia tabaci* on squash plants during summer plantation 2002 and 2003 season in Qalubiya Governorate:

The population density and fluctuation of whitefly, *Bemisia tabaci* (Genn.) adults were counted on squash plants, Tables (1 & 2). Data in these Tables show the population fluctuation of whitefly on squash plants using the four sampling methods (direct counts, sticky coloured traps, water coloured pan and sweeping net).

Results of the first season (2002) presented in Table (1) showed that all sampling methods recorded caught numbers of whitefly in the first inspection on 13/4/2002 recorded 62.7 adults/4 sticky traps followed by the direct count method 43.2 adult/5 leaves, sweeping net 10 insects/25 double strokes and the lowest capture was obtained by the water trap method 4 insects/4 traps. Second inspection on April 20th by the four sampling methods showed an increasing of the counted insects except

in sweeping net method. The sticky trap method was the highest one by recording 324.2 individuals/4 traps.

Record of the following week on April 26th were 7, 212, 53.2 and 19.0 insects by using sweeping net, direct count, coloured water and sticky traps, respectively.

Increase numbers and decrease during the growing season until the end of June. The comparison between seasonal total and mean of the caught insects of population showed that the direct count method occupied the first category in catching whitefly individuals followed by sticky trap counts, water traps and net method recording 732.7, 643.2, 228.6 and 84.0 as total counts and 61.1, 53.6, 19.1 and 7.0 individuals as a seasonal mean, respectively. These results showed a significant differences between the direct counting method and the two last methods (water & net methods), between the sticky, water and the net traps, the significance difference varied (Table, 1) and L.S.D. value = 40.6 insects.

A simlar trend was found by the statistical analysis of the results of the second season Table (2). From that table it could be concluded that the total number of whitefly collected by direct counts was 2043.3 individuals/sample with a mean of 185.75 individuals followed by sticky trap 788.7 with a mean of 71.7 individuals/sample, followed by the water trap method (322.4 with a mean of 29.3 individuals/sample) and finally sweeping net 60.0 captured insects with a mean of 5.5 individuals/sample on squash plants during 2003 summer season. (where "F" value = 7.7*** and LSD value at 5% = 82.5 insects. The illustration in Figs (1) and (2) showing the efficiency of the different four sampling methods used for estimating the whitefly insects infesting squash plants during 2002 and 2003 summer plantations, represented by the relative percentages. These results were clarifying that the direct count method was the most efficient during the two tested seasons by recording 43.39% whitefly total population in the first tested season and 63.58% in the second season from the total of the counted insects by the four tested methods, followed by the sticky trap 38.09% in 2002 and 24.52% in 2003 season. The water trap ranked the third by capturing 13.54% in 2002 and 10.03% in the second season, while the sweeping net was the lowest in collecting the whitefly adults lasting to 4.97% in 2002 and 1.87% in 2003 season.

The reason for that was that the direct counted whitefly insects consists the mature (adult) + immature stages also, but stages also, but by the other three traps only adults counted (see Tables, 1&2). Therefore, to estimate the right population density to get the seasonal fluctuation of whiteflies insects, you have use the direct counting method.

Table 1. Mean number of the whitefly insects, *B. tabaci* estimated by four various sampling methods during 2002 summer plantation on Squash plants at Qalubiya Governorate.

Date	Direct counts per 5 plant leaves		Four sticky traps	Four water traps	Sweeping net (in 25 double strikes)	Total No. of insects per sample date	Average No. of insects
	Adults	Immatures	Adults	Adults	Adults	119.9	-..29.9
13/4	9.60	33.6	62.7	4	10	324.2	81.1
20/4	18.30	48.0	246.3	5.6	6	291.2	72.8
26/4	23.00	189.0	19.0	53.2	7	278.9	69.7
3/5	15.30	177.3	46.3	33	7	199.0	49.8
11/5	3.55	116.7	64.5	9.2	5	60.0	15.0
18/5	8.00	9.0	16.8	20.2	6	119.2	29.8
26/5	5.00	14.3	74.4	17.5	8	71.8	17.9
1/6	0.00	27.0	22.5	15.3	7	52.1	13.0
8/6	4.00	4.0	16.8	13.3	14	56.6	14.2
15/6	0.60	19.6	14.1	14.3	8	59.8	14.9
21/6	3.30	0.6	31.4	20.5	4	55.8	13.9
29/6	2.30	0.6	28.4	22.5	2		
Total	92.40	640.3					
Mean	7.70	53.35					
General Total	732.7		643.2	228.6	84	1688.50	422.00
General mean	61.05		53.6	19.05	7	140.71	35.17

Calculated F = 3.38*   LSD 5% = 40.64

Table 2. Mean number of the whitefly insects, *B. tabaci* estimated by four various sampling methods during 2003 summer plantation on Squash plants at Qalubiya Governorate.

Date	Direct counts per 5 plant leaves		Four sticky traps	Four water traps	Sweeping net (in 25 double strikes)	Total No. of insects per sample date	Average No. of insects
	Adults	Immatures	Adults	Adults	Adults		
18/4	20.3	24.0	169.8	0	6	220.1	55.0
24/4	123.0	380.0	139.0	49.6	4	695.6	173.9
1/5	65.0	282.3	63.3	57.9	7	475.5	118.9
8/5	56.0	410.6	98.1	92.5	1	658.2	164.6
16/5	24.3	68.0	84.4	46.9	10	233.6	58.4
23/5	28.6	154.0	80.7	34.8	7	305.1	76.3
30/5	37.6	209.4	70.4	15.8	6	339.2	84.8
6/6	6.3	108.0	41.1	15.9	7	178.3	44.6
13/6	10.3	23.3	6.2	6.5	3	49.3	12.3
20/6	1.6	8.7	35.2	0.9	5	51.4	12.6
27/6	0.0	2.0	0.0	1.6	4	7.6	1.9
Total	373.00	1670.30					
Mean	33.91	151.85					
General Total	2043.3		788.2	322.4	60	3213.90	803.30
General mean	185.75		71.65	29.31	5.45	292.17	73.03

Calculated F = 7.67***   LSD 5% =82.52

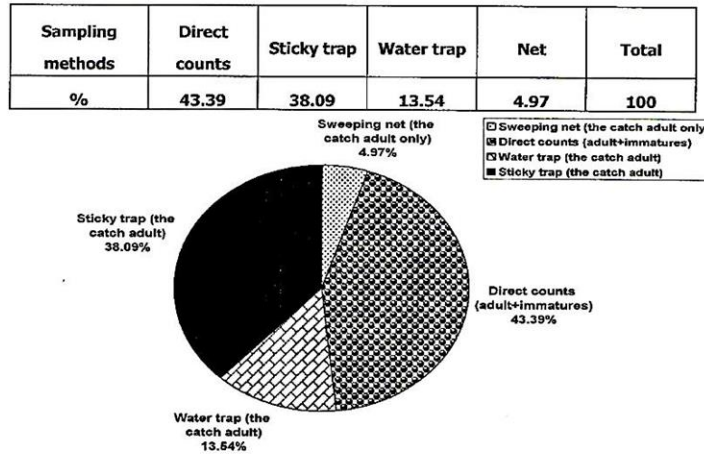| Sampling methods	Direct counts	Sticky trap	Water trap	Net	Total
%	43.39	38.09	13.54	4.97	100

Fig. 1.   Efficiency of various sampling methods for estimating the collected numbers of the whitefly *B. tabaci* insects represented by percentages during 2002 summer plantation on Squash plants at Qalyubia Governorate.

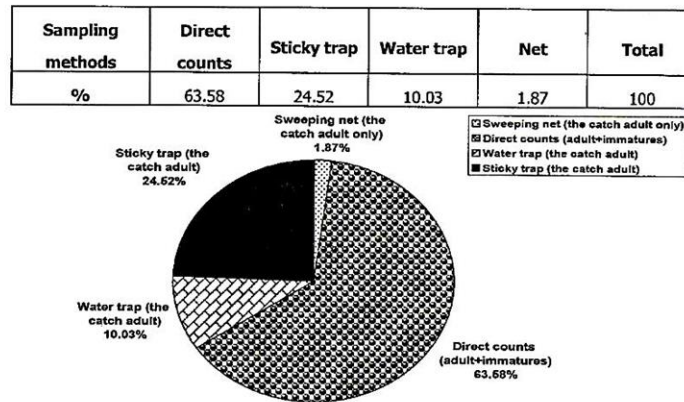| Sampling methods	Direct counts	Sticky trap	Water trap	Net	Total
%	63.58	24.52	10.03	1.87	100

Fig. 2.   Efficiency of various sampling methods for estimating the collected numbers of the whitefly *B. tabaci* insects represented by percentages during 2003 summer plantation on Squash plants at Qalubiya Governorate.

The previous results are in agreement with those obtained by Ibraheem (1993) in Egypt who found that the plant sampling method was the best technique for surveying pests infesting solanaceous plants compared with sweeping net, yellow pan water traps and sticky broad traps. Salah El Din (2004) found that direct count method was less than sticky trap count for *B. tabaci* on squash plants at Qalubiya Governorate.

2. Effect of trap coloures for attracting the whitefly, *B. tabaci* adults on squash plants:

The results illustrated in revealed (Tables 3&4) it is clear that the yellow colour was the most attractive for the adults of the whitefly for sticky or water coloured traps followed by the green, red and blue traps, these average were 401.14, 2.20, 4.53 and 3.73 adults / trap, respectively in the first season. The same trend was observed in the second tested year (2003). Statistical analysis of results proved highly significant difference between yellow colour and other colours, where the yellow colour represents the first group and other colours represent the second group. No significant differences were obtained among the other colours, Tables (3&4). Byrne *et al.* (1986) in USA reported that *B. tabaci* and *T. abulilonea* are attracted to yellow coloured surface area despite they are poor fliers. When flight is undirected and wind-dependent, these animals attach to traps that offer sticky surfaces most consistently. Also, Roa *et al.* (1991) in India evaluated different coloured traps for monitoring populations of the aleyrodid *Bemisia tabaci* on cotton. They observed that rectangular yellows sticky trap was the most effective. Traps placed either inside or around the field and facing the sky were attracted most aleyrodids.

Table 3. Mean number of whitefly adults collected by various water colour traps during the tested two seasons 2002/2003 at Qalubiya Governorate.

Colored Water traps									
Date	Whitefly / trap (2002)				Date	Whitefly / trap (2003)			
	yellow	Green	Blue	Red		yellow	Green	Blue	Red
13/4	1.00	3.00	0.0	0.0	18/4	0.00	0.00	0.00	0.00
20/4	2.00	2.60	1.30	0.0	24/4	41.00	4.00	2.60	2.00
26/4	16.30	16.30	10.60	10.00	01/5	39.60	5.00	8.00	5.30
03/5	11.60	10.60	5.00	5.60	08/5	48.30	22.30	11.30	10.60
11/5	4.00	1.60	1.30	2.30	16/5	20.30	16.60	1.00	9.00
18/5	9.30	3.30	4.00	0.60	23/5	19.30	7.60	8.60	6.30
26/5	6.30	5.60	1.30	4.30	30/5	6.30	1.60	3.60	4.30
01/6	9.00	2.00	3.00	1.30	60/6	5.30	4.00	1.30	5.30
08/6	9.60	2.30	1.00	1.00	13/6	3.00	1.30	0.60	1.60
15/6	10.30	3.00	1.00	0.0	20/6	0.00	0.60	0.30	0.00
21/6	14.60	2.30	1.60	2.00	27/6	1.30	0.60	0.00	0.00
29/6	13.60	4.30	1.30	3.60	Total	184.40	63.60	37.30	44.40
Total	107.60	56.90	31.40	30.70	Mean	16.76	5.78	3.39	4.04
Mean	8.97	4.74	2.62	2.56					
F	7.25***					4.13*			
LSD at 0.05	3.18					8.81			

Table 4. Mean number of whitefly adults collected by various sticky traps during the tested two seasons 2002/2003 at Qalubiya Governorate.

Colored sticky traps									
Date	Whitefly / trap (2002)				Date	Whitefly / trap (2003)			
	yellow	Green	Blue	Red		yellow	Green	Blue	Red
13/4	56.20	2.30	2.30	1.90	18/4	141.30	4.60	1.60	7.30
20/4	187.60	19.90	14.60	24.20	24/4	85.60	19.60	11.60	7.90
26/4	13.60	2.60	1.90	0.90	01/5	70.60	10.90	4.60	6.90
03/5	31.90	6.60	2.90	4.90	08/5	48.90	7.90	8.60	17.00
11/5	48.00	7.60	4.60	4.30	16/5	55.60	16.00	4.60	10.60
18/5	12.30	1.60	1.60	1.30	23/5	49.60	8.30	4.30	8.60
26/5	54.90	6.60	8.30	4.60	30/5	81.90	4.30	2.00	6.20
01/6	15.60	3.00	3.00	0.90	60/6	14.90	8.90	3.60	1.90
08/6	7.60	2.60	2.30	4.30	13/6	5.30	3.90	0.60	0.60
15/6	9.20	2.60	1.00	1.30	20/6	13.90	2.20	1.20	0.00
21/6	22.90	4.00	1.30	3.20	27/6	0.00	0.00	0.00	0.00
29/6	21.90	3.00	0.90	2.60	Total	567.60	86.60	42.70	67.00
Total	481.70	62.40	44.70	54.40	Mean	51.60	7.87	3.88	6.09
Mean	40.14	5.20	3.73	4.53					
F	6.01**					12.24***			
LSD at 0.05	20.75					18.69			

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كفاءة بعض طرق معاينة الكثافة العددية للذبابة البيضاء علي نباتات الكوسة
في محافظة القليوبية

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أجريت هذه الدراسة لتقييم كفاءة أربع طرق من طرق أخذ العينات لتقـدير الكثافـة العدديـة
والنشاط الموسمي لحشرة الذبابة البيضاء علي نباتات الكوسة خلال العروة الصيفية لموسمي ٢٠٠٢،
٢٠٠٣.

ويمكن تلخيص النتائج المتحصل عليها كالتالي:

وجد أن أعلي تعداد للذبابة البيضاء قد سجل بواسطة طريقة العد المباشر علي الأوراق النباتية
بمجموع كلي متوسطه ٧٣٢,٧، ٢٠٤٣,٣ حشرة لكل ٥ ورقات علي محصول الكوسة خلال العـروة
الصيفية لموسمي ٢٠٠٢، ٢٠٠٣ علي الترتيب.

وعلي الجانب الآخر وجد أن طريقة الجمع بالشبكة قد سجل أقل متوسط تعداد لحشرات الذبابة
البيضاء بمجموع كلي متوسطه ٦٠,٨٤ حشرة لكل ٢٥ ضربة مزدوجة، بينما المصيدة المائية كانـت
متوسطة الكثافات الحشرية الكلية هي ٢٢٨,٦، ٣٢٢,٤ لكل مصيدة وأخيرا المصائد اللاصقة أعطـت
متوسطات قدرها ٦٤٣,٢، ٧٨٨,٢ حشرة لكل ٤ مصايد خلال العروة الصـيفية لموسمي ٢٠٠٢،
٢٠٠٣ علي الترتيب.

كما وجد أن المصائد المائية واللاصقة الملونة باللون الأصفر تلعب دورا مهمـا فـي جـذب
(إصطياد) الذبابة البيضاء حيث ثبت أن اللون الأصفر أكثر الألوان المختبرة جذبا للحشـرات خـلال
موسمي الدراسة ٢٠٠٢-٢٠٠٣.