

## Control of the white fly as a vector of virus diseases to cantaloupe (*Cucumis melo*)

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### ABSTRACT

Comparative efficiency of certain agrochemicals and aluminum foil against whiteflies infesting cantaloupe plants (*Cucumis melo var cantalopensis*) (Family: Cucurbitaceae) was determined in field trials at the experimental farm, Faculty of Agriculture, Saba-Basha, Alexandria University during seasons of 2011-2012. The results of season 2011 indicated that thiamethoxam treatment showed superior activity against adult stage of the whitefly giving 79.2%, 61%, also was the most efficient against immature stage 68%, 75.5% followed by salicylic acid 72.5%, 58% aluminum foil 65.3%, 40.4% and azadirachtin 38%, 25.7% while abamectin gave the least whitefly control 36.6%, -16.7%. Azadirachtin gave 32%, 41.1% followed by aluminum foil 19%, 43.9%, salicylic acid 15%, 52.3% and abamectin -7.2%, 15.1% in the first and second application, respectively.

The data of the season of 2012 confirmed the findings of that season of 2011. Thiamethoxam proved to be the most potent insecticide against adult stage of whitefly 90.6%, 90% followed by salicylic acid 77.8%, 65%, Aluminum foil 66.4%, 49.6%, and azadirachtin 60.1%, 64.3% abamectin has no effect in reducing the number of adults giving -20.4%, -16%. Thiamethoxam showed superior activity against immature stage 80%, 73.8% followed by salicylic acid 47.1%, 53.1%, aluminum foil 45.8%, 61.4%, azadirachtin 43.9%, 28.2% and abamectin 35.8%, 7.9% in the first and second application, respectively.

The percent infection of zucchini yellow mosaic virus in the treatment of azadirachtin, salicylic acid and thiamethoxam kept constant estimated by 1%, 1%, 7% after 3 days post application, 1%, 3%, 7% after 10 days post application and 1%, 3%, 7% after 3 and 10 days post application in the first and second application. In case of abamectin and aluminum foil, the virus infection increased estimated by (9%, 11%), (13%, 13%) and (1%, 9%), (9%, 9%) after 3 and 10 days post application, in the first and second application. However there were no virus infection on 2012 season.

**Keywords:** abamectin, aluminum foil, azadirachtin, salicylic acid, thiamethoxam, *Bemisia tabaci*, ZYMV, cantaloupe

### INTRODUCTION

Cucurbitaceous crops form a diverse group consists of about 90 genera and 750 species, grown under many different conditions all around the world for use in many different purposes. The cultivated species are important crops in the tropics, subtropics and milder portion of the temperate zones.

The whitefly species complex has a worldwide distribution that recognized as an insect pest on over 500 plant species. This homopteran destructive insect transmits more than 100 viruses belonging to the genus Begomovirus (Family: Geminiviridae). Begomoviruses are transmitted in a persistent manner by the whitefly *B. tabaci* and can be acquired by immature or adult stages. These viruses are dangerous

pathogens and reduced yields significantly in a number of crops (Polston and Sherwood, 2003).

Virus diseases are important constraints on the production of cucurbit vegetables in the United States and worldwide. The potyviruses Watermelon mosaic virus (WMV), Papaya ringspot virus type-W (PRSV-W), Zucchini yellow mosaic virus (ZYMV); and the cucumovirus, *Cucumber mosaic virus* (CMV) are found at varying levels wherever these crops are grown. The viruses cause mosaic, mottling, enation, and puckering of foliage; mosaic and distortion of fruit; and plant stunting. Effects on yield can be severe, particularly where early infections severely stunt plants and where symptoms render unmarketable fruits. Transmission of virus can take place through plant sap by contact, mechanical transmission, insect vectors and in few cases also through seed. Sucking insects such as aphids, hoppers and whitefly dominate the insect vectors. The viruses are spread by aphids in a non-persistent (stylet-borne) manner, and many species are involved in virus spread. The control of such insect vectors might reduce virus diseases in plants.

The present study was directed to evaluate several control measures against whitefly in relation to their effect on transmitting virus diseases which play an essential role in destroying cantaloupe plants.

## MATERIALS AND METHODS

### Agrochemicals and treatments used in the study:

1-

Abamectin (Vertemec<sup>®</sup> 1.8% EC) [10E, 14E, 16E, 22Z] (1R, 4S, 5'S, 6S, 6'R, 8R, 12S, 13S, 20R, 21R, 24S)-6'-[(S)-sec-butyl]-21, 24-dihydroxy-5', 11, 13, 22-tetramethyl-2-oxo-3, 7, 19-trioxatetracyclo[15.6.1.1<sup>4,8</sup>.0<sup>20,24</sup>]pentacos-10, 14, 16, 22-tetraene-6-spiro-2'-(5', 6'-dihydro-2'H-pyran)-12-yl 2, 6-dideoxy-4-O-(2, 6-dideoxy-3-O-methyl- $\alpha$ -L-*arabino*-hexopyranosyl)-3-O-methyl- $\alpha$ -L-*arabino*-hexopyranoside (i) mixture with (10E, 14E, 16E, 22Z)-(1R, 4S, 5'S, 6S, 6'R, 8R, 12S, 13S, 20R, 21R, 24S)-21, 24-dihydroxy-6'-isopropyl-5', 11, 13, 22-tetramethyl-2-oxo-3, 7, 19-trioxatetracyclo[15.6.1.1<sup>4,8</sup>.0<sup>20,24</sup>]pentacos-10, 14, 16, 22-tetraene-6-spiro-2'-(5', 6'-dihydro-2'H-pyran)-12-yl 2, 6-dideoxy-4-O-(2, 6-dideoxy-3-O-methyl- $\alpha$ -L-*arabino*-hexopyranosyl)-3-O-methyl- $\alpha$ -L-*arabino*-hexopyranoside (ii) (4:1)

Recommended dose: 40 ml / 100 liters of water

2- Aluminium foil was placed on bare soil between the rows, seedlings were transplanted in holes made in the reflective surfaces.

3-

Azadirachtin (Nembicidine<sup>®</sup> 0.15% EC), dimethyl(3S, 3aR, 4S, 5S, 5aR, 5a<sup>1</sup>R, 7aS, 8R, 10S, 10aS)-8-acetoxy-3, 3a, 4, 5, 5a, 5a<sup>1</sup>, 7a, 8, 9, 10-decahydro-3, 5-dihydroxy-4-[(1S, 3S, 7S, 8R, 9S, 11R)-7-hydroxy-9-methyl-2, 4, 10-trioxatetracyclo[6.3.1.0<sup>3,7</sup>.0<sup>9,11</sup>]]dodec-5-en-11-yl]-4-methyl-10[(E)-2-

methylbut-2-enoyloxy]-1*H*,7*H*-naphtho[1,8*a*,8-*bc*:4,4*a-c'*]difuran-3,7*a*-dicarboxylate

Recommended dose: 1L /200 liters of water

4- Salicylic acid(from *Latinsalix*, *willow tree*, from the bark of which the substance used to be obtained) is a monohydroxybenzoic acid, a type of phenolic acid and a beta hydroxy acid. This colorless crystalline organic acid is widely used in organic synthesis and functions as a plant hormone. It is derived from the metabolism of salicin. In addition to being a compound that is chemically similar to but not identical to the active component of aspirin (*acetylsalicylic acid*), it is probably best known for its use in anti-acne treatments. The salts and esters of salicylic acid are known as salicylates).

Recommended dose: 5 mM/10liters of water

5- Thiamethoxam(Actara® 25 % WG)[3-(2-chloro-1,3-thiazol-5-ylmethyl)-5-methyl-1,3,5-oxadiazinan-4-ylidene(nitro)amine].

Recommended dose: 20g /100 liters of water

Treatments were evaluated against the whitefly .Two applications were used at ten days interval.

#### Field trials and sampling techniques:

Treatments were arranged in a complete randomized blocks design with three replicates for each. The experimental area (260 m<sup>2</sup>) was divided into plots, the area of each was 10.5m<sup>2</sup> (3x3.5 m). Buffer paths of one meter wide between plots were made. Plants were spaced at 20 cm. The normal agricultural practices were applied.

The inspection of samples of whitefly adult individuals were carried out before and after treatment at periods of zero, 1, 3, 5, 7 and 10 days post treatment (residual effect) to control the adult individuals in the field. The sampled leaves were picked randomly from each plot in the field. The samples were transferred to the laboratory to be inspected under binocular microscope to inspect and count the individuals of immature stages.

The percentages of infestation reduction were calculated in accordance with Henderson and Tilton's equation (Henderson and Tilton, 1955). Data were subjected to the analysis of variance test (ANOVA) (Steel and Torrie, 1981). The least significant difference (LSD) at the 5% level of probability was determined using a computer program Costat and Duncan's Multiple Range (Duncan, 1955) .

## RESULTS AND DISCUSSION

### a-Effect of the treatments on the whitefly (*Bemisia tabaci*) during theseason of 2011:

#### The adult stage:

Data in Table (1) illustrated the effect of the applied running treatments at two sequential applications on the inspected numbers of adult stage of whitefly (*Bemisia tabaci*) populations. It was revealed that each of salicylic acid and aluminum foil were the most initially effective in reducing the

adult stage of whitefly (*Bemisia tabaci*) populations giving 83.9% , 83.0%, respectively on cantaloupe plants followed by thiamethoxam (63.6%) and azadirachtin (58.7%). The least initially effective tested compound was abamectin inducing a reduction of 27%.

The residual effect of the evaluated treatments represented as reduction percentages throughout 4 consequent inspection periods (3, 5, 7 and 10 days post application) showed that thiamethoxam was the superior effective compound giving 90.4, 87.6, 90.0 and 48.9% reduction, followed by salicylic acid (79.4, 75.0, 64.6 and 71.0%) and aluminum foil (87.0, 52.4, 48.7 and 73.3%), consecutively. The calculated general means of the obtained reduction percentages confirmed that pattern, whereas, thiamethoxam recorded a general mean of reduction of 79.2% followed by salicylic acid (72.5%) and aluminum foil (65.3 %), respectively. While, azadirachtin and abamectin induced a weak effect showing only 38.02 and 36.6% general reduction.

Moreover, the obtained results post the 2<sup>nd</sup> application showed that both of tested salicylic acid and thiamethoxam were the significant superior treatments giving initial reductions amounted to 71.4% and 71.3%, followed by aluminum foil (58.8%), abamectin (39%) and azadirachtin (21%), successively.

The calculated values of general means of reductions showed significant differences between all the run treatments. Comparatively, Thiamethoxam was the most effective treatment throughout the following inspection periods in reducing the number of occurring whitefly adults giving a reduction of 61% followed by salicylic acid (58%), aluminum foil (40.4%) and azadirachtin (25.7%). Abamectin has no effect in reducing the number of adult of whitefly showing an increase of the number of whitefly adults reached -16.7% more untreated check.

**Table (1): Performance of certain agrochemicals and other agents against the adult stage of whitefly *Bemisia tabaci* (Genn.) on cantaloupe plants (season 2011).**

Treatments	No. of inspected <i>Bemisia tabaci</i> , adults											Average general reduction (%)
	Pre spray	Initial reduction (one day)		% reduction inspection intervals								
				3 days		5 days		7 days		10 days		
		A*	B* <sup>‡</sup>	A	B	A	B	A	B	A	B	
The 1 <sup>st</sup> application												
Abamectin	60	66	27.0 <sup>‡</sup>	49	35.0 <sup>e</sup>	10	65.5 <sup>c</sup>	18	50.0 <sup>c</sup>	66	-4.0 <sup>a</sup>	36.6 <sup>a</sup>
Aluminum foil	117	30	83.0 <sup>b</sup>	18	87.0 <sup>b</sup>	27	52.4 <sup>d</sup>	36	48.7 <sup>d</sup>	33	73.3 <sup>a</sup>	65.3 <sup>c</sup>
Azadirachtin	72	45	58.7 <sup>d</sup>	33	63.5 <sup>d</sup>	0	39.7 <sup>e</sup>	36	16.0 <sup>a</sup>	51	32.9 <sup>d</sup>	38.0 <sup>d</sup>
Salicylic acid	99	34	83.9 <sup>a</sup>	6	79.4 <sup>c</sup>	12	75.0 <sup>b</sup>	21	64.6 <sup>b</sup>	30	71.0 <sup>b</sup>	72.5 <sup>b</sup>
Thiamethoxam	100	55	63.6 <sup>c</sup>	12	90.4 <sup>a</sup>	6	87.6 <sup>a</sup>	6	90.0 <sup>a</sup>	54	48.9 <sup>c</sup>	79.2 <sup>a</sup>
Untreated check	105	159	-	132	-	51	-	63	-	111	-	-
The 2 <sup>nd</sup> application												
Abamectin	66	78	39.0 <sup>b</sup>	78	6.1 <sup>a</sup>	57	4.0 <sup>c</sup>	50	-40.0 <sup>a</sup>	44	-37.0 <sup>a</sup>	-16.7 <sup>a</sup>
Aluminum foil	60	48	58.8 <sup>b</sup>	33	53.7 <sup>c</sup>	18	66.7 <sup>b</sup>	27	16.7 <sup>d</sup>	22	24.6 <sup>c</sup>	40.4 <sup>c</sup>
Azadirachtin	51	78	21.0 <sup>d</sup>	40	34.0 <sup>d</sup>	39	15.0 <sup>f</sup>	18	34.7 <sup>c</sup>	20	19.3 <sup>d</sup>	25.7 <sup>d</sup>
Salicylic acid	81	45	71.4 <sup>a</sup>	30	68.8 <sup>b</sup>	24	67.0 <sup>b</sup>	21	52.0 <sup>a</sup>	22	44.0 <sup>b</sup>	58.0 <sup>b</sup>
Thiamethoxam	70	39	71.3 <sup>a</sup>	20	76.0 <sup>a</sup>	18	71.4 <sup>a</sup>	19	49.7 <sup>b</sup>	18	47.0 <sup>a</sup>	61.0 <sup>a</sup>
Untreated check	111	216	-	132	-	100	-	60	-	54	-	-

\*A: Mean number of insects

\* \*B: Reduction percentage (%)

‡Means followed with the same letter (s) are not significantly different.

### The immature stages:

Table (2) shows the initial effect of both the applied sprays of the tested treatments against the immatures of the whitefly after two days and their residual effect after 5, 7 and 10 days from application. There were significant differences between all adopted treatments at all intervals of made inspections.

Regarding the first spray, thiamethoxam treatments showed a superior initial effect giving 41% reduction followed by salicylic acid (27%), aluminum foil (25%) and azadirachtin (23%). Abamectin had no effect and gave a negative value of initial reduction comprised (-29%).

In respect to their estimated residual effect throughout three following periods (5, 7 and 10 days), thiamethoxam gave steady growing reduction values of inspection 48.0, 70.0 and 86%, respectively, with a general mean of 68%. The other treatments showed lower activities in reducing the immatures of the whitefly. Whereas, azadirachtin recorded only 31.0%, 29.0% and 36.0%, consequently, revealing 32% general mean of reduction. Aluminum foil and salicylic acid showed very weak effect giving 19%, 15% general mean of reduction, consecutively. Abamectin did not show any effect on the treated immatures of the whitefly (-7.2%).

After the 2<sup>nd</sup> application, the included results in Table (2) showed that thiamethoxam was the superior treatment against whitefly immatures followed by aluminum foil, salicylic acid, azadirachtin and the least, abamectin giving significant initial reduction values of 78.2%, 46.9%, 38.8%, 26% and 12%, respectively.

In this concept, the calculated percentages of the general mean of the residual reduction throughout the whole inspection periods (5, 7 and 10 days) proved and confirmed that thiamethoxam was the most effective tested compound giving a general mean of reduction of 75.5%.

A moderate level of residual reduction was achieved by salicylic acid giving reduction of 52.3% followed by aluminum foil 43.9%, azadirachtin 41.1% and the least abamectin 15.1%.

These results are in agreement with those of Liguori and Cestari (2003) they found that thiamethoxam in term, is a neonicotinoid insecticide that provides effective control against a wide variety of target

**Table (2): Performance of certain agrochemicals and other agents against the immature stages of the whitefly *Bemisia tabaci* (Genn.) on cantaloupe plants (season 2011)**

Treatments	No. of inspected <i>Bemisia tabaci</i> , immature									Average general reduction (%)
	Pre spray	% Initial reduction		% reduction inspection intervals						
				5 days		7 days		10 days		
		A*	B**	A	B	A	B	A	B	
1 <sup>st</sup> application										
Abamectin	369.0	576.0	-29.0 <sup>‡</sup>	387.3	-2.0 <sup>e</sup>	452.6	-2.8 <sup>e</sup>	436.3	-17.0 <sup>e</sup>	-7.2 <sup>e</sup>
Aluminum foil	287.3	257.3	25.0 <sup>c</sup>	222.3	22.0 <sup>c</sup>	267.0	22.0 <sup>c</sup>	250.6	13.0 <sup>d</sup>	19.0 <sup>c</sup>
Azadirachtin	290.6	270.6	23.0 <sup>d</sup>	198.0	31.0 <sup>b</sup>	245.6	29.0 <sup>b</sup>	185.0	36.0 <sup>b</sup>	32.0 <sup>b</sup>
Salicylic acid	279.0	248.3	27.0 <sup>b</sup>	228.3	17.6 <sup>d</sup>	297.3	10.6 <sup>d</sup>	233.3	16.8 <sup>c</sup>	15.0 <sup>d</sup>
Thiamethoxam	411.0	292.6	41.0 <sup>a</sup>	212.3	48.0 <sup>a</sup>	142.6	70.0 <sup>a</sup>	56.0	86.0 <sup>a</sup>	68.0 <sup>a</sup>
Untreated check	335.3	405.0	-	333.3	-	400.0	-	337.3	-	-
2 <sup>nd</sup> application										
Abamectin	436.3	505.0	12.0 <sup>a</sup>	376.6	25.5 <sup>d</sup>	412.3	-4.0 <sup>d</sup>	285.3	23.9 <sup>e</sup>	15.1 <sup>e</sup>
Aluminum foil	431.3	301.0	46.9 <sup>b</sup>	271.0	45.8 <sup>c</sup>	303.3	28.0 <sup>bc</sup>	155.3	58.0 <sup>c</sup>	43.9 <sup>c</sup>
Azadirachtin	185.0	180.0	26.0 <sup>d</sup>	182.0	15.0 <sup>e</sup>	134.0	26.7 <sup>c</sup>	68.3	57.0 <sup>c</sup>	41.1 <sup>d</sup>
Salicylic acid	344.3	277.3	38.8 <sup>c</sup>	177.3	55.0 <sup>b</sup>	235.6	30.0 <sup>b</sup>	81.0	72.0 <sup>b</sup>	52.3 <sup>b</sup>
Thiamethoxam	174.3	50.6	78.2 <sup>a</sup>	63.3	69.0 <sup>a</sup>	51.0	70.0 <sup>a</sup>	18.6	87.7 <sup>a</sup>	75.5 <sup>a</sup>
Untreated check	337.3	444.0	-	391.3	-	333.3	-	290.0	-	-

\*A: Mean number of insects

\*\*B: Reduction percentage (%)

‡Means followed with the same letter (s) are not significantly different.

insect pests including whiteflies even at low rates of application. It reduces adult emergence of *B. tabaci*. Imidacloprid and thiamethoxam are available in different formulations for their specific use as seed treatments and foliar sprays. The efficacy of these formulations differs among insect pests (Peterson , 2007).

**b-season of 2012:**

**The adult stage:**

Table (3) illustrates the initial effect (24 hrs after application) and the prolonged residual effects (after 3,5,7 and 10days)of both performed successive treatments applications against the adult stage of whitefly.

The results confirmly, indicated thatthiamethoxam was also the mostsignificant effective compound among the tested treatments , inducing initial reduction of 98.6% ,followed by salicylic acid (94.4%), azadirachtin(84%),abamectin(47.5%)and the less effective aluminium foil (40%).

The determined residual effect for each along the inspection intervals (3, 5, 7 and 10 days) revealed the ranking activity order in reducing the individuals of adult stage as follows:thiamethoxam (84.2, 93.4, 95.1 and 89.9 %) followed by salicylic acid (81.8, 78.4, 80.8 and 70.4%), aluminum foil (93.7, 69.7, 86.6 and 15.9%) and azadirachtin (55.5, 60.0, 69.3 and 55.8%), respectively. Moreover, calculating the general reduction percentage confirmed that thiamethoxam was very effective against the adult stageachieving 90.6% followed by salicylic acid 77.8%, aluminum foil 66.4 %, azadirachtin 60.1%. Abamectin has no effect in reducing the number of adults giving -20.4%.

Identical results were also attained after the 2<sup>nd</sup> application of tested materials, whereasthiamethoxamwas the superior treatment giving initial reduction of 86.7% followed by salicylic acid (69.1%), azadirachtin(66.9%), aluminum foil (42%) and abamectin(14.4%), respectively. The same higher ranking order was also repeated for the general reduction mean of residual activity ofthiamethoxam (90.0%) followed by salicylic acid (65.0%), azadirachtin(64.3%) and aluminum foil 49.6%.An obviousimpact was also recorded for thiamethoxam achieving 100.0% reduction after 7 and 10 days post treatment., versusabamectinwhich has no effect in reducing the number of whiteflies giving general mean-1.6%.



**Table (3): Performance of certain agrochemicals and other agents against the adult stage of the whitefly *Bemisia tabaci* (Genn.) on cantaloupe plants (season 2012)**

Treatments	No. of inspected <i>Bemisia tabaci</i> , adult											
	Pre spray	Initial reduction (one day)		% reduction inspection intervals								Average general reduction (%)
				3 days		5 days		7 days		10 days		
		A*	B**	A	B	A	B	A	B	A	B	
The 1 <sup>st</sup> application												
Abamectin	4	21	47.5 <sup>d‡</sup>	34	-64.5 <sup>e</sup>	26	-8.0 <sup>e</sup>	32	-6.6 <sup>e</sup>	26	-2.6 <sup>e</sup>	-20.4 <sup>e</sup>
Aluminum foil	3	12	40.0 <sup>e</sup>	1	93.7 <sup>a</sup>	5	69.7 <sup>c</sup>	3	86.6 <sup>b</sup>	16	15.9 <sup>d</sup>	66.4 <sup>c</sup>
Azadirachtin	10	16	84.0 <sup>c</sup>	23	55.5 <sup>d</sup>	22	60.0 <sup>d</sup>	23	69.3 <sup>d</sup>	28	55.8 <sup>c</sup>	60.1 <sup>d</sup>
Salicylic acid	16	9	94.4 <sup>b</sup>	15	81.8 <sup>c</sup>	19	78.4 <sup>b</sup>	23	80.8 <sup>c</sup>	30	70.4 <sup>b</sup>	77.8 <sup>b</sup>
Thiamethoxam	11	14	98.6 <sup>a</sup>	9	84.2 <sup>b</sup>	7	93.4 <sup>a</sup>	4	95.1 <sup>a</sup>	7	89.9 <sup>a</sup>	90.6 <sup>a</sup>
Untreated check	6	60	-	31	-	33	-	45	-	38	-	-
The 2 <sup>nd</sup> application												
Abamectin	26	24	14.4 <sup>e</sup>	12	41.5 <sup>e</sup>	18	-5.2 <sup>e</sup>	18	-19.6 <sup>e</sup>	16	-23.0 <sup>e</sup>	-1.6 <sup>e</sup>
Aluminum foil	16	10	42.0 <sup>d</sup>	5	66.8 <sup>d</sup>	4	62.0 <sup>d</sup>	4	32.0 <sup>d</sup>	5	37.5 <sup>d</sup>	49.6 <sup>d</sup>
Azadirachtin	28	10	66.9 <sup>c</sup>	6	72.0 <sup>c</sup>	6	67.4 <sup>c</sup>	4	61.0 <sup>b</sup>	6	57.0 <sup>b</sup>	64.3 <sup>c</sup>
Salicylic acid	30	10	69.1 <sup>b</sup>	6	74.6 <sup>b</sup>	3	84.8 <sup>a</sup>	5	54.7 <sup>c</sup>	8	46.0 <sup>c</sup>	65.0 <sup>b</sup>
Thiamethoxam	7	1	86.7 <sup>a</sup>	2	81.9 <sup>a</sup>	1	78.2 <sup>b</sup>	0	100.0 <sup>a</sup>	0	100.0 <sup>a</sup>	90.0 <sup>a</sup>
Untreated check	38	41	-	30	-	25	-	22	-	-	-	-

\*A: Mean number of insects

\*\*B: Reduction percentage (%)

‡Means followed with the same letter (s) are not significantly different.

### The immature stage:

The data presented in Table (4) show that the used treatment induced significant different initial reduction percentages after 2 days post treatment. In the 1<sup>st</sup> application, the superior treatment was salicylic acid giving 69% initial effect followed by thiamethoxam, abamectin, aluminum foil and azadirachtin giving 50.0%, 48%, 47.4% and 47.4%, respectively. Thiamethoxam also gave the highest significant general mean of reduction percentage (80%) followed by salicylic acid (47.1%), aluminum foil (45.8%), azadirachtin (43.9%) and abamectin (35.8)%.

After the 2<sup>nd</sup> application, aluminum foil recorded the highest initial moderate effect (57.5%) followed by salicylic acid (46.9%), thiamethoxam (46.7%), azadirachtin (27.3%). However, abamectin was also inefficient in reducing the number of whitefly immatures (-0.4%). The general mean of reduction percentage values also showed the significant differences between the superior effective thiamethoxam treatment (73.8%), followed by aluminum foil (61.4%), salicylic acid (53.1%), azadirachtin (28.2%) and the least efficient, abamectin (7.9%).

Our above cited results are agreed with the previous findings of many investigators who evaluated the efficiency of both imidacloprid and thiamethoxam on early cotton sucking pests (Eissa, 1991; Attique and Ghaffar, 1996; Emara, 1996; Zang *et al.*, 1998; Abdel-Meguid *et al.*, 1999; Lentz *et al.*, 2000; Mathirajan and Regupathy, 2001a&b) and showed that thiamethoxam and imidacloprid were equally effective in reducing pest populations of aphids, jassids and whiteflies.

Moreover, chemical control is still an important component of integrated pest management systems. Imidacloprid (as a neocotinoid), pyriproxyfen, buprofezin and pyridaben can be powerful tools for managing the greenhouse whitefly on strawberries, especially considering that greenhouse whiteflies have already developed resistance to some conventional insecticides such as acephate and dicrotophos in California (Omer *et al.*, 1992). These insecticides are selective to targeted insect pests including the greenhouse whitefly and relatively safe to beneficial insects and other organisms (Darvas and Polgar, 1998; Ishaaya and Horowitz, 1998). Introducing and alternating these chemicals on strawberries in a

**Table (4): Performance of certain agrochemicals and other agents against immature stage of whitefly *Bemisia tabaci* (Genn.) on cantaloupe plants (season 2012)**

Treatments	No. of inspected <i>Bemisia tabaci</i> , immature									Average general reduction (%)
	Pre spray	% Initial reduction		% reduction inspection intervals						
				5 days		7 days		10 days		
		A*	B**	A	B	A	B	A	B	
1 <sup>st</sup> application										
Abamectin	126.3	110.0	48.0 <sup>cf</sup>	151.0	29.0 <sup>e</sup>	79.0	36.2 <sup>e</sup>	52.3	42.4 <sup>b</sup>	35.8 <sup>e</sup>
Aluminum foil	93.6	85.3	47.4 <sup>c</sup>	44.3	65.6 <sup>b</sup>	42.3	44.0 <sup>d</sup>	40.0	27.9 <sup>a</sup>	45.8 <sup>c</sup>
Azadirachtin	107.3	78.3	47.4 <sup>c</sup>	96.0	35.6 <sup>d</sup>	37.0	57.0 <sup>b</sup>	38.6	39.2 <sup>c</sup>	43.9 <sup>d</sup>
Salicylic acid	162.6	69.3	69.0 <sup>a</sup>	108.0	52.2 <sup>c</sup>	60.0	54.3 <sup>c</sup>	62.6	35.0 <sup>d</sup>	47.1 <sup>b</sup>
Thiamethoxam	153.3	87.6	50.0 <sup>b</sup>	40.0	77.2 <sup>a</sup>	27.0	73.5 <sup>a</sup>	52.3	89.3 <sup>a</sup>	80.0 <sup>a</sup>
Untreated check	88.3	122.6	-	122.6	-	71.3	-	52.3	-	-
2 <sup>nd</sup> application										
Abamectin	10.0	84.6	-0.4 <sup>d</sup>	83.0	2.6 <sup>a</sup>	83.0	8.2 <sup>a</sup>	65.0	13.0 <sup>a</sup>	7.9 <sup>b</sup>
Aluminum foil	89.6	52.3	57.5 <sup>a</sup>	56.3	54.9 <sup>b</sup>	61.6	53.0 <sup>b</sup>	25.6	76.5 <sup>a</sup>	61.4 <sup>b</sup>
Azadirachtin	41.3	41.3	27.3 <sup>c</sup>	46.6	18.8 <sup>d</sup>	47.0	22.8 <sup>d</sup>	28.6	43.0 <sup>d</sup>	28.2 <sup>d</sup>
Salicylic acid	94.0	68.6	46.9 <sup>b</sup>	60.0	54.1 <sup>c</sup>	78.0	43.7 <sup>c</sup>	44.0	61.6 <sup>c</sup>	53.1 <sup>c</sup>
Thiamethoxam	61.3	7.3	46.7 <sup>b</sup>	4.6	66.5 <sup>a</sup>	3.0	79.6 <sup>a</sup>	3.0	75.3 <sup>b</sup>	73.8 <sup>a</sup>
Untreated check	64.0	88.0	-	89.0	-	94.3	-	78.0	-	-

\*A: Mean number of insects

\*\*B: Reduction percentage (%)

#Means followed with the same letter (s) are not significantly different.

defined way will be strategic to combat the potential risk of greenhouse whitefly resistance to these insecticides.

**Effect of the adopted treatments on the incidence of virus diseases in cantaloupe plants**

In Table (5) ,it was noticedthat the percent infection of zucchini yellow mosaic virus in the treatment of azadirachtin, salicylic acid and thiamethoxam kept constant estimated by 1%,1%,7% after 3 days post application, 1%,3%,7% after 10 days post application and 1%,3%,7% after 3 and 10 days post application in the first application in comparison by check untreated.

In the second application , the same trend was obtained in the case of azadirachtin , salicylic acid and thiamethoxamestimated by 1%, 3% ,7% after 3 and 10 days post application . While the findings was different in the case of abamectinand aluminium foil, the virusinfection increased estimated by (9%,11%),(13%,13%) and (1%,9%) , ( 9%,9%) after 3 and 10 days post application , in the first and second application.

Beek and de Groot (1986) listed 14 characteristics of an ideal anti-feedant and while most of these are met by azadirachtin,its inability to prevent inoculationof treated plants with PLRV and its phytotoxicityeffects at high concentrations may preclude its use as a means of preventing the introduction..of this virus to crops. Many authors (Schmutterer, 1988 and 1990;Jermy,1991) consider the effects of azadirachtinon fecundity,development and growth to be more important for the practical control of insects than the anti-feeding effects.

**Table (5): Effect of different treatments on the incidence of virus disease of cantaloupe plants in the growing season 2011**

Treatments	Infection percentage (%)*					
	1 <sup>st</sup> application			2 <sup>nd</sup> application		
	Pre spray	3day	10day	Pre spray	3day	10day
Abamectin	9	9	11	11	13	13
Aluminum foil	1	1	9	9	9	9
Azadirachtin	1	1	1	1	1	1
Salicylic acid	1	1	3	3	3	3
Thiamethoxam	7	7	7	7	7	7
Untreated check	1	1	11	11	11	11

\*Infection percentage = (No. of infected plants / No. of total plants) × 100

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## الملخص العربي

## مكافحة الذبابة البيضاء كناقل للأمراض الفيروسية في محصول الكنتالوب

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أجريت هذه الدراسة بمزرعة كلية زراعة- سلبا باشا ،جامعة الإسكندرية خلال موسمي ٢٠١١، ٢٠١٢، وذلك لمقارنة تأثير بعض المواد الكيماوية ورقائق الألومنيوم في مكافحة الذبابة البيضاء التي تصيب نباتات الكنتالوب تحت ظروف الحقل. بينت النتائج خلال موسم ٢٠١١ أن مبيد الثياميثوكسام كان أكثر كفاءة في خفض تعداد الأطوار الكاملة حيث وصلت نسبة الخفض ٧٩.٢%، ٦١% وكذلك كان الأكثر كفاءة في خفض الحوريات وأعطى ٦٨%، ٧٥.٥% بعد الرشة الأولى والثانية على التوالي يليه حمض السلسليك ٧٢.٥% ، ٥٨% ، رقائق الألومنيوم ٦٥.٣%، ٤٠.٠%، الأزديراختين ٣٨%، ٢٥.٧%. بينما الأبيامكتين كان أقل المعاملات كفاءة في مكافحة الذبابة البيضاء معطياً ٣٦.٦%، - ١٧.٦% . وقد أعطى الأزديراختين ٣٢%، ٤١% يليه رقائق الألومنيوم ١٩% ، ٤٣.٩% ، حمض السلسليك ١٥% ، ٥٢.٣% ، الأبيامكتين - ٧.٢%، ١٥.١% في التأثير على الحوريات بعد الرشة الأولى والثانية على التوالي. وقد حصلنا على نفس النتائج خلال موسم ٢٠١٢ حيث أثبت مبيد الثياميثوكسام أنه الأكثر كفاءة في مكافحة الأطوار الكاملة معطياً ٩٠.٦% ، ٩٠% يليه حمض السلسليك ٧٧.٨%، ٦٥%، رقائق الألومنيوم ٦٦.٤%، ٤٩.٦% ، والأزديراختين ٦٠.١% ، ٢٤.٣% ، أما الأبيامكتين لم يكن له تأثير على الأطوار الكاملة معطياً - ٢٠.٤%، ١٦% . وقد كان الثياميثوكسام الأكثر كفاءة في التأثير على الحوريات وأعطى ٨٠.٠% ، ٧٣.٨% يليه حمض السلسليك ٤٧.١% ، ٥٣.١% ، رقائق الألومنيوم ٤٥.٨% ، ٦١.٤% ، الأزديراختين ٤٣.٩% ، ٢٨.٢% ، الأبيامكتين ٣٥.٨%، ٢٩.٠% بعد الرشة الأولى والثانية. وقد كانت نسبة الإصابة بفيروس موزايك الكوسة الأصفر ثابتة عند المعاملة بالأزديراختين وحمض السلسليك ، الثياميثوكسام قدرت ب ١% ، ٧% بعد ٣ أيام و ١% ، ٧% بعد ١٠ أيام من التطبيق في الرشة الأولى ، سجلت ١% ، ٣% ، ٧% بعد ٣ ، ١٠ أيام من التطبيق في الرشة الثانية. أدت المعاملة بالأبيامكتين ، رقائق الألومنيوم إلى زيادة نسبة الإصابة الفيروسية والتي سجلت ( ٩% ، ١١% ) ، ( ١٣% ، ١٣% ) و ( ٩% ، ٩% ) ، ( ٩% ) بعد ٣ ، ١٠ أيام من التطبيق في الرشة الأولى والثانية وذلك خلال موسم ٢٠١١ . كما لم تظهر الإصابة بالفيروس خلال موسم ٢٠١٢ .