Evaluation of Chemical Control in A Rotational Program Against Whitefly on Tomato Crop

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ABSTRACT

A chemical control program against *Bemisia Tabaci* was applied after treatment of tomato seedlings variety Rover F1 hybrid in the nursery using thiamethoxam and imidacloprid. In addition, six treatments with different rational and conventional insecticides in a rotational program have been applied at Syngenta Kaha Station, Kalubia Governorate, Egypt. Two treatments were sprayed according to the proposed economic threshold (less than one adult per compound leaf) rotationally. Another two treatments were sprayed periodically every 6 days without taking into consideration the degree of infestation. The last two treatments were used as block application and sprayed every 6 days twice using the same chemical.The results showed that the best treatment was the block application, in the sequence of thiamethoxam, lambda-cyhalothrin, pymetrozine, pyriproxyfen and imidacloprid, fenpropathrin, pyriproxyfen, pymetrozine. They gave the highest efficacy on the adults of whitefly and obtained high yield of tomato crop. Regarding the virus infestation, both treatments showed the least number of infested plants with minimal surfaces of viral symptoms. The present study suggests that block application was a good rotational program in reducing the number of chemicals and reducing the hazard of pesticides to the environment.

INTRODUCTION

In recent years, the whitefly, *Bemisia tabaci* (Genn.) has become serious pest of cotton, other field crops, vegetables, ornamentals and medical plants in Egypt. The high infestation results in significant reductions in total yield and quality. Furthermore, the adult stage acts as a vector of virus diseases for various hosts, and reductions in virus spread are usually achieved by vector control using insecticides (Cohen & Nitzani 1966; Gameel 1974; Shaheen, 1977 and Mazyad *et al.*, 1979&1986; Youssef *et al.*,1979; El Nawawy *et al*., 1979 and El Dakroury *et al.*, 1983).

In most instances, however, the levels of vector control which are attainable with conventional insecticides are not sufficient to reduce virus spread to acceptable levels in either tomato nurseries where infestation first occurs, or in open production fields (Sharaf and Allawi, 1981). At high summer temperature a generation of whiteflies can develops in only 2 to 3 weeks (Butler *et al.*, 1983). Also development of resistance to insecticides in whiteflies (Dittrich & Ernst 1983, Rowland *et al.*, 1991, Cahill *et al.*, 1995, Prabhaker *et al.*, 1998) has highlighted the need for an effective resistance management strategy (Prabhaker *et al.*, 1992). Integrated pest management (IPM) is the strongest enemy for resistance. Recently there is a great need for the wide use of IPM technique in pest control. This approach combines all the various tools and methods to manage pests at acceptable level. One of this tool is the development of a suitable insecticide rotation. First of all the spray program must begin when number of adults reached the economic thresholds (less than one / compound leaf). Therefore, the objective of this work is to compare the spray programs, according to the proposed economic threshold or every 6 days, with different classes of insecticides or as block application every 6 days twice using the same insecticide for whitefly control, virus reduction and on the yield of harvested tomatoes.

MATERIAL AND METHODS

An experiment was conducted on tomato variety Rover (E-446) F1 hybrid which can tolerate viral infestation. Seedlings were obtained from plastic houses at Fayoum Agricultural Research Center. Six treatments with different conventional insecticides in a rotational program were applied for the control of whitefly *Bemisia tabaci*. The field trial was conducted at Syngenta Kaha Station, Kalubia Governorate, Egypt.

Tomato seedlings were transplanted on open field plots on 23 rd August. The experimental design was strips of six treatments and two untreated check. Plot size was 375 m^2, four replicates were used and normal agricultural practices were followed. The rotational and conventional insecticides (Table 1) were applied in the season in a rotational program of eight treatments.

Treatments (A&B) were sprayed according to the proposed economic threshold (less than one adult / compound leaf)

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Table 1. Trade name, common name, formulation, chemical name and recommended rate of compounds used against *Bemisia tabaci* on tomato plantation

Trade name	Common name	Formulation	Chemical name	Recommended rate
Actellic	Pirimiphos-methyl	EC 50%	O-(2-(diethylamino)-6-methyl-4- pyrimidinyl) O,O-dimethyl phosphorothioate	375 ml / 100L water
Sumithion	Fenitrothion	EC 50%	O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate	1.5 L / feddan
Dathrin	Fenpropathrin	EC 20%		750 ml / feddan
Karate	Lambdacyhalothrin	EC 5%	cyano(3-phenoxyphenyl)methyl 3-(2- chloro-3,3,3-trifluoro-1 propenyl)- 2,2 dimethylcyclopropane= carboxylate, (1A(S*),3A(Z))- (±)-	94 ml / 100 L water
Actara	Thiamethoxam	WG 25%	3-((2-chloro-5-thiazolyl)methyl)tetrahydro- 5-methyl-N-nitro-4H-1,3,5- oxadiazin-4-imine	40 gm / 100 l
Confidor	Imidacloprid	SC 35%	1-(6-chloro-3-pyridinyl) methyl)-N-nitro-2- imidazolidinimine	350 ml / fedan
Marshal	Carbosulfan	WP 50%	2,3-dihydro-2,2-dimethyl-7-benzofuranyl ((dib tylamino)thio)methylcarbamate	150 gm/ 100 l
Admiral	Pyriproxyfen	EC 10%	2-(1-methyl-2-(4-phenoxyphenoxy)= ethoxy)pyridine	75 ml / 100 l water
Chess	Pymetrozine	WP 25%	4,5-dihydro-6-methyl-4-((3-pyridinyl= methylene)amino)-1,2,4-triazin- 3(2H)-one, (E)-	480 gm / feddan
Polo	Diafenothuron	SC 50%	N-(2,6-bis(1-methylethyl)-4-phenoxy= phenyl)-N'-(1,1-dimethylethyl)= thiourea	300 ml / 100 l
Bemistop	Etofenprox		1-((2-(4-ethoxyphenyl)-2-methylpropoxy)= methyl)-3-phenoxybenzene	1 L / feddan
Evisect	Thiocyclam	SP50%	N,N-dimethyl-1,2,3-trithian-5-amine ethanedioate (1:1)	250 gm/100 L water
Lannate	Methomyl	WP 90%	methyl N-((methylamino)carbonyl)oxy)= ethanimidothioate	150 gm / 100 l water
Challenger	Chlorfenapyr	SC 36%	4-bromo-2-(4-chlorophenyl)-1- (ethoxymethyl)-5-(trifluoromethyl)- 1H-pyrrole-3-carbonitrile	
Match	Lufenuron	EC 5%	N-(((2,5-dichloro-4-(1,1,2,3,3,3- hexafluoropropoxy)phenyl)amino)= carbonyl)-(2,6-difluorobenzamide	200 ml / feddan

(C&D) were sprayed every 6 days .

(E&F) were sprayed as block application every 6 days using the same insecticide twice (during the generation of whitefly).

(G&H) were untreated [check], as illustrated in (Table 2).

Applications were done using a single nozzle knapsack sprayer with a spray volume of 200l / feddan.

The efficacy of the products used against the adult stage of whitefly was determined by counting insects on the lower surface of 20 compound leaves at the center of each replicate (80/treatment). Counts were made in the early morning when light activity is minimal according to Butler et al., (1988). Pre-treatment counts were made in the early morning just before application, and post treatment counts were made at three days intervals.

Percent reduction of adult stages of *Bemisia tabaci* was calculated for all treatment using the equation of Henderson & Tilton (1955). The virus symptoms were evaluated on 20 randomized plants in each replicate, at different time intervals 27,34,41,48,54, 63and 71 days after transplanting. Symptoms were evaluated morphologically. The number of plants exhibiting virus symptoms was recorded and percent plants showing virus symptoms estimates visually. The yield of the harvested tomatoes in each treatment was also recorded. The data of tomato yield were statistically analyzed according to Snedecore & Cochran (1980).

RESULTS AND DISCUSSION

Data in Table 3 showed the number of whitefly adults per 100 leaves and percent reduction of infestation at different time intervals. The best results were given by treatments E,F,D,B,C and A in descending order which mean that in the field the best treatment was the one of block application with 6 days intervals.

Treatment E was sprayed in the nursery with thiamethoxam (Actara) then sprayed in the field with twice applications of Actara, twice applications of Karate (lambda-cyhalothrin) twice applications of Chess (pymetrozine) and twice applications of Admiral (pyriproxyfen).the number of field applications was 8 during the season.

Treatment F was sprayed in the nursery with imidacloprid (Confidor). Then sprayed in the field twice applications of Confidor, with twice applications of Dathrin (fenpropathrin), twice applications of Admiral (pyriproxyfen) and twice applications of Chess (pymetrozine). Also, they number of field applications in this case was 8 during the season.

Treatment D was better than treatment B. Both treatments were treated with Confidor in the nursery and in the field. Treatment D had only eight sprays while B had ten sprays (economic threshold). The last treatment C followed by A both were treated in the nursery with Actara and in the field treatment C had only eight sprays and treatment A had twelve sprays (economic threshold).

Regarding the rate of virus infection, in general these rates varied according to three factors: days after transplanting (incubation period), the insecticide used and the tomato variety. It is obvious from the average percentages of viral infected plants that treatment E was the least infected followed by B, D,C, A and F then the check.

The minimal severity of infection was obtained also by E and F followed by B, D, A, and C (equally) then the check (Table 4). Similar observation was found by Verma *et al.*, (1989), Rosset *et al.*(1990), and Dawood *et al.*,(1999). They reported that the incidence of tomato leaf curl virus was directly related to the population density of the vector *B. tabaci*

It is worthy to note that tomato plants resistant to TYLCV under field conditions is difficult to obtain Ahmed *et al.*, (1991) reported that 90% of the plants were highly susceptible, 9% were intermediate,0.5% were slightly susceptible and 0.3% showed no symptoms.

The effects of the tested programs on tomato yield were evaluated and presented in Table 5. The data showed that fruit yield of tomatoes were increased by all treatments. The highest yield was obtained after the application of program F which increased the yield by 174.17% (relative to untreated plots), while the lowest yield was recorded with program C which increased the yield by 81.83%. The data also showed no significant differences between the yield of A and D as well as between E and F. Generally it could be concluded that the programs applied on tomato are arranged according to the fruit yield (Kg) in the following order; F>E>D>A>B>C.

In conclusion, it can be deduced that treatment E gave the best results for whitefly control as well as highest yield (showing the least number of infested plants with minimal surface of virus symptoms) taking into consideration that it was treated in the field as block application sparing classes of insecticides, and reducing the number of sprays because they were well protected from the beginning with foliar sprays of neonicotinoids (only 8 sprays in the field during the season) these results may be helpful as an approach for managing insecticide resistance in *B.tabaci* population.

Table 2. Rotation programs of the insecticides application

		Open fild													
Application	**Nursery 23.8**	**30.8**	**5.9**	**11.9**	**14.9**	**17.9**	**23.9**	**26.9**	**29.9**	**2.10**	**5.10**	**8.10**	**11.10**	**NO. of appl.**	**Programm followed**
A	Actara Thiamethoxam	Karate Lambdacyhalothrin	Chess Pymetrozine	Admiral Pyriproxyfen	Actellic Pirimiphos-methyl	Confidor Imidacloprid	Bemistop etofenprox	Evisect Thiocyclam hydrogen oxalate	Polo Diafenothuron	Lannate Methomyl	Challenger Chlorfenapyr	Match Lufenuron	Marshal Carbosulfan	12	Threshold
B	Confidor Imidacloprid	Dathrin Fenpropathrin	Admiral Pyriproxyfen	Chess Pymetrozine	----------	Sumithion Fenitrothion	Actara Thiamethoxam	----------	Bemistop etofenprox	Evisect Thiocyclam hydrogen oxalate	Polo Diafenothuron	Lannate Methomyl	Challenger Chlorfenapyr	10	Threshold
C	Actara Thiamethoxam	Karate Lambdacyhalothrin	Chess Pymetrozine	Admiral Pyriproxyfen	----------	Actellic Pirimiphos-methyl	Confidor Imidacloprid	----------	Bemistop etofenprox	----------	Evisect Thiocyclam hydrogen oxalate	----------	Polo Diafenothuron	8	6 day intervals
D	Confidor Imidacloprid	Dathrin Fenpropathrin	Admiral Pyriproxyfen	Chess Pymetrozine	----------	Sumithion Fenitrothion	Actara Thiamethoxam	----------	Bemistop etofenprox	----------	Evisect Thiocyclam hydrogen oxalate	----------	Polo Diafenothuron	8	6 day intervals
E	Actara Thiamethoxam	Actara Thiamethoxam	Actara Thiamethoxam	Karate Lambdacyhalothrin	----------	Karate Lambdacyhalothrin	Chess Pymetrozine	----------	Chess Pymetrozine	----------	Admiral Pyriproxyfen	----------	Admiral Pyriproxyfen	8	Block appl. 6 day intervals
F	Confidor Imidacloprid	Confidor Imidacloprid	Confidor I midacloprid	Dathrin Fenpropathrin	----------	Dathrin Fenpropathrin	Admiral Pyriproxyfen	----------	Admiral Pyriproxyfen	----------	Chess Pymetrozine	----------	Chess Pymetrozine	8	Block appl. 6 day intervals
G&H Check															

Table 3. Effect of insecticide rotation program on adults of whitefly

Treatment /100leaves	No of adult and % Reduction	30.8 0DDA1	2.9 3DDA1	5.9 6DDA1	8.9 9DDA1	11.9 12DDA1	14.9 15DDA1	17.9 18DDA1	20.9 21DDA1	23.9 24DDA1	26.9 DDA1**	29.9 30DDA1	2.10 33DDA1	5.10 36DDA1	8.10 39DDA1	11.10 42DDA1	14.10 45DDA1	18.10 48DDA1	Average 3DDA1: 49DDA1
A	No of adults	105	15	316	57	135	209	414	79	167	250	226	210	237	131	185	194	117	184
	% Reduction		89	67	95	87	75	62	92	83	75	7	79	75	[illegible]	79	74	76	79
B	No of adults	109	18	105	77	324	39	261	15	132	62	255	167	311	99	188	121	110	143
	% Reduction		87	90	94	69	95	77	98	87	94	77	84	68	89	79	84	79	85
C	No of adults	99	11	296	36	153	204	362	183	404	57	148	151	329	113	162	92	94	175
	% Reduction		91	67	97	84	74	65	79	57	94	85	84	63	87	80	87	80	80
D	No of adults	118	10	102	67	257	39	341	54	131	43	178	162	426	100	172	70	93	140
	% Reduction		93	91	95	77	96	72	95	88	96	85	86	60	90	82	92	83	86
E	No of adults	101	15	223	45	130	44	271	29	146	28	96	47	147	98	113	91	96	101
	% Reduction		88	76	96	86	94	74	97	85	97	91	95	84	89	86	87	80	88
F	No of adults	120	17	218	51	163	37	123	21	56	159	361	138	402	88	89	78	78	130
	% Reduction		89	80	96	86	96	90	98	95	86	71	88	63	91	91	91	86	87
G & H Check)	No of adults	110	139	1010	1280	1049	865	1140	978	1045	1049	1127	1069	991	939	904	786	517	930

Table 4. Effect of insecticides treatment in viral infection

Treatment	Total number of infected plants with virus							Percent surface area showing virus symptoms						
	27DAA1	34DAA1	41DAA1	48DAA1	54DAA1	63DAA1	71DAA1	27DAA1	34DAA1	41DAA1	48DAA1	54DAA1	63DAA1	71DAA1
A	13	27	48	48	66	72	77	4.8	13	24	26	34	40	47
B	7	17	40	45	59	65	69	2.2	10	18	20	26	34	38
C	10	30	54	55	60	64	73	3.9	14	24	29	37	42	48
D	5	18	48	49	58	69	71	1.8	9	22	24	28	38	44
E	5	16	41	43	53	60	65	2.3	7	18	21	24	28	37
F	4	19	25	38	51	56	80	1.3	7	9	17	20	28	37
G & H Check	40	70	80	80	80	80	80	13.5	36	65	73	87	91	96

*DAA= Days after Application

Table 5. Effect of insecticide treatments on tomato yield

Treatments	Harvested tomatoes			Yield in Kg	Yield %
	1st	2nd	3rd		
A	635	655	660	1950[b]	122.86
B	588	579	570	1737[c]	98.51
C	520	536	535	1591[d]	81.83
D	651	668	658	1977[b]	125.94
E	791	782	793	2366[a]	170.40
F	800	801	798	2399[a]	174.17
G & H Check	285	293	295	875[e]	100

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الملخص العربي

تقييم المكافحة الكيميائية في برامج دوريه علي الذبابة البيضاء في محصول الطماطم

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تم تقييم المكافحة الكيميائية في برامج دوريه برش المبيدات التقليدية وغير التقليدية في تتابع علي صنف الطماطم Rover (E-446) F1 hybrid لمكافحه الذبابة البيضاء علي محصول الطماطم في محطة بحوث Syngenta قها محافظه القليوبية. قسمت المنطقة التجريبية إلي ثمانية معاملات، ثلاثة معاملات رشت في المشتل بال Thiamethoxam وثلاثة معاملات رشت بالمشتل بال Imidacloprid وذلك قبل نقلها إلي الأرض المستديمة ب ٤٨ ساعة، والمعاملتين الباقيتين تركتا كمقارنه بدون معامله.

في الأرض المستديمة كان يتم رش النباتات في برنامج دوري كلما اقترب عدد الحشرات الكاملة إلي الحد الاقتصادي الحرج (متوسط حشره واحده / ورقه مركبه وذلك في معاملتين [A &B]. كان يتم رش النباتات كل ٦ أيام في برنامج دوري في المعاملتين [C &D] بمبيدات تتبع مجاميع مختلفة.

بغض النظر عن نسبه الاصابه:

كان يتم رش النباتات كل ٦ أيام في تتابع دوري في المعاملتين [E&F] كل رشتين كانتا بنفس المبيد في نفس جيل الحشرة block application وتركت المعاملات [G&H] كمقارنه تم اخذ متوسطها.

أوضحت النتائج أن أفضل المعاملات هي التي استخدمت block application و قد أعطت أفضل نتيجة بالنسبة لمكافحه الحشرات الكاملة كذلك المحصول مع انخفاض في شده الاصابه الفيروسيه. فاستخدام block application عمل علي خفض مجاميع المبيدات المستخدمة ويعمل علي تأجيل تكون صفة المقاومة مع خفض تأثير المبيدات علي البيئة.