Insecticides Rotation Strategy for Controlling *Bemisia Tabaci* (Genn.) on Tomato Crop

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ABSTRACT

Insecticides rotation strategy was applied after treatment of the seedlings of tomato variety Rover (E-446) F1 hybrid in the nursery using thiamethoxam and imidacloprid (foliar and drench application) for the control of *Bemisia Tabaci*. Twelve treatments with biorational and conventional insecticides in a rotation programs was applied at Syngenta Kaha Station, Kalubia Governorate, Egypt.

The best treatment was seedlings treated with thiamethoxam at 30g/20000 seedlings as drench application in the nursery and a sequence of thiamethoxam, twice fenpropathrin, and twice pymetrozine in open field. It gave good results for controlling the adults stage of *B. tabaci* and minimized the number of infected plants and percent surface area showing virus symptoms. Also, the highest yield of tomato was obtained after five sprays during the season.

The present study suggests that drench application in the nursery was a good treatment in reducing and delaying attacks by *B. tabaci*.

INTRODUCTION

The whitefly, *Bemisia tabaci* Gennadius causes great concern among agricultural producers throughout the world. This pest damages plants in several ways including direct damage from feeding individuals, production of massive quantities of honey dew upon which sooty mold fungus can grow which interferes with the photosynthesis process, thus delaying crop development and decreasing the yield; and transmission of germiniviruses (Costa *et al.*,1991; Brown.,1992; Costa *et al.*,1993). The combination of these effects has promoted this species to be one of the most damaging pest in agriculture production of vegetable crops specially tomato. Additionally this pest is notable for its ability to develop resistance to chemical pesticides quickly (Costa & Brown., 1991; Cahill *et al.,* 1995, 1996).

Depending upon the circumstances, certain insecticides use strategies may be more effective than others in delaying the onset of insecticide resistance in a particular pest and geographical area. Among the more common strategies that have been characterized include the use of insecticides sequentially, in mixture or rotation (Georghiou., 1983; Curtis.,1985; Tabashnik., 1989). Geoghiou (1994) further defined resistance management tactics according to the intensity of insecticide exposure and the sequence or diversity of insecticides that are applied. The particular strategy employed ideally should account for the risks of resistance developing to the candidate insecticides based on knowledge of the biology and ecology of the pest species (Keiding,1986; Georghiou,1994). Efforts to measure resistance changes in fields experimentally subjected to various insecticide regimens have been notably few

Immaraju *et al.*, (1990) found that resistance levels increased most under the sequential regimen and that rotation of insecticides was superior to mixtures. Mc Kenzie & Byford (1993) reported that the highest resistance level developed in the single insecticide, sequential use schemes, whereas treatments with mixtures or rotations of insecticides yielded much lower resistance.Resistance to various insecticides belonging to different classes has been well documented in *B. tabaci* around the world (Dittrich *et al*., 1985, 1990; Prabhaker *et al.*, 1985, 1992; Horowitz *et al.*, 1988; Cahill *et al.,* 1995) and has been implicated as a factor in its elevated pest status (Dittrich *et al.,* 1985).

Our objective was to apply rotation strategy through a crop season by measuring the toxic responses of *B. tabaci*. We were also interested in exploring the control efficacies of different insecticide used strategies by measuring whitefly densities and tomato yields in field plots subjected to different insecticide use regimens to evaluate the pest management potential of this strategy. Finally this work was done in order to find some better control measures for such injurious pest.

MATERIAL AND METHODS

A field trial was conducted at Syngenta Agricultural Research station at Kaha, Kalubia Governorate, Egypt. Seedlings of tomato variety E- 448 F_1 hybrid were planted in trays on Sep. 22. Twenty four

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Project # FC/20/28-97, financed from Bureau de Liaison AgricoJe., Franco-Egyptien.
Received June20, 2009, Accepted June29, 2009

hours before transplanting, seedlings were divided into five parts and nursery treated as follows:

- Thiamethoxam at 30 g /20000 seedlings as foliar application [plots 101 & 102]
- Thiamethoxam at 30 g /20000 seedlings as drench application [plots 103 & 104]
- Imidachloprid at 125 ml/100l as foliar application [plots 105 & 106]
- Imidachloprid at 200g/20000 seedlings as drench application [plots 107 & 108]
- untreated check [plots 109,110,111,112]

Seedlings of tomato, 34 days old, were transplanted in open field plots on October 26 after wheat crop. The experimental design was established on area of one feddan included twelve treatments in addition to untreated check, 4 replicates were used. Treatments were taking numbers from 101 to 112 according to nursery treatments. Normal agricultural practices were followed by the application of the recommended rates of the biorational and conventional insecticides in a rotational program as indicated in Table1.

Applications were carried out using a single nozzle Knapsack sprayer and a spray volume of 200l/feddan. Sprays were done according to the economic threshold (less than one/ compound leaf).

The efficacy of the insecticides against the adult stage was determined by counting insects on the lower surface of 25 compound leaves at random. Counts were made in the early morning when flight activity is minimal according to Butler et al (1988). Pre-treatment counts were done in the early morning just before application and at 1,3,6,9,12,15,18,21,24,27,30, 33,36,39,42,45 days after transplanting (DAT)

The efficacy against eggs, nymphs and immature stage (eggs + nymphs) was evaluated by inspection of 20 compound leaves at random every 34,42,49,55, and 62 DAT Leaves were transfered to the laboratory and stages were counted with the aid of a binocular microscope.Percent reduction of all stages (adults, eggs, nymphs and all immature) of *B. tabaci* was calculated for all treatments using the equation of Henderson & Tilton (1955).

The virus symptoms were evaluated on 25 randomized plants in each replicate 18,26,36,45,54,64 and 73,83 and 93 (DAT).Symptoms were evaluated morphologically. The number of plants exhibiting virus symptoms was recorded and percent of surface area showing virus symptoms was estimated visually.

RESULTS AND DISCUSSION

Data in Table 2 showed the efficacy of the chemicals used on adults of *B. tabaci* and represented as percent reduction of infestation at different time intervals from treatment. The treatments could be arranged in a descending order as follows:

104> 102>103> 101> 106> 108>110>111>109> 105> 107.

The best result was given by treatment 104 in which tomato seedlings were treated at nursery with thiamethoxam as drench application , at open field with thiamethoxam as foliar application followed by twice applications of fenpropathrin and twice applications of pymetrozine. (5 field applications).

Table 3 represented the efficacy of the chemical used against eggs, nymphs and immature stage which the efficacy of the treatments on egg stage could be arranged in a descending order as follows.

103> 106=108> 105> 104> 107>110>101>111> 109>102.

The best result was given by treatment 103 in which tomato seedlings were treated at nursery with thiamethoxam as drench application and at open field with twice applications of fenpropathrin followed by twice applications of Pymetrozine then twice applications of pyriproxyfen and one application of diafenthiuron. (7 field applications).

The efficacy of the chemicals against nymphal stage treatments could be arranged in a descending order as follows.

103> 108>107> 106> 111> 102>105>109>110> 104> 101.

The best result was given by treatment 103 as in the case of egg stage.

The efficacy of the chemicals used against immature stage (eggs+ nymphs), could be arranged in the following descending order.

108> 105>103> 106> 107> 111> 110> 104> 109> 102>101.

The best result was given by 108 in which tomato seedlings treated at nursery with imidacloprid as drench application and at open field with imidacloprid as foliar application followed by twice applications of fenpropathrin, then twice applications of pymetrozine, then twice applications of pyriproxyfen then twice applications of diafenthiuron, then twice applications of lufenuron. (10 field applications) (Table3). This finding is in agreement with Castle *et al.*, (2002) who stated that the rotation regimen generally performed better than the sequential treatments. Although his findings did not prove that insecticide rotation strategy was superior to the use of mixtures to control *B. taboci*.

Also, Palumbo *et al.*, (1996) suggested that incorporation of imidacloprid into the upper 3 – 4 cm of

Table 1. Description of insecticide rotation program according to the economic threshold

TREAT. #	AT THE NURSERY	Layout	*AT THE OPEN FIELD*											
			1St appl.	2nd appl.	3rd appl.	4th appi.	5th appl.	6th appl.	7th appl.	8th oppi.	9th appi.	10th appi.	11th appi.	12th appi.
1	Actara WG25 Foliar 30gai/20000 seedlings	101	Danitol EC200 50ml/hl	Danitol	Chess WP25 480gr/fed.	Chess	Admiral EC100 75ml/hl	Admiral	Polo 5C500 300ml/hl	polo	Match ECO5O40ml/hl	Match	----	----
2		102	Actara Drench 200gai/20000 seedlings	Danitol	Danitol	Chess	----	----	----	----	----	----	----	----
3	Actara WG25 Drench 200gai/20000 seedlings	103	Danitol	Danitol	Chess	Chess	Admiral	Admiral	Polo	----	----	----	----	----
4		104	Actara Foliar 4Ogr/hl	Danitol	Danitol	Chess	Chess	---	----	----	----	----	----	----
5	Admire *5C200* Foliar 125ml/hl	105	Danitol	Danitol		Chess	Admiral	Admiral	Polo	Polo	Match	Match	Abamectin ECO18 50ml/hl	Abamectin
6		106	Admire Drench 200gai/20000 seedlings	Danitol	Danitol	Chess	Chess	Admiral	Admiral	Polo	Polo	Match	Match	----
7	Admire *5C200* Drench 200gcii/20000 seedlings	107	Danitol	Danitol	Danitol	Chess	Admiral	Admiral	Polo	Polo	Match	Match	Abamectin	Abamectin
8		108	Admire Foliar 125ml/hl	Danitol		Chess	Chess	Admiral	Admiral	Polo	Polo	Match	Match	----
9	*untreated*	109	Danitol	Danitol	Danitol	Chess	Admiral	Admiral	Polo	Polo	Match	Match	Abamectin	Abamectin
10		110	Actara Foliar 4Qgr/hl	Danitol		Chess	Chess	Admiral	Admiral	Polo	Polo	Match	Match	Abamectin
11		111	Admire Foliar 125ml/hl	Danitol	Danitol	Chess	Chess	Admiral	Admiral	Polo	Polo	Match	Match	Abamectin
12		112	Check											

Table 2. Efficacy of some insecticide treatments on whitefly adults, represented as per-cent reduction of infestation at different intervals from treatments

Treatments \ Days After transplanting	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	Average
101	74	92	81	93	99	99	92	99	97	88	74	74	61	41	26	79
102	77	93	83	98	99	98	98	99	98	95	98	96	89	95	92	94
103	83	96	96	95	98	92	95	99	98	88	97	90	87	68	57	89
104	0	96	96	95	99	96	95	96	98	95	97	95	91	95	93	95
105	26	77	95	86	98	81	86	90	85	75	58	36	20	4	0	60
106	0	92	96	92	99	91	92	99	97	86	74	58	67	54	38	78
107	20	77	94	81	98	75	81	91	81	58	52	3	8	0	0	55
108	60	87	96	90	99	78	90	99	96	82	71	50	57	49	36	76
109	0	68	96	82	98	79	82	92	87	75	61	44	27	16	0	61
110	3	64	97	88	99	83	88	98	98	92	81	63	44	39	29	72
111	0	54	97	88	98	76	88	96	96	79	74	51	47	26	6	65

Table 3. Efficacy of some insecticide treatments on whitefly eggs, nymphs and immature stages represented as percent reduction of infestation at different intervals from treatments

Treatment	Stages	34 DAT	42	49	55	62	Average
	Eggs	64	0	0	0	0	12.9
101	Nymphs	0	0	59	89	100	49.5
	Immature	35	0	0	0	0	7.1
	Eggs	45	0	0	0	0	8.9
102	Nymphs	41	37	67	78	100	64.6
	Immature	48	0	0	0	0	9.7
	Eggs	82	0	0	0	0	16.3
103	Nymphs	89	66	68	84	100	81.6
	Immature	86	47	26	4	0	32.6
	Eggs	68	0	0	0	0	13.5
104	Nymphs	72	10	43	33	100	51.6
	Immature	72	0	0	0	0	14.4
	Eggs	71	0	0	0	0	14.1
105	Nymphs	6	50	80	94	92	64.3
	Immature	47	48	47	31	0	34.8
	Eggs	72	0	0	0	0	14.3
106	Nymphs	60	69	76	94	100	79.7
	Immature	70	57	23	7	0	31.3
	Eggs	67	0	0	0	0	13.4
107	Nymphs	28	81	96	95	100	80.1
	Immature	57	60	33	1	0	30.2
	Eggs	72	0	0	0	0	14.3
108	Nymphs	40	74	91	97	100	80.3
	Immature	65	63	48	54	0	45.8
	Eggs	50	0	0	0	0	10.0
109	Nymphs	0	47	84	85	95	62.1
	Immature	23	27	21	0	0	14.2
	Eggs	66	0	0	0	0	13.2
110	Nymphs	0	45	81	88	89	60.7
	Immature	35	30	27	4	0	19.3
	Eggs	54	0	0	0	0	10.9
111	Nymphs	1	54	87	88	96	56.1
	Immature	30	35	31	14	0	22.1

Table 4. Table 4.Effect of insecticide rotation program on virus infection on tomato

Treatments	Total number of infected plants with virus									Average	Percent surface area showing virus symptoms									Average
	18	٢٦	36	45	54	64	73	83	93	18-93	18	٢٦	36	45	54	64	73	83	93	18-93
check	0	100	100	100	100	100	100	100	100	89	0	16	24	31	36	63	69	73	86	44
101	0	0	16	17	17	40	40	43	58	26	0	0	2	3	3	11	11	14	16	7
١٠٢	0	0	8	13	17	23	27	30	38	17	0	0	1	2	3	4	6	9	12	4
١٠٣	0	0	15	16	17	26	28	36	39	20	0	0	2	2	2	6	7	11	12	5
١٠٤	0	0	4	6	7	27	27	30	38	15	0	0	0	1	1	7	7	9	11	4
١٠٥	0	25	44	48	53	61	64	76	100	52	0	3	7	10	10	20	21	25	35	15
١٠٦	0	13	22	25	26	57	61	62	66	37	0	1	4	4	5	19	20	20	24	11
١٠٧	0	11	19	23	26	38	41	45	63	30	0	1	3	3	4	10	11	14	20	7
١٠٨	0	0	6	13	22	38	40	46	65	26	0	0	1	2	4	11	11	16	21	7
١٠٩	0	32	57	63	69	83	100	100	100	67	0	5	11	12	14	27	32	38	41	20
١١٠	0	28	47	71	82	91	100	100	100	69	0	4	9	14	17	26	36	42	44	21
١١١	0	30	54	68	79	83	100	100	100	68	0	5	10	16	20	32	33	43	44	23

Table 5. Effect of different insecticide rotation program on tomato yield

Treatments / Days After transplanting	156	186	Total
Check	61	328	389
101	131	1255	1386
102	189	1683	1872
103	168	1679	1847
104	198	1781	1979
105	126	990	1116
106	171	1356	1527
107	167	1455	1622
108	183	1608	1791
109	86	858	944
110	95	920	1015
111	84	826	910

soil below the seed furrow is optimal for absorption and translocation. This treatment may provide a more environmentally suitable method measure tool and effective alternative to control *B. taboci* than is currently possible with foliar treatment. This finding supports our results which indicated that drench application is better than foliar one

The number of infected plants with virus and percent surface area showing virus symptoms was presented in Table 4.

Concerning the number of infected plants with virus, the best result was given by treatment 104 followed by 102,103= 108,107 106,105, 109, 111, 110 and 112, and the percent surface area showing virus symptoms in a descending order, the best result was given by treatment 102= 104,103, 101= 107=108, 106, 105, 109, 110, and 111.

Treatment 104, 102 and 103 gave the best results for controlling adults, reducing the number of infected plants with virus and percent surface area showing virus symptoms and the highest yield of harvested tomatoes. Similarly Ayad *et al.*, (2003) found that insecticide rotation gave good control of *B. tabaci.*

Also Ayad *et al.*, (2002) found that seed treatment followed by insecticide rotation gave good control of *B. tabaci* as well as high yield showing the least the number of infected plants with minimal surface of virus symptoms.

From these results it could be suggested that drench application in the nursery followed by block application of insecticide in the field in a rotational program--insecticide reduced the number of application per season, delayed the development of resistance.

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الملخص العربي

برامج دوريه لترشيد استخدام المبيدات لمكافحه الذبابة البيضاء علي الطماطم

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تم تقييم اثني عشر معامله بالمبيدات التقليدية وغير التقليدية في برامج دوريه علي صنف طماطم Rover (E-446) F1 hybrid لمكافحه الذبابة البيضاء في محطة البحوث Syngenta Kaha Station, Kalubia بعد معامله الشتلات بالثياميثوكسام والايميداكلوبريد بطريقه الرش وبطريقه التشريب ٤٨ساعة قبل نقل الشتلات إلي الأرض المستديمة.

أوضحت النتائج أن الشتلات التي عوملت بطريقه التشريب قبل النقل إلي الأرض المستديمة أعطت أفضل النتائج من حيث مكافحه الذبابة البيضاء واعلي محصول مع انخفاض نسبه الاصابه الفيروسية وشدتها مما ينصح باستخدام هذه الطريقة في المكافحة المتكاملة.