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Evaluation of Several Programs of Sequences Pesticides Application on Cotton Bollworms and Some Other Sucking Pests in Cotton Field

[1]A.E.M. Abd El-Mageed, [1]E.M. Anwar, [2]L.R.A. Elgohary and [1]H.F. Dahi
[1]Plant Protection Research Institute, Agricultural Research Center,
Dokki, Giza, Egypt
[2]Department of Pesticide, Faculty of Agricultural, Mansoura University, Egypt

Abstract: Field experiments were carried to evaluate five programs with three sprays of application using nine insecticides belongs to five different chemical groups on reducing the infestation of cotton bollworms, pink bollworm *Pectinophora gossypiella* (Saund.) and spiny bollworm *Earias insulana* (Boisd.) and some other sucking pests, cotton whitefly, *Bemisia tabaci* (Genn.), cotton aphids, *Aphis gossypii* (Colov.), cotton jassid *Empoasca lypica* (de Berg), cotton thrips *Thrips tabaci* (L.) and spider mite *Tetranychus urticae* (Koch) in Dakahlia Governorate during 2005 cotton season. According to general of reduction average it is clear that both the program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad) and the program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) induced the highest effect representing 81.04 and 81.08% reduction in pink bollworm larval population, respectively. The percentages of infestation of the spiny bollworm recorded during the season in each of experimental plots at three tested sprays were too low. Also, the results obtained revealed that all programs were significantly reduced the population density of the sucking pests at any date of inspection during all application.

Kay words: Cotton bollworms, sucking pests, sequences, pesticides

INTRODUCTION

Profitable cotton production in Egypt must depend on successful and efficient insect management programme which reduces the risk disastrous crop losses by pests (El-Basyouni, 2003). Cotton is attacked by various pests during the different stages of its development. Many insect species have been reported on cotton and some of these species are regarded as major pests that can destroy the plants in a few days (Mireulle *et al*., 1999). The pink bollworm *Pectinophora gossypiella* (Saud.) and the spiny bollworm *Earias insulana* (Boisd.) are major pests attacking cotton in Egypt, which cause a severe reduction in its yield and quality (Abou Kahla *et al*., 1990). The whitefly, *Bemisia tabaci* (Genn.), the cotton aphids, *Aphis gossypii* (Glover) and the cotton leafhopper, *Empoasca lybica* (De Berg) are considered among the economic pests of cotton plants in Egypt (Abdel-salam, 1995; Samy, 1999). The success of cotton bollworm control programme relies of use pesticides belonging to different groups in certain sequence, timing of application and interval of spraying (Watson *et al*., 1986; El-Feel *et al*., 1991). Previously carbamate insecticides were usually used at the last spray for controlling the spiny bollworm (Thiodiocarb and Carbaryl have been used focussing on carbaryl since 1999). Since 2005, the Egyptian Committee for Agricultural Pesticides (ECAP, 2005) was decision debarring applied the Carbamate group through spray rotation programs. So, it is becoming necessary

Corresponding Author: Ahmed Elsayed Mahmoud Abd El-Mageed, Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt Tel: +20108045055

to find a promising compound environmentally safe and effective against Spiny bollwom to be used instead Carbaryl. Conventional insecticides have not provided a long-term solution to the pink bollworm problem (Henneberry, 1986), moreover as a result of continued massive use of certain synthetic insecticides against the cotton pests, tolerant and resistant strains have been developed (Schmutterer, 1985). Ministry of Agriculture in Egypt is hoping to find a product safe, low dose in the environment, with satisfactory killing power specially for spiny bollworm. So, spinosad was chosen because it is classified by EPA as a reduced risk product and awarded the green chemical challenge award from the white house in the USA in 1999 (Temerak, 2003).

The purpose of this study was to evaluate five programs with three sprays of application using nine insecticides belongs to different five groups include on a new biocide (Spinosad) on reducing the infestation of cotton bollworms, pink bollworm *Pectinophora gossypiella* and spiny bollworm *Earias insulana* and some other sucking pests, cotton whitefly, *Bemisia tabaci* (Genn.), aphids, *Aphis gossypii* (Colov.), cotton jassid *Empoasca lypica* (de Berg), cotton thrips *Thrips tabaci* (L.) and spider mite *Tetranychus urticae* (Koch) in cotton field during 2005 season.

MATERIALS AND METHODS

Experimental Design

The experiments were conducted at Aga district, Dakahlia Governorate to evaluate five programs with three sprays of application using nine insecticides belongs to five different chemical groups (Table 1). The fields were cultivated with Giza 86 cotton variety on April 15, 2005 and the normal agricultural practices were applied. The experimental area was divided into plots of 1/16 of a feddan each and the treatments were arranged in randomized complete blocks with four replicates each. Plots were isolated from each other by unplanted corridors (1 m width) that separated replicates. A ground motor sprayer was used to spray the chemical dilutions. The volume of spray solution was 400 L /feddan.

Procedures of Evaluating the Treatments

According to the protocol of the ministry of agricultural, three application of each insecticide took place at two weeks intervals. To evaluate the effect of tested treatments against cotton bollworms, samples of 100 green boll per treatment (25 bolls for each replicate) were taken at random and dissected. The number of larvae of bollworms in the green bolls was recorded before the first spray and then bolls samples took place every week and so the percent of reduction was calculated.

Table 1: Tested programs of application against cotton bollworms and some other sucking pests in cotton field

Time programs	1st spray 7/8/2005	2nd spray 21/8/2005	3rd spray 4/9/2005
Program 1	Beta-cyfluthrin (Bulldock® 12.5% SC) 150 cm/feddan	Malathion (Malathion® 57% EC) 1000 cm/feddan	Spinosad (Spintor® 24% SC) 50 cm/feddan
Program 2	Manf 6 (Manf 6®) 300 cm/feddan	Methoxyfenozide (Runner® 24% SC) 200 cm/feddan	Spinosad (Spintor® 24% SC) 50 cm/feddan
Program 3	Chlorpyrifos (Dursban® 48% EC) 1000 cm/feddan	Manf 6 (Manf 6®) 300 cm/feddan	Spinosad (Spintor® 24% SC) 50 cm/feddan
Program 4	Lufenuron (Match® 5 % EC) 160 cm/feddan	Malathion (Malathion® 57% E.C.) 1000 cm/feddan	Spinosad (Spintor® 24% SC) 50 cm/feddan
Program 5	Abamectin (Vertimec® 1.8% EC) 100 cm/feddan	Alpha-Cypermethrin (Alphacyper® 10% EC) 250 cm/feddan	Spinosad (Spintor® 24% SC) 50 cm/feddan

Regarding to the sucking pests, samples of 100 cotton leaves (25 leaves for each replicate) were collected at random from the inner rows of each plot to estimate the population counts of sucking pests which previous mentioned. The leaves were collected early in the morning from different levels of the plant and brought to the laboratory and examined by a binocular microscope. The upper and the lower surfaces of the leaf were inspected and the number of aphids (nymphs and adults), whitefly (nymphs), jassid (nymphs), thrips (nymphs) and spider mite were recorded. Sampling and counting were made just before treatment then after 7 and 14 days of spraying. Percent reduction in infestation was estimated using Henderson and Tilton (1955) equation to determine the effect of the tested insecticides.

Statistical Analysis

Statistical analysis were carried out to determine the differences between treatments after spraying by using one way analysis of variance (ANOVA) computed by Costat Statistical Software, 1990.

RESULTS AND DISCUSSION

Efficiency of Tested Programs Against the Bollworms

Efficiency of Tested Programs Against the Pink Bollworm

Data presented in Table 2 revealed that all tested programs reduced the rate of the pink bollworm larvae *Pectinophora gossypiella* (Saund.) during the three sprays. According to general of reduction average it is clear that both the program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad) and the program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) induced the highest effect representing 81.04 and 81.08% reduction in larval population, respectively. While the program 5 (1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad) suppressed the number of pink bollworm larvae by 73.85% compared with the control, whereas the program 2 (1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad) and the program 3 (1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad) were similar in their effect giving 70.94 and 71.87% reduction in pink bollworm larvae, respectively.

Efficiency of Tested Programs Against the Spiny Bollworm

Results in Table 3 showed that the percentages of infestation of the spiny bollworm *Earias insulana* (Boisd.) that recorded during the season in each of experimental plots at three tested sprays were too low especially with the program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad), the program 2 (1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad) and the program 5 (1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad). However, the total mean of spiny bollworm infestation percent for the program 3 (1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad) and the program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) were the same value, it reached 0.5% compared to the control 1.3%.

Efficiency of Tested Programs Against Sucking Pests

Efficiency Against the Whitefly

The results obtained in Table 4 revealed that all programs were significantly reduced the population density of whitefly nymph *Bemisia tabaci* (Genn.) at any date of inspection during all application. At 1st spray, Abamectin at the program 5 gave the best effect (70.90%), while Beta-cyfluthrin at the program 1 gave the lowest effect (48.42%). Manf 6 at the Program 3 was surpass all the other treatment on the reduction of whitefly population density it reached 84.44%, in addition Malathion at the program 1 was the lowest effective treatments (39.44%) at 2nd Spray. The maximum activity of Spinosad was reached its upper limit at the program 3 at the 3rd Spray.

Table 2: The efficacy of various five programs against the pink bollworm larvae *Pectinophora gossypiella* (Saund.) after three sprays

		1st spray					2nd spray					3rd spray					
		7 days		14 days			7 days		14 days			7 days		14 days			
Programs	Pre spray population	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	General of reduction average
Program 1	9	3	52.38	0	100.00	76.19b	0	100.00	4	78.84	89.42a	3	86.11	7	68.89	77.50 d	81.04 A
Program 2	10	0	100.00	10	16.67	58.34d	9	40.00	4	80.95	60.48e	0	100.00	3	88.00	94.00 b	70.94 C
Program 3	14	7	28.57	3	82.14	55.36e	0	100.00	12	59.18	79.59b	13	61.31	0	100.00	80.66 c	71.87 C
Program 4	13	6	34.07	0	100.00	67.04c	0	100.00	13	52.38	76.19c	0	100.00	0	100.00	100.00 a	81.08 A
Program 5	7	0	100.00	3	64.29	82.15a	3	71.43	6	59.18	65.31d	3	82.14	7	60.00	74.11 e	73.85 B
Control	10	7		12			15		21			24		25			

Means followed by the same letter in each column are not significantly different according to duncan multiple range test at 5%; Program 1: 1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad; Program 2: 1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad; Program 3: 1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad; Program 4: 1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad; Program 5: 1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad

Table 3: The efficacy of various five programs against the spiny bollworm *Earias insulana* (Boisd.) after three sprays

		1st spray		2nd spray		3rd spray		
Programs	Pre spray population	7 days	14 days	7 days	14 days	7 days	14 days	Mean
Program 1	0	0	0	0	0	0	0	0
Program 2	0	0	0	0	0	0	0	0
Program 3	0	0	0	1	0	0	2	0.5
Program 4	0	0	0	0	0	1	2	0.5
Program 5	0	0	0	0	0	0	0	0
Control	0	0	1	1	0	2	4	1.3

Program 1: 1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad; Program 2: 1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad; Program 3: 1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad; Program 4: 1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad; Program 5: 1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad

Table 4: The efficacy of various five programs against the whitefly nymph *Bemisia tabaci* (Genn.) after three sprays

		1st spray					2nd spray					3rd spray					
		7 days		14 days			7 days		14 days			7 days		14 days			
Programs	Pre spray population	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	General of reduction average
Program 1	520	404	37.59	336	59.24	48.42d	400	11.72	248	67.16	39.44e	156	82.37	40	42.07	62.22d	50.03B
Program 2	516	332	48.31	204	75.06	61.69b	240	46.62	136	81.85	64.24c	80	90.89	16	76.65	83.77b	69.90AB
Program 3	808	628	37.56	240	81.26	59.41c	164	76.71	92	92.16	84.44a	44	96.80	12	88.82	92.81a	78.89A
Program 4	836	548	47.34	400	69.81	58.58c	484	33.56	364	70.02	51.79d	280	80.31	68	38.71	59.51e	56.63AB
Program 5	856	416	60.96	260	80.84	70.90a	308	58.71	204	83.59	71.15b	136	90.66	40	64.81	77.74c	73.26AB
Control	964	1200		1528			840		1400			1640		128			

Means followed by the same letter in each column are not significantly different according to duncan multiple range test at 5%; Program 1: 1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad; Program 2: 1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad; Program 3: 1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad; Program 4: 1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad; Program 5: 1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad

Table 5: The efficacy of various five programs against the cotton aphids, *Aphis gossypii* (Glover) after three sprays

		1st spray					2nd spray					3rd spray					
		7 days		14 days			7 days		14 days			7 days		14 days			
Programs	Pre spray population	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	General of reduction average
Program 1	460	372	28.65	208	65.92	47.29d	160	66.12	108	70.90	68.51d	60	80.44	12	87.38	83.91c	66.57D
Program 2	1200	360	73.53	248	84.42	78.98a	164	86.69	116	88.02	87.36a	76	90.50	28	88.71	89.61b	85.31A
Program 3	388	280	36.33	136	73.58	54.96b	84	78.91	44	85.94	82.43b	20	92.27	0	100.00	96.14a	77.84B
Program 4	400	280	38.24	168	68.34	53.29c	124	69.81	68	78.93	74.37c	36	92.27	12	85.48	88.88b	72.18C
Program 5	384	332	23.72	240	52.90	38.31e	200	49.27	124	59.97	54.62e	40	84.38	12	84.88	84.63c	59.18E
Control	600	680		796			616		484			400		124			

Means followed by the same letter in each column are not significantly different according to duncan multiple range test at 5%; Program 1: 1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad; Program 2: 1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad. Program 3: 1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad. Program 4: 1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad. Program 5: 1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad

Table 6: The efficacy of various five programs against the cotton jassid *Empoasca lypica* (de Berg) after three sprays

		1st spray					2nd spray					3rd spray					
		7 days		14 days			7 days		14 days			7 days		14 days			
Programs	Pre spray population	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	General of reduction average
Program 1	192	80	69.55	48	80.21	74.88a	40	80.21	16	90.46	85.34a	0	100.00	0	100.00	100.00a	86.74A
Program 2	120	72	56.15	28	81.53	68.84b	60	52.50	40	61.85	57.18d	24	64.82	0	100.00	82.41d	69.48C
Program 3	172	84	64.31	36	83.43	73.87a	60	66.86	32	78.71	72.79c	16	83.64	0	100.00	91.82c	79.49B
Program 4	140	84	56.15	12	93.21	74.68a	40	72.86	8	93.46	83.16b	0	100.00	0	100.00	100.00a	85.95A
Program 5	160	84	61.64	44	78.23	69.94b	52	69.13	32	77.11	73.12c	8	91.20	0	100.00	95.60b	79.55B
Control	380	520		480			400		332			216		40			

Means followed by the same letter in each column are not significantly different according to duncan multiple range test at 5%; Program 1: 1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad; Program 2: 1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad; Program 3: 1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad; Program 4: 1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad; Program 5: 1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad

Table 7: The efficacy of various five programs against the cotton thrips *Thrips tabaci* (L.) after three sprays

		1st spray					2nd spray					3rd spray					
		7 days		14 days			7 days		14 days			7 days		14 days			
Programs	Pre spray population	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	General of reduction average
Program 1	368	320	38.15	240	59.09	48.62d	208	56.09	148	44.36	50.23d	84	42.36	40	45.11	43.74d	47.53E
Program 2	396	280	49.71	172	72.75	61.23c	124	75.67	100	65.06	70.37c	40	74.50	8	89.80	82.15b	71.25C
Program 3	360	252	50.21	164	71.42	60.82c	128	72.38	80	69.25	70.82c	48	66.33	28	60.72	63.53c	65.06D
Program 4	320	204	54.66	116	77.26	65.96a	80	80.58	52	77.52	79.05a	20	84.22	0	100.00	92.11a	79.04A
Program 5	352	248	49.89	124	77.90	63.90b	96	78.81	64	74.84	76.83b	32	77.05	8	88.52	82.79b	74.51B
Control	404	568		644			520		292			160		80			

Means followed by the same letter in each column are not significantly different according to duncan multiple range test at 5%; Program 1: 1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad; Program 2: 1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad; Program 3: 1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad; Program 4: 1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad; Program 5: 1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad

Table 8: The efficacy of various five programs against the spider mite *Tetranychus urticae* (Koch) after three sprays

		1st spray					2nd spray					3rd spray					
		7 days		14 days			7 days		14 days			7 days		14 days			
Programs	Pre spray population	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	P	R (%)	P	R (%)	Reduction average	General of reduction average
Program 1	2360	1200	55.07	840	72.66	63.87b	760	67.25	332	77.49	72.37b	244	79.99	120	48.29	64.14c	66.79B
Program 2	2475	1164	48.05	476	81.53	64.79b	400	79.46	292	76.40	77.93a	200	80.45	96	50.69	65.57b	69.43A
Program 3	1848	840	59.83	596	75.22	67.53a	520	71.39	444	61.56	66.48c	320	66.49	108	40.57	53.53d	62.51C
Program 4	2040	1220	47.15	800	69.87	58.51c	884	55.93	400	68.63	62.28e	212	79.89	84	58.13	69.01a	63.27C
Program 5	2292	1104	57.44	640	78.55	68.00a	710	68.50	564	60.63	64.57d	412	65.21	140	37.88	51.55e	60.04D
Control	2400	2716		3124			2360		1500			1240		236			

Means followed by the same letter in each column are not significantly different according to duncan multiple range test at 5%; Program 1: 1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad; Program 2: 1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad; Program 3: 1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad; Program 4: 1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad; Program 5: 1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad

The tested programs were arranged according to general of reduction average in a descending order as follows: Program 3 (1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad) > Program 5 (1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad) ≥ Program 2 (1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad) ≥ Program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) > Program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad).

Efficiency Against the Cotton Aphid

Data in Table 5 revealed that, Manf 6 at the program 2 was the most effective treatment (78.98%), while Abamectin at the program 5 was the lowest one (38.31%) at 1st Spray against the cotton aphids, *Aphis gossypii* (Glover). The other treatment could be arranged between them with significant differences. Concerning the 2nd Spray data cleared that all programs have the same previous trend of arrangement but with high level of reduction of population density. The maximum activity of Spinosad was reached its upper limit at the program 3 at the 3rd Spray.

The efficiency of the tested programs can be arranged according to general of reduction average in a descending order as follows: Program 2 (1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad) > Program 3 (1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad) > Program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) > Program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad) > Program 5 (1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad).

Efficiency Against the Cotton Jassid

Data presented in Table 6 showed that, all tested programs gave sufficient control against cotton jassid *Empoasca lypica* (de Berg) after three sprays. Beta-cyfluthrin, Lufenuron and Chlorpyrifos at the program 1, 4 and 3 gave the best effect (74.88, 74.68 and 73.87%) at 1st spray, respectively, meantime there were no significant differences between both Abamectin at the program 5 and Manf 6 at the program 2 (69.94 and 68.84%), respectively. After treatment with the 2nd Spray, Malathion at the program 1 recorded the highest effect and significantly surpassed than the other treatments 85.34%, while Methoxyfenozide at the program 2 showed that lowest effect 57.18%. The maximum activity of Spinosad was reached its upper limit at the program 1 and 4 at the 3rd Spray.

Statistical analysis of the general of reduction average of the tested programs can be arranged in a descending order as follows: Program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad) ≥ Program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) > Program 5 (1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad) ≥ Program 3 (1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad) > Program 2 (1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad).

Efficiency Against the Cotton Thrips

The results cleared that, program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) was characteristic during all thee sprays against the cotton thrips *Thrips tabaci* (L.) it reached the upper limit of effective 92.11% after the 3rd Spray. In contrary, Program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad) was the lowest one during the same evaluation, it reached the lower limit of effective 43.74% after the 3rd Spray (Table 7) .

The tested programs were arranged according to general of reduction average in a descending order as follows: Program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) > Program 5 (1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad) > Program 2 (1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad) > Program 3 (1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad) > Program 1 (1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad).

Efficiency Against the Spider Mite

The results presented in Table 8 revealed that Abamectin at the program 5 and Chlorpyrifos at the program 3 were the most effective they gave 68.00 and 67.53% reduction in the population density of spider mite *Tetranychus urticae* (Koch) followed by Manf 6 at the program 2 and Beta-cyfluthrin at the program 1 (64.79 and 63.87%), while Lufenuron at the program 4 was the lowest one (58.51%) at 1st Spray. Regarding the 2nd Spray data cleared that all programs have interchanges of arrangement where Methoxyfenozide at the program 2 was recorded the highest effect (77.93%) while Malathion at the program 4 was still the lowest one(62.28%). Concerning the 3rd Spray Spinosad showed reduce in reduction of the population density of spider mite in all programs except with at the program 4.

The efficiency of the tested programs can be arranged according to general of reduction average in a descending order as follows: Program 2 (1st Spray Manf 6, 2nd Spray Methoxyfenozide and 3rd Spray Spinosad) > Program 1(1st Spray Beta-cyfluthrin, 2nd Spray Malathion and 3rd Spray Spinosad) > Program 4 (1st Spray Lufenuron, 2nd Spray Malathion and 3rd Spray Spinosad) ≥ Program 3 (1st Spray Chlorpyrifos, 2nd Spray Manf 6 and 3rd Spray Spinosad) > Program 5 (1st Spray Abamectin, 2nd Spray Alpha-Cypermethrin and 3rd Spray Spinosad).

The most of yield and quality losses are caused by insect pests, such as the cotton bollworms (Kaushik *et al*., 1969). The larvae of pink and spiny bollworms attack plants at the beginning of the fruiting stage causing a huge losses to the cotton green bolls, fibers and seeds and accordingly great reduction in the cotton yield (Taneja and Jayaswal, 1984; Sidhu and Dahawan, 1986; Khurana and Verma, 1990; Romeilah, 1997). From the opening of the first boll until harvest (late season), the cotton crop is most sensitive to whitefly and aphids damage at this time because honeydew can contaminate the exposed cotton lint which reduce quality (Butler *et al*., 1988). Moreover, severe infestations of the jassid, cotton thrips and spider mite in cotton field. Recently, the National Cotton Council estimated that U.S. cotton producers' annual losses to pink bollworm are about $21 million due to prevention, control costs and lower yields caused by plant damage (NCC, 2001). In Egypt, China and Brazil, it commonly causes cotton losses of up to 20%, although losses can be much higher. From ours previous results noticed that the effect of the third spray (Spinosad for all programs) was highly apparent against the pink bollworm larvae when followed by 1st Spray Lufenuron and 2nd Spray Malathion. El-Feel *et al*. (1991) cited that the most appropriate interval between sprays was 2 weeks, with application beginning in July in control of *Pectinophora gossypiella*. Mourad *et al*. (1991) studied the efficiency of four spray sequences of insecticides against *Pectinophora gossypiella* and *Earias insulana* on cotton. They found that Larvin, Tamaron, Dimethoate and Dimethoate sequence was the most effective. Our results in agreement with the finding of Emara *et al*. (2002) they cited that it could be generally recommend, as 1st spray Chlorpyrifos 75WG followed by Sumialfa as 2nd spray followed by Spinosad 24 SC alone or in combination with mineral oil at the last spray in order to achieve the lowest infestations of both bollworms specially spiny bollworm. Also, Temerak (2003) reported that the best program of field rotation trials for control of both bollworms utilized Chlorpyrifos-ethyl mixed with Hexaflumuron, followed by Es-fenvalerate, Profenfos and ending with Spinosad+oil. This program showed 92% reduction. Other programs were in descending order as reduction %; program ending with Carbaryl (88.5), Spinosad alone (77) and Thiodiocarb (69). Abou-Kahla *et al*. (1992) found that the sequence which contain organophosphours compounds had the higher effects against *Empoasca lypica* and *Aphis gossypii*, while *Bemisia tabaci* was more affected by treatments of Tamron combi, Decis and Cyanox.

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