Results and Discussion

IV. RESULTS AND DISCUSSION

1- Evaluation of the tested insecticides against *A. gossypii* and its predators in cotton fields :

The effects of cyanophos (Cyanox 50 % EC), furathiocarb (Deltanet 40 % EC), buprofezin (Applaud 25 % SC), pyriproxyfen (Admiral 10 % EC), imidacloprid (Confidor 35 % EC), abamectin (Vapcomic 1.8 % EC), azadirachtin (Sharachtin 1 % EC) and the mineral oil (KZ oil 95 %) in reducing th population densities of the cotton aphids, *Aphis gossypii* and their side effects on six associated predators were studied under field conditions during two successive seasons (2000- 2001) at Zefta, Gharbia Governorate.

A- Field evaluation of the used insecticides against *A. gossypii*

The biological efficiency of cyanophos (Cyanox), furathiocarb (Deltanet), buprofezin (Applaud), pyriproxyfen (Admiral), imidacloprid (Confidor), abamectin (Vapcomic), azadirachtin (Sharachtin) and mineral oil (KZ oil) against nymphs and adult stages of *A. gossypii*.

Data presented in Table (1) indicate that in general, all insecticides were significantly effective in reducing the aphid numbers as compared with the untreated control. Imidacloprid was the most potent insecticide in reducing aphid numbers, after two days of application, 98.15 and 97.20 % initial reduction after the first and second sprays, respectively, during 2000-season. It was followed by azadirachtin and abamectin, their reduction percentages were 92.59 and 92.52 % & 93.65 and 93.02 % after the first and second sprays, respectively, during the same season. Initial reduction percentages were 72.96, 71.22, 70.66, 64.44 amd 51.04 % for cyanophos, furathiocarb, mineral oil, pyriproxyfen and buprofezin after the first spray. The same trend was observed in the second spray during 2000 cotton season. After 14 days, period of evaluation, imidacloprid

Table (1) : Initial and residual reductions* in *A. gossypii* populations after spraying certain insecticides in cotton fields during 2000 and 2001 seasons at Zefta, Gharbia Governorate.

Season	Insecticides	First spray			Second spray			General mean reduction %
		Mean reduction percentages						
		Initial**	Residual***	Average	Initial	Residual	Average	
2000	Cyanophos	72.96	22.59	47.77b	79.12	37.80	58.46b	53.11e
	Pirimicarb	71.22	25.51	48.36b	80.84	36.02	58.43b	53.39e
	Buprofezin	51.04	83.56	67.30ab	61.82	72.68	67.25b	67.27c
	Pyriproxyfen	64.44	80.17	72.30ab	78.25	87.87	83.06a	77.68b
	Imidacloprid	98.15	76.66	87.40a	97.20	80.12	88.66a	88.03a
	Abamectin	92.52	59.37	75.94ab	93.02	75.56	84.29a	80.11b
	Azadirachtin	92.59	74.10	83.34a	93.65	80.45	87.05a	85.19a
	Mineral oil	70.66	39.20	54.93ab	74.37	47.41	60.89b	57.91d
	L.S.D. at 0.05	-	-	31.12	-	-	17.06	
2001	Cyanophos	71.87	22.42	47.14c	73.75	42.00	57.87d	52.50e
	Pirimicarb	76.00	22.21	49.10c	78.80	44.93	61.86cd	55.48de
	Buprofezin	57.98	80.40	69.19ab	69.04	80.05	74.54ab	71.86c
	Pyriproxyfen	69.98	82.12	76.05a	75.24	82.24	78.74ab	77.39c
	Imidacloprid	96.12	78.20	87.16a	97.20	80.19	88.69a	87.92a
	Abamectin	87.18	61.06	74.12ab	94.69	80.83	87.76a	80.94ab
	Azadirachtin	91.46	67.29	79.37a	95.04	80.94	87.99a	83.68ab
	Mineral oil	68.45	38.73	53.59bc	79.01	57.60	68.30bc	60.94d
	L.S.D. at 0.05	-	-	18.81	-	-	12.63	

*** Means followed by the same letter in each column are not significantly different according to Duncan's multiple range test.**

**** Means after two days of application.**

***** Means are the averages of counts after 5, 8, 11 and 14 days after application.**

a, b = highly toxic. c = moderately toxic d, e = low toxic

induced the highest average reduction in aphid population (87.40 %), followed by azadirachtin (83.34 %), abamectin (75.94 %), pyriproxyfen (72.30 %) and buprofezin (67.30 %). The lowest reduction percentages in aphid populations were obtained after the treatment of the mineral oil, furathiocarb and cyanophos (54.93, 48.36 and 47.77 %, respectively). Similar results were achieved after the second spray in the same cotton season.

The results of 2001-season are also presented in table (1). The obtained data showed that the averages of initial reduction in aphid infestation were 96.12, 91.46, 87.18, 76.00, 71.87, 69.98, 68.45 and 57.98 % after the first spray compared with 97.20, 95.04, 94.69, 78.80, 73.75, 75.24, 79.01 and 69.04 % after the second spray for imidacloprid, azadirachtin, abamectin, furathiocarb, cyanophos, pyriproxyfen, mineral oil and buprofezin, respectively.

After 14 days from application against cotton aphids in the second season, the average reduction percentages were 87.16, 79.37, 76.05, 74.12, 69.19, 53.59, 49.10 and 47.14 % after the first spray and 88.69, 87.99, 78.74, 87.76, 74.54, 68.30, 61.86 and 57.87 % after the second spray for imidacloprid, azadirachtin, pyriproxyfen, abamectin, buprofezin, mineral oil, furathiocarb and cyanophos, respectively.

The general mean reduction percentages in aphid populations after two sprays of the tested insecticides during 2000 and 2001 cotton seasons are presented in Table (1). Statistical analysis of the obtained results showed that the insecticides can be arranged in three groups based on their initial and residual efficiencies against *A. gossypii* as follows; (1) imidacloprid, azadirachtin and abamectin were highly effective with 87.92-88.03 %, 83.68-85.19 % and 80.11-80.94 % reduction, respectively. (2) pyriproxyfen and buprofezin demonstrated good effect 77.39-77.68 % and 67.27-71.86 % reduction, respectively. (3) mineral oil, furathiocarb abd cyanophos were low effective with 57.91-60.94 %, 53.39-55.48 % and 52.50-53.11 % reduction, respectively.

The present results are in agreement with **Selim *et al.* (1991)** who found that Confidor (imidacloprid) was the most efficient insecticide against *A. gossypii*, the general mean reduction percentage ranged between 99.80- 83.72 %. **Shiokaza *et al.* (1994)** found that imidacloprid toxicity against *A. gossypii* was superior to that of standard insecticides such as buprofezin, etofenprox, pirimicarb and cartap. **Wang *et al.* (1995)** stated that cotton aphids were controlled with imidacloprid. After 5 days, control was above 95 %. After 7-10 days, control was still above 90 %. **Omar (1997)** evaluated certain insecticides against *A. gossypii* infesting cotton. Imidacloprid proved to be highly effective against aphids.

Neem extract (azadirachtin) have good to excellent potential in controlling aphids as reported by **Lindquist and Casey (1990)**. Similarly, **Chita *et al.* (1997)** studied the effect of certain plant extracts against *A. gossypii*. They found that the extract of Margossa (*Azadirachta indica*) and other plant extracts gave an overall efficacy of 88.81-90.06 %. **Immaraja (1998)** stated that azadirachtin is an ideal candidate for insecticide resistance, integrated pest control and organic pest control programmes. It exhibits good efficacy against key pests such as whiteflies, leafminers, thrips, aphids and many leaf-eating caterpillars.

The biorational insecticide (abamectin) also provided good to excellent potential against aphids, leafminers, thrips and whiteflies as reported by **Lindquist and Casey (1990)**. The mortality of adult green peach aphid was evaluated after the exposure to five different concentrations of abamectin, bifenthrin, endosulfan and acephate. The recommended concentration of abamectin and endosulfan gave the best results against the aphid **(Shean and Granshaw, 1991)**.

The juvenile hormone mimic (pyriproxyfen) was tested as aphicide on cotton by **Selim *et al.* (1991)**. They showed that pyriproxyfen gave a general mean reduction percentage (76.24 %) in *A. gossypii* population. **Gamal El-Din (1995)** mentioned that the juvenoid

insect growth regulator, pyriproxyfen had the most profound effect on aphids population at the end of the cotton season. **Wood *et al.* (1998)** found that Knack (pyriproxyfen) was effective in reducing the number of offspring produced by adult aphids as well reducing the survival of nymphs to adulthood. Knack was also effective in reducing survival and reproduction when applied to aphid nymphs at one-tenth the label rate.

The insect growth regulator (buprofezin) was less toxic to *A. gossypii* and several insect pests than imidacloprid **(Shiokawa *et al.*, 1994)**. This result agrees with the present study. **Wood *et al.* (1998)** tested the efficacy of Applaud (buprofezin) against nymphs and adults of *A. gossypii*. They found that Applaud reduced the number of offspring produced by adult aphids but the magnitude of this effect was much less than it was with Knack (pyriproxyfen). This result is also in harmony with the data obtained in the present work.

The mineral oil (KZ oil) was low effective against *A. gossypii* with 57.91-60.94 %. This result is in agreement with that reported by **Kandil *et al.* (1991)** and **Nabil *et al.* (1991)** who found that Folk oil (mineral oil) was the least effective treatment against *A. gossypii* infesting cotton. **Selim *et al.* (1991)** stated that mineral oil is not considered satisfactory aphicide on cotton.

The obtained results in the present work are also in harmony with the finding of **Radwan *et al.* (1990)** who mentioned that the carbamate furathiocarb appeared to be somewhat more effective than OP compounds against *A. gossypii* on cotton. They added that most benzoylurea compounds were more effective to control aphid after 7 days of application. On the contrary, Deltanet (furathiocarb) gave an initial kill of > 90 % against *A. gossypii* **(Kandil *et al.*, 1991)**. Deltanet showed high efficiency against both nymphs and adults of *A. gossypii* **(Nabil *et al.*, 1991)**. Deltanet and Marshal were the most toxic compounds against the investigated strains of *A. gossypii* **(Khalafalla and Abo-Sholoa, 1993)**.

B- Evaluation the side effects of the used insecticides on aphid's predators :

B.1- The effect on *Chrysoperla carnea* :

Data presented in Table (2) indicate the side effect of the used insecticides on the population density of the larvae of *Chrysoperla carnea*. Data of the initial reduction percentage showed that cyanophos was the most toxic compound against *Ch. carnea*, as shown by 90.65 and 90.01 % after the first and second sprays, respectively during 2000 cotton season. The lowest initial toxic effect on the predator was achieved by the treatments of buprofezin and pyriproxyfen. These compounds reduced larval density of *Ch. carnea* only by 6.49 and 12.80 % after the first spray and 20.67 and 8.28 % after the second spray, respectively during 2000 season. All other treatments were moderately effective against the chrysopid predator.

The residual toxicity percentages showed that cyanophos still the most toxic compound against *Ch. carnea*, followed by buprofezin, pyriproxyfen and furathiocarb. They reduced larval density by 81.69, 49.51, 48.57 and 40.10 % after the first spray compared with 76.23, 48.35, 52.02 and 40.69 % after the second spray during 2000-season. The lowest residual toxicity percentage was obtained by azadirachtin, this was exemplified by 8.91 after the first spray and 9.27 % after the second spray during the same season.

Also, results in Table (2) show the average reduction percentages of the tested insecticides on the larval stage of *Ch. carnea*. The obtained data revealed that cyanophos was the most harmful compound against the predator, reduction percentages were 86.17 and 83.12 % after the first and second sprays, respectively, during 2000-season. The least toxic effect was achieved by the treatment of azadirachtin, as shown by 15.36 and 9.08 % for the first and second sprays, respectively.

The general mean reduction percentages after two sprays in 2000-season were 84.64, 47.57, 31.25, 30.83, 30.41, 29.69, 23.07 and

Table (2) : Initial and residual reductions* in *C. carnea* populations after spraying certain insecticides in cotton fields during 2000 and 2001 seasons at Zefta, Gharbia Governorate.

Season	Insecticides	First spray			Second spray			General mean reduction %
		Mean reduction percentages						
		Initial	Residual	Average	Initial	Residual	Average	
2000	Cyanophos	90.65	81.69	86.17a	90.01	76.23	83.12a	84.64a
	Pirimicarb	54.62	40.10	47.36b	54.87	40.69	47.78b	47.57b
	Buprofezin	6.49	49.51	28.00c	20.67	48.35	34.51c	31.25c
	Pyriproxyfen	12.80	48.57	30.68c	8.28	52.02	30.15c	30.41c
	Imidacloprid	37.71	21.78	29.74c	40.63	18.68	29.65c	29.69c
	Abamectin	39.49	18.70	29.09c	27.47	6.63	17.05d	23.07d
	Azadirachtin	15.82	8.91	12.36d	8.91	9.26	9.08d	10.72e
	Mineral oil	44.11	12.58	28.34c	54.69	11.95	33.32c	30.83c
	L.S.D. at 0.05	-	-	12.21	-	-	10.52	
2001	Cyanophos	87.61	79.91	83.76a	90.68	84.83	87.84a	85.80a
	Pirimicarb	54.82	37.67	46.24b	52.27	45.25	48.76b	47.50b
	Buprofezin	16.42	37.53	26.97c	7.83	30.45	19.14c	23.05e
	Pyriproxyfen	12.03	44.45	28.24bc	9.30	47.41	28.35bc	28.29d
	Imidacloprid	29.09	20.30	24.69c	27.53	26.19	26.86bc	25.77de
	Abamectin	36.75	22.30	29.52bc	30.44	22.78	26.61bc	28.06d
	Azadirachtin	24.62	8.72	16.67c	21.15	10.35	15.75c	16.21f
	Mineral oil	45.79	22.02	33.90bc	54.51	11.54	33.02bc	33.46c
	L.S.D. at 0.05	-	-	17.00	-	-	20.40	

*** Means followed by the same letter in each column are not significantly different according to Duncan's multiple range test.**

a = highly toxic. b = moderately toxic c, d, e, f = low toxic

10.72 % for cyanophos, furathiocarb, buprofezin, mineral oil, pyriproxyfen, imidacloprid, abamectin and azadirachtin, respectively. The same trend was also obtained during 2001-season. The general mean reduction percentages were 85.80, 47.56, 33.46, 28.29, 28.06, 25.77, 23.05 and 16.21 % for cyanophos, furathiocarb, mineral oil, pyriproxyfen, abamectin, imidacloprid, buprofezin and azadirachtin, respectively.

Statical analysis of data revealed that the used insecticides in 2000 cotton season can be arranged as follows; (1) cyanophos was highly toxic to the larvae of *Ch. carnea* (84.64 %), (2) furathiocarb was moderately toxic (47.57 %). (3) buprofezin, mineral oil, pyriproxyfen, imidacloprid, abamectin and azadirachtin were low toxic with 31.25, 30.83, 30.41, 29.69, 23.07 and 10.72 %, respectively. In 2001-season; (1) again cyanophos was the most toxic compound to the predator (85.80 % reduction). (2) furathiocarb was moderately toxic (47.50 %). (3) mineral oil, pyriproxyfen, abamectin, imidacloprid, buprofezin and azadirachtin were low toxic with 33.46, 28.29, 28.06, 25.77, 23.05 and 16.21 %, respectively.

B.2- The effect on *Coccinella undecimpunctata* :

Data in Table (3) reveal that all tested insecticides reduced the larval and adult numbers of the coccinellid predator *Coccinella undecimpunctata*. The initial reduction percentages showed that cyanophos was the most toxic compound against the predator, while buprofezin was the least toxic. Reduction percentages were 91.48 and 10.85 % after the first spray & 90.12 and 11.11 % after the second spray, respectively, during 2000-season. The same trend was also observed in 2001-season. The average reduction percentages after 15 days from application, are shown in Table (3). Also, the obtained data indicated that cyanophos was the most pronounced toxicant against this predator, as shown by 87.76 and 85.03 % for the first and second sprays, respectively, during 2000-season & 88.16 and 86.80 % for the

Table (3) : Initial and residual reductions* in *C. undecimpunctata* populations after spraying certain insecticides in cotton fields during 2000 and 2001 seasons at Zefta, Gharbia Governorate.

Season	Insecticides	First spray			Second spray			General mean reduction %
		Mean reduction percentages						
		Initial	Residual	Average	Initial	Residual	Average	
2000	Cyanophos	91.48	84.05	87.76a	90.12	79.94	85.03a	86.39a
	Pirimicarb	60.26	26.29	43.27b	65.36	28.27	46.81b	45.04b
	Buprofezin	10.85	41.41	26.13bc	11.11	28.57	19.84c	22.98d
	Pyriproxyfen	17.23	34.30	25.76bc	20.86	34.13	27.49c	26.62d
	Imidacloprid	37.59	20.79	29.19bc	46.45	25.55	36.00b	32.59c
	Abamectin	46.75	17.68	32.21bc	54.44	30.30	42.37b	37.29c
	Azadirachtin	23.13	19.55	21.34bc	23.03	11.57	17.30c	19.32d
	Mineral oil	34.65	4.71	19.68c	30.08	9.74	19.91c	19.79d
	L.S.D. at 0.05	-	-	19.58	-	-	7.03	
2001	Cyanophos	90.93	85.40	88.16a	91.64	81.97	86.80a	87.48a
	Pirimicarb	57.88	35.34	46.61b	60.88	20.62	40.75b	43.68b
	Buprofezin	7.88	22.07	14.97de	15.09	28.66	21.87c	18.42d
	Pyriproxyfen	9.34	29.38	19.36de	18.49	25.54	22.01c	20.68d
	Imidacloprid	28.98	25.34	27.16cd	22.21	20.86	21.53c	24.34d
	Abamectin	46.73	22.26	34.49bc	41.13	13.37	27.25bc	30.87c
	Azadirachtin	17.88	4.40	11.14e	19.52	8.44	13.98c	12.56e
	Mineral oil	36.54	22.26	29.40cd	25.70	11.71	18.70c	24.05d
	L.S.D. at 0.05	-	-	12.46	-	-	14.94	

*** Means followed by the same letter in each column are not significantly different according to Duncan's multiple range test.**

a = highly toxic. b = moderately toxic c, d, e = low toxic

first and second sprays, respectively during 2001-season. According to the statistical analysis of the general mean reduction percentages in 2000-season, the insecticides can be divided into four groups; (1) cyanophos was highly toxic to the predator (86.39 %). (2) furathiocarb was modeartely toxic (45.04 %). (3) abamectin, imidacloprid, pyriproxyfen, buprofezin, mineral oil and azadirachtin were low toxic with 37.29, 32.59, 26.62, 22.98, 19.79 and 19.32 %, respectively. In 2001-season, the insecticides were as following; (1) cyanophos was also highly toxic (87.48 %), (2) furathiocarb was modeartely toxic (43.68 %). (3) abamectin, imidacloprid, mineral oil, pyriproxyfen, buprofezin and azadirachtin were low toxic to the predator with 30.87, 24.34, 24.05, 20.68, 18.42 and 12.56 %, respectively.

B.3- The effects on *Orius albidipennis* :

Data in Table (4) show the initial, residual and average reduction percentages in *Orius albidipennis* populations after spraying the tested insecticides in cotton fields during 2000 and 2001 seasons. The obtained data indicated that the initial reduction percentages of the predator populations in 2000-season were 87.41, 51.83, 29.67, 21.53, 23.80, 39.79, 39.28 and 35.78 % after the first spray compared with 88.00, 48.57, 25.00, 23.63, 23.35, 34.54, 40.00 and 30.00 % after the second spray for cyanophos, furathiocarb, buprofezin, pyriproxyfen, imidacloprid, abamectin, azadirachtin and mineral oil, respectively. The residual reduction percentages were 78.17, 40.22, 33.82, 48.98, 13.67, 19.27, 17.64 and 19.85 % after the first spray and 61.92, 38.96, 30.01, 43.16, 26.19, 15.86, 14.19 and 15.09 % after the second spray for the same insecticides, respectively. The average reduction percentages in *O. albidipennis* populations were 82.79, 46.02, 31.74, 35.25, 18.73, 29.53, 28.46 and 27.81 % after the first spray compared with 74.96, 43.76, 27.50, 33.39, 24.77, 25.20, 27.09 and 22.54 % after the second spray for cyanophos, furathiocarb, buprofezin, pyriproxyfen, imidacloprid, abamectin, azadirachtin and mineral oil, respectively.

Table (4) : Initial and residual reductions* in *O. albidipennis* populations after spraying certain insecticides in cotton fields during 2000 and 2001 seasons at Zefta, Gharbia Governorate.

Season	Insecticides	First spray			Second spray			General mean reduction %
		Mean reduction percentages						
		Initial	Residual	Average	Initial	Residual	Average	
2000	Cyanophos	87.41	78.17	82.79a	88.00	61.92	74.96a	78.87a
	Pirimicarb	51.83	40.22	46.02b	48.57	38.96	43.76b	46.39b
	Buprofezin	29.67	33.82	31.74bc	25.00	30.01	27.50d	29.62d
	Pyriproxyfen	21.53	48.98	35.25bc	23.63	43.16	33.39c	34.32c
	Imidacloprid	23.80	13.67	18.73c	23.35	26.19	24.77d	21.75f
	Abamectin	39.79	19.27	29.53bc	34.54	15.86	25.20d	27.36d
	Azadirachtin	39.28	17.64	28.46bc	40.00	14.19	27.09d	27.77d
	Mineral oil	35.78	19.85	27.81bc	30.00	15.09	22.54d	25.17e
	L.S.D. at 0.05	-	-	16.71	-	-	4.31	
2001	Cyanophos	92.24	77.00	84.62a	86.45	55.83	71.14a	77.88a
	Pirimicarb	55.31	36.00	45.65b	40.90	33.05	36.97b	41.31b
	Buprofezin	26.29	31.51	28.90cd	27.78	25.60	26.69bc	27.79cd
	Pyriproxyfen	15.76	32.59	24.17cd	26.13	44.27	35.20bc	29.68cd
	Imidacloprid	27.13	12.30	19.71d	27.80	27.38	27.59bc	23.65d
	Abamectin	36.68	27.82	32.25c	40.90	28.83	34.86bc	33.55c
	Azadirachtin	33.49	11.48	22.48cd	30.87	16.30	23.58c	23.03d
	Mineral oil	34.05	24.81	29.43cd	32.58	24.53	28.55bc	28.99cd
	L.S.D. at 0.05	-	-	11.18	-	-	11.75	

*** Means followed by the same letter in each column are not significantly different according to Duncan's multiple range test.**

a = highly toxic. b = moderately toxic c, d, e, f = low toxic

In 2001 season, the initial reduction percentages in the predator populations were 92.24, 55.31, 26.29, 15.76, 27.13, 36.68, 33.49 and 34.05 % after the first spray and 86.45, 40.90, 27.78, 26.13, 27.80, 40.90, 30.87 and 32.58 % after the second spray, the residual reduction percentages were 77.00, 36.00, 31.50, 32.59, 12.30, 27.82, 11.48 and 24.81 % after the first spray and 55.83, 33.05, 25.60, 44.27, 27.38, 28.83, 16.30 and 24.53 % after the second spray and the general mean reduction percentages were 77.88, 41.31, 27.79, 29.68, 23.65, 33.55, 23.03 and 28.99 % for cyanophos, furathiocarb, buprofezin, pyriproxyfen, imidacloprid, abamectin, azadirachtin and mineral oil, respectively.

In conclusion, the toxic effect of the used insecticides on *O. albidipennis* during both seasons can be statistically classified into the following groups; (1) cyanophos proved to be highly toxic to *O. albidipennis* (77.88-78.87 %). (2) furathiocarb was moderately toxic (41.31-46.39 %). (3) pyriproxyfen (29.68-34.32 %), abamectin (27.77-33.55 %), buprofezin (27.79-29.62 %), mineral oil (25.17-28.99 %), azadirachtin (23.03-27.77 %) and imidacloprid (21.75- 23.65 %) were low toxic.

B.4- The effect of *Paederus alfierii* :

The initial and residual as well as the average reduction percentages in *Paederus alfierii* populations after spraying the tested insecticides during two successive cotton seasons 2000 and 2001 are presented in Table (5). The initial reduction percentages (after 48 h from application) in plots treated with cyanophos were 80.00 and 70.00 %, furathiocarb (66.67 and 50.00 %), buprofezin (20.00 and 22.00 %), pyriproxyfen (14.28 and 25.00 %), imidacloprid (33.33 and 27.00 %), abamectin (46.67 and 31.00 %), azadirachtin (30.00 and 22.00 %) and mineral oil (33.33 and 29.00 %) after the first spray during 2000 and 2001-seasons, respectively. The residual reduction percentages after the first spray were 57.00 and 49.12 %, 53,91 and 41.81 %, 40.00 and

Table (5) : Initial and residual reductions* in *P. alfierii* populations after spraying certain insecticides in cotton fields during 2000 and 2001 seasons at Zefta, Gharbia Governorate.

Season	Insecticides	First spray			Second spray			General mean reduction %
		Mean reduction percentages						
		Initial	Residual	Average	Initial	Residual	Average	
2000	Cyanophos	80.00	57.00	68.50a	76.67	30.10	53.38a	60.94a
	Pirimicarb	66.67	53.91	60.29a	72.00	33.50	52.75a	56.52a
	Buprofezin	20.00	40.00	30.00b	30.00	27.81	28.90b	29.45cd
	Pyriproxyfen	14.28	44.24	29.26b	16.00	33.50	24.75b	27.01d
	Imidacloprid	33.33	20.11	26.72b	35.33	21.73	28.57b	27.64d
	Abamectin	46.67	33.61	40.14ab	44.00	33.50	38.75ab	39.44b
	Azadirachtin	30.00	24.72	27.36b	36.00	13.50	24.75b	26.05d
	Mineral oil	33.33	25.76	29.54b	31.33	31.45	31.39ab	30.46cd
	L.S.D. at 0.05	-	-	22.08	-	-	20.71	[illegible]
2001	Cyanophos	70.00	49.12	59.56a	67.85	35.71	51.78a	55.67a
	Pirimicarb	50.00	41.81	45.90b	50.00	35.41	42.70ab	44.30b
	Buprofezin	22.00	29.57	25.78cd	16.67	30.55	23.61c	24.69d
	Pyriproxyfen	25.00	36.19	30.59c	25.62	27.34	26.48c	28.53c
	Imidacloprid	27.00	15.55	21.27cd	26.25	17.65	21.90c	21.58d
	Abamectin	31.00	28.14	29.57cd	43.75	26.59	35.17bc	32.37c
	Azadirachtin	22.00	17.60	19.80d	20.00	25.00	22.50c	21.15d
	Mineral oil	29.00	27.06	28.03cd	25.00	37.50	31.25bc	29.64c
	L.S.D. at 0.05	-	-	8.94	-	-	13.60	[illegible]

*** Means followed by the same letter in each column are not significantly different according to Duncan's multiple range test.**

a, b = highly toxic. c = moderately toxic d = low toxic

29.57 %, 44.24 and 36.19 %, 20.11 and 15.55 %, 33.61 and 28.14 %, 24.72 and 17.60 % & 25.76 and 27.06 % for cyanophos, furathiocarb, buprofezin, imidacloprid, abamectin, azadirachtin and mineral oil during 2000 and 2001 seasons, respectively. The average reduction percentages after the first spray were 68.50 and 59.56 %, 60.29 and 45.90 %, 30.00 and 25.78 %, 29.26 and 30.59 %, 26.72 and 21.27 %, 40.14 and 29.57 %, 27.36 and 19.80 & 29.54 and 28.03 % for the aforementioned insecticides during 2000 and 2001 seasons, respectively. The average reduction percentages in *P. alfierii* populations after the second spray were 53.38 and 51.78 %, 52.57 and 42.70 %, 28.90 and 23.61 %, 24.75 and 26.48 %, 28.57 and 21.90 %, 38.75 and 35.17 %, 24.75 and 22.50 % & 31.39 and 31.25 % during 2000 and 2001-season for cyanophos, furathiocarb, buprofezin, pyriproxyfen, imidacloprid, abamectin, azadirachtin and mineral oil, respectively

According to the statistical analysis of data, the used insecticides can be classified as follows; (1) cyanophos and furathiocarb represent the highly toxic effect on *P. alfierii* (55.67-60.94 % and 44.30-56.52 %, respectively). (2) abamectin and mineral oil were moderately toxic (32.37-39.44 % and 29.64-30.46 %, respectively). (3) buprofezin, pyriproxyfen, imidacloprid and azadirachtin were low toxic (24.79-29.45 %, 27.01-28.53 %, 21.58-27.64 % and 21.15-26.05 %), respectively.

B.5- The effect on *Scymnus interruptus* :

Data presented in Table (6) showed that cyanophos and pirimicarb were drastically toxic against *Scymnus interruptus* than the other insecticides. A significant decrease in the predator populations was observed after two sprays either in 2000 or 2001 cotton seasons as compared with the other used insecticides. The average reduction percentages during 2000-season were 70.00, 73.33, 33.12, 36.61, 38.39, 27.38, 34.71 and 45.00 % after the first spray and 67.18, 55.83,

Table (6) : Initial and residual reductions* in *S. interruptus* populations after spraying certain insecticides in cotton fields during 2000 and 2001 seasons at Zefta, Gharbia Governorate.

Season	Insecticides	First spray			Second spray			General mean reduction %
		Mean reduction percentages						
		Initial	Residual	Average	Initial	Residual	Average	
2000	Cyanophos	55.56	84.44	70.00a	70.00	64.37	67.18a	68.59a
	Pirimicarb	66.67	80.00	73.33a	60.00	51.66	55.83ab	64.58a
	Buprofezin	25.00	41.25	33.12b	20.00	34.16	27.08c	30.10c
	Pyriproxyfen	24.28	48.95	36.61b	28.00	40.50	34.25c	33.43c
	Imidacloprid	55.56	21.22	38.39b	52.00	21.50	36.75c	37.56bc
	Abamectin	33.33	21.44	27.38b	40.00	37.08	38.54c	32.96c
	Azadirachtin	33.33	36.10	34.71b	40.00	27.10	33.55c	34.13c
	Mineral oil	55.56	34.44	45.00b	60.00	21.66	40.83bc	42.91b
	L.S.D. at 0.05	-	-	20.67	-	-	15.67	
2001	Cyanophos	58.33	89.58	73.95a	60.00	84.66	72.33a	73.14a
	Pirimicarb	57.50	77.91	67.70a	63.33	76.64	69.98a	68.84b
	Buprofezin	27.08	37.50	32.29b	24.28	29.51	26.89b	29.59de
	Pyriproxyfen	25.50	38.86	32.18b	20.00	31.11	25.55b	28.86de
	Imidacloprid	37.50	19.26	28.38b	42.85	25.23	34.04b	31.21de
	Abamectin	38.76	22.58	30.67b	40.00	26.66	33.33b	32.00d
	Azadirachtin	31.65	25.26	28.45b	34.28	19.51	26.89b	27.67e
	Mineral oil	46.67	30.55	38.61b	43.33	27.77	35.55b	37.08c
	L.S.D. at 0.05	-	-	16.14	-	-	13.90	

*** Means followed by the same letter in each column are not significantly different according to Duncan's multiple range test.**

a, b = highly toxic. **c, d, e = moderately toxic**

27.08, 34.25, 36.75, 38.54, 33.55 and 40.83 % after the second spray for cyanophos, furathiocarb, buprofezin, imidacloprid, abamectin, azadirachtin and mineral oil, respectively. In 2001 season, the average reduction percentages (after 15 days from application) were 73.95, 67.70, 32.29, 32.18, 28.38, 30.67, 28.45 and 38.61 % after the first spray as compared with 72.33, 69.98, 26.89, 25.55, 34.04, 33.33, 26.89 and 35.55 % after the second spray for the aforementioned insecticides, respectively. Statistically, the used insecticides can be arranged into two groups; (1) Highly toxic compounds include cyanophos and furathiocarb (68.59-73.14 % and 64.58-68.84 %, respectively). (2) Moderately toxic compounds include mineral oil (42.91-45.00 %), abamectin (32.00-32.96 %), imidacloprid (31.12-37.57 %), buprofezin (29.59-30.10 %), pyriproxyfen (28.86-35.43 %) and azadirachtin (27.67-34.12 %).

B.6- The effect on *Syrphus corollae* :

The toxic effects of the tested insecticides against *Syrphus corollae* are presented in Table (7). The obtained data showed that cyanophos was the most toxic compound against the predator, whereas imidacloprid was the lowest toxic compound after the first spray either in 2000 or 2001 season. The average reduction percentages were 61.45 and 17.05 % in the first season & 56.92 and 17.92 % in the second season for cyanophos and imidacloprid, respectively. The same trend was also observed after the second spray. Furathiocarb, buprofezin, pyriproxyfen, abamectin, azadirachtin and mineral oil showed moderately toxic effect against *S. corollae*. The average reduction percentages after the first spray were 45.51, 32.61, 36.94, 29.79, 34.44 and 25.52 % in the first season and 42.79, 28.92, 30.92, 31.28, 32.73 and 26.36 % in the second season for the forementioned insecticides, respectively. The same trend was also observed after the second spray.

The statistical analysis of data revealed that the insecticides can be classified as follows; (1) cyanophos (52.90-54.77 %) and

Table (7) : Initial and residual reductions* in *S. corollae* populations after spraying certain insecticides in cotton fields during 2000 and 2001 seasons at Zefta, Gharbia Governorate.

Season	Insecticides	First spray			Second spray			General mean reduction %
		Mean reduction percentages						
		Initial	Residual	Average	Initial	Residual	Average	
2000	Cyanophos	75.00	47.91	61.45a	66.67	29.52	48.09a	54.77a
	Pirimicarb	50.00	41.03	45.51ab	50.00	37.50	43.75ab	44.63ab
	Buprofezin	20.00	45.23	32.61bc	23.33	27.78	25.55c	29.08c
	Pyriproxyfen	16.67	57.21	36.94bc	26.33	38.89	32.61bc	34.77bc
	Imidacloprid	25.00	9.10	17.05c	30.00	13.24	21.62c	19.33c
	Abamectin	33.33	26.25	29.79bc	33.33	16.66	24.99c	27.39c
	Azadirachtin	50.00	18.89	34.44bc	46.67	25.00	35.83bc	35.13bc
	Mineral oil	33.33	17.72	25.52bc	40.00	17.49	31.94bc	28.73c
	L.S.D. at 0.05	-	-	21.53	-	-	13.21	
2001	Cyanophos	70.00	43.85	56.92a	68.33	29.45	48.89a	52.90a
	Pirimicarb	40.00	45.58	42.76b	44.44	34.02	39.23ab	41.01b
	Buprofezin	26.00	31.85	28.92bc	20.00	29.99	24.99bc	26.95de
	Pyriproxyfen	25.00	35.47	30.23bc	16.67	34.89	25.78bc	28.00de
	Imidacloprid	24.00	11.85	17.92c	33.33	8.33	20.83c	19.37f
	Abamectin	40.00	22.57	31.28bc	37.50	16.66	27.08bc	29.18d
	Azadirachtin	50.00	15.47	32.73bc	48.33	24.47	36.40ab	34.56c
	Mineral oil	35.00	17.73	26.36c	30.00	17.50	23.75bc	25.05e
	L.S.D. at 0.05	-	-	13.92	-	-	16.05	

*** Means followed by the same letter in each column are not significantly different according to Duncan's multiple range test.**

a, b = highly toxic. **c, d, e, f = moderately toxic**

furathiocarb (41.01-44.63 %) were moderately toxic. (2) azadirachtin (34.56-35.13 %), pyriproxyfen (28.00-34.77 %), buprofezin (26.95-29.08 %), abamectin (27.39-29.18 %), mineral oil (25.05-28.73 %) and imidacloprid (19.33-19.37 %) were low toxic.

Concerning the toxic effects of the tested insecticides against the aphids predators, the obtained results are in agreement with those obtained by **Mizell and Sconyers (1992)** who revealed that imidacloprid had little impact on *Chrysoperla rufilabris*. **Omar *et al.* (1997)** found that imidacloprid caused the lowest percentage reduction in *Coccinella undecimpunctata, Scymnus interruptus* and *Chrysoperla carnea* populations.

Lowery and Isman (1995) stated that neem (*Azadirachta indica*) seed oil completely prevented adult eclosion of *Coccinella undecimpunctata*. They added that neem insecticides may be suitable for use in IPM programmes, as under field use, they appear to be relatively harmless to aphid predators and parasites. **Kumar and Babu (1996)** mentioned that commercial neem formulations were safe to larvae of the predatory green lacewing, *Chrysopa carnea* but egg-laying was adversely affected to some extent. **Schmutterer (1997)** reported that neem products are safe to adults of numerous beneficial insect species and eggs of many predators such as coccinellids. **Chakraborti and Chatterjee (1999)** found that all formulations of neem tested were safe to the lady bird predators, *Coccinella septempunctata* and other *Coccinella* sp. **Vekaria and patel (2000)** revealed that the plant extract Neemol was less toxic to *Diaeretiella rapae* and *Coccinella septempunctata* than the chemical insecticides.

Badawy and El-Arnaouty (1999) found that the biocide (abamectin) was less toxic to eggs and larvae of *Chrysoperla carnea* than organophosphorus and carbamates.

Nagai (1991) found that the two insect growth regulators, buprofezin and pyriproxyfen left a large number of *Orius* sp. on the eggplant. While in the chemical control program, the predator

population was inhibited. **Olszak *et al.* (1994)** reported that pyriproxyfen exerted a relatively low influence on adult coccinellids.

El-Hamady (1998) mentioned that Super Royal (the petroleum oil) was less toxic than Tokuthion (the organophosphate) against the predatory insects, *Coccinella undecimpunctata* and *Paederus alfierii*.

Finally, **Badawy and El-Arnaouty (1999)** tested three groups of insecticides (organophosphorus, carbamates and biocides) in the laboratory for toxicity to eggs and larvae of *Chrysoperla carnea*. They found that carbamates were less toxic than organophosphorus, but still more than biocides. These results coincide with the obtained data during the present study.

Generally, it can be concluded that, field evaluation of the used insecticides during two successive seasons (2000-20001) showed that the organophos-phate (cyanophos) was low effective against *A. gossypii*, highly toxic to *C. carnea, C. undecimpunctata, O. albidipennis, P. alfierii, S. interruptus* and *S. corollae*. The carbamate (furathiocarb) was low effective against *A. gossypii*, toxic to *C. carnea, C. undecimpunctata, O. albidipennis* and *S. corollae* and highly toxic to both *P. alfierii* and *S. interruptus*. The insect growth regulator (buprofezin) was moderately effective against *A. gossypii*, moderately toxic to *C. undecimpunctata, O. albidipennis* and *S. interruptus* and low toxic to *C. undecimpunctata* and *P. alfierii*. The juvenile hormone mimic (pyriproxyfen) was moderately effective against *A. gossypii*, moderately toxic to *Ch. carnea, O. albidipennis, S. interruptus* and *S. corollae* and low toxic to *C. undecimpunctata* and *P. alfierii*. The imidazole (imidacloprid) was highly effective against *A. gossypii*, moderately toxic to *Ch. carnea, S. interruptus* and low toxic to *C. undecimpunctata, O. albidipennis, P. alfierii* and *S. corollae*. The produced compound by the soil microorganisms, *Streptomyces avermitilis* (abamectin) was moderately effective against *A. gossypii*, moderately toxic to *C. carnea, C. undecimpunctata, O. albidipennis, P. alfierii, S. interruptus* and *S. corollae*. The plant extract (azadirachtin) was highly effective against *A. gossypii*, low toxic to *Ch.*

carnea, *C. undecimpunctata*, *O. albidipennis*, *P. alfierii* and moderately toxic to both *S. interruptus* and *S. corollae*. The mineral oil (KZ-oil) was moderately effective against *A. gossypii*, moderately toxic to *Ch. carnea*, *O. albidipennis*, *P. alfierii*, *S. interruptus* and *S. corollae* and low toxic to *C. undecimpunctata*.

According to the effectiveness of the used insecticides against *A. gossypii* and their side effects on the associated predators, the obtained results of imidacloprid, azadirachtin, pyriproxyfen and buprofezin reveal that they can serve as environmentally acceptable controlling tools for incorporation in integrated pest management programmes against this pest.

2- Efficiency of the tested insecticides on the population densities of *A. gossypii* and its predators in cotton fields :

2.a- *A. gossypii* :

The tested insecticides were applied in 22/6/2000 and 10/8/2000 in the first season, after 105 and 150 days from sowing date.

Data. *gossypii* had two peaks, the first one was on 30*th* June (82.75 insect/25 plant leaves) and the second on 18*th* August (269.50 insect/25 plant leaves) during the first season, 2000.

In general, all insecticides significantly reduced the total number of aphids as compared with the untreated control. Azadirachtin was the most effective in reducing aphid population (332.50 insect/25 plant leaves), followed by imidacloprid, buprofezin and pyriproxyfen, the average numbers of aphids were 20.76, 23.26 and 23.98 insect/25 plant leave, respectively and there were no significant differences between these treatments. Abamectin came next (24.67 insect/25 plant leaves). Mineral oil, cyanophos and furathiocarb caused the lowest population densities of aphids (30.00, 32.46 and 33.46 insect/25 plant leaves, respectively). The total mean number of aphids in untreated control was 77.73.

In 2001 cotton season, Table (9) and Figs. (3 & 4) indicate that *A. gossypii* had two peaks, the first in 29/6/2001 (82.25 insect/25 plant leaves) and the second in 17/8/2001 (224.00 insect/25 plant leaves). Imidacloprid and azadirachtin were the most effective compounds in reducing the aphid populations. The avarage number of aphids per 25 plant leaves were 20.28, 22.50 and 64.60 in imidacloprid, azadirachtin and untreated plots, respectively

Although there were no significant differences in the efficiency between imidacloprid and azadirachtin, but they were significantly superior to other insecticidal treatments in 2001 where they caused a sharp drop in the aphid numbers after one week from the first application, a gradual increase in the numbers of aphids began from

Table (8): Weekly mean number *A. gossypii* individuals per 25 plant leaves on cotton plants treated with different insecticides, during 2000 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	8	5.75	5.50	5.75	5.50	6.25	6.75	5.50	6.25	5.00
	15	21.25	21.75	20.75	20.25	20.00	18.50	10.25	21.25	22.25
	22	54.75	55.50	53.75	55.50	52.00	55.00	55.50	53.25	54.00
	30	17.50	22.75	9.00	5.00	6.00	8.00	1.25	17.75	82.75
July	6	23.75	32.25	8.75	12.00	4.75	14.50	7.75	27.50	79.25
	13	19.75	20.75	7.00	7.75	2.25	11.00	5.25	21.75	74.75
	20	24.25	24.25	16.50	15.25	5.50	25.25	6.50	30.00	28.75
	27	34.50	35.00	31.25	29.00	34.00	35.25	20.50	36.25	35.75
August	3	40.00	40.50	39.00	39.75	41.00	44.00	40.75	41.50	45.50
	10	140.25	1380.00	137.25	143.00	139.00	139.25	141.00	133.50	151.00
	18	37.50	38.75	19.50	14.25	9.00	6.75	4.75	25.75	269.50
	24	48.75	52.00	16.00	12.00	8.00	15.25	13.50	33.00	158.00
	31	30.50	30.25	11.00	7.50	4.00	7.75	11.75	20.00	30.25
September	7	21.00	18.25	8.25	5.50	0.50	7.50	8.25	12.25	23.25
	14	0	0	0	0	0	0	0	0	0
Total number		519.50	535.50	383.75	372.25	332.25	394.75	332.50	480.00	1210.00
Average		32.46 b	33.46 b	2.3.98 d	23.26 d	20.76 e	24.67 d	20.78 e	30.00 c	77.73 a

L.S.D. at 0.05 = 1.97

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(1) Weekly number of A.gossypii individuals per 25 plant leaves on cotton plants treated with various insecticides in 22/6 and 10/8/2000.

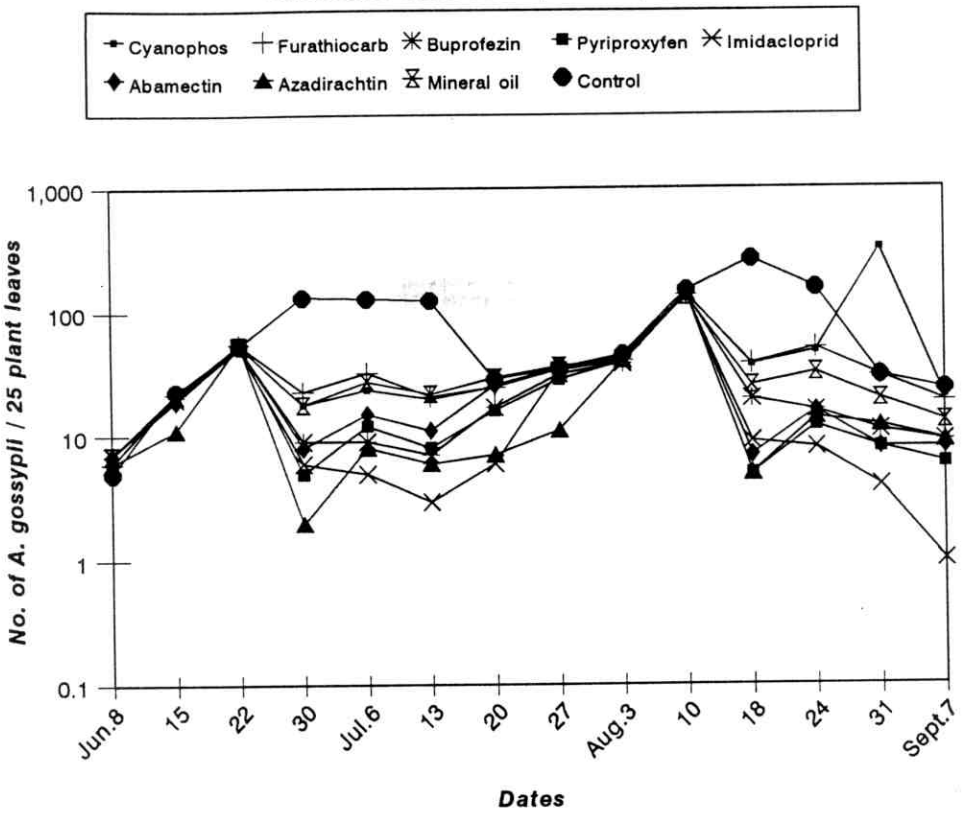


Fig.(2) Average number of A. gossypii individuals per 25 plant leaves on cotton plants treated with various insecticides during 2000 season.

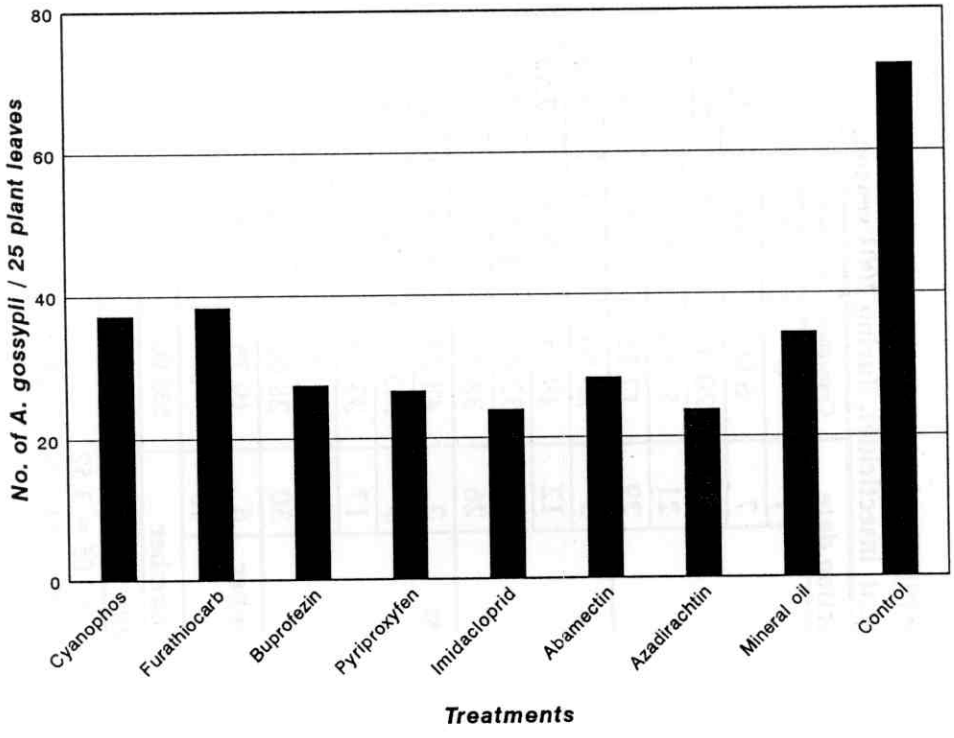


Table (9): Weekly mean number of *A. gossypii* individuals per 25 plant leaves on cotton plants treated with different insecticides, during 2001 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	7	6.00	7.00	6.00	5.75	5.50	5.00	6.00	6.00	6.00
	14	20.00	17.75	20.25	20.50	8.75	20.75	8.75	19.50	24.00
	21	55.50	56.50	54.75	54.75	53.00	50.50	52.75	56.00	56.00
	29	17.25	23.75	9.25	4.50	2.00	7.25	1.75	17.00	82.25
July	5	23.50	33.50	9.50	11.50	4.25	13.50	8.50	29.25	80.25
	12	19.75	26.50	7.50	9.25	11.00	10.50	6.00	21.25	76.00
	19	32.00	32.50	16.50	19.50	14.50	28.00	14.25	32.25	33.50
	26	38.75	38.00	34.50	33.25	28.50	40.75	21.50	40.75	38.00
August	2	48.25	50.00	48.75	50.25	30.00	51.50	30.50	50.50	47.50
	9	145.75	144.25	143.23	147.25	142.75	143.00	145.75	141.00	150.50
	17	33.50	39.25	20.25	14.75	9.75	7.75	5.75	26.75	224.00
	23	51.00	53.25	17.25	13.00	9.00	16.75	14.25	37.00	159.75
	30	28.00	27.50	11.50	8.75	5.00	13.25	10.50	24.25	32.00
September	6	19.75	15.25	7.50	5.75	0.50	7.50	6.25	13.50	24.00
	13	0	0	0	0	0	0	0	0	0
Total number		539.00	565.00	406.75	398.75	324.50	420.00	332.50	515.00	1033.75
Average		33.68 b	35.31 b	25.42 c	24.92 c	20.28 d	27.51 c	22.50 d	32.18 b	64.60 a

L.S.D. at 0.05 = 3.52

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(3) Weekly number of A.gossypii individuals per 25 plant leaves on cotton plants treated with various insecticides in 21/6 and 9/8/2001.

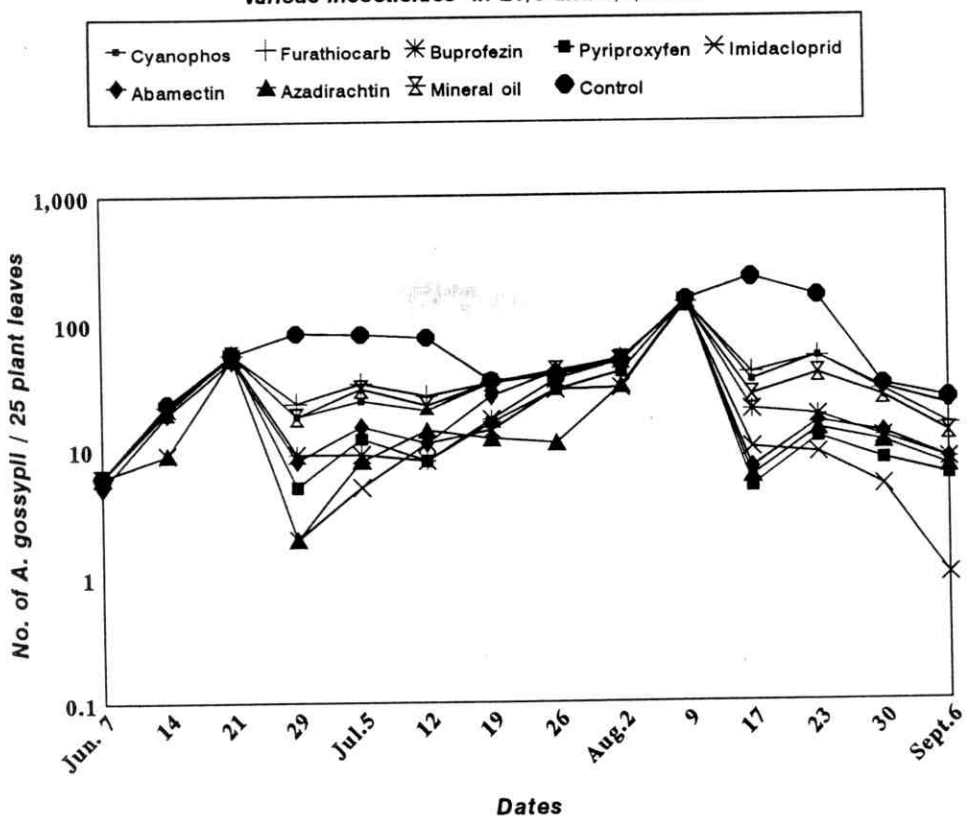
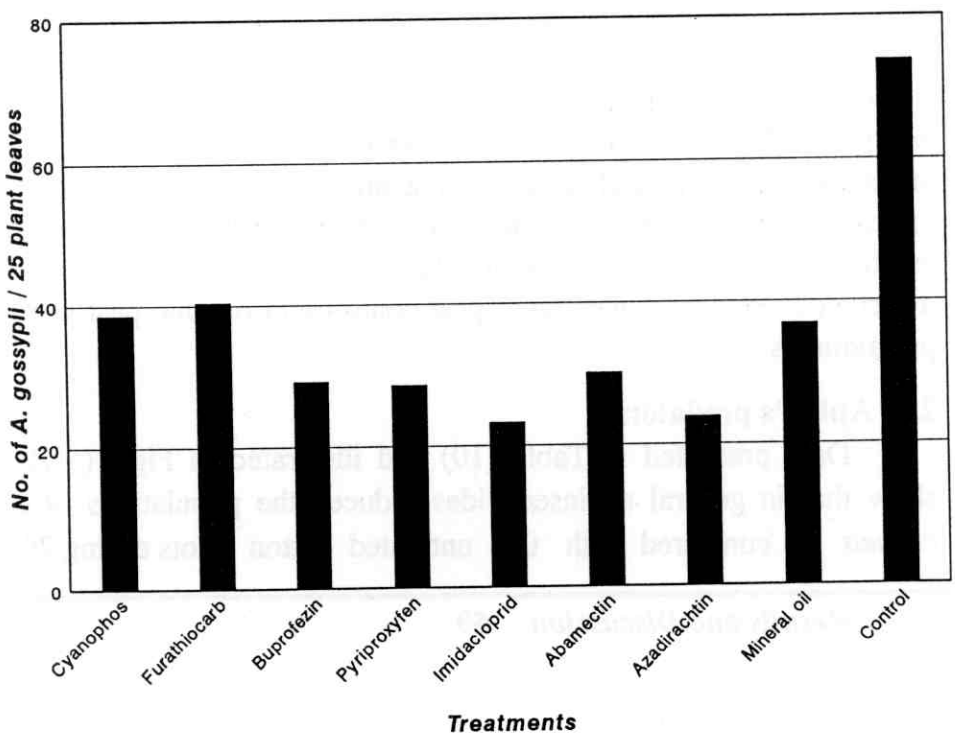


Fig.(4) Average number of A. gossypii individuals per 25 plant leaves on cotton plants treated with various insecticides during 2001 season.



the second week from application and continued up to 9/8/2001, the date of the second application (the number of aphids reached about 150 insect/25 plant leaves). Another sharp decrease in the number of aphids was achieved after one week from the second applications of imidacloprid and azadirachtin, these decreases continued up to the end of the cotton season 2001. The same trend was also observed after the other insecticidal applications but in less magnitude. Pyriproxyfen, buprofezin and abamectin came next in their efficiencies in reducing the populations size of aphids, the average numbers of aphids per 25 plant leaves were 24.92, 25.42 and 27.51. There were no significant differences between the three treatments. While the mineral oil, cyanophos and furathiocarb revealed the least effectiveness against *A. gossypii* during 2001 cotton season.

After the application of the tested insecticides during two successive cotton seasons it can be said that azadirachtin and imidacloprid were the most effective compounds against *A. gossypii*, followed by pyriproxyfen, buprofezin and abamectin. However; mineral oil, cyanophos and furathiocarb were the least effective compounds against *A. gossypii*. These results are in agreement with those obtained by **Shiokawa *et al.* (1994)** who found that imidacloprid toxicity against cotton aphid was superior to that of conventional insecticides. **Omar (1997)** mentioned that imidacloprid at the rates of 21 and 42 g a.i./feddan proved to be highly effective against *A. gossypii*. **Chitra *et al.* (1997)** reported that neem extracts were effective in controlling *A. gossypii* infesting cotton. **Immaraju (1998)** indicated that azadirachtin had insect growth regulator activity. It exhibited good efficacy against aphids and it can be ideal candidate for insecticide resistance, integrated pest control and organic pest control programmes.

2.b- Aphid's predators :

Data presented in Table (10) and illustrated in Figs. (5 & 6) show that in general all insecticides reduced the populations of *Ch. carnea* as compared with the untreated cotton plots during 2000

Table (10): Weekly mean number of *C. carnea* larvae per 25 plant leaves on cotton plants treated with different insecticides, during 2000 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	8	3.00	4.00	3.50	4.50	4.75	4.50	4.00	4.25	4.00
	15	5.00	5.00	5.50	6.50	5.75	6.25	6.25	7.00	6.00
	22	8.50	8.75	8.25	8.50	8.00	8.75	8.25	9.00	9.00
	30	1.00	1.00	4.00	1.25	3.75	4.50	7.50	7.75	9.50
July	6	2.75	2.50	7.00	7.00	8.75	7.75	9.25	9.25	11.00
	13	6.50	5.25	8.50	9.25	10.00	9.00	10.75	11.00	12.50
	20	8.00	8.75	10.75	11.00	12.25	10.25	12.25	12.75	13.25
	27	10.50	11.25	13.50	13.50	15.00	12.00	13.75	14.00	15.00
August	3	14.25	13.50	15.75	14.75	15.25	14.50	15.50	15.25	15.75
	10	15.25	15.75	16.00	15.50	17.25	15.75	17.00	16.25	16.50
	18	2.00	1.00	6.25	5.25	9.25	8.00	16.50	15.75	14.75
	24	4.25	5.00	13.25	12.50	18.50	15.50	18.00	16.75	16.75
	31	4.75	7.25	17.00	16.50	19.50	13.00	20.00	18.25	17.25
September	7	5.00	8.75	13.00	12.00	14.00	12.00	15.75	14.75	14.00
	14	1.00	2.00	3.00	3.00	4.00	5.00	3.00	5.00	6.00
Total number		91.75	99.75	145.25	141.00	166.00	146.75	177.75	177.00	181.25
Average		5.73 c	6.23 c	9.07 b	9.4 b	11.06 ab	10.42 ab	11.85 a	11.8 a	12.08 ±0.51 a

L.S.D. at 0.05 = 1.25

Means followed by the same letter are not significantly different according to Duncan's multiple range test

Fig.(5) Weekly number of C.carnea larvae per 25 plant leaves on cotton plants treated with various insecticides in 22/6 and 10/8/2000.

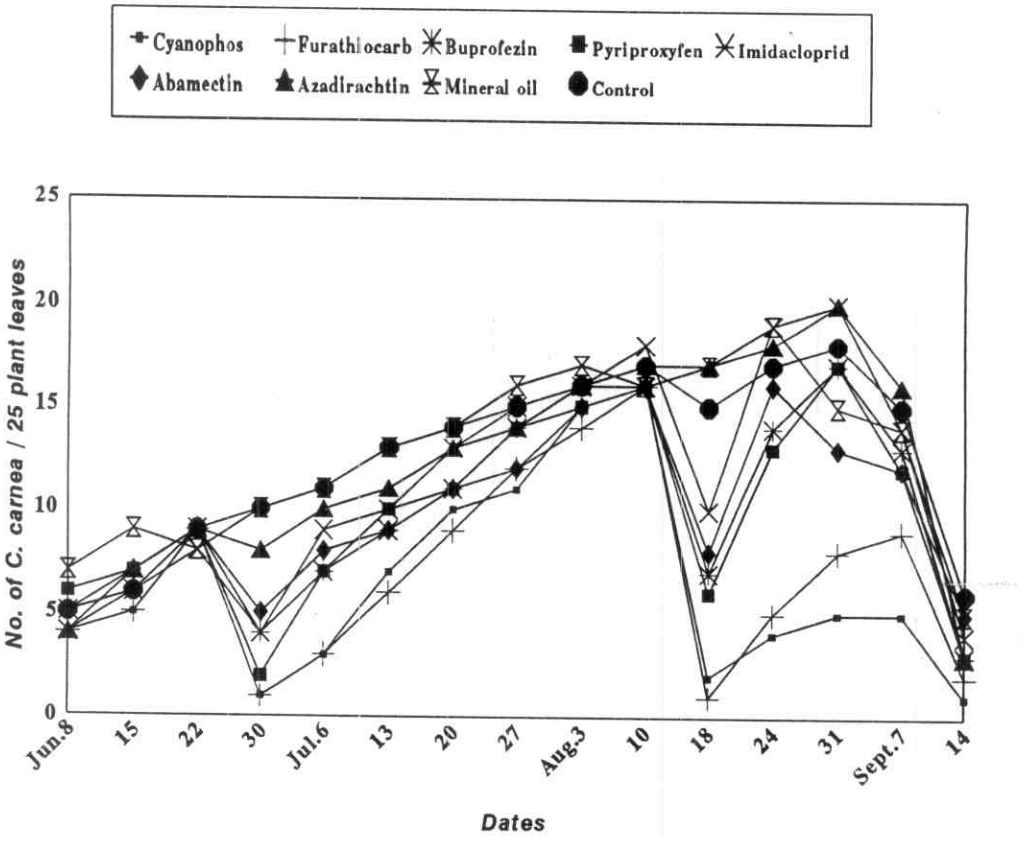
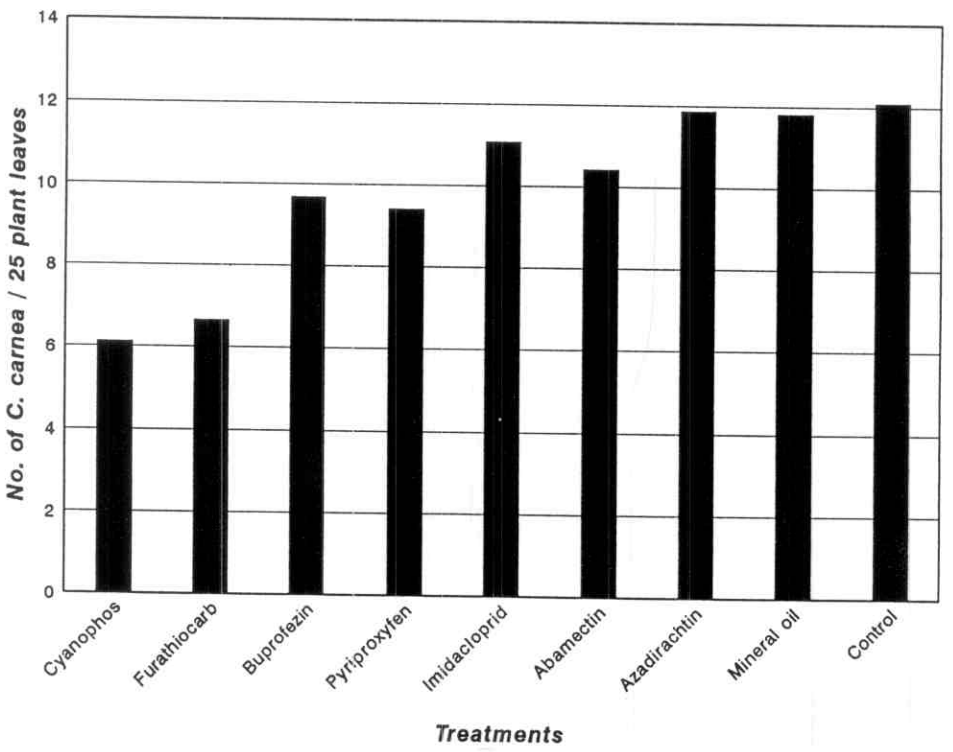


Fig.(6) Average number of C. carnea larvae per 25 plant leaves on cotton plants treated with various insecticides during 2000 season.



during 2000 cotton season. This decrease was not significant in the plots treated with azadirachtin, imidacloprid and mineral oil. The avarage numbers of larvae per 25 plant leaves were 11.10, 11.06 and 10.37, respectively; while it was 11.32 in untreated control. A moderate decrease in the average numbers of *Ch. carnea* was obtained after the treatments of abamectin, buprofezin and pyriproxyfen (9.12, 9.07 and 8.81 larvae/25 plant leaves, respectively). The plots treated with furathiocarb and cyanophos showed a sharp decrease in the populations size of *Ch. carnea*, the average numbers were 6.23 and 5.73 larvae/25 plant leaves, respectively.

In 2001 cotton season, Table (11) and Figs. (7 & 8) show that the first occurrence of the predator *Ch. carnea* was recorded in early June and extended until the second week of September, the average number was 12.73 larvae/25 plant leaves in the untreated plots. All insecticides significantly reduced the predator numbers, the least reductions were achieved by the application of mineral oil, imidacloprid and azadirachtin, the average numbers of predators were 11.54, 10.96 and 10.89 larvae/25 plant leaves, respectively.

A moderate reduction in the numbers of *Ch. carnea* was shown after the applications of abamectin, buprofezin and pyriproxyfen (8.98, 8.89 and 8.57 larvae/25 plant leaves, respectively). A sharp decrease in the numbers of *Ch. carnea* was examined after one week from either the first or the second application of cyanophos and furathiocarb as compared with the other insecticidal applications (Table, 11). The average numbers of predators were 5.59 and 6.14 larvae/25 plant leaves, respectively.

The effectiveness of the tested insecticides on the population density of *Coccinella undecimpunctata* are shown in Tables (12 & 13) and Figs. (9 & 12), whereas the weekly mean numbers of *C. undecimpunctata* had only one brood period during season 2000. This extended from 8/6 until 14/9, one peak was observed in 10/8 (32.00 individuals/25 plant leaves) in untreated plots, the average number was

Table (11): Weekly mean number of *C. carnea* larvae per 25 plant leaves on cotton plants treated with different insecticides, during 2001 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	7	3.50	4.25	4.00	4.75	4.25	4.25	4.50	4.50	4.50
	14	5.25	6.25	5.25	6.50	6.00	6.25	6.00	6.75	6.25
	21	9.00	9.25	9.00	9.50	8.25	9.25	8.50	9.25	9.75
	29	1.00	1.00	4.50	3.25	5.50	4.75	8.00	7.25	9.50
July	5	2.25	2.00	7.75	7.25	12.25	7.25	9.50	9.00	12.00
	12	6.75	4.75	8.25	8.50	13.75	9.25	10.25	10.50	13.25
	19	8.00	7.75	10.50	10.25	14.25	10.25	12.00	11.75	14.50
	26	10.25	11.50	12.75	11.00	15.75	12.50	13.25	13.00	15.25
August	2	13.00	13.75	13.25	13.50	16.50	13.75	15.00	15.25	16.00
	9	14.75	15.25	15.50	15.75	17.25	15.50	16.75	16.00	17.25
	17	1.00	1.00	5.75	4.50	6.50	7.50	15.75	15.25	15.25
	23	3.00	3.75	13.50	12.00	17.00	12.00	17.75	17.25	18.00
	30	5.25	8.00	15.50	14.50	17.50	14.50	18.25	18.50	20.25
September	6	4.00	6.75	14.75	13.00	16.50	13.75	14.00	15.50	17.50
	13	2.50	3.00	2.00	3.00	3.00	3.00	6.00	4.00	3.00
Total number		89.50	98.25	142.25	137.25	174.25	143.75	175.50	173.75	192.25
Average		5.59 c	6.14 c	8.89 b	8.57 b	10.89 a	8.98 b	10.96 a	11.54 a	12.73 a

L.S.D. at 0.05 = 1.27

Means followed by the same letter are not significantly different according to Duncan's multiple range test

Fig.(7) Weekly number of C.carnea larvae per 25 plant leaves on cotton plants treated with various insecticides in 21/6 and 9/8/2001.

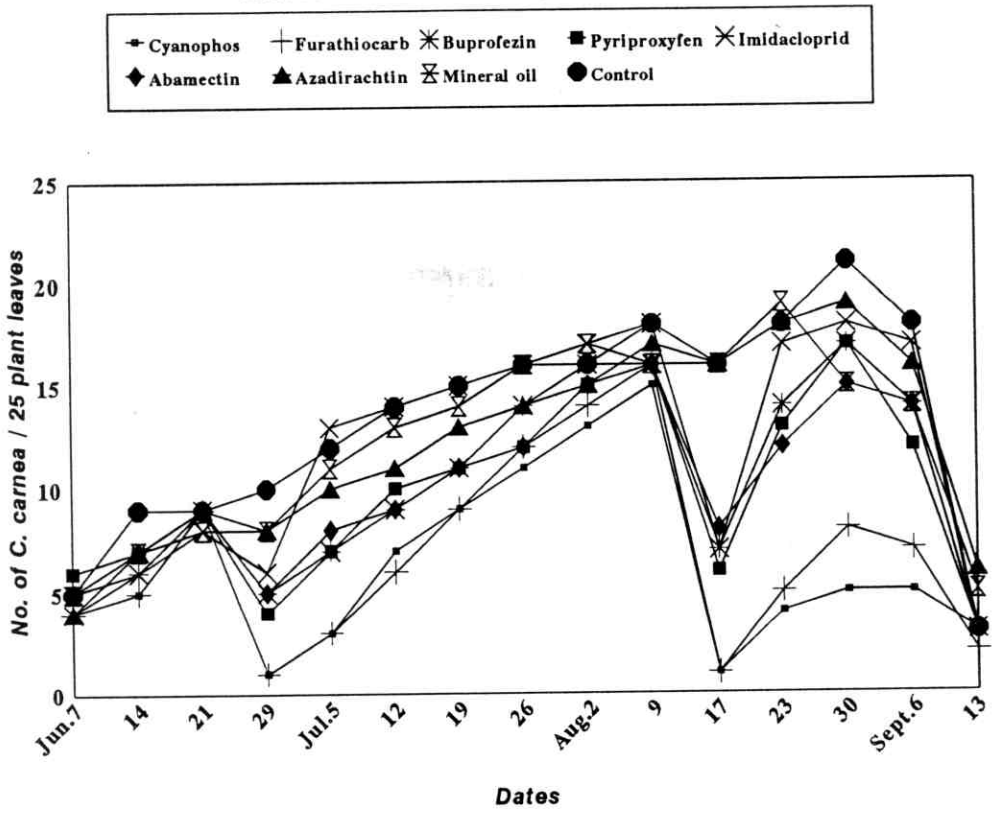


Fig.(8) Average number of C. carnea larvae per 25 plant leaves on cotton plants treated with various insecticides during 2001 season.

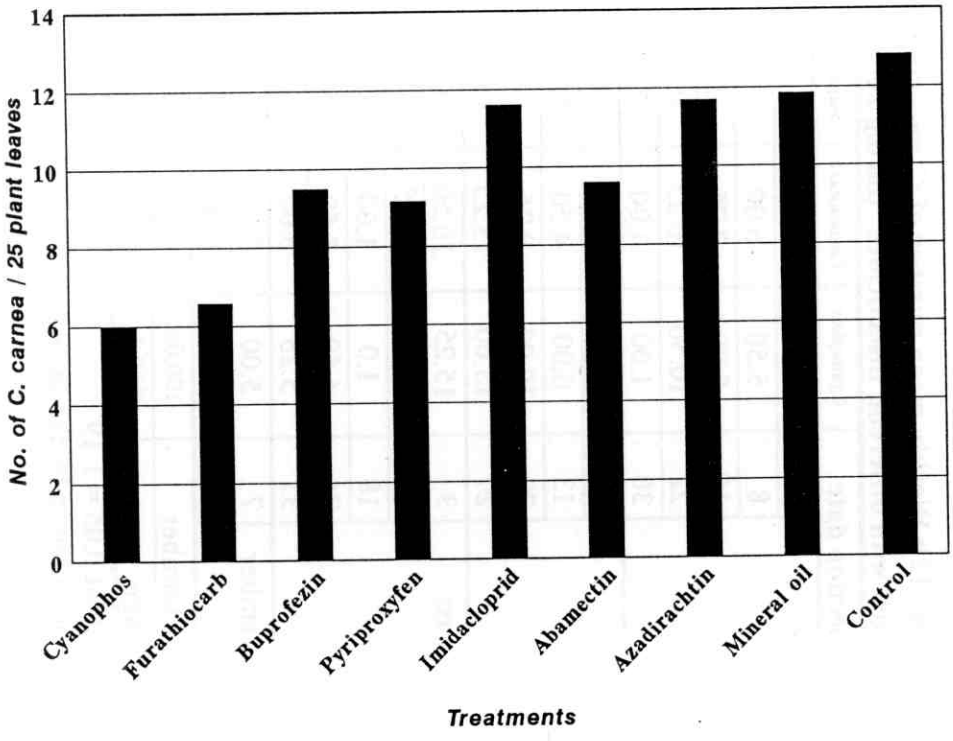


Table (12): Weekly mean number of *C. undecimpunctata* individuals per 25 plant leaves on cotton plants treated with different insecticides, during 2000 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	8	5.50	6.00	6.50	6.00	6.00	5.50	6.25	6.00	6.00
	15	8.00	7.75	9.00	8.25	8.25	7.75	7.75	8.50	8.50
	22	10.50	10.25	10.75	11.00	10.75	11.25	10.75	11.00	11.50
	30	1.00	1.00	7.00	6.00	5.50	7.00	10.50	10.25	11.25
July	6	2.00	2.75	9.25	9.50	9.50	9.75	12.25	11.50	11.75
	13	6.00	4.50	12.50	11.25	12.00	13.00	14.00	13.00	12.25
	20	10.00	9.25	14.00	13.50	13.75	15.25	15.75	16.25	13.00
	27	13.00	13.25	16.25	16.25	15.25	17.50	16.50	17.50	14.50
August	3	15.25	16.50	19.00	18.50	17.75	18.75	18.25	19.25	17.00
	10	18.0	19.25	20.00	20.50	20.75	20.00	20.50	22.25	20.00
	18	1.0	1.00	8.25	6.75	17.50	5.50	19.00	10.50	32.00
	24	4.50	3.50	15.25	13.50	23.25	13.25	22.00	13.00	28.75
	31	5.25	5.00	13.00	11.00	14.00	10.00	13.00	14.00	14.00
September	7	5.00	5.25	5.00	4.00	6.00	4.00	4.00	6.00	5.50
	14	1.00	1.00	2.00	1.00	1.00	2.00	2.00	1.00	2.00
Total number		106.00	106.25	167.75	157.00	181.25	160.50	192.50	180.00	208.00
Average		6.62 d	6.64 d	10.48 c	9.81 c	11.32 bc	10.03 c	12.03 ab	11.25 bc	13.00 a

L.S.D. at 0.05 = 1.19

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(9) Weekly number of C.undecimpunctata individuals per 25 plant leaves on cotton plants treated with various insecticides in 22/6 and 10/8/2000.

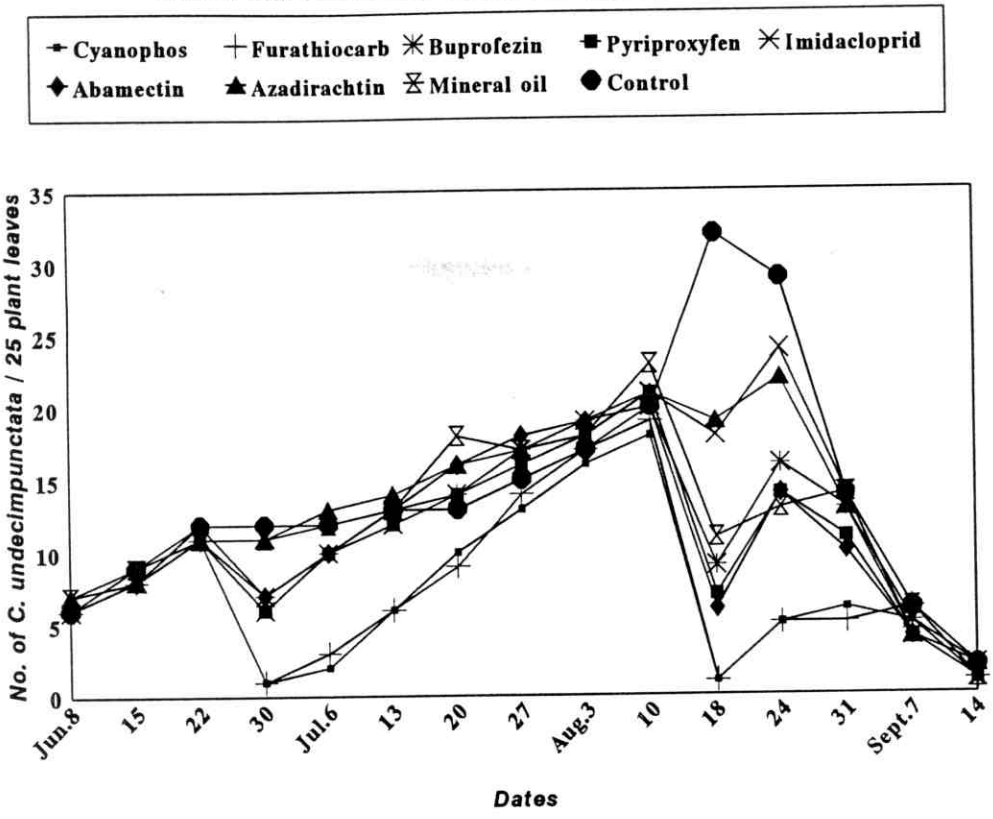
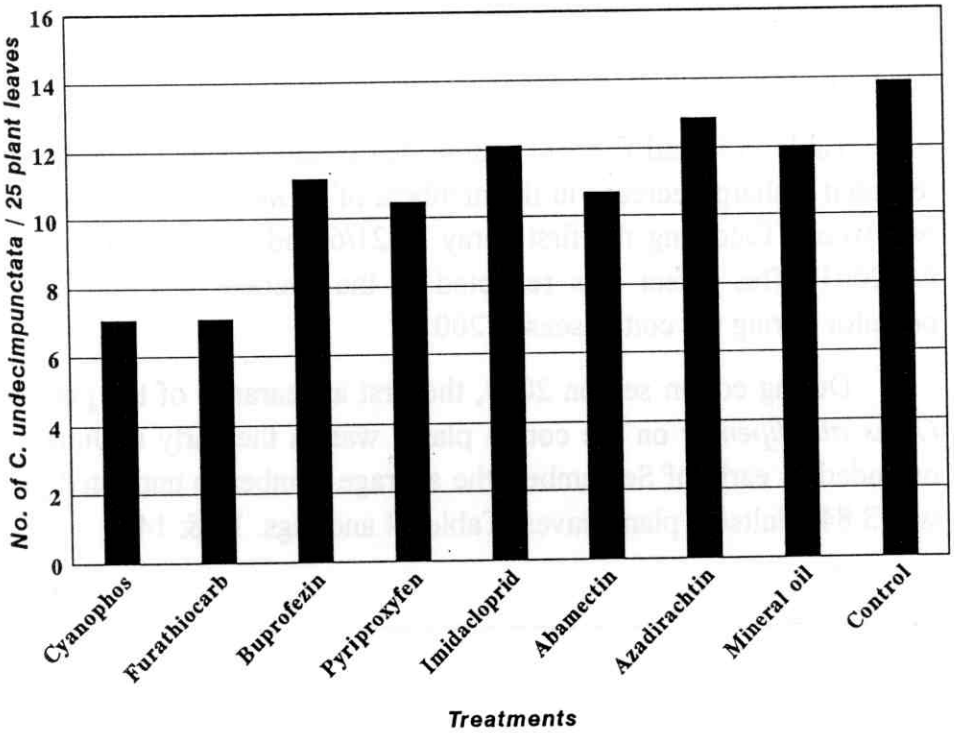


Fig.(10)Average number of C. undecimpunctata individuals per 25 plant leaves on cotton plants treated with various insecticides during 2000 season .



13.00 individuals/25 plant leaves. Applications of insecticides on cotton plants showed varying degrees in decreasing the populations of *C. undecimpunctata*. Azadirachtin was the safest compound against the predator, this treatment did not significantly affects the population of *C. undecimpunctata*. There were no significant differences in the average numbers of the predator after the applications of imidacloprid, mineral oil and buprofezin (Table, 12). Abamectin and pyriproxyfen significantly decreased the populations of *C. undecimpunctata*, the average numbers were 10.03 and 9.81 individuals/25 plant leaves. The highest decrease was obtained in plots treated with cyanophos and furathiocarb (6.62and 6.64 individuals/25 plant leaves, respectively).

Data shown in Table (13) and Fig. (12) reveal that the average number of *C. undecimpunctata* was 12.73 individuals/25 plant leaves in untreated cotton plots during 2001 season. However, cyanophos and furathiocarb treated plots showed the minimum predator numbers (7.00 and 7.42 individuals/25 plant leaves, respectively). The maximum numbers of *C. undecimpunctata* were observed in plots treated with mineral oil and azadirachtin (12.01 and 11.70 individuals/25 plant leaves, respectively), followed by imidacloprid (11.10). Buprofezin, abamectin and pyriproxyfen exhibited a moderate effect on the predator populations, the average numbers during 2001 season were 10.07, 9.70 and 9.56 individuals/25 plant leaves, respectively.

Table (13) and Fig. (11) show that cyanophos and furathiocarb revealed a sharp decrease in the numbers of *C. undecimpunctata* after two weeks following the first spray in 21/6 and the second spray in 9/8/2001. This effect was reflected in the average numbers of the predator during the cotton season 2001.

During cotton season 2000, the first appearance of the predator *Orius albidipennis* on the cotton plants was in the early of June and extended to early of September, the average number in untreated plots was 3.84 adults/25 plant leaves (Table 14 and Figs. 13 & 14).

Table (13): Weekly mean number of *C. undecimpunctata* individuals per 25 plant leaves on cotton plants treated with different insecticides, during 2001 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	7	6.00	5.25	6.00	6.25	6.25	6.00	6.00	6.50	6.50
	14	7.50	8.00	8.50	9.25	9.00	8.25	8.25	9.00	9.00
	21	11.75	10.75	12.00	11.75	12.50	11.00	10.25	11.75	12.25
	29	2.00	3.00	7.25	5.25	5.25	6.50	9.75	10.75	10.75
July	5	4.25	4.25	9.00	9.00	9.75	9.25	11.75	11.00	12.00
	12	5.25	5.25	11.75	11.00	11.75	12.50	13.50	13.50	13.25
	19	10.50	8.75	13.50	13.25	13.50	14.75	15.25	15.25	14.75
	26	13.50	14.50	15.75	15.75	15.00	17.00	16.75	17.75	16.50
August	2	16.00	17.25	17.50	17.25	18.00	18.25	18.00	20.50	18.25
	9	18.50	19.75	19.50	19.50	21.00	19.50	19.75	23.00	20.75
	17	2.00	2.00	7.75	6.00	17.75	5.25	18.75	22.25	31.50
	23	5.50	3.25	14.75	12.75	18.75	13.00	20.75	12.75	18.25
	30	4.25	4.50	11.50	10.00	13.00	9.00	12.00	11.50	13.00
September	6	4.00	5.25	4.50	5.00	5.25	5.00	4.50	5.75	5.00
	13	1.00	1.00	2.00	1.00	1.00	0	2.00	1.00	2.00
Total number		112.00	118.75	161.25	153.00	177.75	155.25	187.25	192.25	203.75
Average		7.00 d	7.42 d	10.07 c	9.56 c	11.10 b	9.70 c	11.70 ab	12.01 ab	12.73 a

L.S.D. at 0.05 = 1.05

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(11)Weekly number of C.undecimpunctata individuals per 25 plant leaves on cotton plants treated with various insecticides in 21/6 and 9/8/2001 .

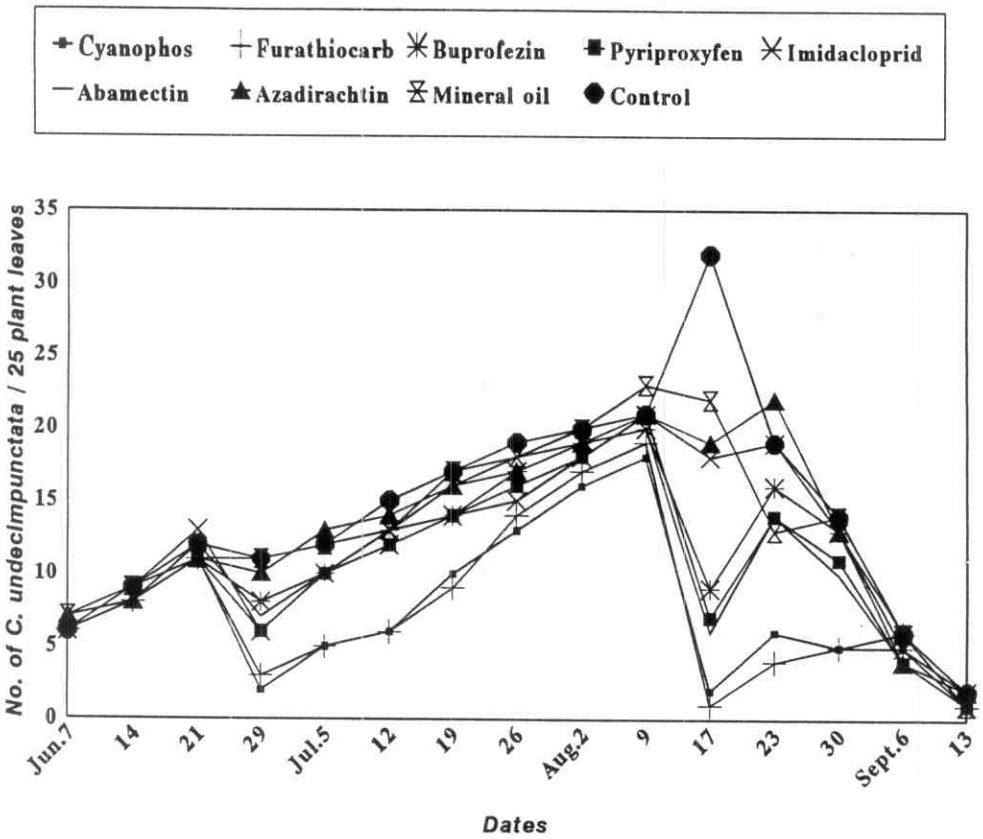


Fig.(12)Average number of C. undecimpunctata individuals per 25 plant leaves on cotton plants treated with various insecticides during 2001 season .

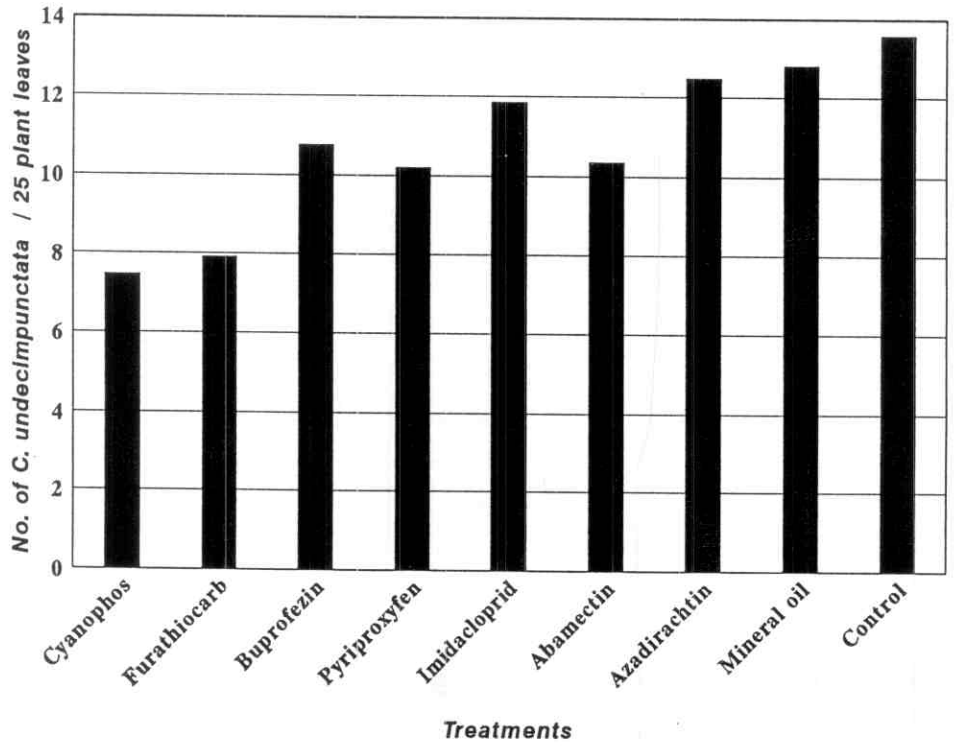


Table (14): Weekly mean number of *O. albidipennis* adults per 25 plant leaves on cotton plants treated with different insecticides, during 2000 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	8	4.00	4.50	4.00	4.00	4.25	4.25	4.00	4.25	4.50
	15	5.25	5.25	4.75	4.50	5.50	5.00	5.25	5.00	5.25
	22	5.50	5.75	5.25	5.00	5.25	5.75	6.00	5.75	6.00
	30	1.00	1.00	3.00	4.00	2.75	4.00	5.50	5.25	6.50
July	6	1.75	2.00	4.50	4.25	4.75	5.25	6.50	6.50	4.50
	13	2.50	2.25	5.25	5.25	7.25	6.00	7.00	7.25	6.75
	20	6.75	6.25	6.25	6.75	8.25	6.50	5.75	5.75	8.75
	27	5.25	4.75	4.75	4.25	5.75	4.25	4.25	4.25	5.50
August	3	3.50	3.25	3.25	3.50	4.50	3.50	3.50	3.50	4.25
	10	2.50	2.50	2.00	2.50	3.00	2.25	2.50	2.00	3.00
	18	1.00	1.00	1.25	0.75	1.00	0.75	1.75	2.00	2.00
	24	1.25	1.25	1.25	1.75	2.50	1.50	2.50	2.50	2.50
	31	0.75	0.75	1.00	1.25	1.25	1.00	1.25	1.75	1.25
September	7	0.50	0.50	0.75	0.75	0.75	0.50	0.75	1.00	0.75
	14	0	0	0	0	0	0	0	0.25	0
Total number		41.50	41.00	47.50	48.50	56.75	50.50	56.50	56.50	61.50
Average		2.59 e	2.56 e	2.96 d	3.03 d	3.54 b	3.15 c	3.53 b	3.53 b	3.84 a

L.S.D. at 0.05 = 0.12

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(13)Weekly number of O.albidipennis adults per 25 plant leaves on cotton plants treated with various insecticides in 22/6 and 10/8/2000.

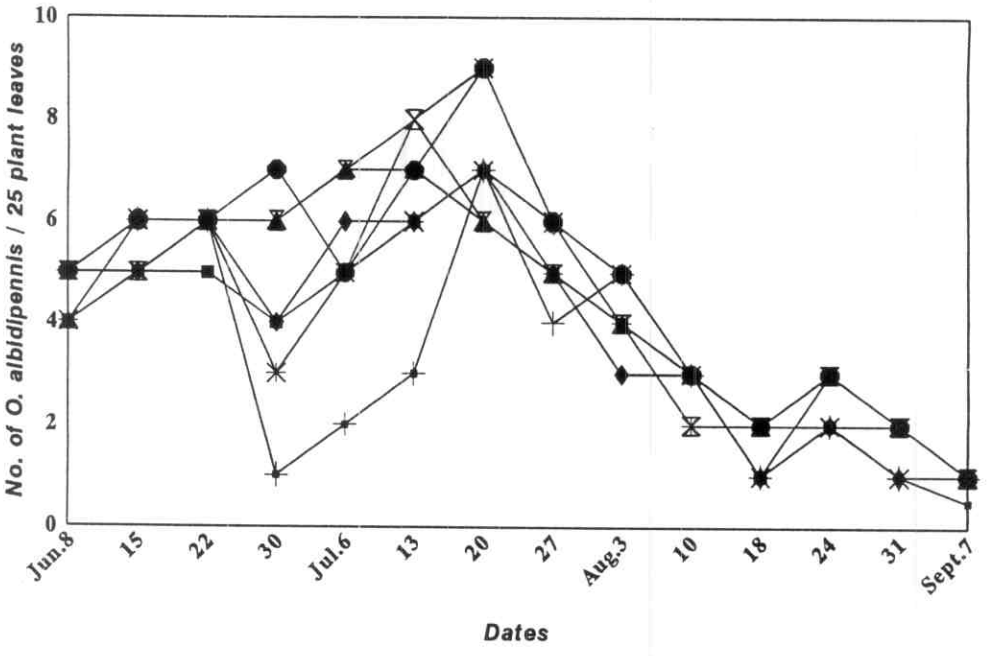
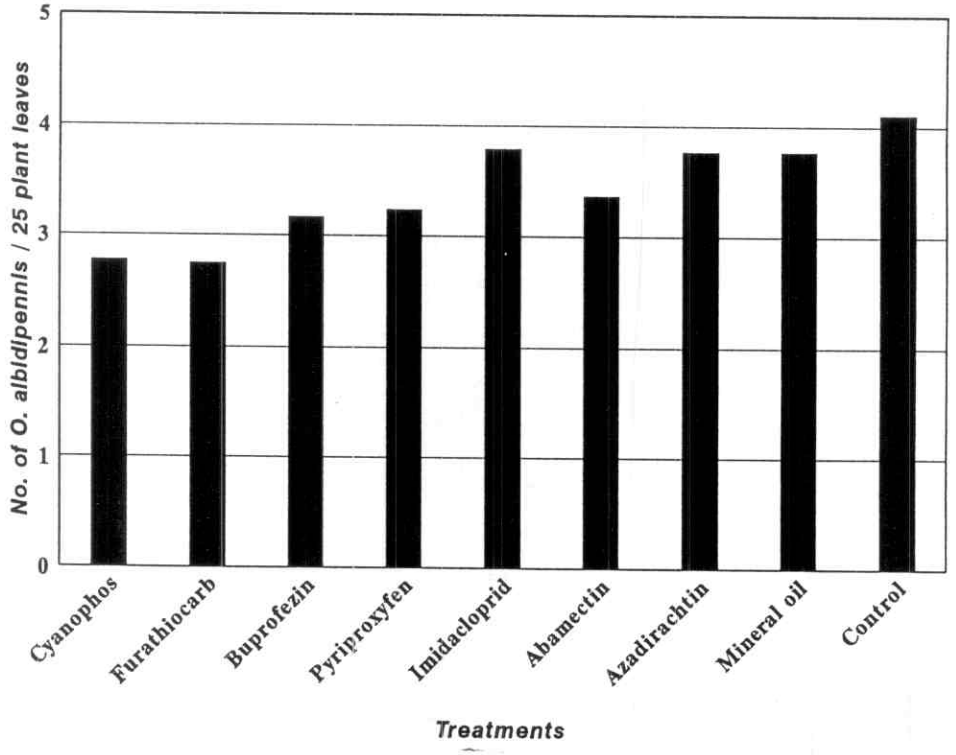


Fig.(14)Average number of O. albidipennis adults per 25 plant leaves on cotton plants treated with various insecticides during 2000 season .



The predator was more abundant in plots treated with imidacloprid, azadirachtin and mineral oil, the average numbers were 3.45, 3.53 and 3.53 adults/25 plant leaves, respectively. A moderate decrease in the populations of *O. albidipennis* was observed in plots treated with abamectin, pyriproxyfen and buprofezin, the average numbers were 3.15, 3.03 and 2.96 adults/25 plant leaves, respectively. The lowest population was obtained in plots treated with cyanophos (2.76) and furathiocarb (2.56).

In 2001, the data presented in Table (15) and illustrated in Figs. (15 & 16) indicate that the first occurrence of *O. albidipennis* in 2001 was in the second week of June and extended to the early September, only one peak was observed in 19/7. The average number was 4.10 adults/25 plant leaves in untreated control. A high decrease in the predator population was observed after the first spray in 21/6 and the second spray in 9/8, this decrease extended three weeks after the treatments of cyanophos and furathiocarb, the average numbers were 2.57 and 2.56 adults/25 plant leaves, respectively. Azadirachtin was the safest compound against *O. albidipennis* followed by mineral oil and imidacloprid, the average numbers were 4.03, 3.60 and 3.59 adults/25 plant leaves, respectively. Abamectin, buprofezin and pyriproxyfen were moderately effective against the predator (Table, 15).

Data in Table (16) and Figs. (17 & 18) show that the predator *Paederus alfierii* appeared in the third week of June and extended to the second week of September in cotton plots during 2000 season. The average number in untreated plots was 1.45 adults/25 plant leaves. In the treated plots with the tested insecticides, the predator disappeared in the third week of August. The most harmful compounds to the predator were furathiocarb, cyanophos, buprofezin and abamectin, the average numbers were 0.62, 0.76, 0.78 and 0.78 adults/25 plant leaves, respectively. Thus, the most harmless compounds to *P. alfierii* were mineral oil, imidacloprid, azadirachtin and pyriproxyfen (1.00, 1.03, 0.95 and 0.90 adults/25 plant leaves, respectively).

Table (15): Weekly mean number of *O. albidipennis* adults per 25 plant leaves on cotton plants treated with different insecticides, during 2001 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	7	4.50	5.00	4.25	5.00	4.00	4.50	4.25	4.50	4.75
	14	5.00	6.00	5.25	5.25	4.25	5.25	5.50	5.25	5.50
	21	6.00	6.25	6.00	5.25	5.75	6.25	7.00	6.00	6.75
	29	1.00	1.00	3.25	2.75	3.50	3.75	6.00	5.50	7.00
July	5	1.00	1.25	4.75	3.75	5.25	5.75	8.00	6.75	4.75
	12	2.25	2.50	5.50	4.25	7.25	6.25	9.25	7.50	7.25
	19	6.50	6.50	6.75	6.50	9.50	6.75	7.50	6.00	9.25
	26	4.50	5.00	5.25	5.25	7.25	4.50	5.25	4.75	6.25
August	2	3.75	3.50	3.75	3.25	4.25	3.75	3.75	3.25	4.25
	9	3.00	2.75	2.25	2.75	2.25	2.75	2.25	2.25	3.25
	17	0.75	0.50	1.00	0.50	2.25	0.50	2.00	1.75	2.75
	23	1.75	0.50	1.00	1.25	1.00	1.00	2.00	2.00	1.75
	30	1.25	0.25	0.75	1.00	0. 75	0.50	1.25	1.50	1.50
September	6	0	0	0.50	0.75	0.25	0.25	0.50	0.75	0.75
	13	0	0	0	0	0	0	0	0	0
Total number		41.25	41.00	50.25	47.50	57.50	51.75	64.50	57.75	65.75
Average		2.57 d	2.56 d	3.14 c	2.96 c	3.59 b	3.23 c	4.03 a	3.60 b	4.10 a

L.S.D. at 0.05 = 0.26

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(15)Weekly number of O.albidipennis adults per 25 plant leaves on cotton plants treated with various insecticides in 21/6 and 9 /8/2001.

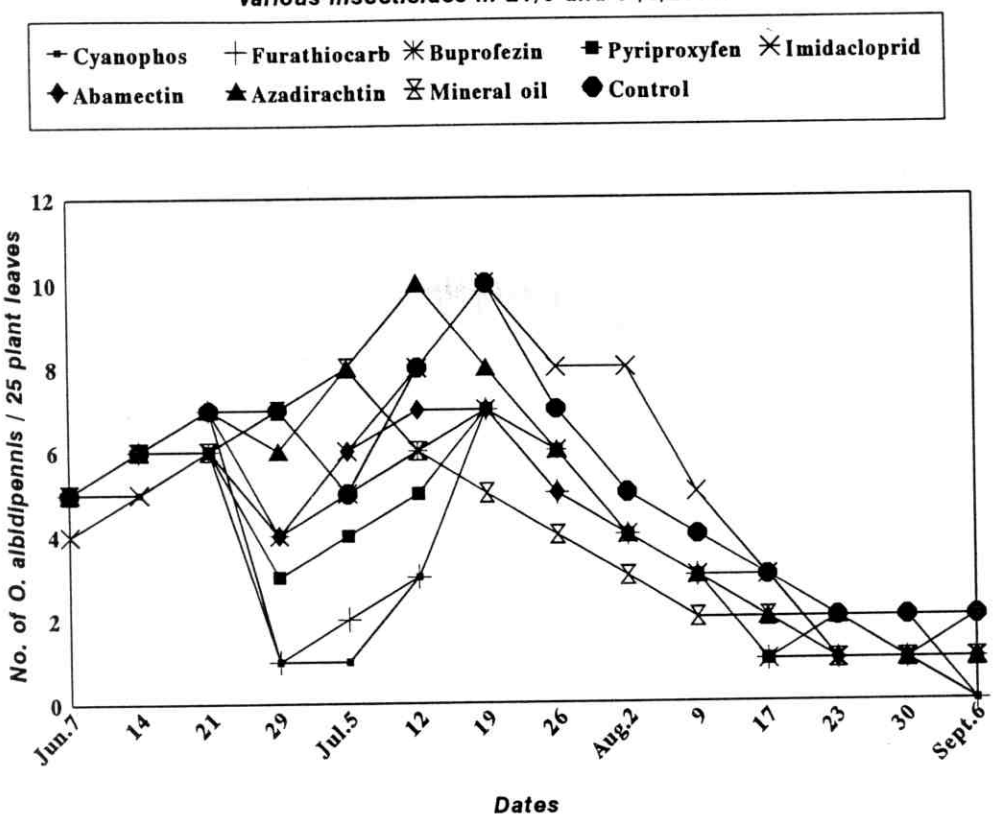


Fig.(16)Average number of O. albidipennis adults per 25 plant leaves on cotton plants treated with various insecticides during 2001 season .

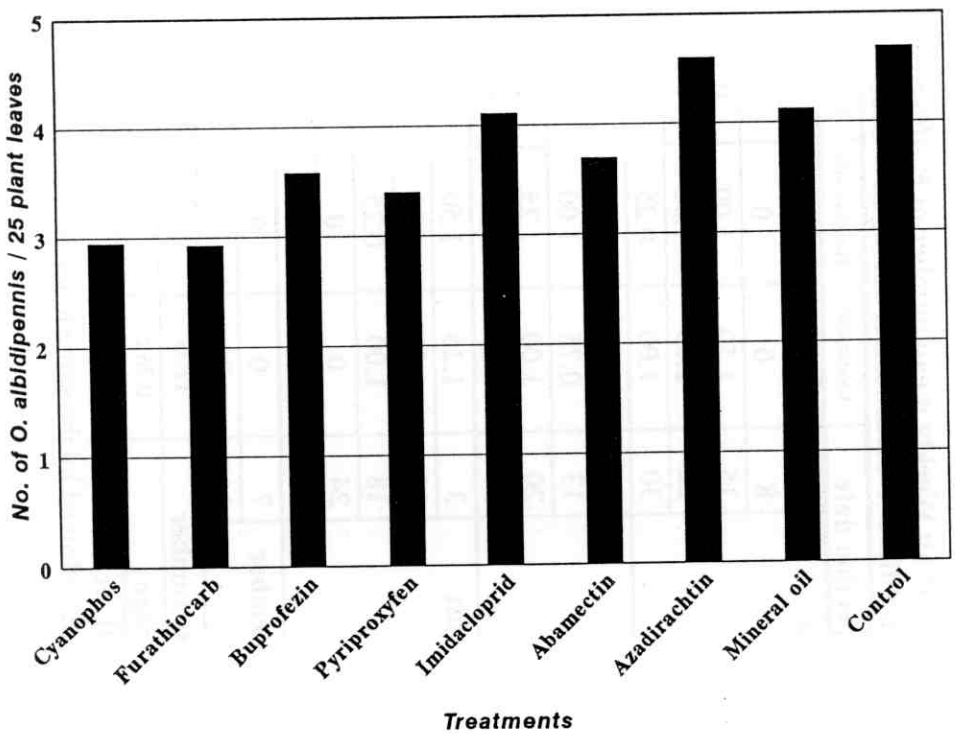


Table (16): Weekly mean number of *P. alfierii* adults per 25 plant leaves on cotton plants treated with different insecticides, during 2000 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	15	1.50	1.00	0.75	1.00	1.50	0.25	1.25	1.50	1.50
	22	2.00	1.50	1.75	2.25	2.50	1.50	2.25	2.25	2.25
	30	1.00	0.25	0.75	1.00	1.25	1.00	2.00	2.00	3.50
July	6	1.00	0.75	2.25	2.00	2.50	2.75	2.75	2.75	8.50
	13	0.75	1.00	2.25	1.50	1.75	1.75	1.75	2.00	9.00
	20	1.00	1.25	1.50	2.00	2.25	1.25	1.50	1.75	6.75
	27	1.25	1.25	1.00	1.50	1.75	1.00	1.25	1.50	5.75
August	3	1.25	1.50	1.00	1.75	1.25	1.50	1.00	1.25	5.50
	10	1.50	1.25	0.75	1.25	1.00	1.25	1.00	1.00	4.25
	18	1.00	0.25	0.25	0.25	0.25	0.25	0.25	0.25	3.00
	24	0	0	0.25	0	0	0	0.25	0.25	5.00
	31	0	0	0	0	0	0	0	0	3.50
September	7	0	0	0	0	0	0	0	0	2.25
	14	0	0	0	0	0	0	0	0	0.75
Total number		12.25	10.00	12.50	14.50	16.00	12.50	15.25	16.50	22.25
Average		0.76 c	0.62 d	0.78 c	0.90 bc	1.00 b	0.78 c	0.95 b	1.03 b	1.45 a

L.S.D. at 0.05 = 0.13

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(17)Weekly number of P.alfierii adults per 25 plant leaves on cotton plants treated with various insecticides in 22/6 and 10/8/2000.

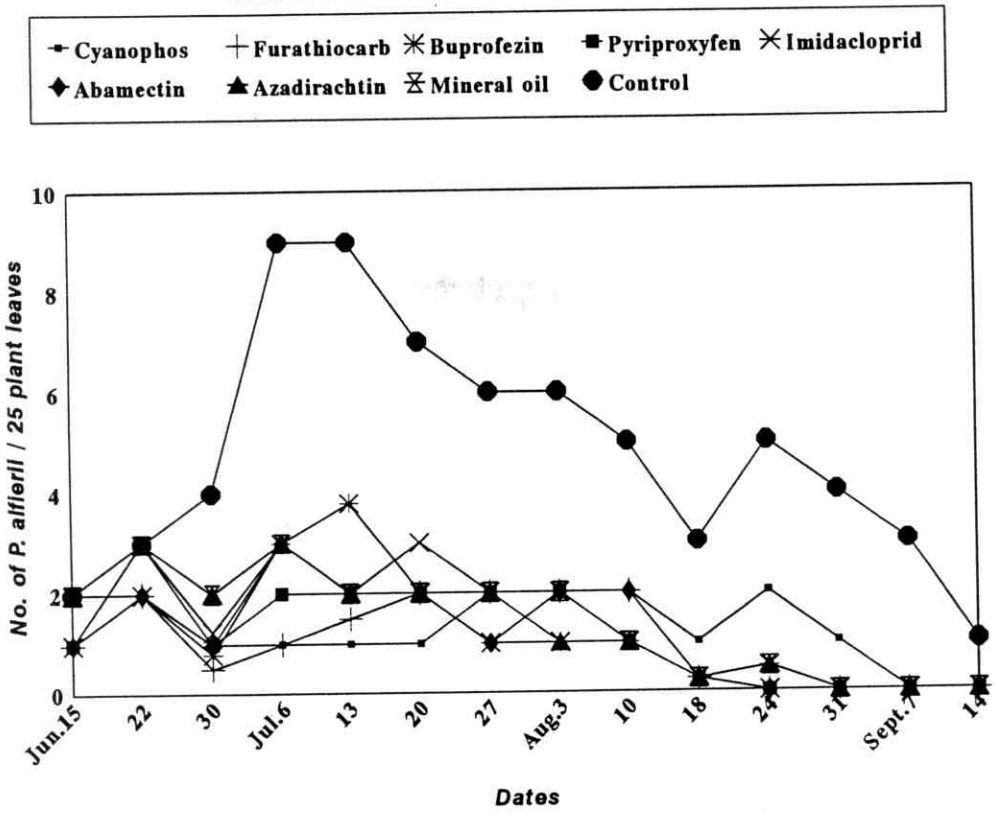
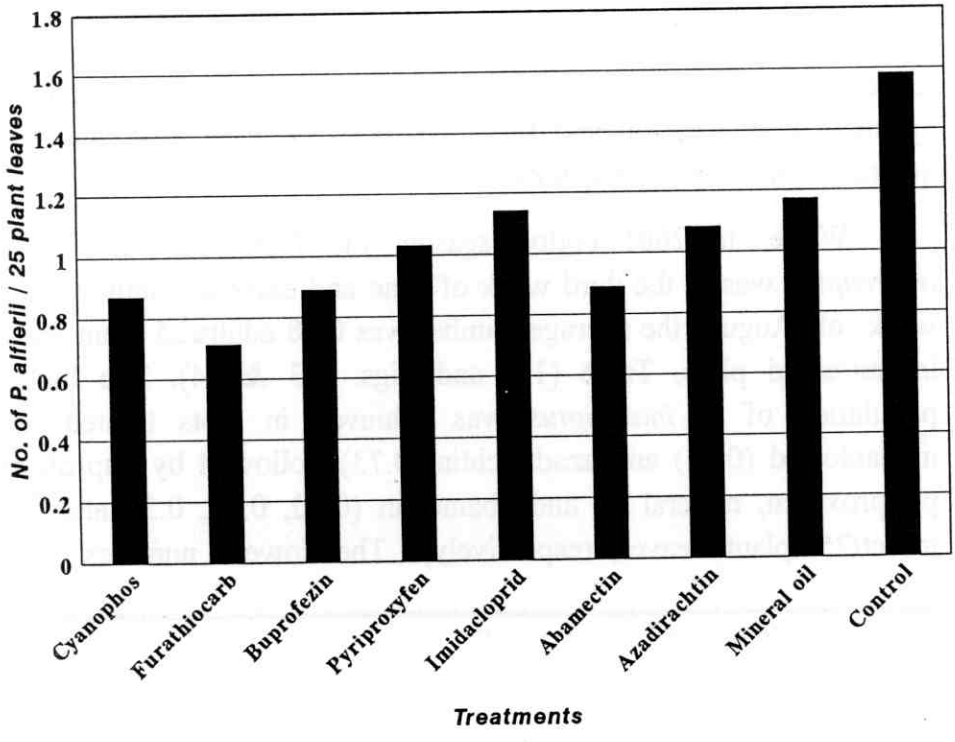


Fig.(18)Average number of P. alfierii adults per 25 plant leaves on cotton plants treated with various insecticides during 2000 season .



Results in Table (17) and Figs. (19 & 20) indicate that all tested insecticides significantly reduced the numbers of *P. alfierii* as compared with the untreated control. The first occurrence of the predator was in 14/6 and extended to 23/8/2001, the average number was 1.43 adults/25 plant leaves in untreated plots. The safest compound to *P. alfierii* was azadirachtin, followed by imidacloprid and mineral oil, the average numbers were 1.01, 0.98 and 0.95 adults/25 plant leaves, respectively. The most harmful compounds were furathiocarb, cyanophos, abamectin and buprofezin (0.54, 0.60, 0.68 and 1.00 adults/25 plant leaves, respectively). Pyriproxyfen came in between it had a moderate effect on *P. alfierii*, the average number was 0.79 adults/25 plant leaves.

Data presented in Table (18) and illustrated in Figs. (21 & 22) show that *Scymnus interruptus* had one brood period, it extended from 15/6 until 31/8, the average number was 0.90 adults/25 plant leaves in the untreated plots throughout 2000 cotton season. In general, all insecticidal applications were not significantly different in respect with each others, but they were significantly different as compared with the untreated control. They may be statistically arranged into two groups. The first comprises imidacloprid, azadirachtin and pyriproxyfen, the average numbers were 0.64, 0.60 and 0.59 adults/25 plant leaves, respectively, and the second comprises buprofezin, abamectin, cyanophos, mineral oil and furathiocarb (0.53, 0.50, 0.48 and 0.40 adults/25 plant leaves, respectively).

While, in 2001 cotton season, the first occurrence of *S. interruptus* was in the third week of June and extended until the third week of August, the average number was 0.98 adults/25 plant leaves in untreated plots, Table (19) and Figs. (23 & 24). The highest population of *S. interruptus* was achieved in plots treated with imidacloprid (0.73) and azadirachtin (0.73), followed by buprofezin, pyriproxyfen, mineral oil and abamectin (0.60, 0.57, 0.59 and 0.51 insect/25 plant leaves, respectively). The lowest numbers of *S.*

Table (17): Weekly mean number of *P. alfierii* adults per 25 plant leaves on cotton plants treated with different insecticides, during 2001 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	14	1.00	1.00	0.75	1.25	1.00	0.75	1.50	1.00	1.75
	21	1.50	1.75	1.75	2.00	3.00	1.00	3.00	2.00	2.00
	29	0.25	0.25	0.50	0.75	0.75	0.75	1.75	1.75	4.00
July	5	0.25	0.50	2.00	1.75	1.50	1.25	3.25	2.50	3.25
	12	0.75	0.50	1.50	1.25	3.25	2.25	1.50	1.75	3.00
	19	1.25	1.25	1.75	1.50	2.00	1.50	1.25	1.75	2.00
	26	1.50	1.25	1.00	1.75	2.00	1.00	1.75	1.50	2.00
August	2	1.50	1.00	0.75	1.50	1.50	1.00	1.25	1.25	1.50
	9	1.50	1.00	0.75	0.75	0.50	0.75	1.00	01.00	1.50
	17	0.25	0.25	0.25	0.25	0.25	0.50	0.50	0.50	1.50
	23	0	0	0	0	0	0	0.25	0.25	0.50
	30	0	0	0	0	0	0	0	0	0
September	6	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0
Total number		9.75	8.75	11.00	12.75	15.75	10.75	17.00	15.25	23.00
Average		0.60 de	0.54 e	0.68 de	0.79 cd	0.98 bc	0.67 de	1.10 b	0.95bc	1.43 a

L.S.D. at 0.05 = 0.24

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(19)Weekly number of P.alfierii adults per 25 plant leaves on cotton plants treated with various insecticides in 21/6 and 9/8/2001 .

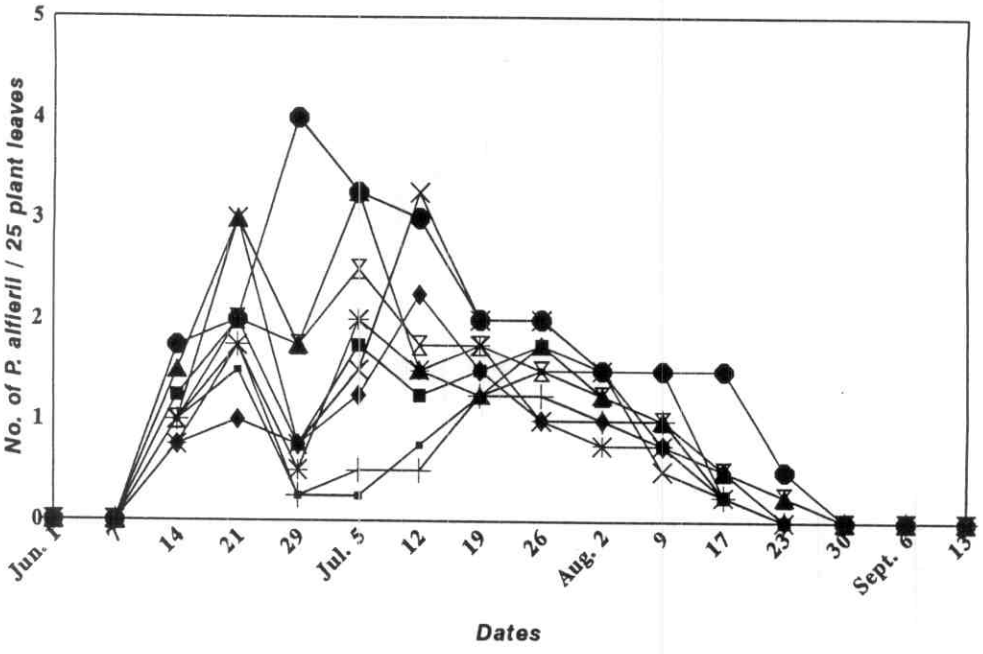


Fig.(20)Average number of P. alfierii adults per 25 plant leaves on cotton plants treated with various insecticides during 2001 season .

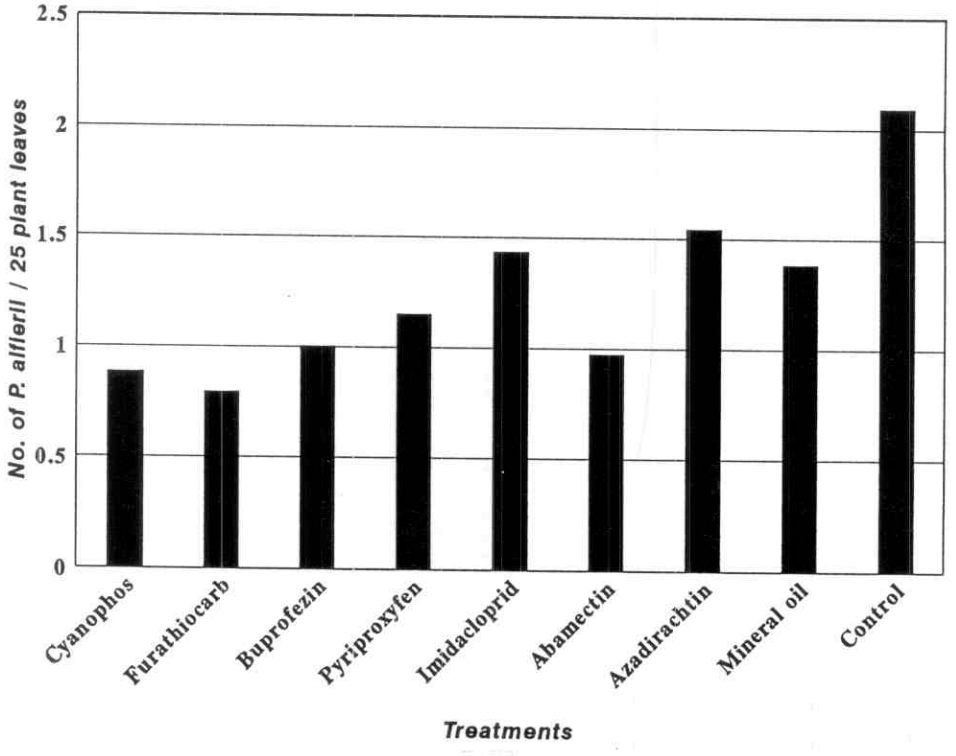


Table (18): Weekly mean number of *S. interruptus* adults per 25 plant leaves on cotton plants treated with different insecticides, during 2000 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	15	1.00	1.00	1.25	1.00	0.75	0.75	0.75	0.75	0.75
	22	1.00	1.00	1.00	1.75	1.25	1.00	1.25	1.00	1.50
	30	0.50	0.25	0.25	0.50	0.25	0.25	0.75	0.25	1.75
July	6	0.25	0.25	0.25	1.25	1.25	0.50	1.00	0.25	1.25
	13	0.50	0.50	1.50	1.50	1.50	1.00	0.75	0.50	1.50
	20	0.75	0.75	1.00	1.75	1.25	1.25	1.25	0.75	2.00
	27	1.50	0.75	1.00	0.50	1.50	1.75	1.50	1.00	1.75
August	3	1.00	0.75	1.00	0.50	1.25	0.75	0.75	0.75	1.50
	10	1.00	0.75	0.75	0.50	0.75	0.50	0.75	0.75	0.75
	18	0.25	0.50	0.25	0.25	0.25	0.25	0.50	0.75	0.75
	24	0	0	0.25	0	0.25	0	0.50	0.25	0.50
	31	0	0	0	0	0	0	0	0	0.50
September	7	0	0	0	0	0	0	0	0	0
	14	0	0	0	0	0	0	0	0	0
Total number		7.75	6.50	8.50	9.50	10.25	8.00	9.75	7.00	14.5 0
Average		0.48 b	0.40 b	0.53 ab	0.59 ab	0.64 ab	0.50 b	0.60 ab	0.43 b	0.90 a

L.S.D. at 0.05 = 0.35

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(21)Weekly number of S.interruptus adults per 25 plant leaves on cotton plants treated with various insecticides in 22/6 and 10/8/2000.

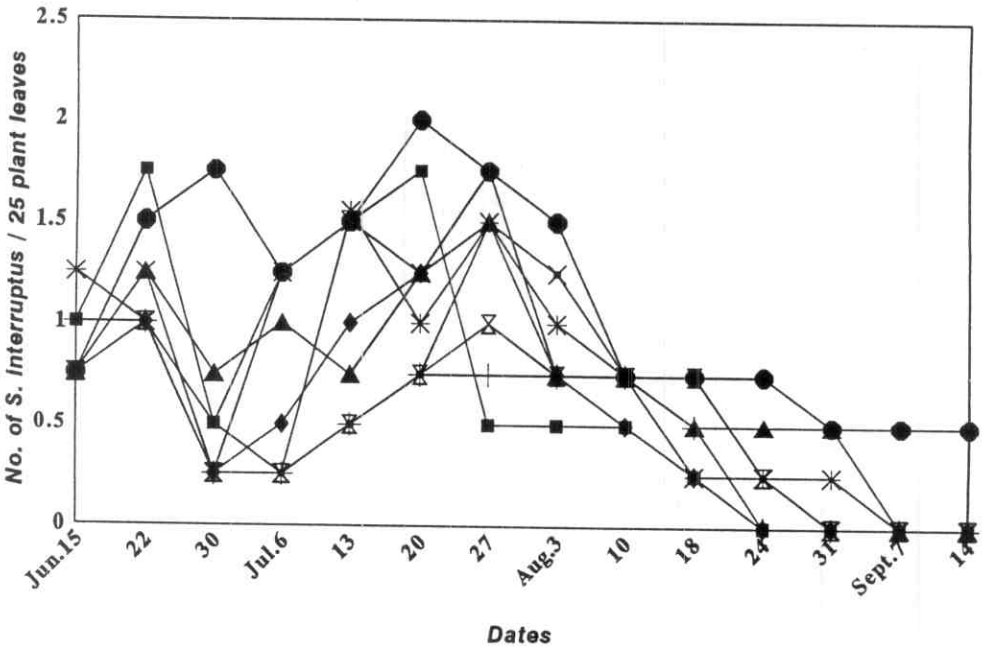


Fig.(22)Average number of S. interruptus adults per 25 plant leaves on cotton plants treated with various insecticides during 2000 season .

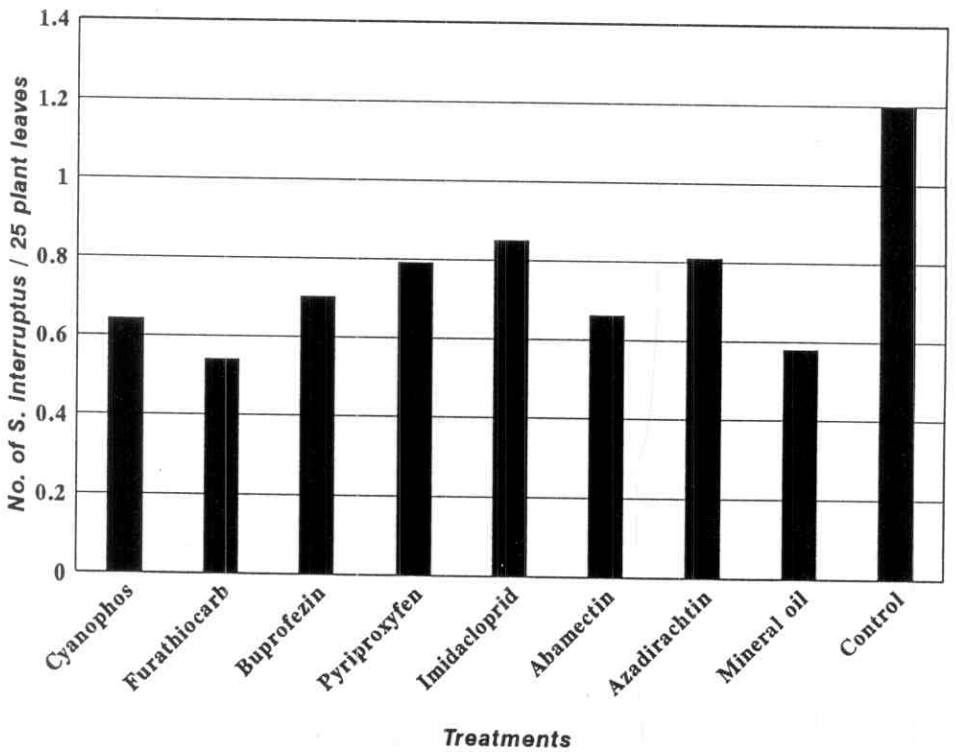


Table (19): Weekly mean number of *S. interruptus* adults per 25 plant leaves on cotton plants treated with different insecticides, during 2001 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	14	1.00	0.50	0.50	0.50	0.50	0.50	1.00	0.75	1.00
	21	1.00	1.00	1.00	1.00	0.75	0.75	1.25	1.00	1.00
	29	0.25	0.25	0.25	0.75	0.25	0.25	0.50	0.50	2.00
July	5	0.25	0.25	0.25	0.25	0.75	0.25	0.75	0.25	1.00
	12	0.75	0.75	0.50	0.75	1.00	0.25	0.50	0.75	1.00
	19	0.75	0.75	1.00	1.25	2.00	0.25	0.75	0.75	2.50
	26	0.75	0.50	1.50	1.00	2.00	1.75	2.00	0.75	2.00
August	2	0.75	1.00	1.75	1.50	1.00	1.75	1.50	1.50	1.75
	9	0.75	1.25	1.25	1.50	1.75	1.25	1.75	1.50	1.75
	17	0.25	0.75	1.25	0.50	1.25	1.00	0.75	0.50	1.25
	23	0	0	0.50	0.25	0.50	0.25	0.50	0.25	0.50
	30	0	0	0	0	0	0	0	0	0
September	6	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0
Total number		6.50	6.00	9.75	9.25	11.75	8.25	11.25	8.75	15.75
Average		0.40 b	0.37 b	0.60 b	0.57 b	0.73 ab	0.51 b	0.70ab	0.59 b	098 a

L.S.D. at 0.05 = 0.37

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(23)Weekly number of S.interruptus adults per 25 plant leaves on cotton plants treated with various insecticides in 21/6 and 9/8/2001.

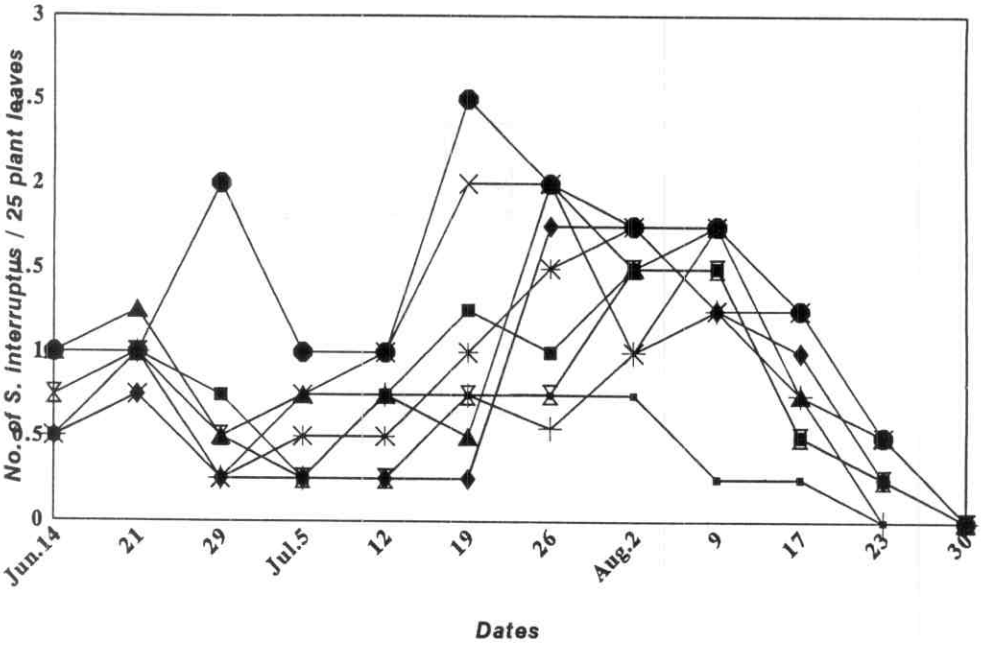
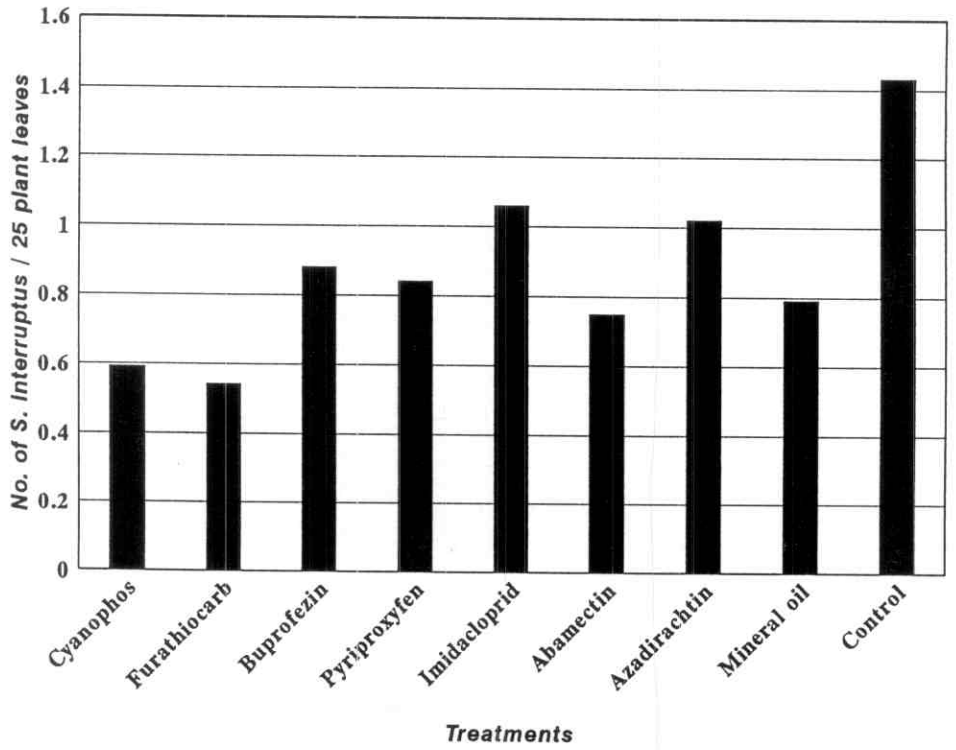


Fig.(24)Average number of S. interruptus adults per 25 plant leaves on cotton plants treated with various insecticides during 2001 season .



interruptus were obtained in plots treated with cyanophos (0.40) and furathiocarb (0.37).

Data shown in Table (20) and Figs. (25 & 26) reveal that the first appearance of *Syrphus corollae* on cotton plants was in third week of June and extended to the third week of August in 2000 season. The average number of the predator was 0.89 larvae/25 plant leaves in untreated plots.

The applications of azadirachtin, mineral oil and imidacloprid were not significantly different compared with the untreated control, the average numbers were 0.74, 0.73 and 0.65 larvae/25 plant leaves, respectively. However, the applications of buprofezin, pyriproxyfen, abamectin, furathiocarb and cyanophos significantly reduced the numbers of *S. corollae* as compared with the untreated control, the average numbers were 0.50, 0.45, 0.46, 0.42 and 0.39 larvae/25 plant leaves, respectively.

Table (21) and Figs. (27 & 28) show that the predator *S. corollae* appeared in 14/6/2001 and disappeared in 30/8/2001 during the growing cotton season, and the average number was 0.90 larvae/25 plant leaves in untreated plots. The applications of buprofezin, abamectin, cyanophos and furathiocarb were harmful to the predator, they significantly reduced the numbers of the predator in respect with the untreated control, the average numbers were 0.54, 0.50, 0.43 and 0.42 larvae/25 plant leaves, respectively. Maximum predator numbers were achieved in plots treated with mineral oil, pyriproxyfen, azadirachtin and imidacloprid (0.81, 0.73, 0.71 and 0.70 larvae/25 plant leaves, respectively).

In this respect, **Mizell and Sconyers (1992)** found that imidacloprid had little impact on the predatory arthropods. **Omar (1997)** stated that imidacloprid caused the lowest percentage reduction in the populations of *Coccinella undecimpunctata, Scymnus interruptus* and *Chrysoperla carnea*. **Lowery and Isman (1995)**

Table (20): Weekly mean number of *S. corollae* larvae per 25 plant leaves on cotton plants treated with different insecticides, during 2000 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	15	0.25	0.75	1.00	0.75	0.50	0.50	0.50	1.00	0.75
	22	1.00	1.25	1.25	1.25	0.75	0.75	1.00	1.50	1.50
	30	0.25	0.25	0.75	0.50	0.50	0.50	0.75	0.75	1.50
July	6	0.50	0.25	0.50	0.75	1.50	0.25	1.25	1.50	1.50
	13	0.50	0.50	0.75	0.75	1.75	0.50	1.50	1.25	1.75
	20	0.75	0.75	0.50	0.50	1.25	0.75	1.75	1.25	1.75
	27	0.75	0.75	0.75	0.50	1.50	1.00	1.50	1.00	1.75
August	3	1.00	0.75	0.75	1.00	1.25	1.25	1.50	1.25	1.25
	10	1.00	1.25	1.00	1.00	1.25	1.00	1.25	1.00	1.50
	18	0.25	0.25	0.50	0.25	0.25	0.25	0.25	0.25	0.50
	24	0	0	0.25	0	0	0	0.25	0.25	0.50
	31	0	0	0	0	0	0	0	0	0
September	7	0	0	0	0	0	0	0	0	0
	14	0	0	0	0	0	0	0	0	0
Total number		6.25	6.75	8.00	7.25	10.50	6.75	11.50	11.00	14.25
Average		0.39 d	0.42 d	0.50 cd	0.4 5 d	0.65 bc	0.46 d	0.74 b	0.73 bc	0.89 a

L.S.D. at 0.05 = 0.23

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(25)Weekly number of S.corollae larvae per 25 plant leaves on cotton plants treated with various insecticides in 22/6 and 10/8/2000.

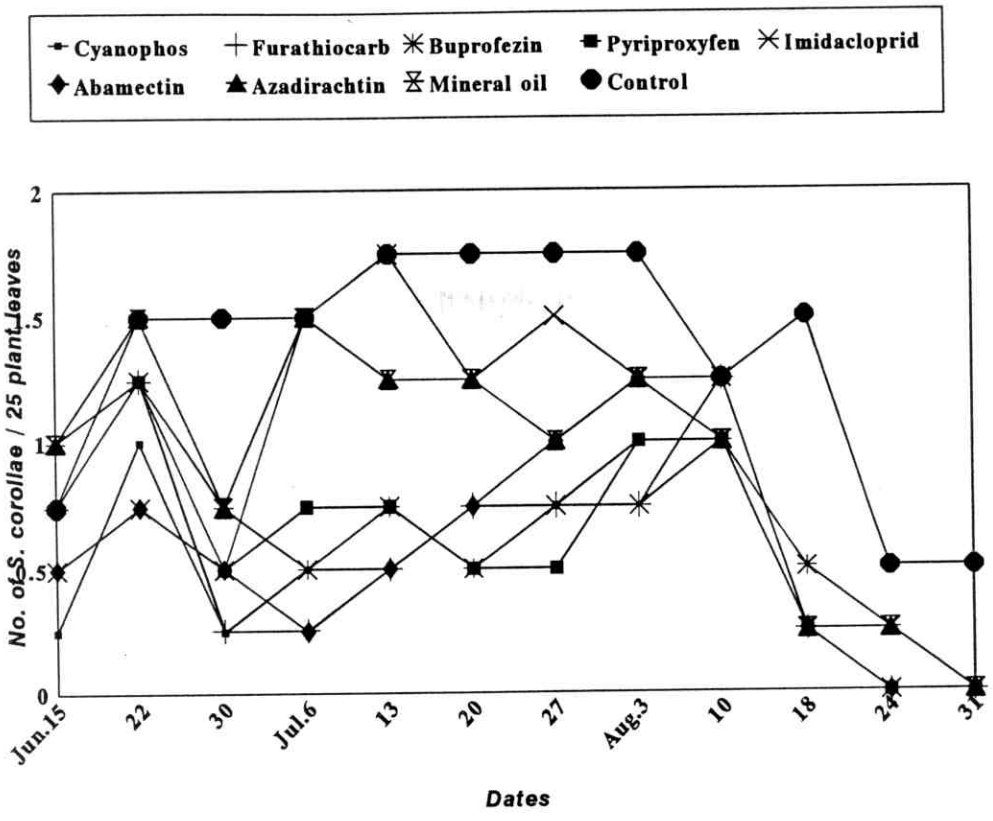


Fig.(26)Average number of S. corollae larvae per 25 plant leaves on cotton plants treated with various insecticides during 2000 season .

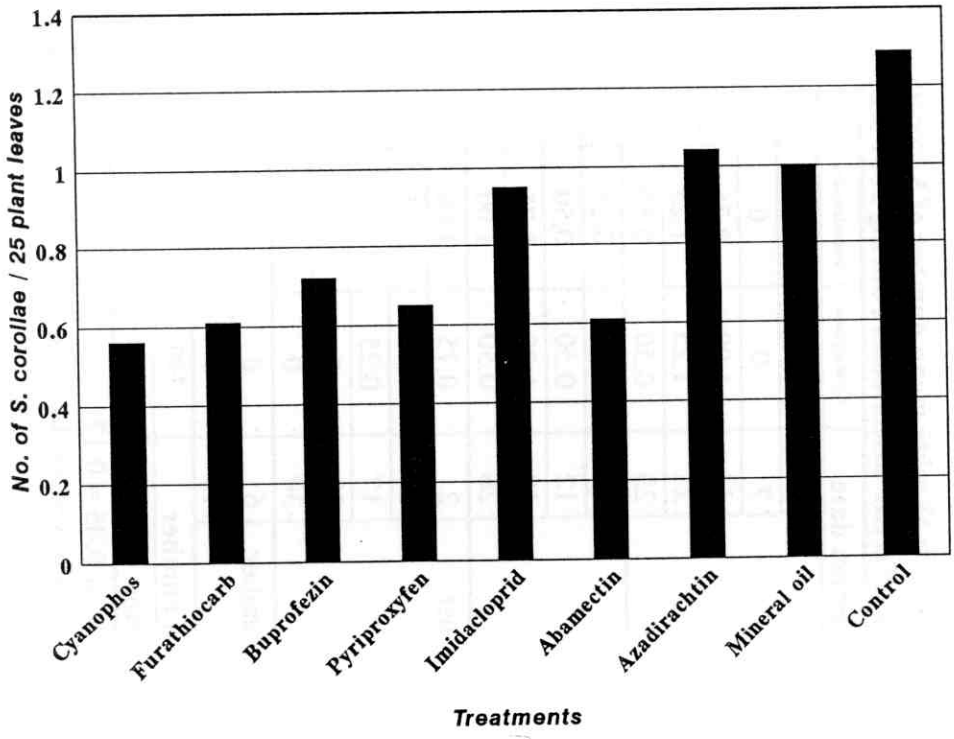


Table (21): Weekly mean number of *S. corollae* larvae per 25 plant leaves on cotton plants treated with different insecticides , during 2001 season.

Inspection date		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
June	1	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	14	1.00	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00
	21	1.25	1.25	1.25	1.75	1.25	1.25	1.25	1.50	1.75
	29	0.50	0.50	0.50	0.50	0.75	0.50	1.00	0.75	1.75
July	5	0.25	0.25	0.25	1.00	1.00	0.50	1.25	1.25	1.25
	12	0.50	0.50	0.50	1.00	0.75	0.50	1.25	1.25	1.50
	19	1.00	0.75	0.75	1.75	1.50	0.75	1.00	1.50	1.75
	26	0.50	1.00	1.25	1.25	1.50	0.75	1.00	1.50	1.50
August	2	0.75	1.00	1.25	1.25	1.00	1.00	1.25	1.25	1.25
	9	1.00	0.75	1.25	1.25	1.25	1.00	1.25	1.25	1.25
	17	0.25	0	0.75	0.75	0.75	0.50	1.00	0.75	1.00
	23	0	0	0.25	0.25	0.50	0.25	0.25	0.25	0.50
	30	0	0	0	0	0	0	0	0	0
September	6	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0
Total number		7.00	6.75	8.75	11.75	11.25	8.00	11.5 0	12.25	14.50
Average		0.43 c	0.42 c	0.54 c	0.73 b	0.70 b	0.50 c	0.71 b	0.81 b	0.90 a

L.S.D. at 0.05 = 0.17

Means followed by the same letter are not significantly different according to Duncan's multiple range test.

Fig.(27)Weekly number of S.corollae larvae per 25 plant leaves on cotton plants treated with various insecticides in 21/6 and 9/8/2001.

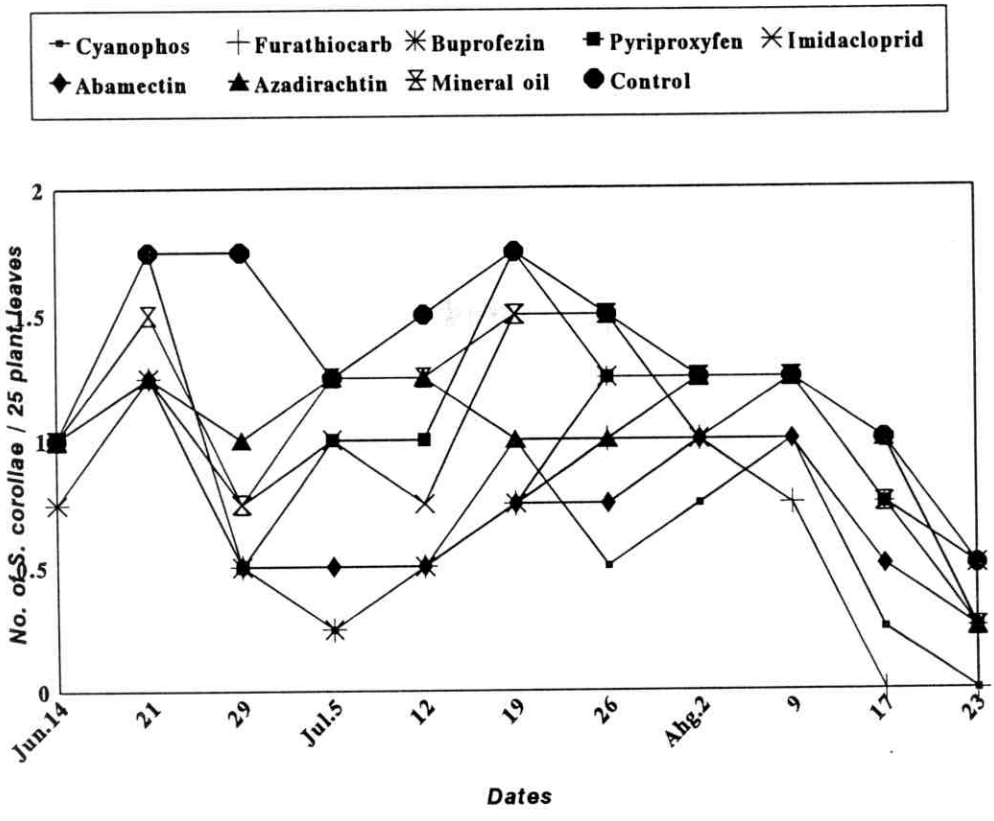
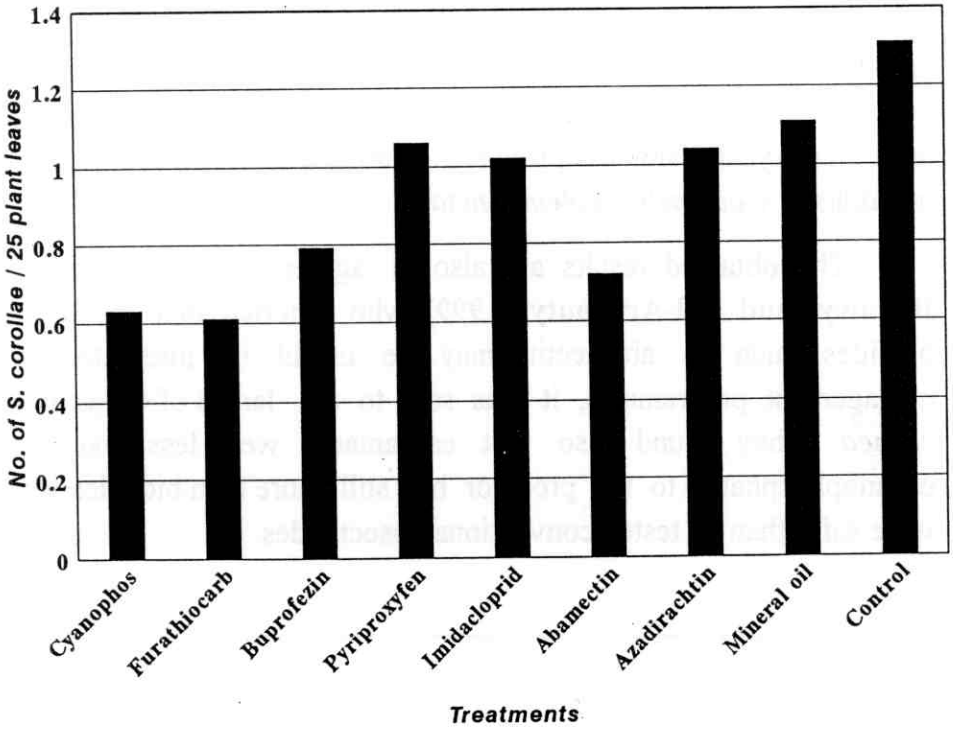


Fig.(28)Average number of S. corollae larvae per 25 plant leaves on cotton plants treated with various insecticides during 2001 season .



mentioned that neem insecticides may be suitable for use in integrated pest management programmes, as under field use they appear to be relatively harmless to aphid predators and parasites. **Kumar and Babu (1996)** recorded that Neem-Azal was safe to larvae of *Chrysoperla carnea*, but egg-laying was adversely affected to some extent. They also found that Neem-Azal revealed no adverse effects on the three parasitoids *Trichogramma brasiliensis*, *T. chilonis* and *T. japonicum*. **Schmutterer (1997)** reported that neem products are safe to adults of numerous beneficials insect species and eggs of many predators such as coccinellids, but nymphal/larval instars are more or less susceptible. **Chakraborti and Chatterjee (1999)** revealed that all formulations of neem tested were found to be safe to the predatory beetles, *Coccinella septempunctata* and other *Coccinella* spp. **Vekaria and Patel (2000)** found that the neem plant product Neemol was less toxic to *C. septempunctata* than the chemical insecticides, dimethoate, methyl parathion and methyl-O-demeton.

The obtained results are in agreement with **Nagai (1991)** who found that the insect growth regulators buprofezin and pyriproxyfen left a large number of *Orius* sp. on the eggplant. While in the chemical control program, the predator population was inhibited. **Olszak *et al.* (1994)** mentioned that the insect growth regulators, triflumuron, cyromazine, chlorfluazuron, teflubenzuron, diflubenzuron, flufenoxuron, fenoxycarb and pyriproxyfen exerted a relatively low influence on adults of *Coccinella septempunctata*.

The obtained results are also in agreement with the results of **Badawy and El-Arnaouty (1999)** who reported that the use of biocides such as abamectin may be useful in integrated pest management programmes, it was safe to the larvae of *Chrysoperla carnea*. They found also that carbamates were less toxic than organophosphates to the predator but still more than biocides which were safer than all tested conventional insecticides.

The results obtained in the present study are also in agreement with those obtained by **El-Hamady (1998)** who stated that Super Royal (the petroleum oil) was less harmful to *C. undecimpunctata* and *P. alfierii* than Tokuthion (organophosphate), Ricinine, glycoalkaloids and volatile chamomile oil.

In general, results presented in Table (22) and illustrated in Fig. (29) indicated that all tested insecticides decreased the total numbers of either aphids or its predators but in different degrees. Also, it is obvious that azadirachtin demonstrated the best effect on aphids and had the lowest impact on the total predators after the two successive cotton seasons. The average reduction percentage in aphid population was 67.45 % and the average reduction percentage in total predators was only 8.96 %. Imidacloprid came next, the average reduction percentages after two successive cotton seasons were 67.74 and 12.96 % for aphids and total predators, respectively. They were followed by the applications of pyriproxyfen, buprofezin and abamectin. The average reduction percentages in the aphid populations were 62.27, 61.31 and 60.13 %, respectively. Thus, the average reduction percentages in the total predators were 27.59, 24.59 and 24.73 %, respectively. The mineral oil was moderately effective against *A. gossypii*, it reduced the aphid population by 51.31 %. However, it was safe against the total predators, the average reduction was only 10.93 %. Cyanophos and furathiocarb demonstrated moderate effect on *A. gossypii*, the average reduction percentages were 48.20 and 46.14 %, respectively. They exhibited the most toxic effect on the total predators populations, the average reduction percentages were 49.23 and 46.24 %, respectively.

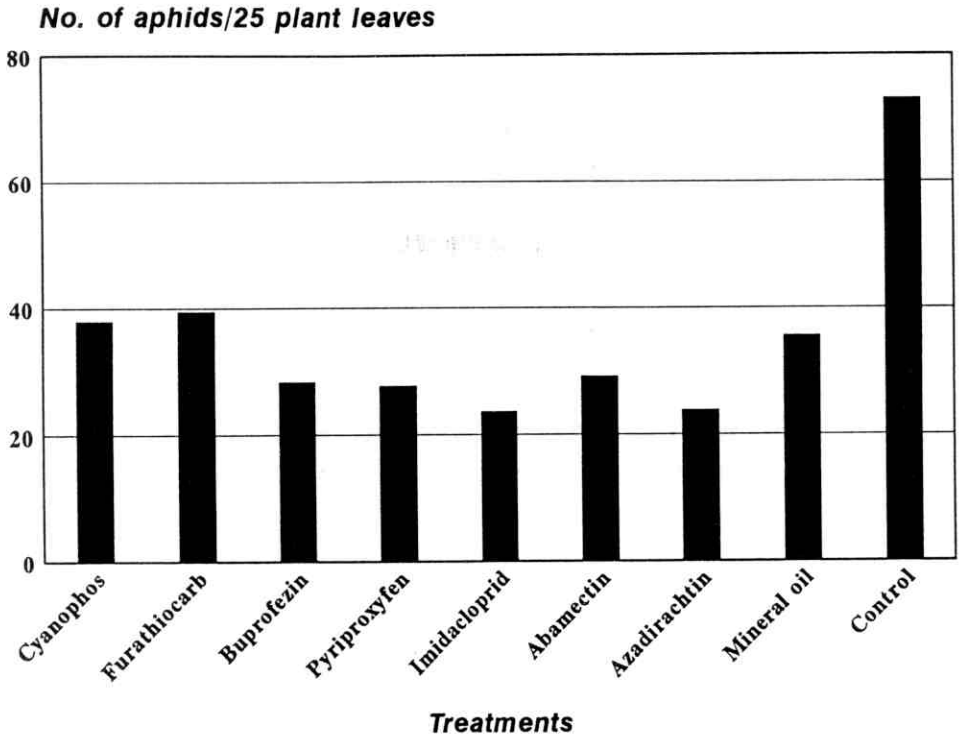
From the above obtained results, it can be said that the natural product from neem plants (azadirachtin), and the nitromethylene analogue insecticide (imidacloprid), were highly effective in reducing the aphid populations under field condition and had a very low toxic effect on the associated predators. So, they may be suitable for use in

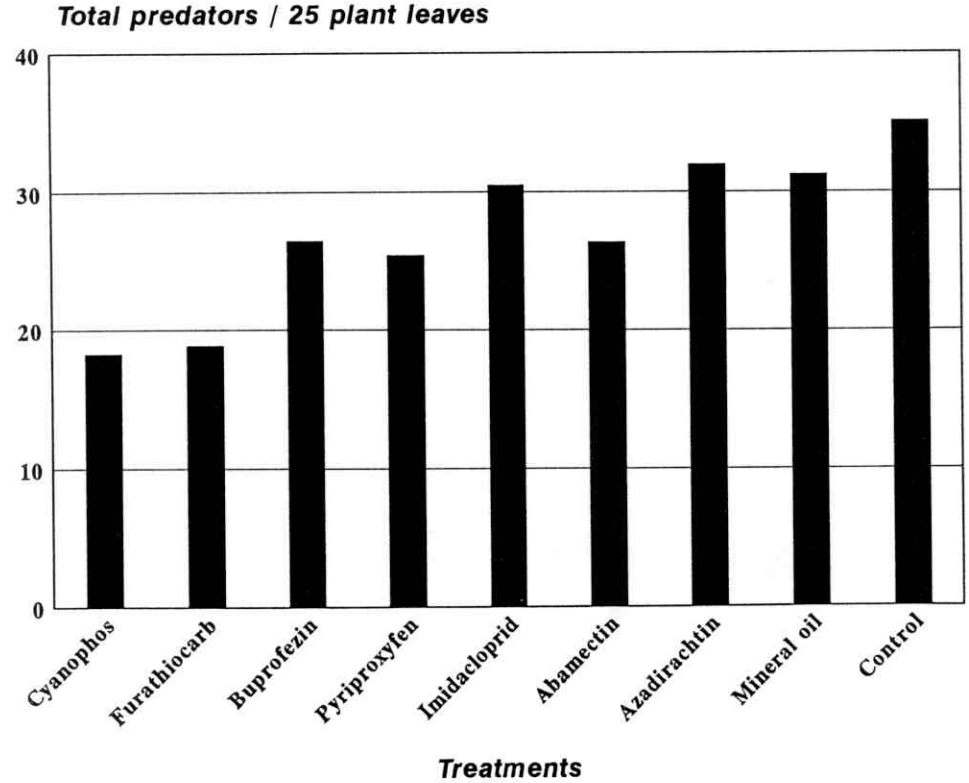
Table (22) : Average number and reduction percentage of cotton aphid and its predators on cotton plants treated with various insecticides.

Insects	Seasons	Average number of insects / 25 plant leaves								
		Treatments								
		Cyanophos	Furathiocarb	Buprofezin	Pyriproxyfen	Imidacloprid	Abamectin	Azadirachtin	Mineral oil	Control
Aphids	2000	37.10	38.25	27.41	26.58	23.92	28.19	23.75	34.28	72.14
	2001	38.50	40.35	29.05	28.48	23.17	30.00	23.75	36.78	73.83
Average		37.80	39.30	28.23	27.53	23.54	29.09	23.75	35.53	72.98
Reduction %		48.20	46.14	61.31	62.27	67.74	60.13	67.45	51.31	-
Total predators	2000	18.00	18.32	26.33	24.91	29.86	26.64	31.37	30.31	34.11
	2001	18.46	19.32	26.48	25.79	31.07	26.06	32.28	32.06	35.91
Average		18.23	18.82	26.40	25.35	30.46	26.35	31.87	31.18	35.01
Reduction %		49.23	46.24	24.59	27.59	12.96	24.73	8.96	10.93	-

$$\text{* Reduction \%} = 1 - \frac{\text{No. of insects in treatment}}{\text{No. of insects in control}} \times 100$$

Fig.(29) Average number of aphids and predators per 25 plant leaves on cotton plants treated with various insecticides after two successive seasons (2000/2001) .





integrated pest management programmes. Although, the juvenile hormone analogue (pyriproxyfen), the insect growth regulator (buprofezin), and the natural product from the soil microorganisms *Streptomyces avermitilis* (abamectin) were effective in reducing the population densities of *A. gossypii*, they were harmful to the associated predators. Field application of mineral oil (KZ oil) was low effective in reducing *A. gossypii* population, while it demonstrated low toxic effect on associated predators. Treatments of the organophosphate (cyanophos) and the carbamate insecticide (furathiocarb) were low effective on cotton aphids. This may due to the extensive use of these insecticides during several years in the control programmes against aphids in cotton fields. Beside that, they exhibited high toxic effect on the associated predators. They may be classified as IPM-incompatible insecticides in the integrated pest management programmes against aphids infesting cotton.

3- Effect of the application of certain sequences of insecticides on the population densities of *A. gossypii* and certain predators in cotton fields :

3.a- *A. gossypii* :

A separate experiment was carried out during the growing cotton season 2001 in order to evaluate the application of certain sequences of insecticides against *A. gossypii*. Three insecticides were chosen according to the results obtained throughout season 2000, *i.e.* imidacloprid, azadirachtin and pyriproxyfen. The most abundant predators on *A. gossypii* were *Ch. carnea, C. undecimpunctata* and *O. albidipennis*. Two insecticidal sprays were applied, the first in 21/6/2001 and the second in 9/8/2001. The sequences were imidacloprid-azadirachtin, imidacloprid- pyriproxyfen, azadirachtin-imidacloprid, azadirachtin- pyriproxyfen, pyriproxyfen-imidacloprid and pyriproxyfen-azadirachtin. The effects of different sequences on the population densities of the cotton aphid are presented in Table (23) and illustrated in Figs. (30 & 31). The obtained results indicate that the first spray of either imidacloprid or azadirachtin in 21/6/2001 caused a sharp decrease in the populations of *A. gossypii*, this decrease extended two weeks after application, then a gradual increase began from the third week. A gradual decrease in aphid populations was observed after the application of pyriproxyfen, these decreases extended three weeks later. These variations in the obtained results may explain the differences in mode of action of the used insecticides. Imidacloprid demonstrates high initial toxic effect. **Mullins *et al.* (1993)** stated out that imidacloprid is a systemic and contact insecticide with primary activity on sucking insects such as aphids. Azadirachtin had a strong repellent and antifeedant effects **(Oroumchi and Lorra, 1993)** and pyriproxyfen (JHM) exhibits late toxic effect **(Moursy and Bartlett, 1991-1992)**. The same trend was observed after the second spray in 9/8/2001. In general, all sequences significantly decreased the aphid populations. The best insecticidal sequences were imidacloprid-azadirachtin and azadirachtin- imidacloprid. They significantly reduced aphid number in respect to other sequences. The average numbers of

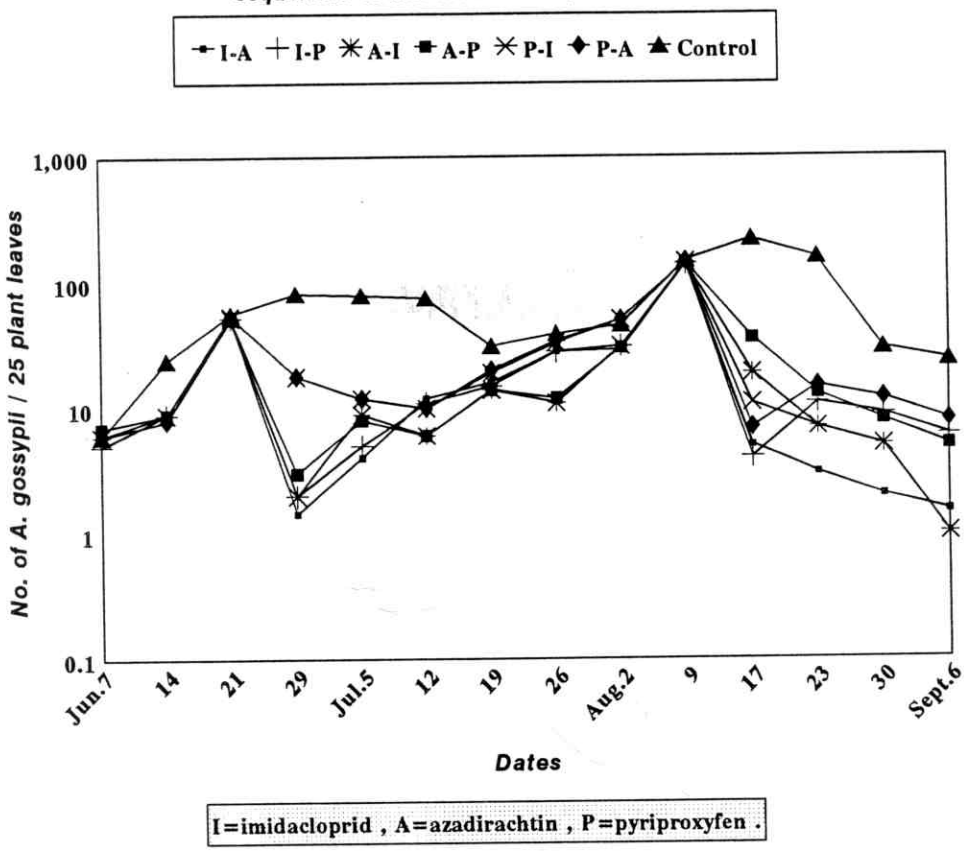
Table (23): Weekly mean number of *A. gossypii* individual per 25 plant leaves on cotton plants treated with various insecticidal sequences, during 2001 season.

1*st* spray 2*nd* spray Inspection dates		Imidacloprid Azadirachtin	Imidacloprid Pyriproxyfen	Azadirachtin Imidacloprid	Azadirachtin Pyriproxyfen	Pyriproxyfen Imidacloprid	Pyriproxyfen Azadirachtin	Control
June	1	0	0	0	0	0	0	0
	7	6.00	5.00	5.50	6.25	6.00	5.50	5.50
	14	7.75	8.25	8.25	8.50	8.75	8.00	23.50
	21	50.75	52.75	52.50	51.50	55.00	54.50	57.00
	29	1.75	1.75	1.50	2.25	17.25	18.00	82.50
July	5	4.00	4.50	5.25	5.50	11.25	11.75	79.75
	12	11.25	10.75	8.25	7.75	9.50	9.75	75.00
	19	14.25	14.25	13.75	13.75	19.25	20.25	31.00
	26	27.50	28.00	10.75	11.75	33.00	33.75	39.00
August	2	29.75	30.25	30.25	29.50	50.50	50.75	46.00
	9	142.50	141.50	145.25	145.0	147.00	148.00	151.00
	17	5.25	10.25	18.50	35.75	6.25	6.25	221.00
	23	2.75	8.50	6.50	12.75	10.25	14.50	159.00
	30	1.50	5.25	4.25	7.50	4.50	11.25	31.00
September	6	1.25	3.25	0.75	4.50	0.75	7.25	23.50
	13	0	0	0	0	0	0	0
Total number		306.25	324.50	311.25	342.25	379.25	399.50	1024.75
Average		19.14 e	20.28 d	19.45 e	21.39. d	23.70 c	24.96 b	64.04 a

LSD at 0.05 = 1.24

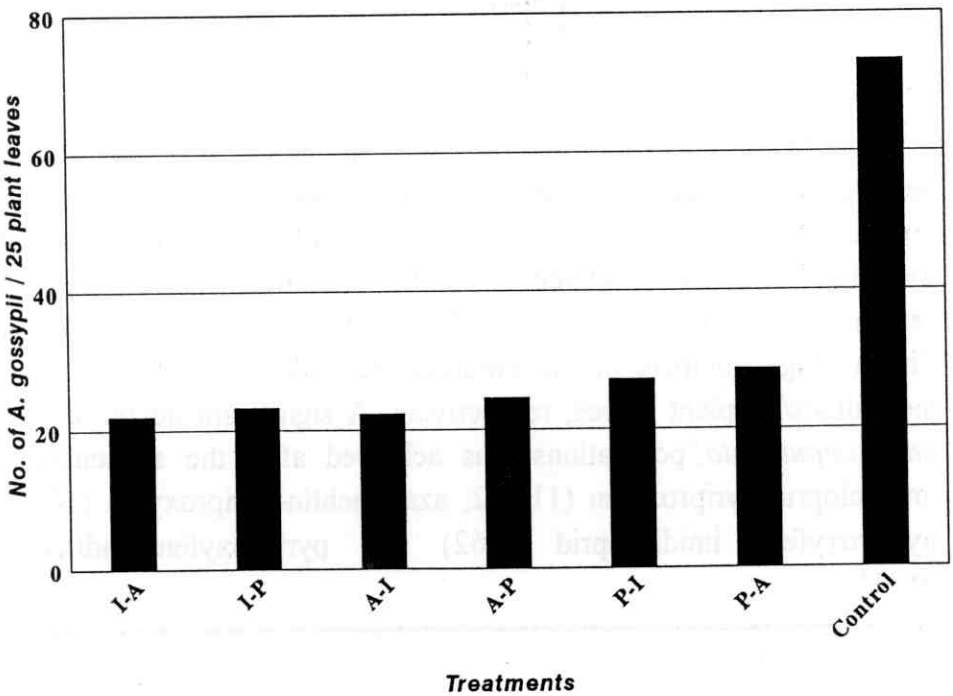
Means followed by the same letter are not significantly different to Duncan's multiple range test.

Fig.(30)Weekly number of A.gossypii individuals per 25 plant leaves on cotton plants treated with sequences of insecicides in 21/6 and 9/10/2001.



I=imidacloprid , A=azadirachtin , P=pyriproxyfen .

Fig.(31)Average number of A. gossypii individuals per 25 plant leaves on cotton plants treated with sequences of insecticides during 2001 season .



I=imidacloprid , A=azadirachtin , P=pyriproxyfen .

aphid per 25 plant leaves were 19.14 and 19.45 individuals, respectively. This average in untreated plots was 64.04 individuals. While, the lowest reductions in aphid numbers were achieved after the sequences of pyriproxyfen-azadirachtin and pyriproxyfen-imidacloprid, the average numbers were 24.96 and 23.70 individuals/25 plant leaves, respectively.

In this respect, **Omar (1997)** found that the highest reductions in aphid populations on cotton plants were achieved after the sequences of imidacloprid-diafenthiuron or diafenthiuron- imidacloprid.

3.b- Preadtors :

Table (24) and Figs. (32 & 33) show the effect of different sequences of insecticides on the population densities of *Ch. carnea*. The obtained data reveal that the effect of insecticidal sequence, imidacloprid-azadirachtin was not significantly different in respect with the untreated control. The average numbers of the predator were 11.42 and 11.73 larvae/25 plant leaves, respectively. The following sequences in descending order were azadirachtin-imidacloprid, imidacloprid-pyriproxyfen, azadirachtin-pyriproxyfen, pyriproxyfen-azadirachtin and pyriproxyfen-imidacloprid. The average numbers were 11.00, 10.59, 10.12, 8.87 and 8.64 larvae/25 plant leaves, respectively.

Data presented in Table (25) and Figs. (34 & 35) show that, in general, all insecticidal sequences manifested a decrease in the population density of *Coccinella undecimpunctata*. This decrease was not significant as compared with the untreated control after the sequences of imidacloprid-azadirachtin and azadirachtin-imidacloprid. The average numbers of the predator were 12.85, 12.28 and 11.78 individuals/25 plant leaves, respectively. A significant decrease in *C. undecimpunctata* populations was achieved after the sequences of imidacloprid-pyriproxyfen (110.32, azadirachtin-pyriproxyfen (10.25), pyriproxyfen- imidacloprid (9.62) and pyriproxyfen-azadirachtin (9.31).

Fig.(32)Weekly number of C.carnea larvae per 25 plant leaves on cotton plants tretaed with sequences of insecticides in 21/6 and 9/10/2001 .

Table (25): Weekly mean number of *Coccinella undecimpunctata* individuals per 25 plant leaves on cotton plants treated with various insecticidal sequences, during 2001 season.

1*st* spray / 2*nd* spray / Inspection dates		Imidacloprid / Azadirachtin	Imidacloprid / Pyriproxyfen	Azadirachtin / Imidacloprid	Azadirachtin / Pyriproxyfen	Pyriproxyfen / Imidacloprid	Pyriproxyfen / Azadirachtin	Control
June	1	0	0	0	0	0	0	0
	7	6.00	6.25	5.75	5.50	6	6.25	6.25
	14	9.25	8.75	8.50	9.00	8.75	9.00	9.25
	21	12.25	13.25	10.75	11.25	11.25	11.50	12.50
	29	5.75	5.75	9.50	10.00	4.75	5.25	11.00
July	5	10.25	10.25	12.00	11.50	8.50	8.75	12.25
	12	12.00	12.25	13.75	12.50	10.50	10.25	14.00
	19	13.75	14.50	15.50	14.75	12.75	12.50	15.25
	26	15.25	16.75	17.00	16.50	14.50	14.25	16.75
August	2	17.75	19.50	18.50	18.00	16.25	16.50	18.00
	9	21.25	21.75	20.25	20.50	18.75	18.25	20.50
	17	23.50	5.50	17.50	5.25	4.50	3.75	31.75
	23	25.25	13.50	19.00	12.25	15.50	12.50	18.50
	30	17.50	11.25	13.50	10.50	12.75	10.75	12.75
September	6	5.50	5.50	6.50	6.25	8.75	8.25	5.25
	13	1.25	0.50	0.50	0.25	0.50	1.25	1.75
Total number		196.50	165.25	188.50	164.00	154.00	149.00	205.75
Average		12.28 a	10.32 bc	11.78 ab	10.25 bc	9.62 c	9.31 c	12.85 a

LSD at 0.05 = 1.52

Means followed by the same letter are not significantly different to Duncan's multiple range test.

Fig.(34)Weekly number of C.undecimpunctata individuals per 25 plant leaves on cotton plants treated with sequences of insecticides in 21/6 and 9/10/2001.

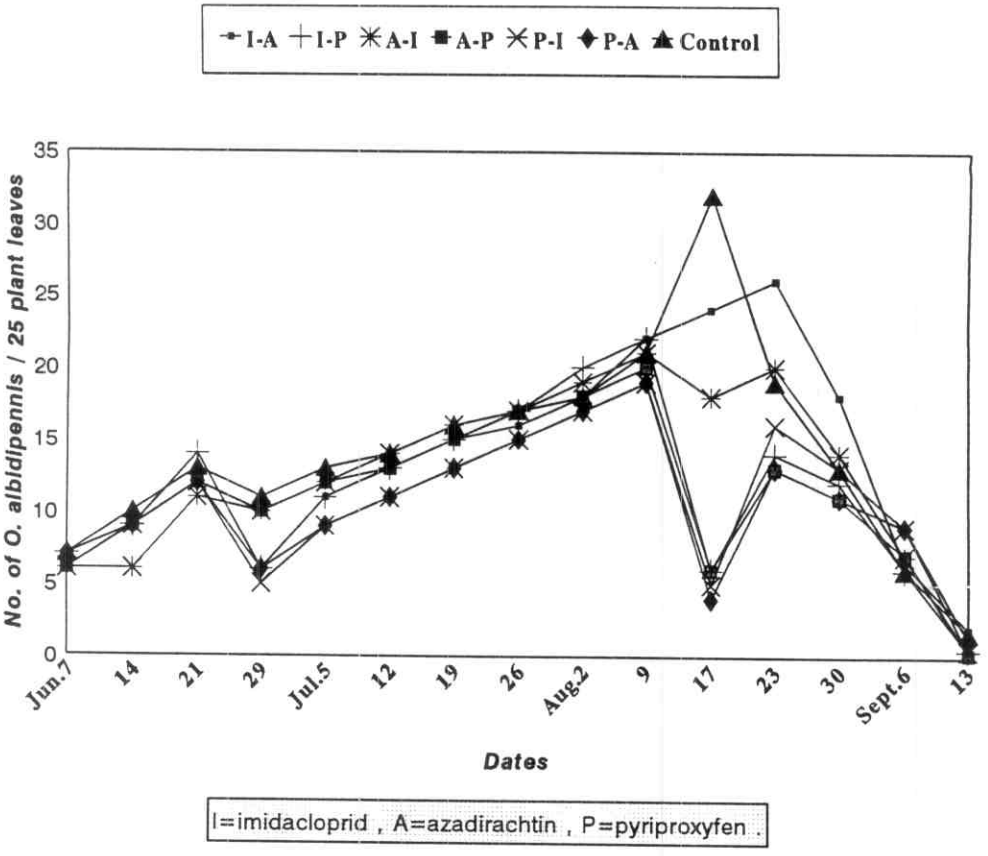
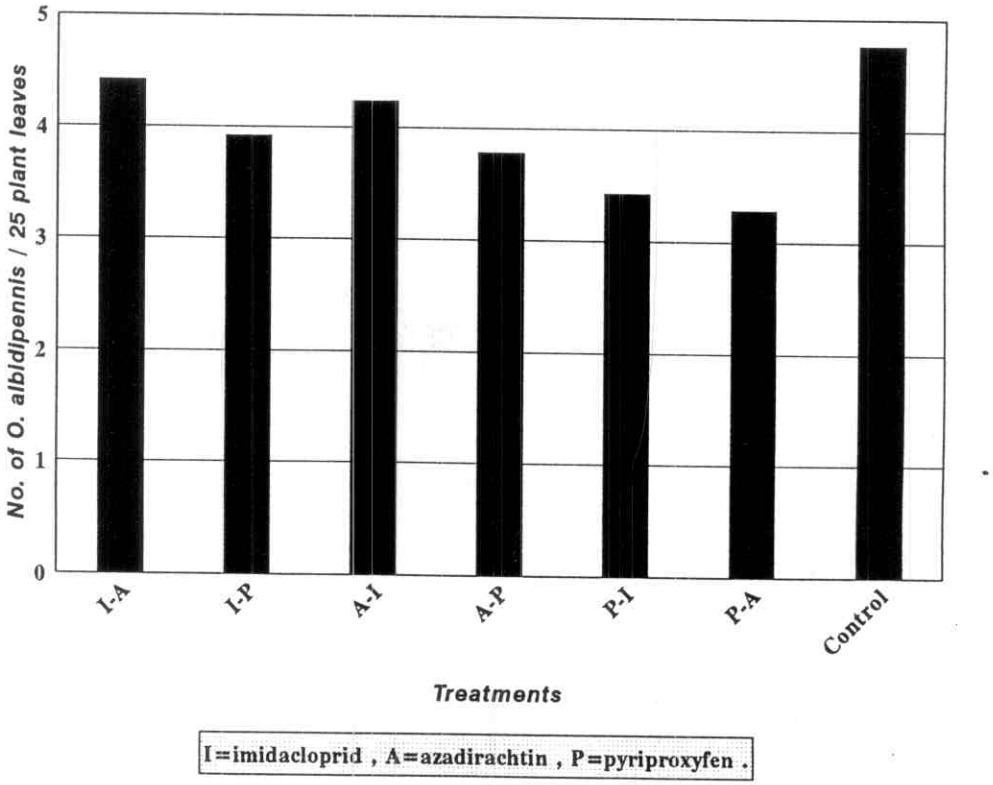


Fig.(35)Average number of C. undecimpunctata individuals per 25 plant leaves on cotton plants treated with sequences of insecticides during 2001 season.



Data in Table (26) and Figs. (36 & 37) reveal that, in general, the insecticidal sequences decreased the population densities of *Orius albidipennis*. They can be classified into three groups according to their side-effects on the predator : (1) Imidacloprid-azadirachtin and azadirachtin- imidacloprid were not significantly different in respect with the untreated control. The average numbers of *O. albidipennis* were 3.85, 3.70 and 4.17 adults/25 plant leaves, respectively. (2) Imidacloprid-pyriproxyfen and azadirachtin- pyriproxyfen significantly decreased the population densities of the predator as compared with the first group. The average numbers of *O. albidipennis* were 3.43 and 3.31 adults/25 plant leaves, respectively. (3) Pyriproxyfen-imidacloprid and pyriproxyfen- azadirachtin demonstrated the highest decrease in the population densities of *O. albidipennis*. average numbers were 3.00 and 2.87 adults/25 plant leaves, respectively.

Table (27) and Fig. (38) reveal that the best sequence for the control of *A. gossypii* was imidacloprid-azadirachtin. It reduced the aphid population by 70.11 % and total predators only by 4.16 %. The sequence of azadirachtin-imidacloprid reduced *A. gossypii* population by 69.62 % and total predators by 7.94 %. The sequences of imidacloprid-pyriproxyfen, azadirachtin-pyriproxyfen, pyriproxyfen-imidacloprid and pyriproxyfen-azadirachtin reduced the aphid populations by 68.34, 66.60, 63.00 and 61.01 % and total predators by 15.33, 17.65, 25.89 and 26.82 %, respectively.

From the aforementioned results, it can be concluded that the insecticidal sequences imidacloprid- azadirachtin or azadirachtin-imidacloprid were the most effective in reducing the populations of *A. gossypii* infesting cotton and manifested the lowest toxic effect on associated predators. These sequences may be involved in the integrated pest management programmes for the control of this insect pest. In this respect, **Omar (1997)** reported that the sequences of diafenthiuron-imidacloprid and imidacloprid-diafenthiuron resulted in the maximum predators populations in cotton fields. He mentioned that this may be attributed to the little side-effects of these insecticides on predators.

Table (26): Weekly mean number of *Orius albidipennis* adults per 25 plant leaves on cotton plants treated with various insecticidal sequences, during 2001 season.

1*st* spray 2*nd* spray Inspection dates		Imidacloprid Azadirachtin	Imidacloprid Pyriproxyfen	Azadirachtin Imidacloprid	Azadirachtin Pyriproxyfen	Pyriproxyfen Imidacloprid	Pyriproxyfen Azadirachtin	Control
June	1	0	0	0	0	0	0	0
	7	4.50	3.75	4.00	4.00	4.50	4.25	500
	14	5.25	4.50	5.25	5.25	5.00	4.75	5.75
	21	6.75	5.25	6.50	6.50	5.25	5.50	7.25
	29	3.75	3.50	5.75	4.00	2.50	2.25	7.50
July	5	5.50	5.75	7.25	6.50	3.25	3.25	5.00
	12	7.75	7.50	8.50	7.25	4.50	4.25	7.25
	19	9.75	8.25	7.00	6.50	5.75	5.50	9.50
	26	7.50	6.50	4.50	4.00	5.25	5.00	6.00
August	2	3.50	4.75	3.25	3.50	3.50	3.25	4.50
	9	2.75	1.75	2.75	2.75	3.00	2.50	3.25
	17	2.25	0.50	2.50	0.50	2.25	2.25	2.50
	23	1.50	1.50	1.25	1.25	1.50	1.50	1.50
	30	0.75	1.00	0.50	0.75	1.25	1.25	1.25
September	6	0.25	0.50	0.25	0.25	0.50	0.50	0.50
	13	0	0	0	0	0	0	0
Total number		61.75	55.00	59.25	53.00	48.00	46.00	66.75
Average		3.85 ab	3.43 ab	3.70 ab	3.31 ab	3.00 b	2.87 b	4.17 a

LSD at 0.05 = 0.70

Means followed by the same letter are not significantly different to Duncan's multiple range test.

Fig.(36)Weekly number of O.albidipennis adults per 25 plant leaves on cotton plants treated with sequences of insecticides in 21/6 and 9/10/2001 .

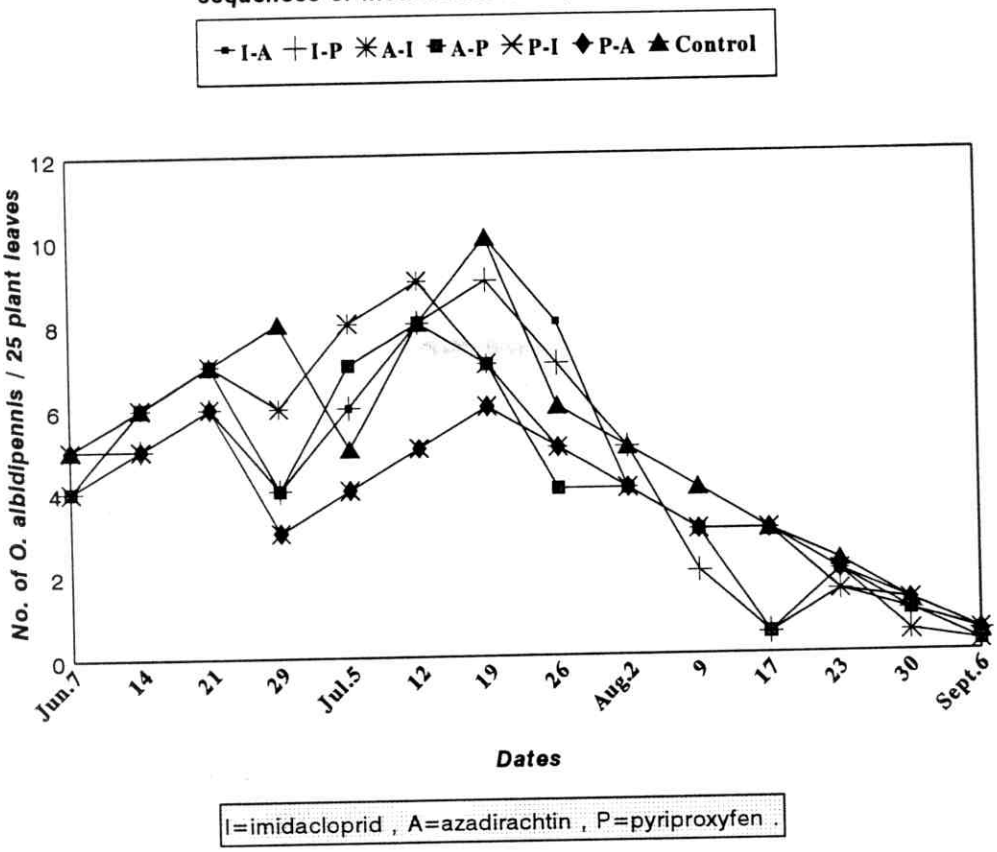


Fig.(37)Average number of O. albidipennis adults per 25 plant leaves on cotton plants treated with sequences of insecticides during 2001 season .

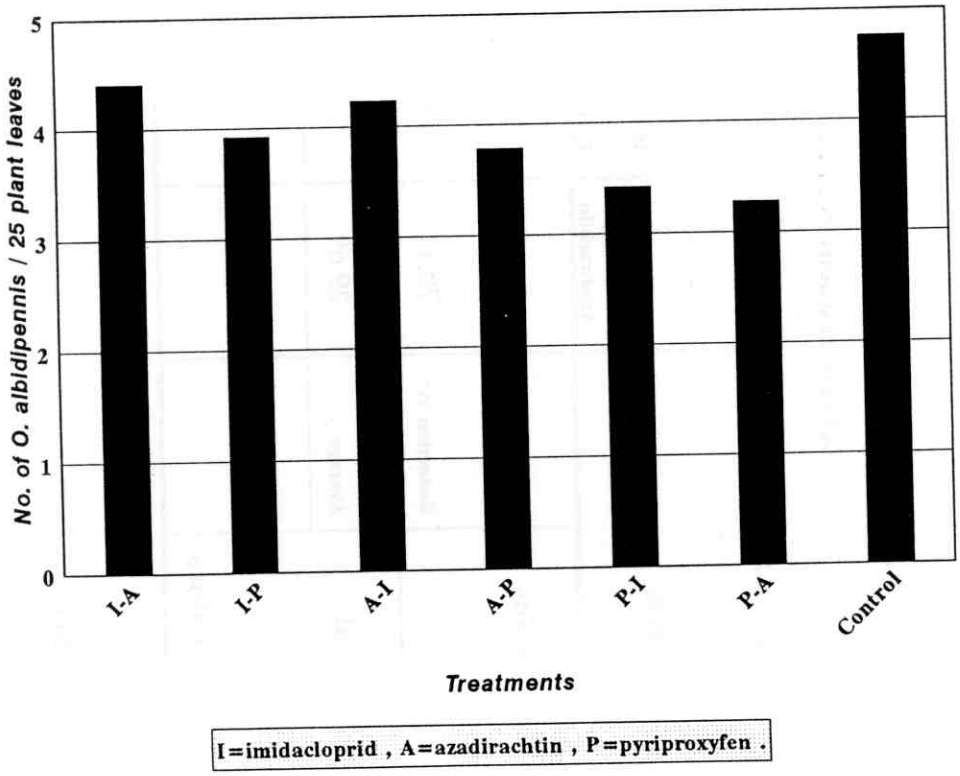
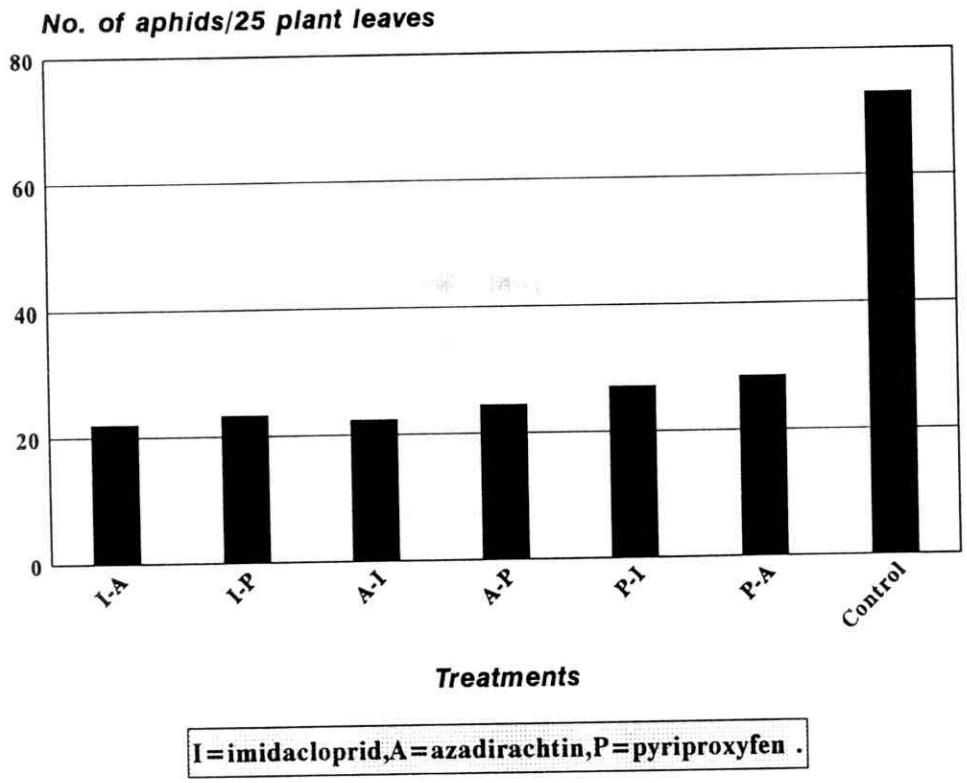


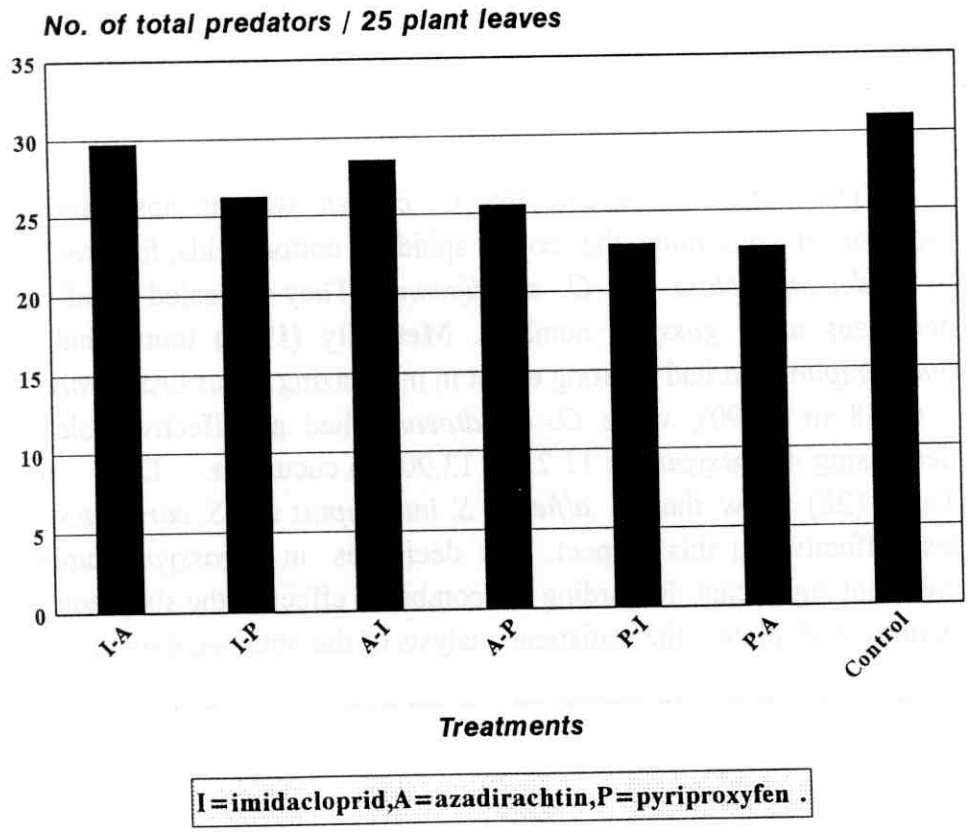
Table (27) : Average number of insects per 25 leaves and their reduction rates on cotton plants treated with certain sequences of insecticides.

Insects		Sequences						
		Imidacloprid Azadirachtin	Imidacloprid Pyriproxyfen	Azadirachtin Imidacloprid	Azadirachtin Pyriproxyfen	Pyriproxyfen Imidacioprid	Pyriproxyfen Azadirachtin	Control
Aphids	Average	21.87	23.17	22.23	24.44	27.08	28.53	73.19
	Reduction %*	70.11	68.34	69.62	66.60	63.00	61.01	-
Total predators	Average	29.69	26.23	28.52	25.51	22.89	22.67	30.98
	Reduction %*	4.16	15.33	7.94	17.65	25.89	26.82	-

$$* \text{ Reduction \%} = 1 - \frac{\text{No. of insects in treatment}}{\text{No. of insects in control}} \times 100$$

Fig.(38) Average number of aphids and predators per 25 plant leaves on cotton plants treated with sequences of insecticides after two successive seasons (2000/2001) .





4- Aphid-predators relationship in cotton fields influenced by the tested insecticides :

The simple correlation (r) and partial regression (b) values between *A. gossypii* and the populations of *Chrysoperla carnea, Coccinella undecimpunctata, Orius albidipennis, Paederus alfierii, Scymnus interruptus* and *Syrphus corollae* during two successive cotton seasons 2000 and 2001 are presented in Table (28). Statistical analysis revealed that there was a negative correlation between the population of *A. gossypii* and the associated predators in untreated plots. The (r) values were -0.72, -0.65, -0.46, -0.31, -0.25 and -0.19, respectively. Regarding the (b) values; -81.65, -56.52, -25.14, -10.06, -9.73 and -6.18, respectively. It can be said that the increase of one individual of *C. carnea, C. undecimpunctata, O. albidipennis, P. alfierii, S. interruptus* and *S. corollae* may decrease the populations of *A. gossypii* by 81.65, 56.52, 25.14, 10.06, 9.73 and 6.18 individuals, respectively. In 2001, the (r) values were -0.81, -0.73, -0.55, -0.42, -0.33 and -0.26. The (b) values were -86.75, -60.53, -27.18, -17.36, -13.50 and -9.25. This means that the increase of one individual of *C. carnea, C. undecimpunctata, O. albidipennis, P. alfierii, S. interruptus* ad *S. corollae* can decrease the numbers of *A. gossypii* by 86.75, 80.53, 57.18, 17.36, 13.50 and 9.25 individuals, respectively (Table, 28).

The difference indicate that *C. carnea* was the most effective predator in consuming the cotton aphids in cotton fields, followed by *C. undecimpunctata* and *O. albidipennis*. They revealed significant decreases in *A. gossypii* numbers. **Metwally (1998)** found that *C. undecimpunctata* had a strong effect in minimizing *Aphis craccivora* (1 : 67.58 or 88.90), while *O. albidipennis* had an effective role in decreasing *A. gossypii* (1 : 11.22 or 13.90) on cucumber. Data in Table (28) show that *P. alfierii, S. interruptus* and *S. corollae* were less effective in this respect. The decreases in *A. gossypii* numbers were not significant. Regarding the combined effect of the six predators in untreated plots, the statistical analysis of the obtained data in Table

Table (28) : Simple correlation and partial regression coefficient of predators in untreated cotton fields on the population density of *A. gossypii* during 2000 and 2001 seasons.

Predators	Fields sprayed in 22/6 and 10/8/2000			Fields sprayed in 21/6 and 9/8/2001		
	r	b	E.V. %	r	b	E.V. %
C. carnea	-0.72*	-81.65	91.36	-0.81*	-86.75	93.54
C. undecimpunctata	-0.65*	-56.52		-0.73*	-60.53	
D. albidipennis	-0.52*	-25.14		-0.55*	-27.18	
P. alfierii	-0.31	-10.06		-0.42	-17.36	
S. interruptus	-0.25	-9.73		-0.33	-13.50	
S. corollae	-0.19	-6.18		-0.26	-9.25	

r = Simple correlation, b = Partial regression, E.V. = = Explained variance, * = Significant.

(28) show that the percentage of explained variance was 91.36 % in 2000 and 93.54 % in 2001. This indicates that there were another factors, such as climatic factors, affecting the aphid-predators relationship in cotton fields. These effects have been estimated by 8.64 % in 2000 and 6.64 % in 2001.

The statistical analysis of the aphid-predators relationship in cotton fields treated with cyanophos are presented in Table (29). The results show that the use of the organophosphate affected the pest predators relationship. A positive correlation was observed between *A. gossypii* and its associated predators. The (r) values were 0.42, 0.31, 0.21, 0.15, 0.14 and 0.09. The (b) values were 39.12, 26.05, 11.36, 9.46, 7.71 and 5.18 for *C. carnea, C. undecimpunctata, O. albidipennis, P. alfierii, S. interruptus* and *S. corollae*, respectively, during 2000 season. These results revealed that the increase in the populations of the pest is followed by an increase in predators populations. This increase was significant only in the case of *C. carnea* and *C. undecimpunctata*. The same trend was also observed in 2001 season. The percentage of explained variance was 31.52 % in 2000 and 35.96 % in 2001. Regarding the explained variances in untreated plots 91.36 and 93.54 % in 2000 and 2001 seasons, respectively (Table, 28). It is obvious that cyanophos had a strong effect on the natural occurring predators in reducing the aphid population in cotton fields. **Kerns and Gaylor (1993)** found that there are factors other than the lack of natural enemies influence aphids outbreaks. Sulprofos, for example, has been shown to affect amino acid concentrations in cotton plant sap, which may benefit cotton aphid population growth.

Omar (1997) mentioned that the response of predators to insecticides differed from one to the other. He found that *S. interruptus* was more sensitive to monocrotophos than *C. undecimpunctata* and *C. carnea*.

In the present study, *S. interruptus* was the most sensitive predator to cyanophos, while *C. carnea* was the most tolerant and the other investigated predators came in between (Table, 29).

Table (30) : Simple correlation and partial regression coefficient of predators in furathiocarb-treated cotton fields on the population density of *A. gossypii* during 2000 and 2001 seasons.

Predators	Fields sprayed in 22/6 and 10/8/2000			Fields sprayed in 21/6 and 9/8/2001		
	r	b	E.V. %	r	b	E.V. %
C. carnea	0.36*	41.92	40.62	0.39*	43.51	43.36
C. undecimpunctata	0.31*	28.43		0.34*	31.30	
O. albidipennis	0.18	15.81		0.19	14.49	
P. alfierii	0.15	11.54		0.17	12.62	
S. interruptus	0.12	8.75		0.14	9.28	
S. corollae	0.10	6.62		0.11	8.17	

r = Simple correlation, b = Partial regression, E.V. = = Explained variance, * = Significant.

Table (32) indicates that there was a negative correlation between the aphid populations and *C. carnea* and *C. undecimpunctata* in pyriproxyfen-treated plots. The (r) values were -0.44 and -0.40 in 2000 and -0.47 and -0.43 in 2001 season. The (b) values were -31.34 and -28.43 in 2000 and -33.68 and -31.10 in 2001 for *C. carnea* and *C. undecimpunctata*, respectively. These results revealed that the increase of one individual of the chrysopid and the coccinellid may decrease the aphid population by 31.34-33.68 and 28.43-31.10 individuals, respectively.

A positive correlation was observed between the subsequent predators and *A. gossypii*. This indicates that these predators were more sensitive to the application of pyriproxyfen, they became unable to reduce the aphid populations. The increase in *O. albidipennis, P. alfierii, S. interruptus* and *S. corollae* populations were followed by an increase in *A. gossypii* populations (Table, 32).

The combined effect of all the associated predators in pyriproxyfen-treated plots on the populations of *A. gossypii* was good, the percentages of explained variances were 68.25 and 70.13 % in 2000 and 2001 seasons, respectively.

Table (33) reveals that the use of imidacloprid caused a negative correlation between the aphid populations and *C. carnea, C. undecimpunctata* and *O. albidipennis*. The (r) values were -0.57, -0.51 and -0.36 in 2000 seasons and -0.59, -0.55 and -0.40 in 2001 season, respectively. The (b) values were -58.34, -55.42 and -21.71 in 2000 season, and -62.40, -56.29 and -24.58 in 2001 season, respectively. One individual of *C. carnea, C. undecimpunctata* and *O. albidipennis* can reduce the aphid populations by 54.34- 62.40, 52.42-56.29 and 11.71-14.58 individuals, respectively. The percentages of explained variances were 71.43 and 74.12 %, this indicates that predators had a good effect in reducing aphid populations in imidacloprid-treated plots. The previous findings were closely related to those of **Omar (1997)** who found that imidacloprid caused the lowest percentage reduction in

Table (33) : Simple correlation and partial regression coefficient of predators in imidacloprid-treated cotton fields on the population density of *A. gossypii* during 2000 and 2001 seasons.

Predators	Fields sprayed in 22/6 and 10/8/2000			Fields sprayed in 21/6 and 9/8/2001		
	r	b	E.V. %	r	b	E.V. %
C. carnea	-0.57*	-58.34	71.43	-0.59*	-62.40	74.12
C. undecimpunctata	-0.51*	-55.42		-0.55*	-56.29	
O. albidipennis	-0.36	-21.71		-0.40	-24.58	
P. alfierii	0.23	9.50		0.27	11.21	
S. interruptus	0.14	7.89		0.19	9.62	
S. corollae	0.11	4.63		0.14	6.17	

r = Simple correlation, b = Partial regression, E.V. = = Explained variance, * = Significant.

C. carnea, C. undecimpunctata and *S. interruptus* populations. **Omar *et al.* (2001)** also mentioned that imidacloprid was intermediate in its effect on *C. carnea, C. undecimpunctata* and *O. albidipennis*.

It is seen from Table (34) that the relation between *A. gossypii* and *C. carnea, C. undecimpunctata* and *O. albidipennis* was negative, while it was positive between this insect pest and *P. alfierii, S. interruptus* and *S. corollae*. The relation was only significant in the case of *A. gossypii* and *C. carnea* which was the most efficient predator in reducing aphid populations in abamectin-sprayed plots. One individual of the predator can reduce the pest population by45.82-48.48 individuals. *C. undecimpunctata* acme next in this respect, it can reduce aphid population by 21.14-23.10 individuals followed by *O. albidipennis* (11.75-14.31 individuals). The percentages of explained variances were 65.25 and 68.16 % for 2000 and 2001 seasons, respectively. These results show that the effect of total predators in reducing the aphid populations in plots treated with abamectin was moderate.

Table (35) shows that azadirachtin had a significant effect on the relationship between aphids and *C. carnea, C. undecimpunctata* and *O. albidipennis*. The simple correlation (r) values were -0.65, -0.54 and -0.51 in 2000 and -0.67, -0.55 and -0.50 in 2001 seasons. The (b) values were -54.16, -51.91 and -17.06 and -0.67, -0.55 and -0.46 in 2000 and 2001 seasons, respectively. The relation between *A. gossypii* and *P. alfierii, S. interruptus* and *S. corollae* was positive. The (b) values were 13.75, 10.63 and 6.53 in 2000 season and 14.25, 16.14 and 11.38 in 2001 season, respectively. Regarding the combined effect of the six predators in azadirachtin-treated plots, the percentages of explained variance were 75.58 % in 2000 and 78.14 % in 20001 seasons. These results reflect the potentiality of predators in reducing the aphid populations in azadirachtin-treated plots.

The statistical analysis of the aphid-predators relationship in cotton fields sprayed with mineral oil are shown in Table (36). A

Table (34) : Simple correlation and partial regression coefficient of predators in abamectin-treated cotton fields on the population density of *A. gossypii* during 2000 and 2001 seasons.

Predators	Fields sprayed in 22/6 and 10/8/2000			Fields sprayed in 21/6 and 9/8/2001		
	r	b	E.V. %	r	b	E.V. %
C. carnea	-0.51*	45.82	65.25	-0.55*	48.48	68.16
C. undecimpunctata	-0.40	21.14		-0.43	23.10	
O. albidipennis	-0.22	11.75		-0.28	14.31	
P. alfierii	0.11	5.60		0.16	7.24	
S. interruptus	0.09	3.16		0.11	5.52	
S. corollae	0.05	2.58		0.07	4.65	

r = Simple correlation, b = Partial regression, E.V. = = Explained variance, * = Significant.

Table (35) : Simple correlation and partial regression coefficient of predators in azadirachtin-treated cotton fields on the population density of *A. gossypii* during 2000 and 2001 seasons.

Predators	Fields sprayed in 22/6 and 10/8/2000			Fields sprayed in 21/6 and 9/8/2001		
	r	b	E.V. %	r	b	E.V. %
C. carnea	-0.065*	-54.16	75.58	-0.67*	-58.17	78.14
C. undecimpunctata	-0.54*	-51.91		-0.55*	-54.42	
O. albidipennis	-0.51*	-17.06		-0.50*	-22.54	
P. alfierii	0.23	13.75		0.26	14.25	
S. interruptus	0.12	10.63		0.19	16.14	
S. corollae	0.08	6.53		0.10	11.38	

r = Simple correlation, b = Partial regression, E.V. = = Explained variance, * = Significant.

Table (36) : Simple correlation and partial regression coefficient of predators in mineral oils-treated cotton fields on the population density of *A. gossypii* during 2000 and 2001 seasons.

Predators	Fields sprayed in 22/6 and 10/8/2000			Fields sprayed in 21/6 and 9/8/2001		
	r	b	E.V. %	r	b	E.V. %
C. carnea	-0.67*	-68.34	81.15	-0.66*	-69.26	82.52
C. undecimpunctata	-0.58*	-59.15		-0.59*	-61.67	
O. albidipennis	-0.52*	-34.58		-0.54*	-32.40	
P. alfierii	0.21	11.24		0.25	13.40	
S. interruptus	0.17	9.37		0.18	10.58	
S. corollae	0.11	6.16		0.13	8.11	

r = Simple correlation, b = Partial regression, E.V. = = Explained variance, * = Significant.

significant negative correlation between *A. gossypii* and *C. carnea, C. undecimpunctata* and *O. albidipennis* was observed. The simple correlation (r) were -0.67, 0.58 and 0.52 and -0.66, 0.59 and 0.54 for 2000 and 2001 seasons, respectively. The (b) values were -68.34, -59.15 and -34.58 and -69.26, -61.67 and -32.40 for 2000 and 2001 seasons, respectively. A positive correlation was shown between *A. gossypii* and *P. alfierii, S. interruptus* and *S. corollae*. The percentages of the explained variance were 81.15 and 82.52 % in 2000 and 2001 seasons, respectively. The total predators were effective in reducing the aphid populations in cotton plots sprayed with mineral oil.

The mineral oil was the safer compound for the beneficial arthropods evaluated in the field and this was in agreement with the findings of **Gravena *et al.* (1988)** who found that mineral oil was more selective than dimethoate for coccinellids and chrysopids. **Bachatly and Sedrak (1997)** mentioned that mineral oil was the safer compound affecting predator community, when compared with malathion and fenvalerate. **Omar *et al.* (2001)** reported that the mineral oil (Super Royal) was the most secure compound in its effect on predators populations than imidacloprid and malathion.

The simple correlation (r) and the partial regression (b) values between *A. gossypii* and *C. carnea, C. undecimpunctata* and *O. albidipennis* in cotton fields treated with certain sequences of insecticides in 2001 cotton season are presented in Table (37). Statistical analysis showed that there was a negative correlation between aphids and the three associated predators in cotton plots sprayed with imidacloprid-azadirachtin, azadirachtin-imidacloprid, imidacloprid-pyriproxyfen and untreated plots. The (r) values were -0.64, -0.58 and -0.52 & -0.57, -0.51 and 0.50 & -0.61, -0.56 and -0.52 & -0.73, -0.65 and -0.54, respectively. The (b) values were -65.12, -41.18 and -21.23 & -51.45, -37.36 and 16.70 & -64.95, -36.47 and -19.88 & -79.23, -76.68 and -23.45, respectively. The best sequence was imidacloprid-azadirachtin, one individual of *C. carnea* can reduce

Table (37) : Simple correlation and partial regression coefficient of predators in cotton fields treated with certain sequences of insecticides on the population density of *A. gossypii* in 2001.

Sequences	Predators	r	b	E.V. %
Imidacloprid & Azadirachtin	*C. carnea*	-0.64*	-65.12	80.54
	C. undecimpunctata	-0.58*	-41.18	
	O. albidipennis	-0.52*	-21.23	
Imidacloprid & Pyriproxyfen	*C. carnea*	-0.57*	-51.45	75.35
	C. undecimpunctata	-0.51*	-37.36	
	O. albidipennis	-0.50*	-16.70	
Azadirachtin & Imidacloprid	*C. carnea*	-0.61*	-64.95	78.25
	C. undecimpunctata	-0.56*	-36.47	
	O. albidipennis	-0.52*	-19.88	
Azadirachtin & Pyriproxyfen	*C. carnea*	0.31	28.57	65.36
	C. undecimpunctata	0.25	21.96	
	O. albidipennis	0.14	14.65	
Pyriproxyfen & Imidacloprid	*C. carnea*	0.27	23.09	61.45
	C. undecimpunctata	0.21	17.74	
	O. albidipennis	0.12	9.10	
Pyriproxyfen & Azadirachtin	*C. carnea*	0.24	21.83	60.17
	C. undecimpunctata	0.20	15.91	
	O. albidipennis	0.11	7.02	
Control	*C. carnea*	-0.73*	-79.23	91.28
	C. undecimpunctata	-0.65*	-56.68	
	O. albidipennis	-0.54*	-26.45	

r = Simple correlation, b = Partial regression, E.V. = = Explained variance, * = Significant.

the aphid population by 65.12 individuals (79.23 individuals in untreated plots), one individual of *C. undecimpunctata* can reduce *A. gossypii* population by 41.18 individuals (56.68 individuals in untreated plots), whereas one individual of *O. albidipennis* can reduce the aphid population by 21.23 individuals (26.45 individuals in untreated plots). Regarding the percentages of explained variance, the values in descending order were 91.28, 80.54, 78.25, 75.35, 65.36, 61.45 and 60.17 for untreated, imidacloprid-azadirachtin, azadirachtin-imidacloprid, imidacloprid-pyriproxyfen, azadirachtin- pyriproxyfen, pyriproxyfen-imidacloprid and pyriproxyfen-azadirachtin treated plots, respectively.

Finally, it can be concluded that azadirachtin, imidacloprid, mineral oil and pyriproxyfen were the safest materials in their effects on the aphid- predators relationship in cotton fields. The best sequences in this respect were imidacloprid- azadirachtin, azadirachtin-imidacloprid and imidacloprid-pyriproxyfen.