RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

Field experiments:

Part .1

Effect of tested agrochemicals on the infestation percent and larval contents of pink and spiny bollworms in cotton fields during 2004 and 2005 in Egypt

Data concerning the effect of tested agrochemicals, i.e. EM (microorganisms complex), Dipel (*Bacillus thuringenesis*) biocide, Mikrofol (foliar fertilizer complex) and pleo (a.i. of pyridalyl: new chemical group) at the recommended rates of 1/2 L/fed, 200g/fed, 2.5 L/fed and 100 ml/fed, respectively in comparison with conventional rational program for bollworms control into three successive applications at fifteen day intervals in cotton fields at Kalubia governorate, on the infestation percent and larval content of pink and spiny bollworms during the two cotton seasons 2004 and 2005 are tabulated in Tables (1-11) and illustrated in Figs. (1-11). Examination of the obtained results indicated the important role of the studied factors, i.e. agrochemical type, spray number and time, date after application, spray season and insect species in determining the infestation percent and larval content of both pink and spiny bollworms in cotton fields. To facilitate the presentation of data, each insect pest was considered separately in the followings:

1. Pink bollworm, *Pectinophora gossypiella*

1.1. Infestation percent

1.1.1. Cotton season, 2004

Data in Table (1) and Fig. (1) indicated the great role of tested agrochemicals in determining the infestation percent of cotton bolls by the pink bollworm, such reducing effects were pronounced within the two studied seasons. On the other hand, the time after agrochemical sprays showed fluctuated infestation according to the tested compound, but, in general, pink bollworm infestations were lower than the untreated check. By the end of the season, the mean infestation percent by pink bollworm during 2004 reached 26.56 % (control plots), 20.17 % (EM), 17.20 % (Dipel), 18,67 (Mikrofol), 4.10 % (Pleo) and Conventional Spray Program for bollworms showed the mean infestation % of 5.6 % . Such figures of infestation percent are significant in differences than the untreated check.

The reduction percentages in infestation percent than the untreated ones reached 26.15, 35.65, 33.45, 83.45 and 78.45 % in case of EM, Dipel, Mikrofol, Pleo and conventional spray program treatments, respectively.

As for the agrochemical spray infestation relation, data in Table (2) and Fig. (2) indicated the moderate reduction percentages in pink bollworm infestation after the 1st spray than untreated check. The reduction percentages reached 38.33, 47.33, 46.00, 76.00 and 58.00% with EM, Dipel, Mikrofol, Pleo and conventional spray program one week after spray, respectively. The prolongation of post treatment period with the

Table (1): Effect of tested agrochemicals on % infestation by pink bollworm during 2004 season.

Treatments / Inspection date	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
1/7 1st spray	3.0	3.0	3.0	3.0	3.0	3.0
8/7	7.0	4.0	4.0	4.0	2.66	3.1
15/7 2nd spray	16.0	13.0	9.33	11.33	3.66	4.1
22/7	22.0	16.67	13.33	14.67	4.33	4.33
29/7 3rd spray	28.33	23.33	19.67	21.0	5.33	6.0
5/8	30.67	25.0	22.0	24.0	4.33	4.0
12/8	38.0	26.67	24.33	25.0	7.0	8.0
19/8	39.0	29.0	26.0	27.0	5.0	4.0
26/8	40.0	28.67	25.33	27.33	6.33	6.0
2/9	34.33	25.33	23.33	23.33	5.33	7.33
9/9	30.33	24.33	22.33	21.33	4.33	8.67
16/9	29.0	23.0	20.0	22.0	5.0	7.0
Mean	26.56	20.17	17.20	18.67	4.10	5.6

L.S.D. at (0.5 %) between treatments = 0.41

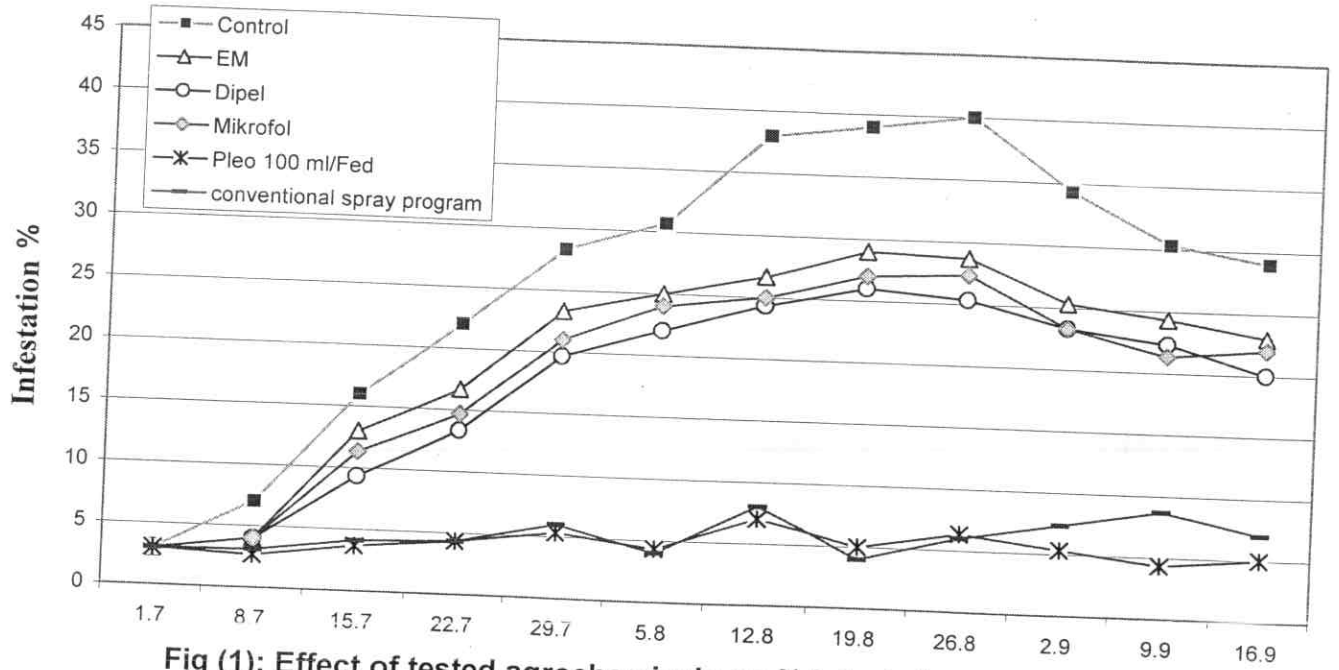


Fig (1): Effect of tested agrochemicals on % infestation by pink bollworm during 2004 season

Table (2): Reduction percentages in infestation by pink bollworm larvae than control during 2004 season after spraying of different agrochemicals on cotton plants.

Treatments / Dates	EM	Diple	Mikrofol	Pleo	Conventional Spray Program
8/7	38.33	47.33	46.00	76.00	58.00
15/7	26.00	42.00	43.47	73.00	75.00
22/7	22.33	38.33	32.00	86.33	81.33
29/7	22.67	38.33	37.33	83.67	81.67
5/8	16.67	27.33	23.00	88.67	86.67
12/8	29.00	34.00	28.33	85.33	78.33
19/8	26.67	32.33	29.33	86.00	89.00
26/8	26.00	34.00	31.00	86.00	85.00
2/9	30.33	37.00	32.67	85.00	81.00
9/9	27.33	32.33	31.67	86.33	70.33
16/9	22.33	31.33	27.00	83.00	72.00
Mean	26.15	35.85	33.45	83.45	78.45

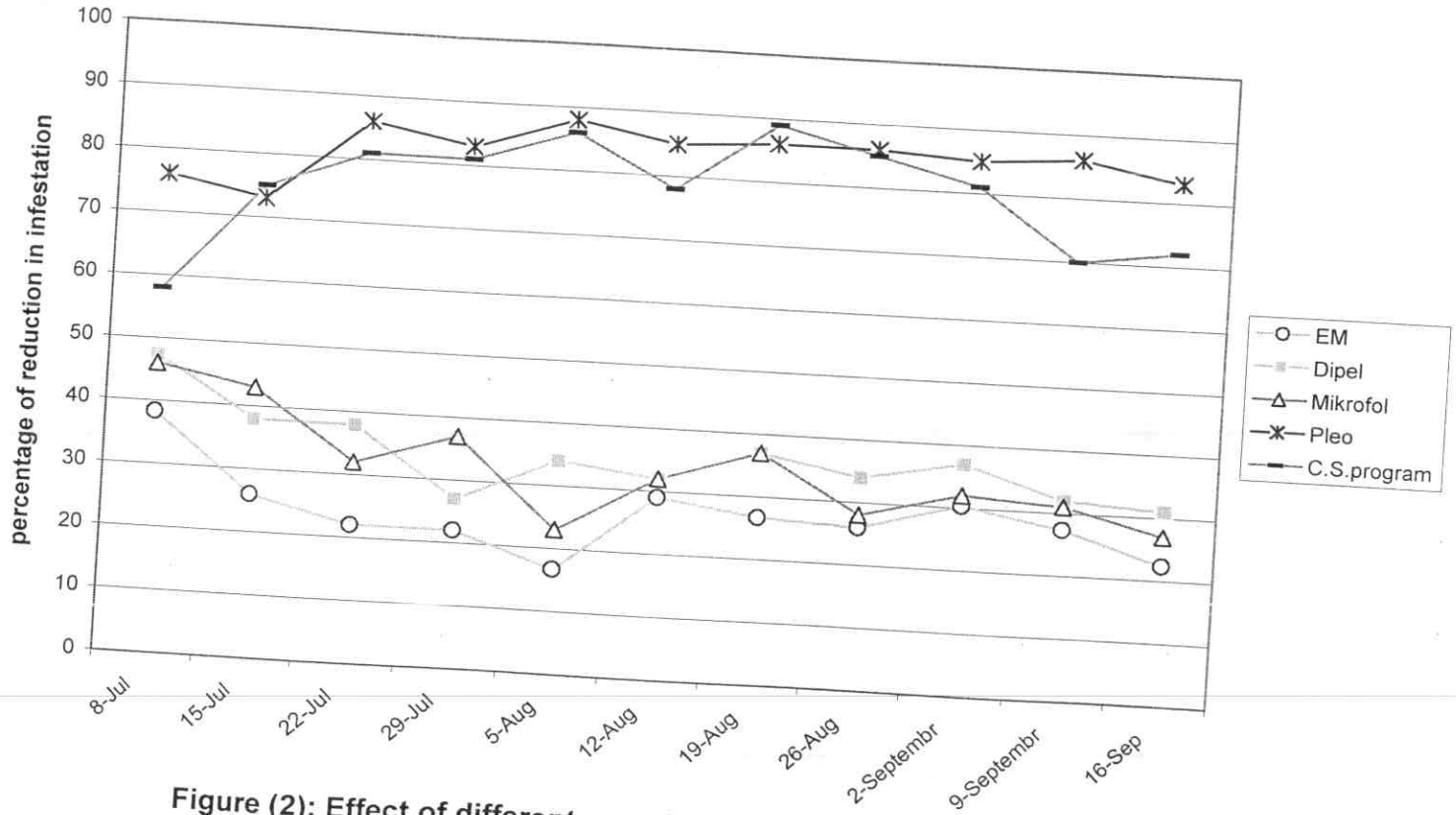


Figure (2): Effect of different agrochemicals on the percentage of reduction in infestation by pink bollworm during 2004season.

successive two sprays indicated gradual but lower reduction percentages in pink bollworm infestation until the end of experiment. The corresponding values of infestation reduction were 26.00, 42.00, 43.47, 73.00 and 75.00 % after two weeks from the 1st spray with the same agrochemicals, respectively. The reduction of infestation two weeks after 2nd sprays reached 22.67, 38.33, 37.33, 83.67 and 81.67 %, respectively. Two weeks after 3rd spray showed the reduction percent in pink bollworm infestation by 29.00, 34.00, 28.33, 85.33 and 78.33 % with the same compounds, respectively.

As conclusion, Pleo (a.i. Pyridalyl) and conventional spray program showed superior influences in reducing pink bollworm infestation of cotton bolls during 2004 season than the other tested agrochemicals. Such activity was pronounced after 1st week from 1st spray and continuously increased by the successive two sprays and by the prolongation of post treatment intervals until the end of experiment. This indicated the inducing effect of Pleo (Pyridalyl) in enhancing the resistance of cotton plants against the attack of pink bollworms compared with the other agrochemicals.

The reduction in pink bollworm infestation by agrochemicals sprays was reported by many investigators in Egypt and other countries such as **Lohar and Nahyoon (1995)** who evaluated the comparative effectiveness of three insecticides against cotton bollworms (mainly *Earias insulana, E. vittella* and *Pectinophora gossypiella*) at Sindh Agriculture University, Tandojam, Pakistan. Results indicated that the insecticide Hostathion [triazophos] caused maximum reduction

percentage population of bollworms, followed by Sumicidin [fenvalerate] and Sevin [carbaryl]. All the insecticides showed their highest efficacy against three species of bollworms and resulted in significantly increased yields. In addition, in Egypt, **Hamed *et al.*, (2006)** recorded the efficacy of different insecticide mixtures belonging to different groups, i.e. Decis [deltamethrin] 2.5EC + Thiodan [endosulfan] 35EC, Decis 2.5 EC + Curacron [profenofos] 500 EC, Decis 2.5 EC + Somialfa 110 EC, Decis 2.5 EC + Advantage [carbofuran] 20 EC, Thiodan 35EC + Curacron 500 EC and Thiodan 35 EC + Somialfa 110 EC using their field recommended doses against *H. armigera*. The percentage mortality was determined to compare the efficacy of mixtures and their probability of synergism. The organophosphates in combination with pyrethroids exhibited an enhanced toxicity showing the high probability of synergistic effects. Significantly, high toxicity was shown by Decis 2.5 EC + Curacron 500 EC which caused 100 % mortality to the insect followed by thiodan 35 EC + Somialfa 110 EC causing 83.3 % mortality after 72 h of exposure. These findings on insecticide mixtures could serve as useful tool in the management of insecticide resistance.

1.1.2. Cotton season, 2005

Data in Table (3) and Fig. (3) indicated the same trend of results as that obtained with the cotton season 2004, where agrochemical type, number and time of sprays as well as post treatment intervals proved influential on pink bollworm infestation of cotton bolls. Significant differences were calculated between agrochemical treatments and untreated

Table (3): Effect of tested agrochemicals on % infestation by pink bollworm during 2005 season.

Treatments / Dates	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
1/7 1st spray	3.0	3.0	3.0	3.0	3.0	3.0
8/7	8.0	5.0	5.0	5.0	2.0	4.0
15/7 2nd spray	18.0	14.33	11.0	12.33	6.0	6.0
22/7	25.33	21.0	16.33	16.67	3.0	4.1
29/7 3rd spray	30.67	22.33	17.67	18.0	4.33	9.0
5/8	31.0	27.33	23.67	24.0	3.66	4.0
12/8	39.0	29.0	25.0	28.33	6.0	9.0
19/8	42.0	30.0	27.0	30.0	6.0	4.3
26/8	42.0	28.0	26.0	28.0	7.0	6.0
2/9	36.0	26.0	23.0	24.0	5.0	7.0
9/9	34.33	24.33	22.33	22.33	5.33	9.33
16/9	31.0	24.0	22.33	25.0	6.0	8.0
Mean	28.39	21.22	18.67	19.78	4.75	6.1

L.S.D. at (0.5 %) between treatments = 0.46

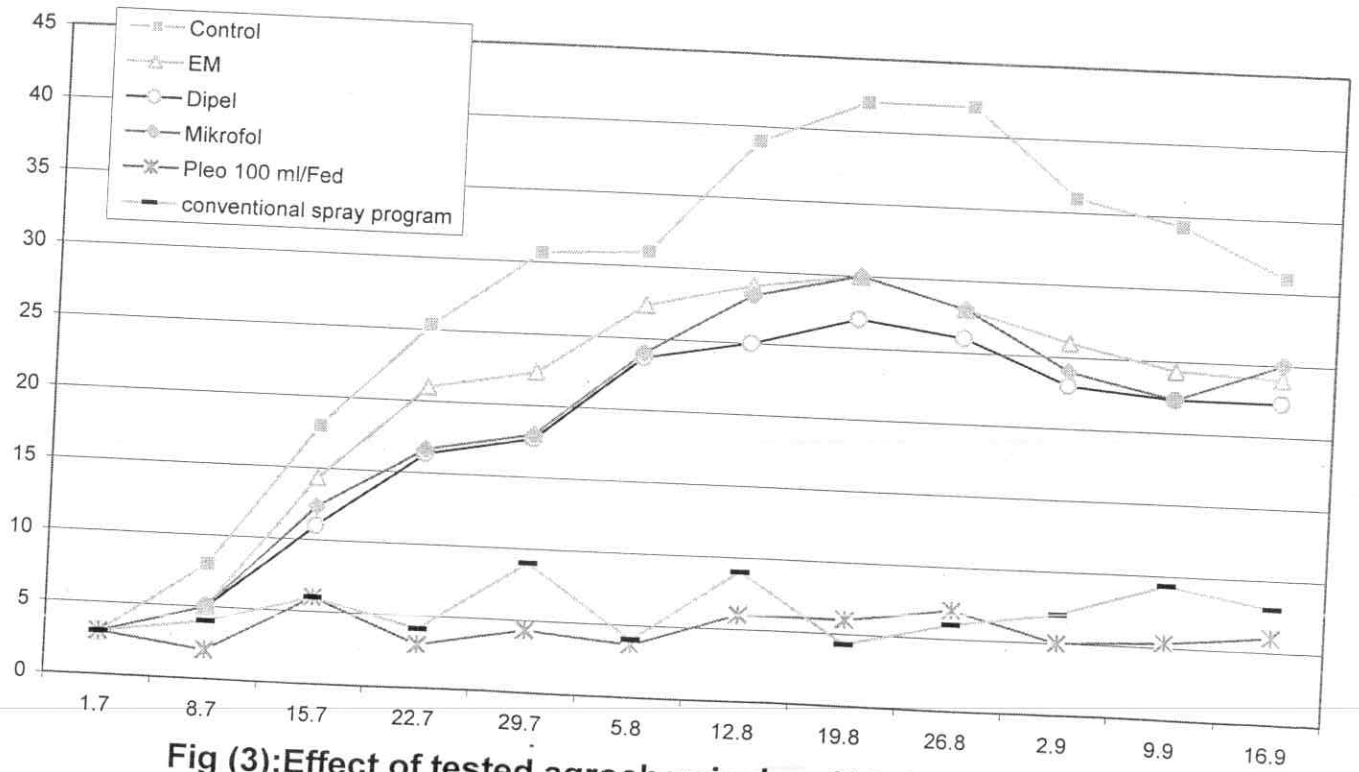


Fig (3):Effect of tested agrochemical on % infestation by pink bollworm during 2005 season

check. The mean percentages of infestation of bolls were 28.39, 21.22, 18.67, 19.78, 4.75 and 6.10 % in cases of untreated check, EM, Dipel, Pleo and conventional spray program, respectively. These results confirmed that Pleo treatment at 100 ml/fed and conventional spray program proved of superior effect in reducing and protecting cotton bolls against the pink bollworm attack.

It is clearly evident that the differences between seasonal mean of bolls' infestation percentage of 2004 and 2005 cotton seasons for each treatment were insignificant.

As for the reduction in pink bollworm infestation than the untreated check because of agrochemicals' application, data in Table (4) and Fig. (4) indicated the highest mean reduction with Pleo treatment (84.21 %), followed by Conventional Spray Program (76.5 %); a mean throughout the experiment). On the other treatments, lower reductions were recorded in different values according to the agrochemical nature and structure, reaching 26.64, 36.52 and 33.15 % in cases of EM, Dipel, Mikrofol, respectively. The corresponding reduction percentages in 2004 were 26.15, 35.85, 33.45, 83.45 and 78.45 % with EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively.

It is evident to notice the high reduction in infestation 1st week after 1st spray, followed by fluctuated changes after the two successive sprays and with the prolongation of post-treatment periods until the end of experiment. In terms of figures, the reduction percentages after 1st spray were 38.33, 47.00, 47.00, 76.00 and 50.00 % (1st week); 26.00, 41.00, 33.00, 77.00 and 66.00 % (2nd week) in cases of EM, Dipel, Mikrofol, Pleo and

Table (4): Reduction percentages in infestation by pink bollworm larvae than control during 2005 season after spraying of different agrochemicals on cotton plants.

Treatments / Dates	EM	Diple	Mikrofol	Pleo	Conventional Spray Program
8/7	38.33	47.00	47.00	76.00	50.00
15/7	26.00	41.00	33.00	77.00	66.00
22/7	21.00	37.00	33.00	88.67	84.67
29/7	25.00	42.67	42.67	85.67	73.67
5/8	12.00	24.33	23.00	88.67	87.67
12/8	26.00	34.67	29.00	85.00	77.00
19/8	29.00	34.67	29.00	86.00	90.00
26/8	34.00	39.00	33.00	83.00	86.00
2/9	27.00	36.33	33.67	86.00	81.00
9.9	29.67	35.67	35.67	85.00	73.00
16/9	24.33	29.33	25.67	84.67	74.67
Mean	26.64	36.52	33.15	84.21	76.5

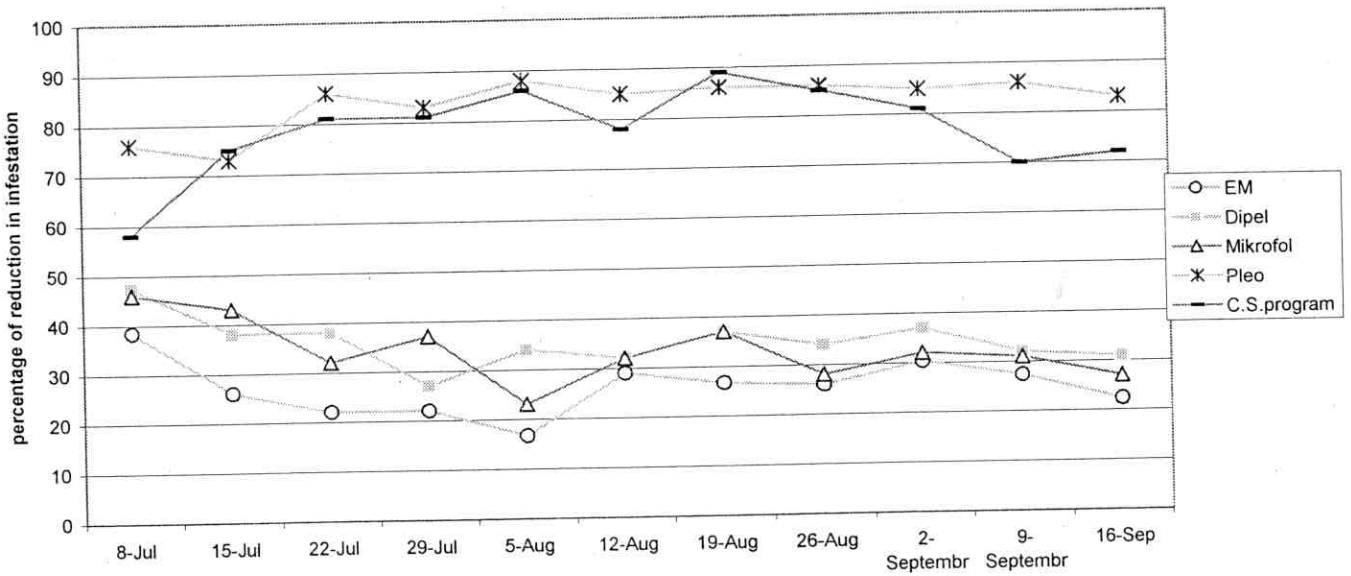


Figure (4): Effect of different agrochemicals on the percentage of reduction in infestation by pink bollworm during 2005 season.

Conventional Spray Program, respectively. The corresponding values of reductions after 2nd spray were 21.00, 37.00, 33.00, 88.67 and 84.67 % (1st week) and 25.00, 42.67, 42.67, 85.67 and 73.67 % (2nd week) at the same treatments, respectively.

As conclusion, the same trend of pink bollworm infestation percentages and reductions were noticed with the two studied seasons. Pleo (a.i. Pyridalyl) and Conventional Spray Program proved significantly to be superior influences compared with the other agrochemicals.

Such findings agree with those obtained by several researchers in Egypt and other countries such as **Mahar et al., (2004)** evaluated the three insecticide, fenpropathrin (Danitol 10EC), chlorpyrifos (Lorsban 40EC) and endosulfan (Thiodan 35EC) against the spiny bollworms' *Earias insulana* and *E. vitella* in Sindh, Pakistan. All three applications of insecticides were applied based on the threshold of spotted bollworms population. All three insecticides were effective against the spotted bollworm larvae. However, the maximum effectiveness was observed upon treatment with Danitol, followed by Lorsban and Thiodan treatments in one week. However, Lorsban exhibited effectiveness up to three weeks. The yield data showed a highly significant effect of insecticides.

1.2. Larval content

1.2.1. Cotton season, 2004

Data in Table (5) and Fig. (5) indicated the superior role of Pleo insecticide in protecting cotton bolls from the attack by the pink bollworm larvae, followed by Conventional Spray

Table (5): Effect of tested agrochemicals on numbers of pink bollworm larvae in 100 cotton bolls during 2004 season.

Treatments / Dates	Control	EM	Dipel	Mikrofol	Pleo	CSP
1/7 1st spray	3	3	3	3	3	3
8/7	8.33	4	4	4	2.66	3.5
15/7 2nd spray	16.33	13.33	9.66	11.67	3.66	4
22/7	23	17.67	14	15.67	4.33	4.33
29/7 3rd spray	27.33	24.33	20.67	21.67	5.33	6.33
5/8	32.67	25.67	23	25	4.33	4.33
12/8	38.67	29	25.67	25.67	7	8
19/8	42.33	32.0	27.67	28.67	6.01	6.4
26/8	40	30.0	25.33	27.33	6.33	7
2/9	34.3	31.33	23.33	23.33	5.33	7.33
9/9	30.67	30.1	22.67	21.33	4.33	9
16/9	29.67	28.33	20.33	22.33	5	10
Mean	27.19	22.33	19.44	20.01	4.75	6.1

L.S.D. at (0.5 %) between treatments = 0.44

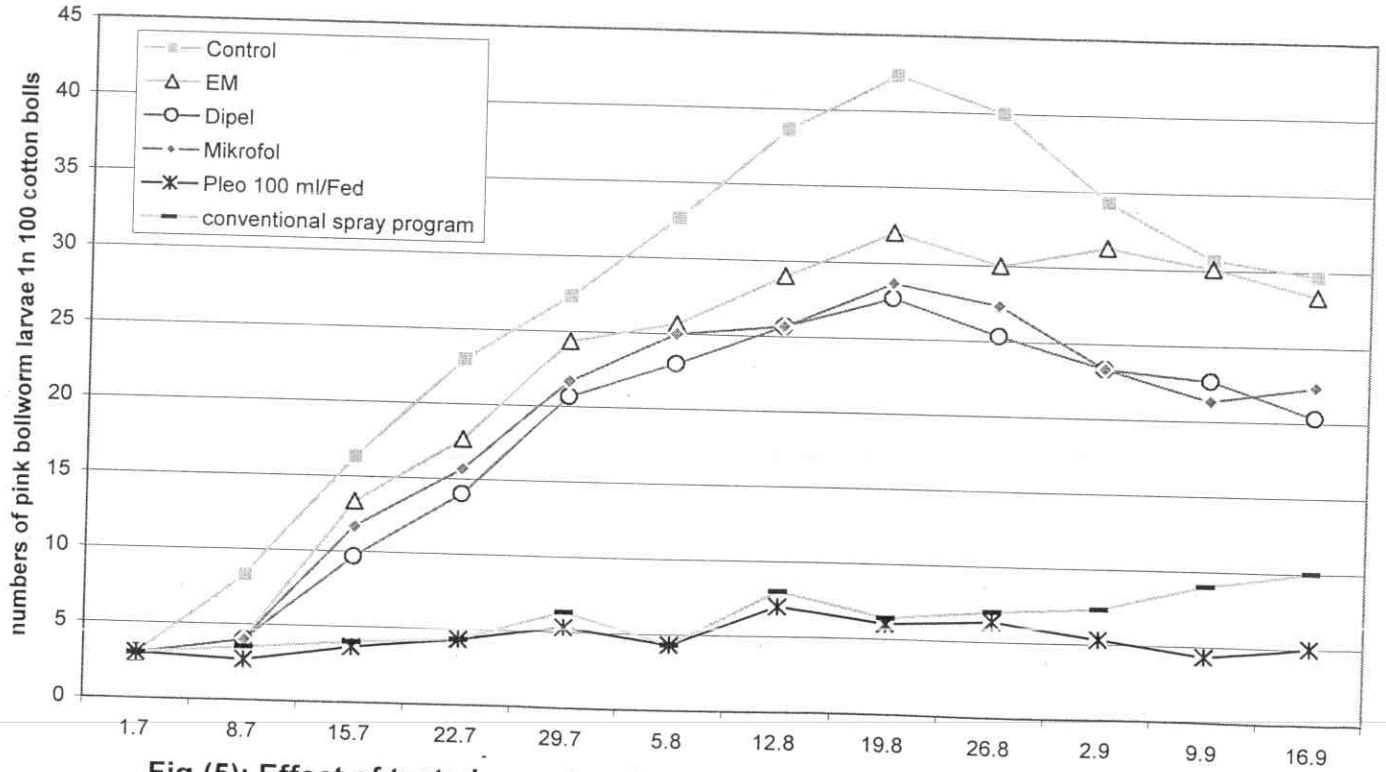


Fig (5): Effect of tested agrochemicals on numbers of pink bollworms larvae in 100 cotton bolls during 2004 season.

Program as shown from the numbers of larvae in examined bolls during 2004. The pre spray count of larvae counts/100 bolls was 3.0 in untreated plots. It is evident to notice the fluctuated increase in larval content by the progression of growing season. Such finding was pronounced in untreated as well as treated plots. The mean larval counts/100 bolls within the season reached 27.19 larvae (untreated); 22.33, 19.44, 20.01, 4.75 and 6.10 larvae/100 bolls in case of EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively. The highest larval content in untreated bolls was recorded during the 3rd week of August (42.33 larvae/100 bolls). The same trend of results was obtained with EM (32.00), Dipel (27.67) and Mikrofol (28.67 larvae/100 bolls) at the same date, while Pleo and Conventional Spray Program showed larval content of 6.01 and 6.40 larvae/100 bolls. These data indicated the poor performance of bacterial and fertilizer complex preparations in inducing the resistance of cotton bolls against the attack by pink bollworm larvae. On the other hand, Pleo and Conventional Spray Program proved of influential effect in reducing both bolls infestation as well as larval content. Such findings are in accordance with the results obtained by **Salem (2002)** as he recorded that chemical insecticide (Herculis) and foliar fertilizer (Mikrofol) decreased the infestation percent and number of pink and spiny bollworms, but chemical insecticide (Herculis) was the most effective in reducing the infestation and larval content in green cotton bolls.

1.2.2. Cotton season, 2005

Data in Table (6) and Fig. (6) indicated the same trend of larval content in cotton bolls in relation to the applied agrochemicals

Table (6): Effect of tested agrochemicals on numbers of pink bollworm larvae in 100 cotton bolls during 2005 season.

Treatments / Dates	Control	EM	Dipel	Mikrofol	Pleo	CSP
1/7 1st spray	3	3	3	3	3	3
8/7	10	5	5	5	2	5.33
15/7 2nd spray	20	14.67	11.67	12.67	5	7.67
22/7	28.33	21.67	17	17.33	3	5.5
29/7 3rd spray	31.67	23	18.3	19	4	11
5/8	33	28	24.33	24.67	3.33	6.33
12/8	40.33	33.2	27	29	6	10
19/8	45.3	34.5	29	31.3	6	8
26/8	42	32.1	26	28.33	7.33	8.33
2/9	36.33	33.2	23.33	24.33	5.33	9
9/9	34.67	32.5	22.67	22.67	5.33	10.33
16/9	31.67	29.7	30.3	25.33	6	11
Mean	29.69	24.2	19.81	20.22	4.69	7.9

L.S.D. at (0.5 %) between treatments = 0.42

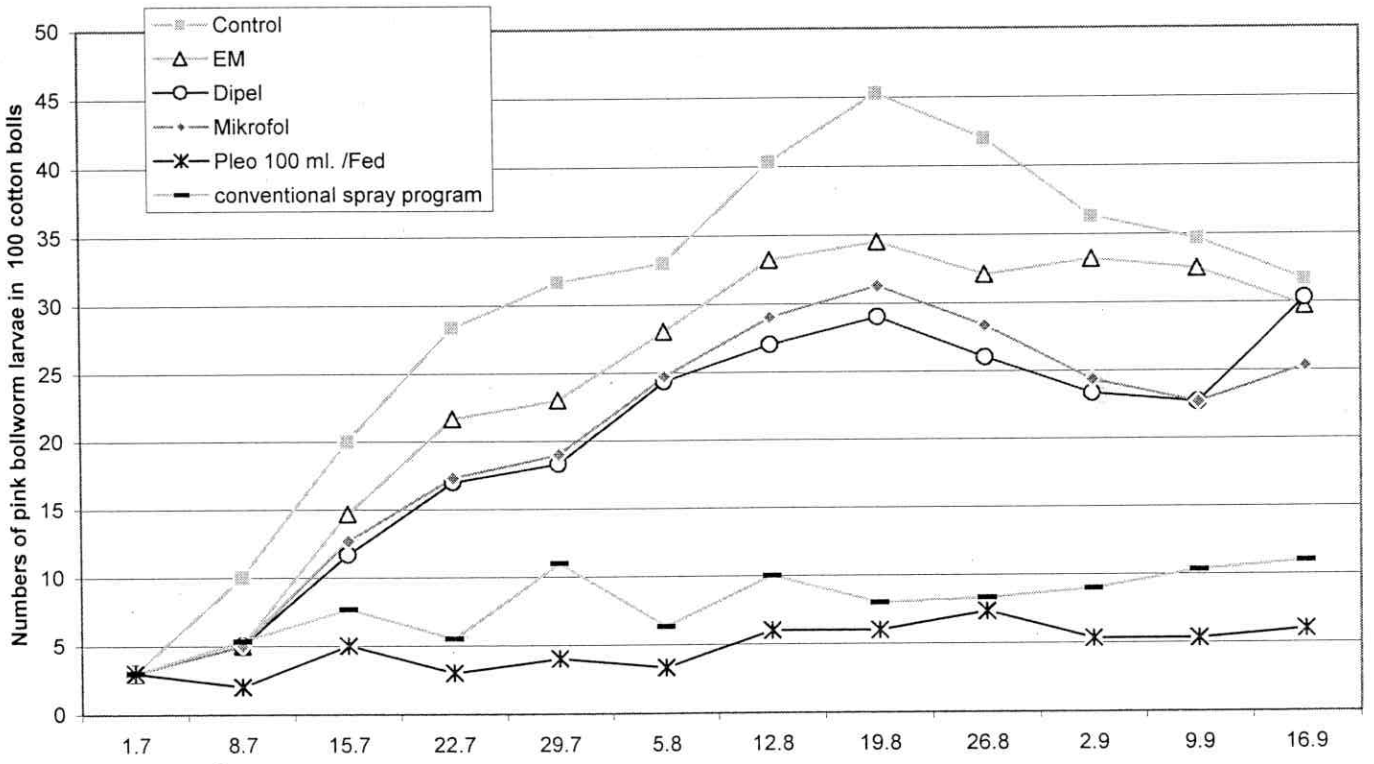


Fig (6): Effect of tested agrochemicals on numbers of pink bollworm larvae in 100 cotton bolls during 2005 season

as recorded in 2004 season. Microbial and fertilizers' complex caused slight reduction in larval numbers and percent in examined bolls than the untreated check, while Pleo and Conventional Spray Program showed great reduction in larval content under the same experimental conditions. In terms of figures, the mean numbers of pink bollworm larvae within the growing season, 2005 were 29.69 (untreated plots), 24.20, 19.81, 20.22, 4.69 and 7.90 larvae/100 cotton bolls in case of EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively. The corresponding numbers of larval numbers during 2004 were 27.19, 22.33, 19.44, 20.00, 4.75 and 6.10 larvae with the same treatments, respectively. The ratios of 2005: 2004 were 1.09, 1.08, 1.09, 1.04, 0.99 and 1.30 for untreated, EM, Dipel, Mikrofol, Pleo and conventional spray program, respectively.

Such findings are in accordance with the results obtained by **Lu-Zhengsong et al., (1999).** They found that the cotton plants which were treated with EM (effective microorganisms) preparations, 10 genera of bacteria (photosynthetic bacteria, lactic acid bacteria) and fungi (Actinomyces), showed decrease in bollworms than untreated plant. **Salem (2002)** recorded that chemical insecticide (Herculis) and foliar fertilizer (Mikrofol) decreased the infestation percent and number of pink bollworm larvae, but chemical insecticide (Herculis) was the most effective in reducing the infestation and larval content in green cotton bolls.

2. Spiny bollworm, *E. insulana*

2.1. Infestation of cotton bolls

2.1.1. Cotton season, 2004

Data in Table (7) and Fig. (7) indicated significant differences between treatments in infestation percentages of cotton bolls by the spiny bollworm during 2004. Infestation of bolls showed fluctuated values by the time elapsed after treatment as well as with untreated check. Pretreatment count of infested cotton was 2.33 % as average in the experimental area. Untreated plots showed great increase in infestation % by the extension of growing season until mid September, 2004. Peaks of infestation % were recorded on August, 19th; being 34.33, 28.33, 23.67, 24.33 and 6.33 % for bolls of the control, EM, Dipel, Mikrofol and Pleo treatments. While this peak was reached on September 2nd and 9th in case of Conventional Spray Program (12 %; Table, 7). The seasonal means in percentages of infested bolls were 22.56 % (untreated check), 19.06, 16.89, 17.89, 4.41 and 7.30 % in case of EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively.

As for spray numbers in relation to infested bolls, data in the same table indicated the poor performances of tested chemicals except Pleo and Conventional Spray Program that resulted significant decreas in infestation percentage than the prespray count irrespective to the spray numbers. That was pronounced with the 1st, 2nd and 3rd sprays, respectively, and continued until the end of experiment. Pleo when used at 100 ml/fed proved superior as it resulted the lowest infestation of

Table (7): Effect of tested agrochemicals on % infestation by spiny bollworm during 2004 season.

Treatments / Dates	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
1/7 1st spray	2.33	2.33	2.33	2.33	2.33	2.33
8/7	8.33	5.33	4.33	4.33	2.33	4
15/7 2nd spray	15	12	12	12	3	6
22/7	19	16.33	14.33	15.33	3.3	3
29/7 3rd spray	26.33	24.33	19.67	19.67	5.66	8
5/8	25.67	20.67	19	19.33	3.3	4
12/8	30	25	21	23	6	11
19/8	33	26.33	22.67	23.33	5.33	6
26/8	34.33	28.33	23.67	24.33	6.33	10
2/9	31	25.67	21	22.33	5	12
9/9	24	23	20	20	5	12
16/9	21.67	19.33	16.68	17.33	5.33	10
Mean	22.56	19.06	16.89	17.89	4.41	7.3

L.S.D. at (0.5 %) between treatments = 0.45

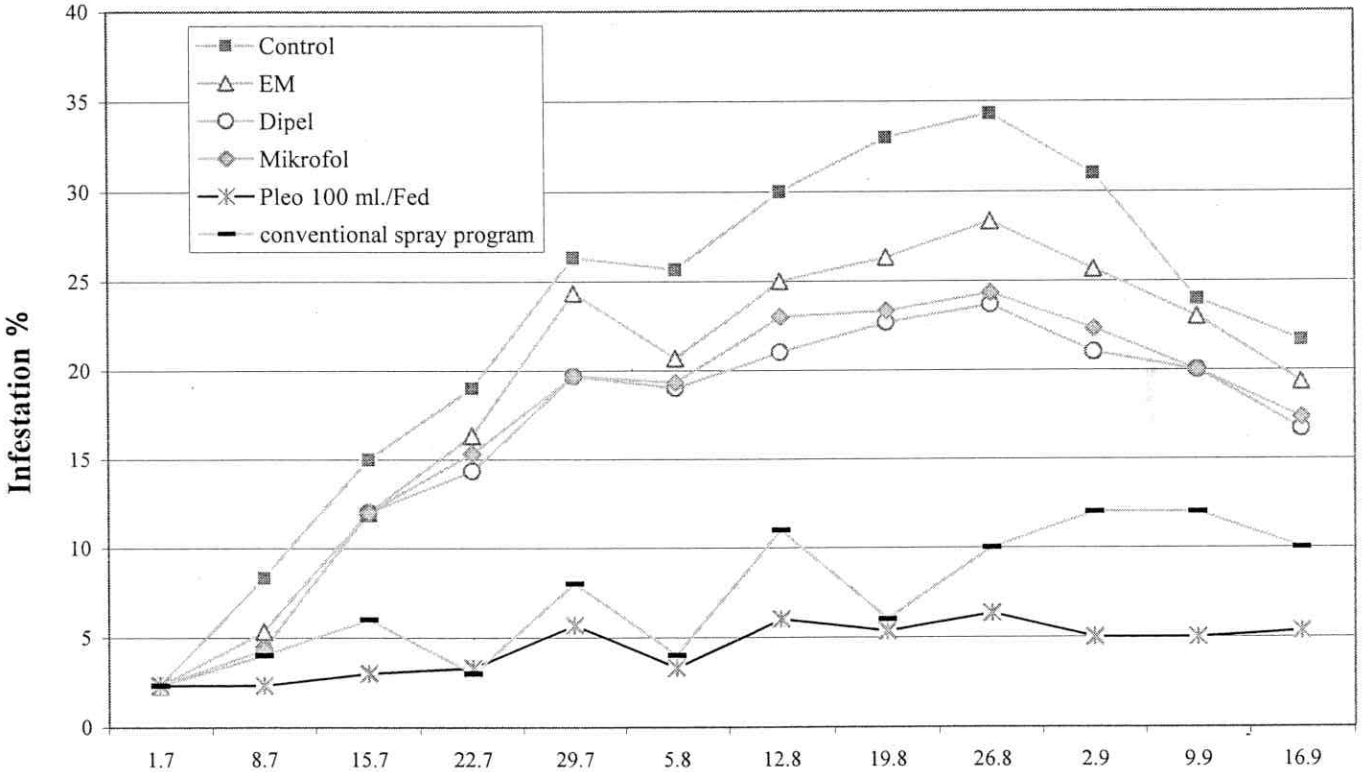


Fig (7):Effect of tested agrochemical on % infestation by spiny bollworm during 2004 season

cotton bolls compared with the other treatments and followed by Conventional Spray Program. This was pronounced with the three sprays and within all the considered post application intervals. Microorganisms complex (EM), bacterial insecticide (Dipel) and foliar fertilizer complex (Mikrofol) showed inferior performance on boll infestation by the spiny bollworm.

Data concerning the reduction percentages in bolls infestation than the control are tabulated in Tables (8) and Fig (8). It showed the same trend of results as for the infestation percentages. The seasonal means of reduction percentages in bolls infestation reached 16.33, 28.15, 27.00, 80.76 and 71.76 % in case of EM, Dipel, Mikrofol, Pleo and conventional spray program, respectively. In terms of figures, the reduction percentages in spiny bollworm infestation than the untreated check reached 18.67, 25.33, 24.67, 74.33 and 53.33 % (1^{st} week after 1^{st} spray); 16.33, 21.33, 19.67, 76.00 and 60.00 %(2^{nd} week, 1^{st} spray); 11.67, 27.33, 20.33, 84.00 and 84.5 % (1^{st} week, 2^{nd} spray); 19.00, 26.33, 26.67, 80.00 and 70.67 % (2^{nd} week, 2^{nd} spray); 19.67, 31.00, 26.67, 87.00 and 84.30 % (1^{st} week, 3^{rd} spray) and 17.33, 32.00, 28.00, 81.33 and 63.33 % (2^{nd} week, 3^{rd} spray) in case of EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively. Again, such findings indicated the superiority of Pleo insecticide and Conventional Spray Program in protecting cotton bolls against the attack of spiny bollworm, while inferior influences were recorded with the other treatments. Such results are in harmony with that obtained by **Dhawan et al., (1990)** who studied the effectiveness of synthetic pyrethroid insecticide sprays with organophosphorus

Table (8): Reduction percentages in infestation by spiny bollworm larvae than control during 2004 season after spraying of different agrochemicals on cotton plants.

Treatments / Dates	EM	Diple	Mikrofol	Pleo	Conventional spray program
8/7	18.67	25.33	24.67	74.33	53.33
15/7	16.33	21.33	19.67	76.00	60.00
22/7	11.67	27.33	20.33	84.00	84.50
29/7	19.00	26.33	26.67	80.00	70.67
5/8	19.67	31.00	26.67	87.00	84.30
12/8	17.33	32.00	28.00	81.33	63.33
19/8	19.00	32.00	30.67	84.33	82.33
26/8	17.00	30.67	29.33	81.00	71.67
2/9	15.00	32.33	27.67	84.67	61.67
9/9	5.33	17.67	17.67	79.67	71.67
16/9	10.67	19.00	17.67	76.00	55.00
Mean	16.33	28.15	27.00	80.76	71.76

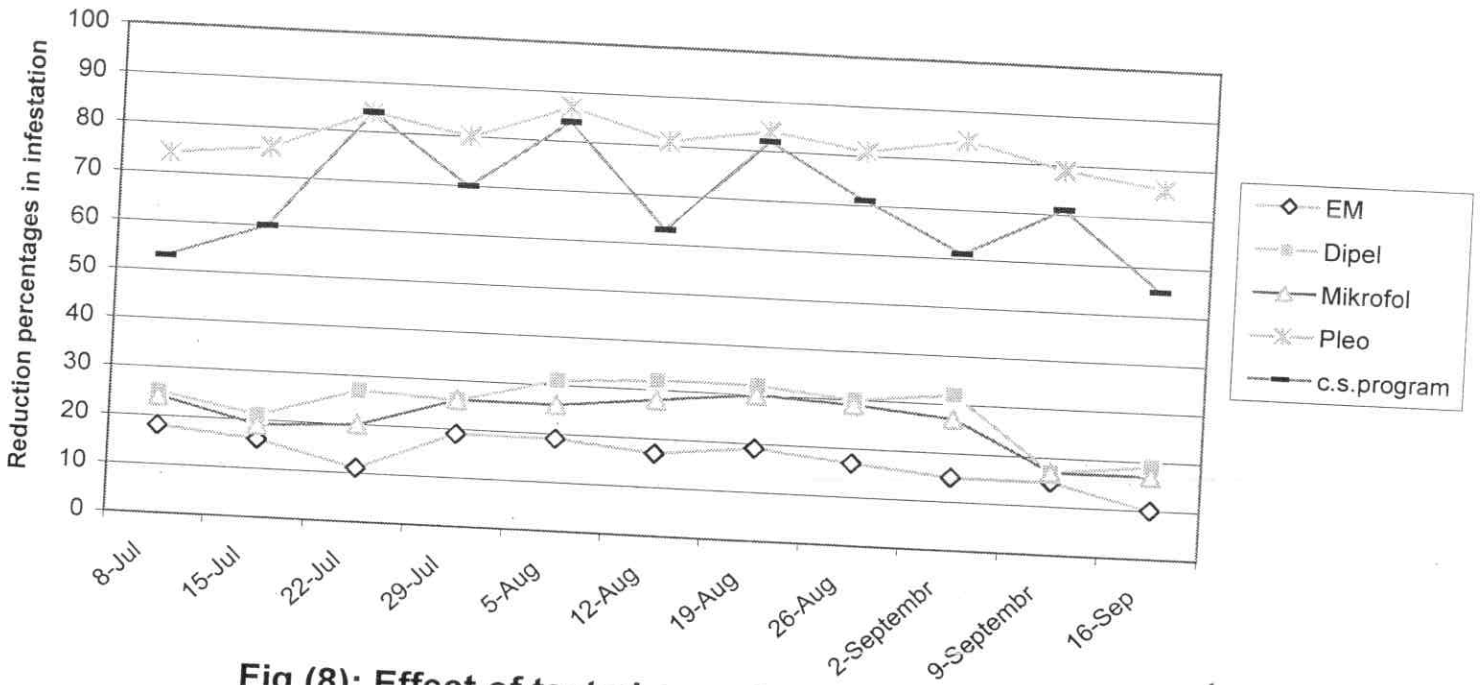


Fig (8): Effect of tested agrochemicals on the percentage of reduction in infestation by spiny bollworm during 2004 season

insecticide sprays to control *Pectinophora gossypiella, Earias insulana* and *E. vittella* on the cotton variety F 414. Alternate spraying with organophosphorus and pyrethroid insecticides at10- to 15-day intervals reduced damage and increased productivity by the same level as that obtained by giving alternate sprays of organophosphorus and pyrethroid insecticides at 10-day intervals.

2.1.2. Cotton season, 2005

Data in Table (9) and Fig (9) indicated the same trend of infestation percent of cotton bolls by spiny bollworm during 2005 season as that recorded with 2004. Infestation percent, gradually, increased by the progression of growing season, showing different peaks of infestation during July, August and September. Peaks of infestation by this insect pest varied throughout the period elapsed after chemical application. Pre spray infestation percent by *E. insulana* was 2.33 % in all experimental plots. As for the performance of Pleo and Conventional Spray Program, those proved of superior influences in protecting cotton bolls against the attack by spiny bollworm compared with the other tested agrochemicals. Such finding was pronounced with the three applied sprays. The seasonal mean percentages of infestation during 2005 cotton season were 24.23 % (untreated check) opposed to 20.02, 17.87, 18.05, 4.65 and 7.11 % in case of EM, Dipel, Mikrofol, Pleo and conventional spray program, respectively. These figures indicated the same trend of infestation by the spiny bollworm as that recorded during 2004 season, i.e. 22.56 % (untreated check) and 19.06, 16.89, 17.89, 4.41 and 7.30 with the same insecticidal

Table (9): Effect of tested agrochemicals on % infestation by spiny bollworm during 2005 season.

Treatments / Dates	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
1/7 1st spray	2.33	2.33	2.33	2.33	2.33	2.33
8/7	7.33	4.33	4.33	4.33	2.33	3.00
15/7 2nd spray	14.67	12.00	11.00	11.00	3.00	7.00
22/7	20.33	17.67	16.33	15.67	3.33	4.00
29/7 3rd spray	25.33	21.67	19.00	19.33	4.33	7.00
5/8	28.33	23.33	20.33	21.50	5.33	5.00
12/8	30.00	24.33	23.50	22.85	5.00	10.00
19/8	34.00	29.00	22.33	23.57	6.00	9.00
26/8	33.67	28.67	24.67	24.67	6.00	9.00
2/9	32.67	27.33	23.98	24.00	6.00	10.00
9/9	31.10	25.91	23.50	23.90	5.90	10.00
16/9	31.00	23.70	23.20	23.50	6.33	9.00
Mean	24.23	20.02	17.87	18.05	4.65	7.11

L.S.D. at (0.5 %) between treatments = 0.39

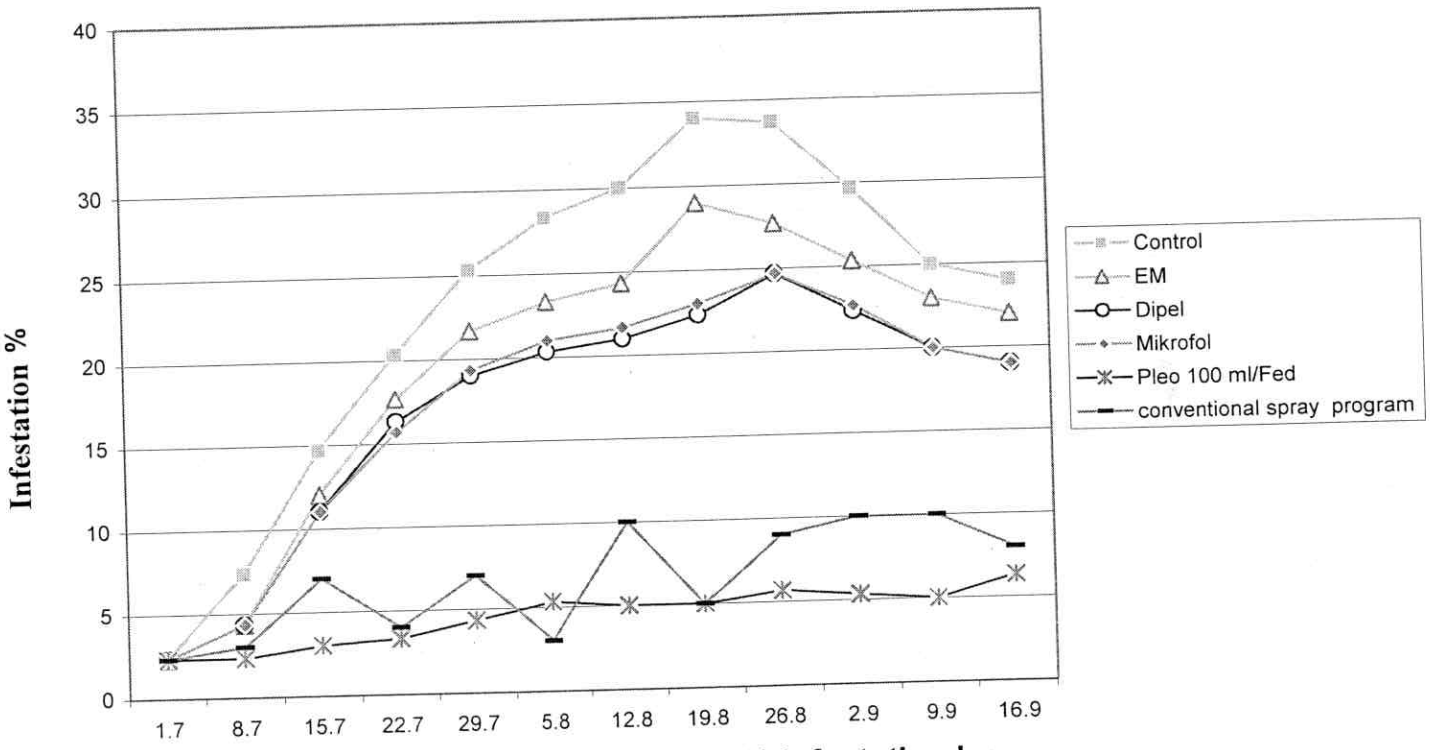


Fig (9): Effect of tested agrochemicals on % infestation by spiny bollworm during 2005 season.

treatments, respectively. The ratios of infestation 2005:2004 reached 1.07, 1.05, 1.05, 1.00, 1.05 and 0.97 in case of untreated check and the same mentioned treatments, respectively.

As for the infestation post treatment relation, data in the same table indicate the occurrence of fluctuated increase in infestation by the late of time until the end of experiment. This was significantly pronounced with the untreated check as well as used treatments. The infestation increased from 2.33 % (pre spray count) to higher values in untreated plots, showing higher insect infestation from mid July until mid September. The highest peaks were recorded during August, 19th when infestation % among cotton bolls reached 34.0 % in the control treatment. Among treatments by EM, Dipel and Mikrofol, infestation % peaked during August also as it reached 29, 24.67 and 24.67 %, respectively. On the other hand, Pleo insecticide and conventional spray program achieved high effect against *E. insulana* larvae.

Data, also, indicated no clear role of spray number on infestation of cotton bolls by spiny bollworms. It is clearly evident to notice the progressive increase in infestation percent by spiny bollworms one week after the insecticide treatments. In terms of figures, the infestation percent with EM sprays reached 4.33 and 12.00 (1st spray), 17.67 & 21.67 (2nd spray), 23.33 & 24.33% (3rd spray) after one and two weeks, respectively. Dipel treatments showed infestation percentages of 4.33 & 11.00 (1st spray), 16.33 & 19.33 (2nd spray) and 20.33 & 21.00 % (3rd spray) after one and two weeks from spraying. The fertilizer complex Mikrofol showed the infestation percentages of 4.33 &

11.00 (1st spray), 15.67 & 19.33 % (2nd spray) and 21.00 & 21.67 % (3rd spray) after one and two weeks from spraying, respectively. The effective insecticide Pleo showed 2.33 & 3.00 (1st spray), 3.33 & 4.33 (2nd spray), 5.33 and 5.00 % (3rd spray) after one and two weeks from spraying, respectively. The conventional spray program showed 3.00 and 7.00 (1st spray), 4.00 & 7.00 % (2nd spray) and 3.00 & 10.00 % (3rd spray) after one and two weeks from spraying, respectively.

As conclusion, data concerned of cotton bolls infestation by spiny bollworm during the two studied seasons indicate the poor performance of insect pathogenic bacteria and fertilizer complex tested in enhancing resistance of cotton plants against the attack by bollworms. On the contrary, the novel insecticide Pleo contains the active ingredient Pyridalyl showed satisfactory protective potential against bollworms infesting cotton bolls. The same trend of results was recorded with the conventional spray program for bollworms control in Egypt.

The present findings agree with those obtained by, **Jai-Singh and Sandhu (1995)** who conducted field experiments in Ludhiana, Indian Punjab, India, during 1991 and 93 to study the control of *Earias vittella, E. insulana* and *Pectinophora gossypiella* based on infestation level in fruiting bodies of *Gossypium arboreum*. Fenvalerate (50 g i.e. /ha) alternated with quinalphos (0.5 kg i.e. /ha) was used in all the treatments. Six sprays of these insecticides (given at 10-day intervals starting from squaring on 25% plants until 2 weeks before the 1st picking) controlled pests most efficiently and gave the highest seed cotton yield (1718 kg/ha). Applying insecticide sprays

when the pest population was at 5% on freshly shed fruiting-bodies (5 sprays) was the 2nd most effective treatment. Sprays applied at two larvae /plant and 10% incidence on intact fruiting-bodies had little effect. Also **El-Gemeiy et al., (1999)** determined the effectiveness of and Ecotech-Pro (*Bacillus thuringiensis* subsp. *kurstaki*) in controlling *Pectinophora gossypiella* and *Earias insulana* in laboratory and field experiments conducted in Egypt during 1997 and 98. In field experiments, Ecotech-Pro was tested at 1 and 2 kg. and recorded lower LC50 values compared to isometaphos for both insect species, with the LC50 values being lower for *E. insulana*. A 100 % reduction in the population of first instar larvae of *P. gossypiella* treated with 1 and 2 kg Ecotech-Pro, whereas only a 75% reduction in the population of the pest was observed during 1997. The insecticide was more toxic to the first than the fourth instar larvae of both pests during both years. Also

As for reduction percent in infestation by the spiny bollworm in relation to the applied agrochemicals, data in Table (10) and Fig. (10) indicate that the great reduction caused by Pleo and conventional spray program treatments, while the other agrochemicals showed inferior performance in this respect. The mean reduction percentages within 2005 season than the untreated check reached 16.79, 27.39, 25.28, 80.09 and 72.5 % in case of EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively.

It is clearly evident to notice the moderate reduction percent after one week from the first spray of microbial and fertilizer treatments showing 41.67, 41.33 and 38.33 % with EM,

Table (10): Reduction percentages in infestation by spiny bollworm larvae than control during 2005 season after spraying of different agrochemicals on cotton plants.

Treatments / Dates	EM	Diple	Mikrofol	Pleo	Conventional spray program
8/7	41.67	41.33	38.33	71.33	60
15/7	15.00	24.00	21.67	67.33	53.33
22/7	10.67	22.00	21.33	86.33	81.33
29/7	15.33	22.33	22.33	84.00	73.00
5/8	16.67	28.33	27.00	83.00	90.00
12/8	19.67	30.33	28.00	84.00	67.00
19/8	15.33	33.67	32.00	85.67	86.67
26/8	18.33	27.33	27.33	83.67	74.67
2/9	15.00	31.00	26.33	81.33	67.33
9/9	8.33	20.33	19.00	80.33	70.33
16/9	8.66	20.67	20.67	74.00	6700
Mean	16.79	27.39	25.82	80.09	72.5

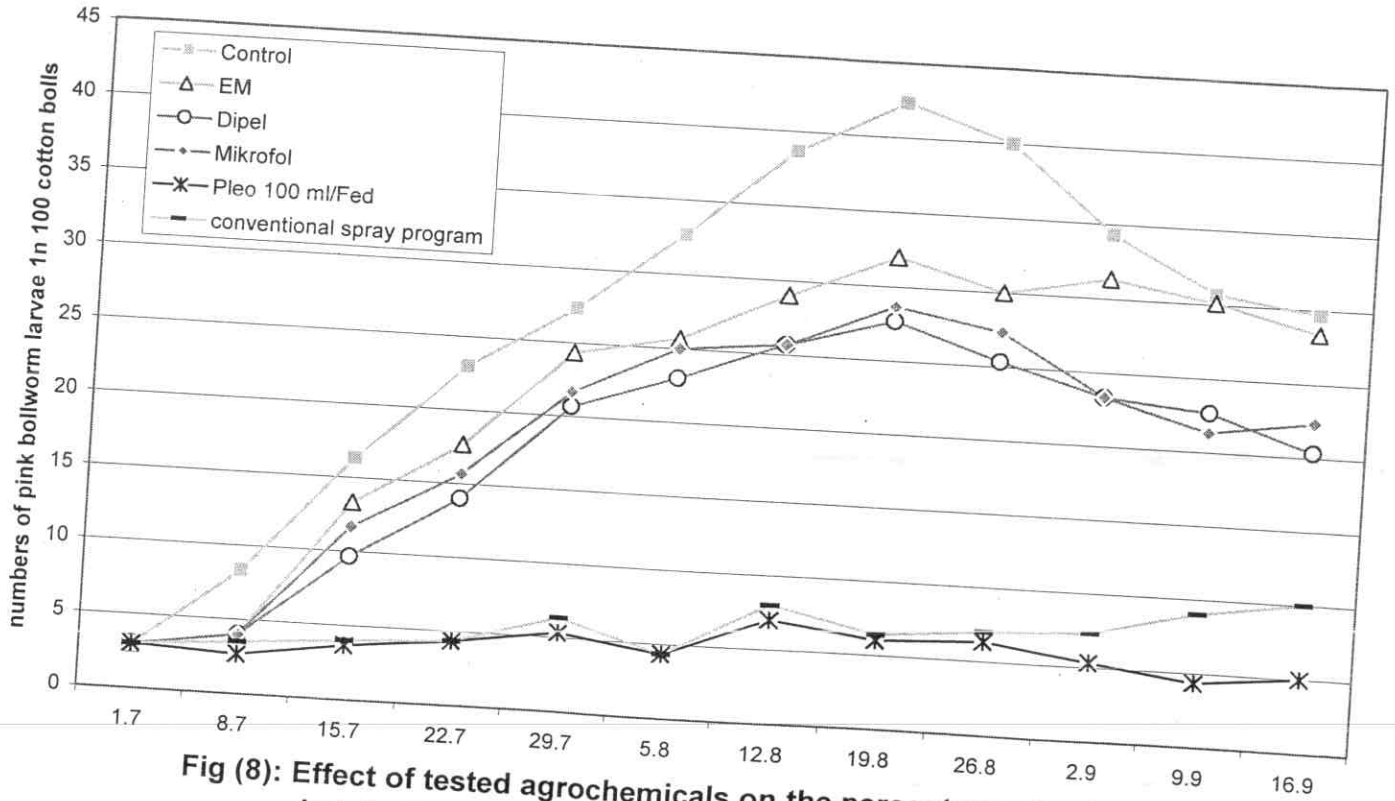


Fig (8): Effect of tested agrochemicals on the percentage of reduction in infestation by spiny bollworm during 2005 season

Dipel and Mikrofol, respectively, opposed to 71.33 and 60.00 % reduction in bolls infestation by spiny bollworm, 2005 when treatment took place by pleo and conventional spray program, respectively (Table, 10) The progression of post treatment period as well as the succession of sprays by the tested agrochemicals showed gradual but lower reduction rates in bolls infestation until the end of experiment. This pattern was quite similar to that recorded within 2004 season.

2.2. Larval content

2.2.1. Cotton season, 2004

Data in Table (11) and Fig. (11) indicate the great role of Pleo insecticide and conventional spray program in reducing the number of spiny bollworms larvae in cotton bolls during 2004 than untreated check. The mean number within the experimental period of Pleo was 4.3 larvae/100 cotton bolls, while the check bolls recorded 34.2 %. On the other hand, Conventional Spray Program came next, showing 10.20 larvae/100 cotton bolls, microorganisms complex, Bacillus bactericide, Foliar fertilizers complex showed moderate reduction in larval attack than the check, showing the mean numbers of 27.19, 20.33 and 20.79 larvae/100 cotton bolls with EM, Dipel and Mikrofol, respectively.

It is clearly evident to notice the great increase of larval content in untreated bolls from end July (28.33 larvae/100 cotton bolls) and continued in increase pattern by the progression of growing season, i.e. 28.67, 34.67, 45.20, 48.00, 53.00, 55.00 and 50.00 larvae/100 cotton bolls during the successive weeks from

Table (12): Effect of tested agrochemicals on numbers of spiny bollworm larvae in 100 cotton bolls during 2005 season.

Treatments / Date	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
1/7 1st spray	2.33	2.33	2.33	2.33	2.33	2.33
8/7	7.33	4.33	4.33	4.33	2.33	4.00
15/7 2nd spray	14.00	12.00	11.00	11.00	3.00	8.33
22/7	20.33	18.33	16.33	16.00	3.33	7.10
29/7 3rd spray	30.00	22.67	22.00	21.67	4.66	9.00
5/8	32.00	27.67	23.00	25.33	5.33	5.30
12/8	37.67	30.10	29.07	30.10	5.00	12.00
19/8	48.33	38.30	32.00	33.20	5.33	8.00
26/8	51.00	41.20	31.00	33.00	5.66	11.00
2/9	50.00	35.00	33.00	34.20	5.66	14.10
9/9	51.00	39.70	30.0	30.00	5.00	13.00
16/9	52.33	40.30	30.50	31.00	6.33	10.20
Mean	32.60	26.41	21.88	22.50	4.50	8.60

L.S.D. at (0.5 %) between treatments = 0.42

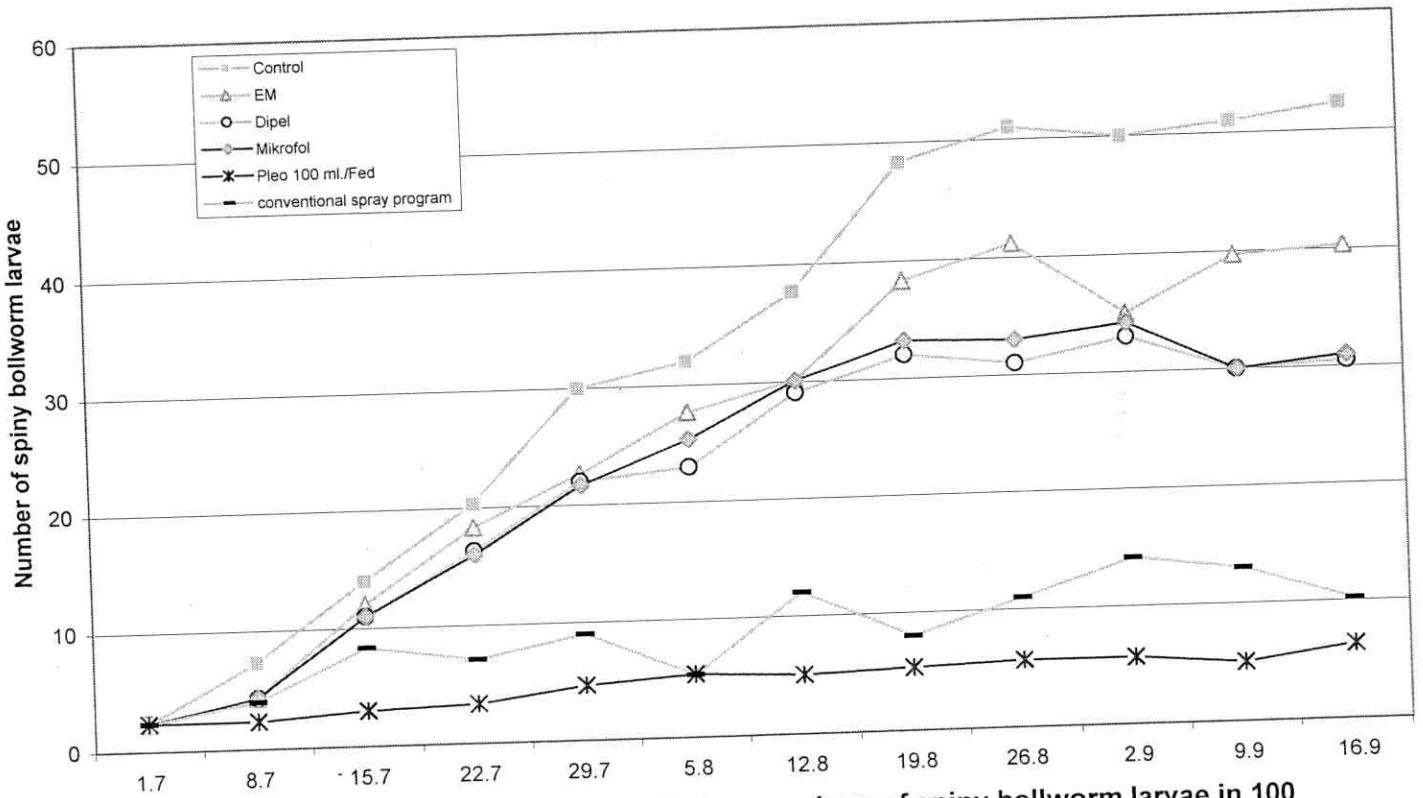


Fig (12): Effect of tested agrochemical on numbers of spiny bollworm larvae in 100 cotton bolls during 2005 season.

August, 5th to mid- September, respectively. These data indicate the seriousness of spiny bollworm attack in cotton bolls, which will be reflected on cotton production and fiber quality. The same trend of results was recorded with EM (23.67, 29.00, 39.00, 40.00, 38.67, 40.00 and 46.00 larvae, respectively; Dipel (21.67, 23.33, 27.00, 29.30, 30.40, 29.00 and 29.33 12.8, 19.8, 26.8, 2.9, 9.9 and 16.9, respectively) and Mikrofol (21.67, 22.67, 27.67, 30.50, 31.7, 30.00 and 31.30, respectively). Data also, showed the inferior role of sprays number on larval content of cotton bolls in treated plots with EM, Dipel and Mikrofol. The contrary was obtained with Pleo treatment, where larval population continued in lower numbers until the end of experiment, i.e. 3.3, 6.00, 5.33, 6.33, 5.00, 5.00 and 5.33 larvae at the same dates respectively, while Conventional Spray Program showed 7.1, 14.00, 9.00, 11.20, 15.10, 16.00 and 12.14 larvae/100 bolls, respectively.

2.2.2. Cotton season, 2005

Data in Table (12) and Fig. (12) indicated the same trend of larval content in cotton bolls as that recorded during, 2004. The seasonal means of larval content were 32.60, 26.41, 21.88, 22.50, 4.50 and 8.60 larvae/100 cotton bolls in case of untreated check, EM, Dipel, Mikrofol, Pleo and Conventional Spray Program treatments, respectively. The pre spray count was 2.33 larvae/100 bolls in experimental plots. Larval numbers increased gradually by the progression of time until the end of experiment during September, 2005. In terms of figures the numbers of larvae were 27.67, 30.10, 38.30, 41.20, 35.00, 39.70 and 40.30 larvae (EM), 23.00, 29.07, 32.00, 31.00, 33.00, 30.00 and 30.5

Table (12): Effect of tested agrochemicals on numbers of spiny bollworm larvae in 100 cotton bolls during 2005 season.

Treatments / Date	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
1/7 1st spray	2.33	2.33	2.33	2.33	2.33	2.33
8/7	7.33	4.33	4.33	4.33	2.33	4.00
15/7 2nd spray	14.00	12.00	11.00	11.00	3.00	8.33
22/7	20.33	18.33	16.33	16.00	3.33	7.10
29/7 3rd spray	30.00	22.67	22.00	21.67	4.66	9.00
5/8	32.00	27.67	23.00	25.33	5.33	5.30
12/8	37.67	30.10	29.07	30.10	5.00	12.00
19/8	48.33	38.30	32.00	33.20	5.33	8.00
26/8	51.00	41.20	31.00	33.00	5.66	11.00
2/9	50.00	35.00	33.00	34.20	5.66	14.10
9/9	51.00	39.70	30.0	30.00	5.00	13.00
16/9	52.33	40.30	30.50	31.00	6.33	10.20
Mean	32.60	26.41	21.88	22.50	4.50	8.60

L.S.D. at (0.5 %) between treatments = 0.42

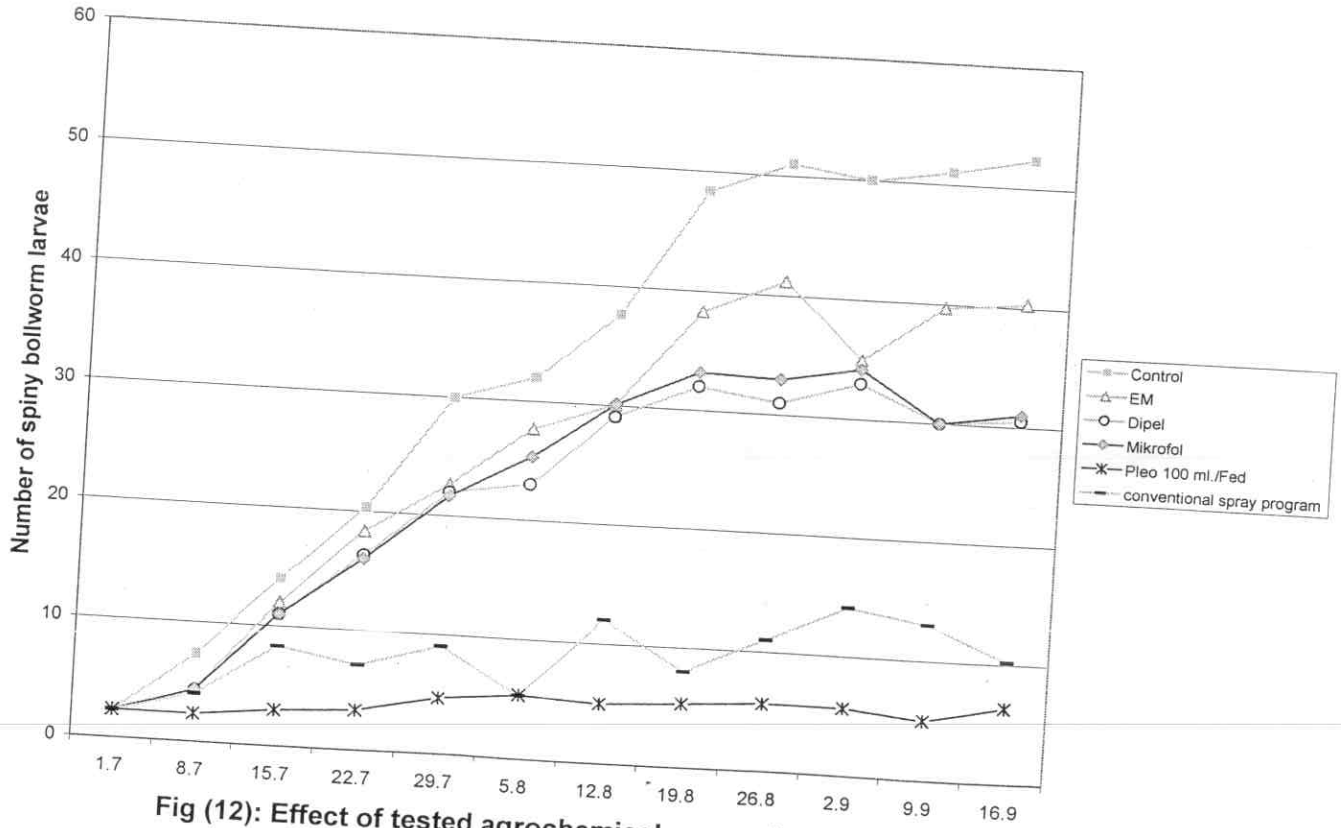


Fig (12): Effect of tested agrochemical on numbers of spiny bollworm larvae in 100 cotton bolls during 2005

larvae/100 bools (Dipel); 25.33, 30.10, 33.20, 33.00, 34.20, 30.00 and 30.00 larvae (Mikrofol); 5.33, 5.00, 5.33, 5.66, 5.66, 5.00 and 6.33 larvae/100 bools (Pleo) and 5.30, 12.00, 8.00, 11.00, 14.10, 13.00 and 10.20 larvae/100 bools (Conventional Spray Program) at August, 5, 12, 19 and 26th and September, 2, 9 and 16th, respectively.

Such results agree with those obtained by **El-Sayed (2001)** who found that, the lowest number of spiny bollworm larvae was recorded in case of mixture of microelements. **Salem (2002)** recorded that chemical insecticide (Herculis) and foliar fertilizer (Mikrofol) decreased the infestation percent and number of spiny bollworms, but chemical insecticide (Herculis) was the most effective in reducing the infestation and larval content in green cotton bolls.

Reviewing the aforementioned results, it could be concluded that the microorganisms complex, bacterial insecticide and foliar fertilizers complex treatments were of inferior influence in reducing the infestation percent and larval content of the spiny bollworm in cotton bolls during the two studied seasons 2004 and 2005.

On the other contrary, spray of cotton fields by the novel insecticide Pleo, greatly, protected cotton bolls from bollworms attack and reduced the larval content. The same performance was confirmed by Conventional Spray Program implemented by the Ministry of Agriculture of Egypt.

Part-2

Effects of tested agrochemicals on cotton bolls' opening & characters, yield and lint properties during 2004 and 2005, seasons.

Data concerning the effects of tested agrochemicals, namely EM (microorganism complex) and the novel insecticide pleo containing the active ingredient pyridallyl on bolls' opening, yield of seeded cotton, major nutrients (N, P, K and carbohydrate), allelochemicals (indols and phenols) and photosynthetic pigments (chl.a, b and caretenoids of cotton plants during the two successive seasons 2004 and 2005 are tabulated in Tables (13-18) and illustrated in Figs (13-18). Different factors, i.e. agrochemical type, post treatment interval and cotton season were studied in relation to cotton productivity and bolls' characters as well as biochemical components. To facilitate the presentation of data, each of the studied characters will be discussed separately as follows:

1. Opening of cotton bolls:

Data in Tables (13 &14) and Figs (13 & 14) indicated the significant increase in bolls opening due to the treatment of mikrofol (fertilizers complex) than the untreated check. Such increase was pronounced during the two successive seasons, showing the mean percentage of opened bolls reached 36.3 and 38.2 % during 2004 and 2005, respectively. The untreated check recorded 30.5 and 32.4 % during the same seasons, respectively. EM (microorganisms complex) also, showed significant increase in boll opening percent than the untreated check; being 33.1 and

Table (13): Effect of tested agrochemicals on percentage of opened bolls during 2004 season

Treatments / Dates	% of opened bolls in different treatments					
	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
29/7	0.5	0.5	0.4	1	0.5	0.5
5/8	4	4.2	4.1	7	4.2	4.1
12/8	10	11.1	10.2	15	11.5	11
19/8	19	21	20	25	21	19
26/8	29	31	30	35	30	29.2
2/9	48	54	47	57	51	50
9/9	60	66	59	70	62	60
16/9	74	77	75	81	76	75
Mean	30.5	33.1	30.7	36.3	32.0	31.1

L.S.D. at (0.5 %) between treatments = 0.89

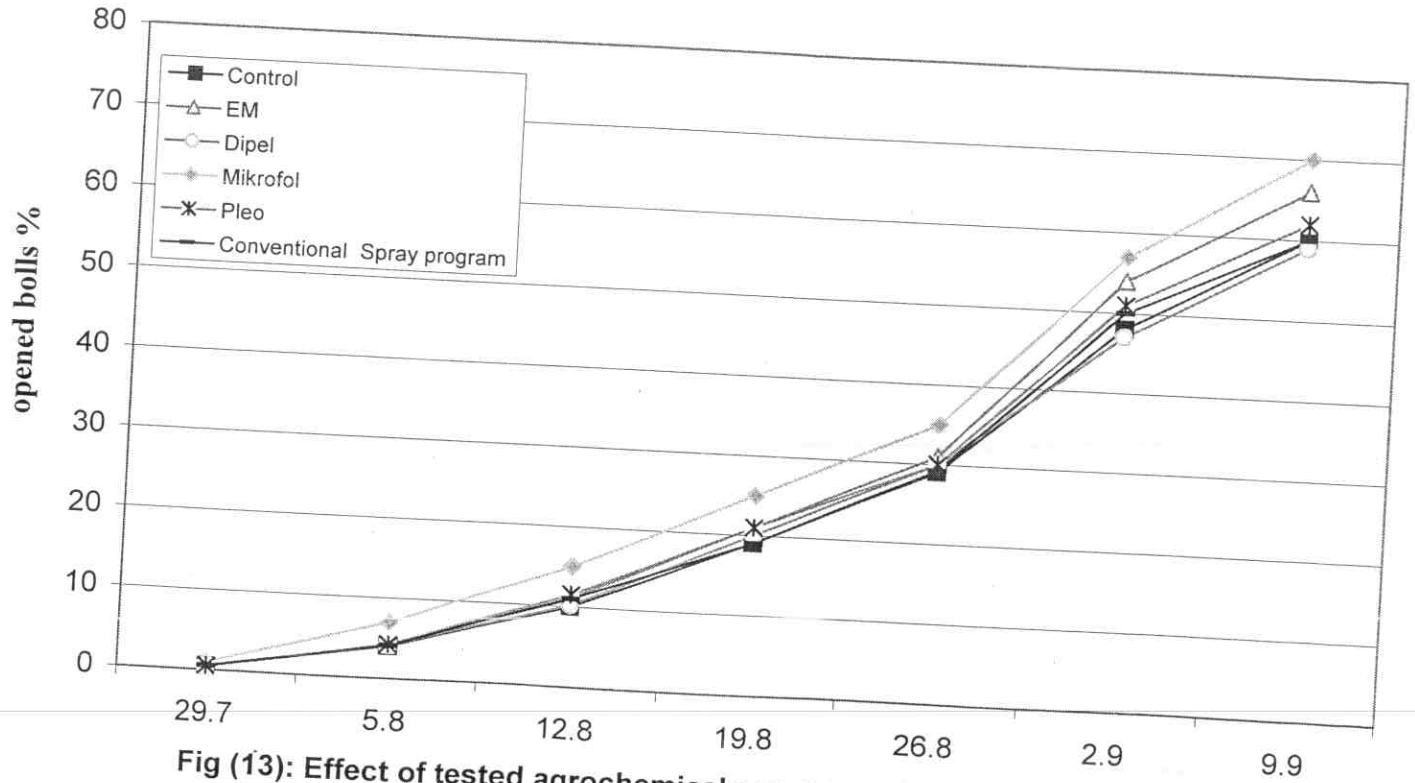


Fig (13): Effect of tested agrochemicals on percentage of opened bolls during 2004 season

Table (14): Effect of tested agrochemicals on percentage of opened bolls during 2005 season.

Treatments / Dates	% of opened bolls in different treatments					
	Control	EM	Dipel	Mikrofol	Pleo	Conventional Spray Program
29/7	0.6	0.7	0.6	1.1	0.8	0.8
5/8	5.0	6.0	5.2	8.0	5.7	5.5
12/8	12.0	14.1	12.6	15.8	14	13
19/8	21.0	23.0	21.0	26.0	22.0	22.0
26/8	30.7	35	31	37	30.4	30.5
2/9	50.3	55	49.5	59	51.1	51
9/9	63.5	69.5	64	74	62	63.0
16/9	76.1	79.2	77	85	78	77
Mean	32.4	35.3	32.6	38.2	33.0	32.8

L.S.D. at (0.5 %) between treatments = 0.91

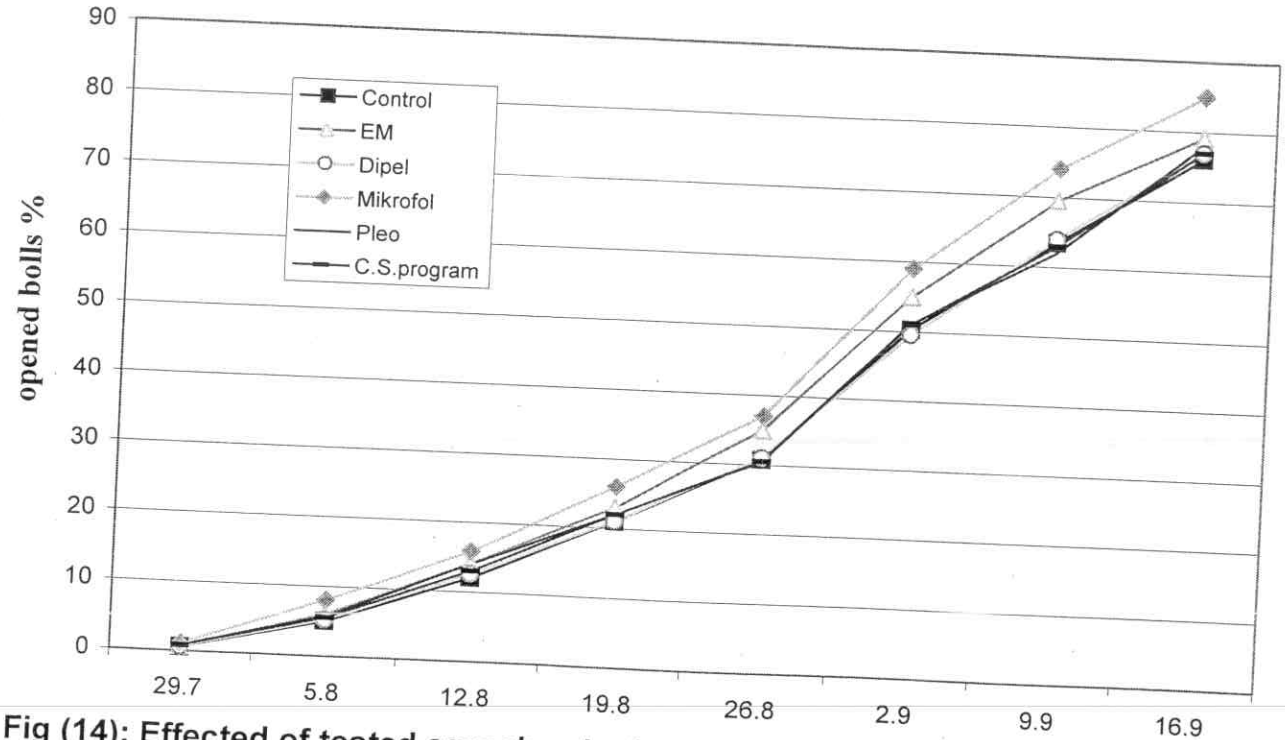


Fig (14): Effected of tested agrochemicals on percentage of opened bolls during 2005 season.

35.3 % during 2004 and 2005, respectively. On the contrary, Dipel, pleo and conventional spray program treatments showed insignificant influence on bolls opening.

In terms of figures, the percentage of opened bolls reached 30.7 & 32.6 % (Dipel), 32.0 & 33.0 % (pleo) and 31.1 & 32.8 % (conventional spray program) during 2004 and 2005, respectively

The present findings are in agreement with those obtained by several researchers; **Bishara (1968)** indicated that adding super phosphate before nitrates tend to cause a slight earliness in the bolling curve and a slight reduction in bollworms' attack. **EL-Nawawy et al., (1983)** in Egypt, revealed that the foliar fertilizers Iral, Stemifol, complesal and bayfolan gave good protection of cotton bolls and also increased the numbers of bolls ripening and opening simultaneously. Also, **Salem (2002)** in Egypt, recorded that foliar fertilizer (Mikrofol) increased the number of opening bolls than the untreated check, chemical insecticide and plant extraction.

2. Yield of seeded cotton:

Data in Table (15) and Fig (15) indicated the significant role of tested agrochemicals application in increasing the yield of seed cotton than the untreated check. Such effects were pronounced within the two studied years. Pleo insecticide proved superior influence in this respect. In terms of figures the cotton yield reached 1202.5 & 1172.5 kg/fed (untreated check), 1480 & 1445 kg/fed (EM), 1637.5 & 1597.5 kg/fed (Dipel), 1667.5 &1630 kg/fed (Mikrofol), 2257.5 & 2207.5 kg/fed (Pleo) and

Table (15): Effected of tested agrochemicals on seeded cotton yield in 2004 & 2005 seasons.

Treatments used	Cotton yield production				Two Years mean	
	Season2004		Season 2005			
	kg/fed	% increase*	Kg/Fed	% increase*	Kg/Fed	% increase*
Control	1202.5	–	1172.5	–	1170.0	–
EM	1480.0	23.88	1445.0	23.24	1462.5	25.0
Dipel	1637.5	36.18	1597.5	36.25	1617.5	38.25
Mikrofol	1667.5	38.67	1630.0	39.02	1662.5	42.05
Pleo	2257.5	87.73	2207.5	88.27	2232.5	90.81
Conventional Spray Program	1952.5	62.37	1865.0	59.06	1908.7	63.14

L.S.D. at (0.05%) for treatments = 92.32 (year 2004), 86.12 (year 2005) and 84.47 (two years mean).

*** Increase % than check treatment.**

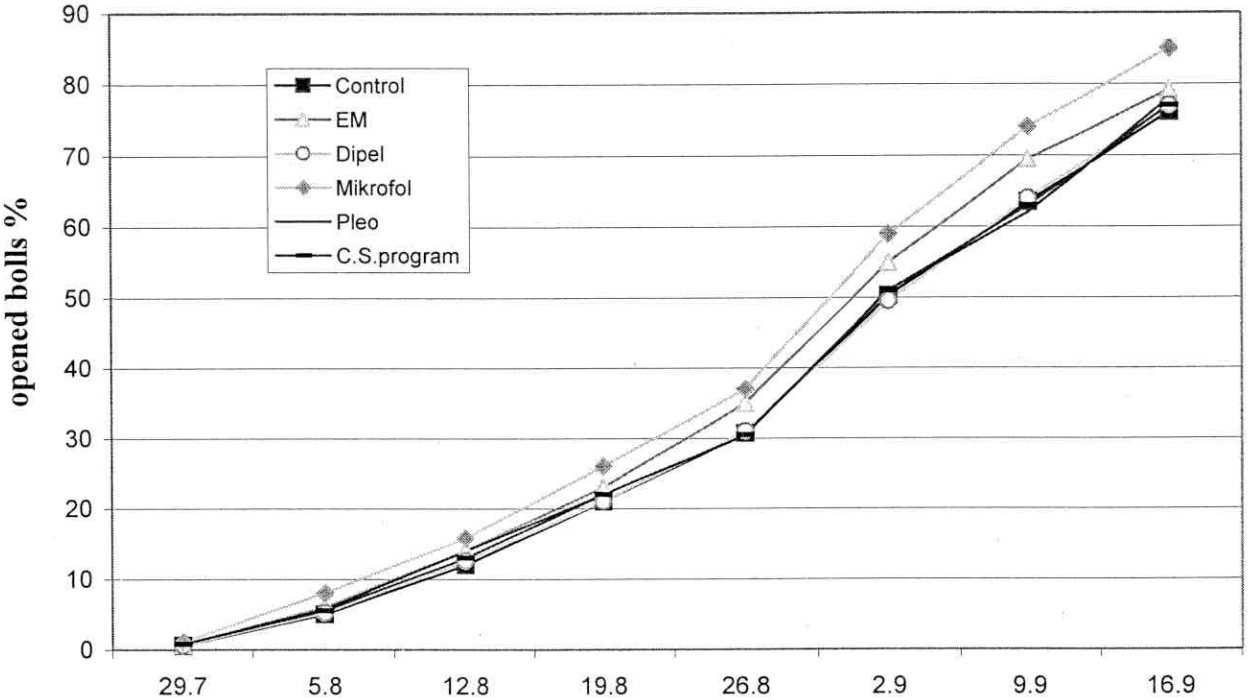


Fig (14): Effected of tested agrochemicals on percentage of opened bolls during 2005 season.

1952.5 & 1865 kg/fed (Conventional spray program) in 2004 and 2005 seasons, respectively. The increase percent in seed cotton than the untreated check during 2004 reached 23.88, 36.18, 38.67, 87.72 and 62.37 % after using the mentioned treatments, respectively, opposed to 23.24, 36.25, 39.02, 88.27 and 59.06 % in season 2005, respectively. The average production within the two years reached 1170 kg/fed (untreated check), while it was 1462.5, 1617.5, 1662.5, 1908.7, 2232.5 and 1908.7 kg/fed, respectively, showing two year averages of 25.00, 38.25, 42.05, 90.81 and 63.14 % increase of treatments than control, respectively.

Such results are in accordance with those obtained by **Gupta *et al.* (1996)** who used *Bacillus thuringiensis* formulations and their combinations with synthetic insecticides against cotton bollworms *P.gossypiella*, *E.insula* and *H.armigera*. The application of neem or *Bacillus thuringiensis* in a 4-sprays schedule gave effective control and increase on cotton yield. **Mahar *et al.* (2004)** evaluated three insecticides, fenpropathrin (Danitol 10EC), chlorpyrifos (Lorsban 40EC) and endosulfan (Thiodan 35EC) against cotton bollworms *Earias insulana* and *E. vitella* in Sindh, Pakistan. All three applications of insecticides were applied based on the threshold of spotted bollworms' population. All three insecticides were effective against the spotted bollworm larvae. However, the maximum effectiveness was observed upon treatment with Danitol, followed by Lorsban and Thiodan treatments in one week. However, Lorsban exhibited effectiveness up to three weeks. The yield data showed a highly significant effect of insecticides.

3. Major nutrients and carbohydrates content in cotton bolls:

Data in Table (16) and Fig (16) indicated the significant role of tested agrochemicals in increasing the nitrogen content of bolls than the untreated check. The nitrogen percentages +were 1.06 (untreated check); 1.75, 1.56, 2.11, 1.35 and 1.37 % in cases of EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively. Phosphorous content showed different trend, where Mikrofol only caused significant increase than the check and while the other treatments caused insignificant influence in this respect. The phosphorous content expressed as % reached 0.41% (untreated check) and 0.49, 0.47, 0.53, 0.46 and 0.46 % with EM, Dipel, Mikrofol, Pleo and Conventional spray program, respectively. Data also showed the significant increase in potassium content of bolls treated with EM and Mikrofol, while Dipel, Pleo and Conventional spray program showed insignificant changes in potassium content than the normal level. Potassium content reached 1.14, 1.83, 1.11, 2.14, 1.11 and 1.09 % in cases of untreated check, EM, Dipel, Mikrofol, Pleo and Conventional spray program, respectively.

As for carbohydrates content of cotton bolls, data in the same table indicated the significant increase in the amount of this biochemical component because of EM and Mikrofol treatments, while Dipel, Pleo and conventional spray program showed insignificant role in this respect. The carbohydrate content reached 10.1, (untreated check), 11.7, 10.4, 15.4, 10.1 and 9.98 % with the mentioned agrochemical treatments, respectively.

Table (16): Effect of tested agrochemical compounds on the nutrient contents in cotton bolls.

Treatments	N	P	K	Carbohydrates
Control	1.06	0.41	1.14	10.1
EM	1.75	0.49	1.83	11.7
Dipel	1.56	0.47	1.11	10.4
Mikrofol	2.11	0.53	2.14	15.4
Pleo	1.35	0.47	1.12	10.1
C.S. Program	1.38	0.46	1.09	9.86

L.S.D at (0.5 %) between treatments for N= 0.18

L.S.D at (0.5 %) between treatments for P= 0.01

L.S.D at (0.5 %) between treatments for K= 0.14

L.S.D at (0.5 %) between treatments for carbohydrates= 0.89

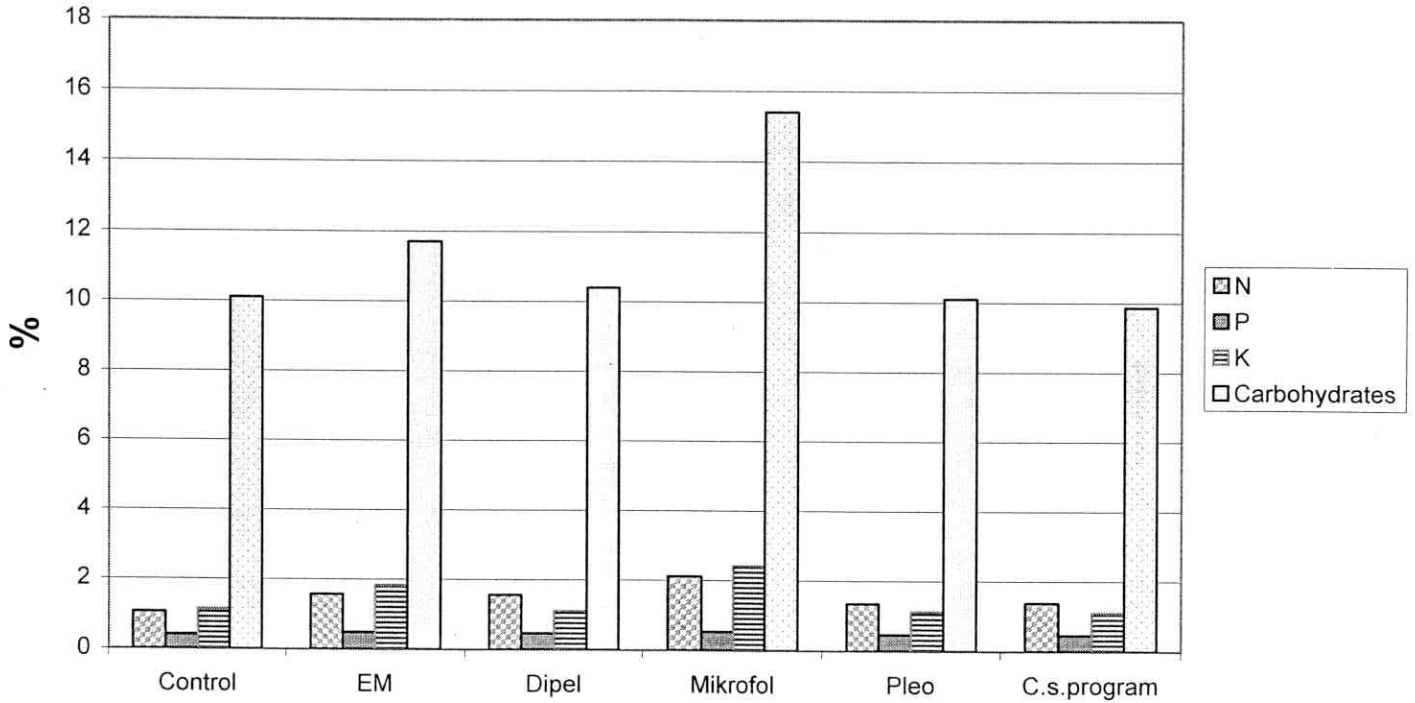


Fig (16): Effect of tested agrochemical compounds on the nutrients' content in cotton bolls.

As conclusion, data clearly indicated the significant role of Mikrofol (fertilizers complex) in increasing N, P, K and carbohydrate contents of cotton bolls than the normal levels. The other treatments showed various effects in this respect.

Such findings agree with **Salem (2002)** showed that significant increase in total carbohydrate and proteins in cotton bolls when the cotton plants treated by Mikrosol (foliar fertilizer) than chemical insecticide, Herculis.

4. Effect on total indoles, phenols and photosynthetic pigments in cotton bolls:

Data in Table (17) and Fig (17) indicated significant increase in total indoles of cotton bolls treated with the tested agrochemicals than the untreated check. The total indoles reached 184.8 mg/100 fresh weights (untreated check), opposed to 339.0, 336.0, 341.0, 232 and 244 mg/100 fresh weights in cases of EM, Dipel, Mikrofol, Pleo and Conventional spray program, respectively. The percent increase than the untreated check were 83.44, 81.81, 84.52, 25.54 and 29.32 % with the same treatments, respectively. The contrary was obtained with total phenols of cotton bolls, where agrochemical treatments significantly decreased this biochemical aspect than the untreated check. The total phenols reached 190.0 mg/100 fresh weight (untreated check), while those were 189.0, 171.0, 165.0, 207 and 237 mg/100 fresh weights. The percent decrease in total phenols than the check reached 0.53, 10.0, and 13.15 % with EM, Dipel and Mikrofol respectively. But in case of Pleo and

Table (17): Effect of tested agrochemical compounds on the total indoles, phenols, chl.a & b and carotenoids.

Treatment	Total Indoles Mg/100 g. f.w	Total phenoles Mg/100 g. f.w	Chl.a Mg/100 g,f.w	Chl.b Mg/100 g.f.w	Carotenoids
Control	184.8	190	213	207.1	170
EM	339	189	323.8	251.8	232.8
Dipel	336	171	232.2	217.3	201.9
Mikrofol	341	165	360.5	291.5	264
Pleo	232	207	221	212	186
C.S. Program	244	237	220	209	180

f.w. = fresh weight

L.S.D. at (0.5 %) for Total Indoles between treatments = 52.8
L.S.D. at (0.5 %) for Total phenoles between treatments = 38.4
L.S.D. at (0.5 %) for Chl.a between treatments = 38.97
L.S.D. at (0.5 %) for Chl.b between treatments = 14.42
L.S.D. at (0.5 %) for Carotenoids between treatments = 11.32

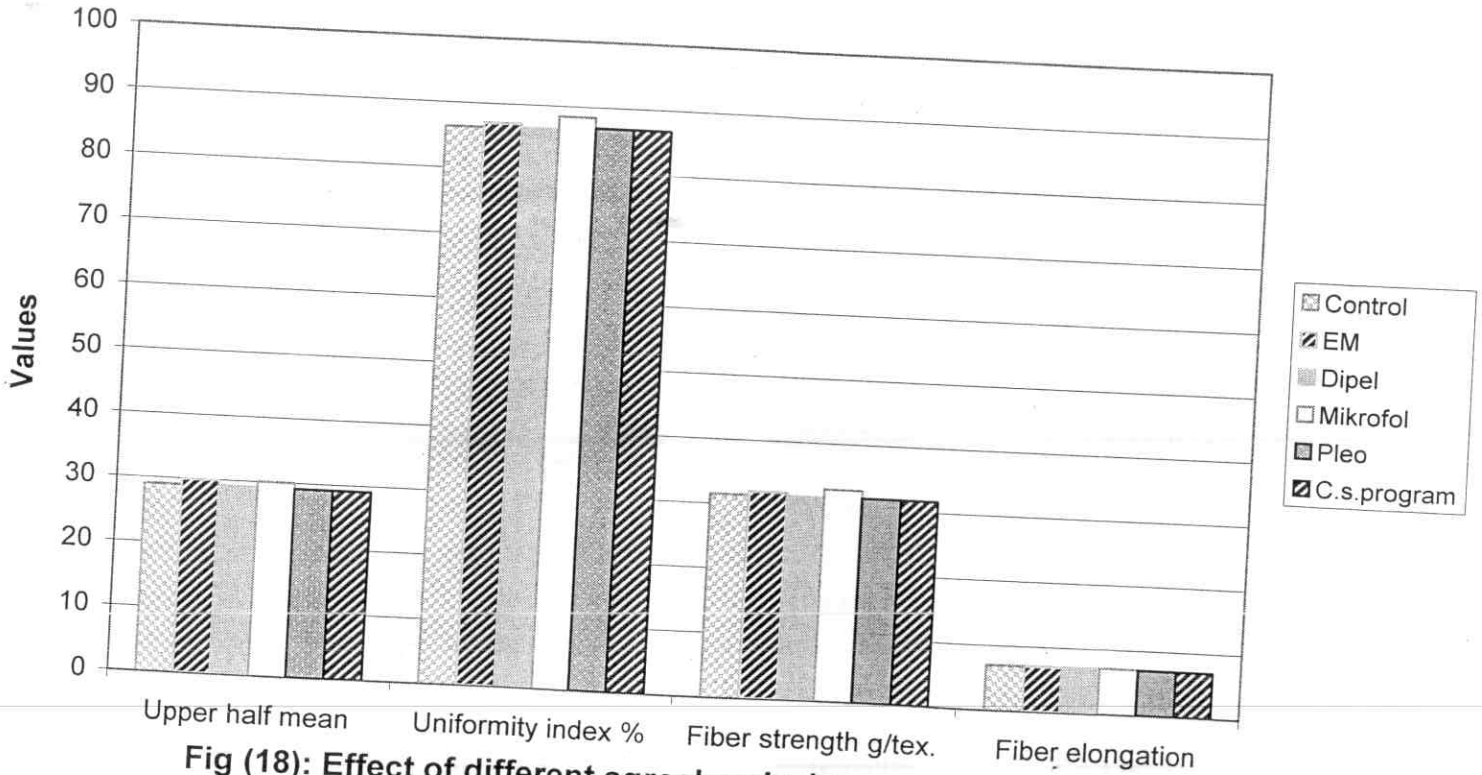


Fig (18): Effect of different agrochemicals on certain measures cotton fiber quality.

Conventional Spray Program the percent increase in total phenols than the check reached 8.95 and 24.74 %, respectively.

The role of agrochemicals (including pesticides) on indoles and phenol contents in cotton bolls was extensively studied and proved by many investigators. **Paech and Tracey (1955)** found that alkaloids, even in very small amount, have physiological effects on living organisms. Alkaloids are widely distributing in plant families such as legumes and Solanaceae, they contain toxic substance which protect plants from insects' attack. **Hango and Uthamasamy (1989)** found that total phenols content decreased with the increase in boll age in both entries, declining from 0.98 to 0.42 mg/g in JK260 and from 0.80 to 0.31 mg/g in Sharada. Gossypol content, which is known to be deleterious to bollworms, declined with boll age in both entries but was consistently higher in JK260. This, together with the higher total phenol and crude fiber contents, is thought to contribute to the greater resistance of JK260. **Kim and Oosterhuis (1998)** demonstrated that bollworm and boll weevil damage to developing cotton (*Gossypium hirsutum*) bolls declines dramatically at approximately 350 heat units after flower fertilization. Use was made of this phenomenon for timing the cessation of insecticide application to the cotton crop; a study was designed to explain this phenomenon by investigating physical, anatomical and biochemical changes in the capsule wall in relation to boll age and insect feeding. The effect of plant growth regulators, PIX and PCR-IV, on the development of the boll wall was also investigated. The greatest change in resistance to penetration occurred at 350 heat units.

Light and electron microscopy showed massive lignifications of the endocarp cells of the boll wall at about 350 heat units which may be related to resistance to insect feeding. This study helps explain the decline in attractiveness of the cotton boll with age to *H. zea* and *A. grandis*, and insecticide application can be terminated at this stage.

Data in the same table indicate the occurrence of different influences on the photosynthetic pigment chl.a and chl.b of cotton bolls by the assayed agrochemicals. The microorganisms complex (EM) and Mikrofol (fertilizers complex) significantly increased these pigments, while Dipel , Pleo and conventional spray program treatments showed insignificant differences in chl. a, chl. b than the untreated check. In terms of figures, the chl.a contents were changed from 213.0 mg/100 gm. fresh weight (untreated check) to 323.0 (EM), 232.2 (Dipel), 360.5 (Mikrofol), 221.0 (Pleo) and 220.0 mg/100 fresh weight (conventional spray program). The percent increase in chl.a content after agrochemical treatments than the check were 52.02, 9.01, 69.25, 3.75 and 3.2 % in cases of EM, Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively. The same trend of results was recorded with chl.b, showing the amounts of 207.1 (untreated check), 251.8 mg/100 gm. fresh weight (EM), 217.3 (Dipel), 291.5 (Mikrofol), 212.0 (Pleo) and 209.0 mg/100 fresh weight (conventional spray program). The percent increase in chl.b content after agrochemical treatments than the check were 21.58, 4.33, 40.75, 2.37 and 0.9 % in cases of EM, Dipel, Mikrofol, Pleo and Conventional spray program, respectively.

Data, also, indicate the significant role of tested agrochemicals in increasing the carotenoids content of bolls than the untreated check. Carotenoids content changed from 170 mg/100 gm. fresh weight (untreated check) to 232.8 (EM), 201.9 (Dipel), 264.0 (Mikrofol), 186 (Pleo) and 180 mg/100 gm. fresh weight (conventional spray program). The percent increase in carotenoids content in agrochemical treatments than the check reached 36.94, 18.77, 55.29, 9.41 and 5.88 % with the same mentioned treatments, respectively.

5. Effect of tested agrochemicals on cotton fiber quality:

Data in Table (18) and Fig (18) indicated the insignificant influence of tested agrochemicals on the fiber quality of cotton lint compared with the untreated check. In terms of figures, the upper half mean expressed on fiber length parameters changed from 29.0 (untreated check) to 29.9, 30.0, 29.1 and 29.1 with EM, Dipel, Mikrofol, Pleo and Conventional spray program treatments, respectively, showing 3.0, 3.4, 0.3, 0.3 and 0.3 % increase than the check, respectively. The same trend of results was obtained with uniformity index which changed from 86.3 (untreated check), to 87.0, 88.4, 86.4, 86.4 and 86.8 with the same treatments, respectively, indicating 0.80, 2.40, 0.11, 0.50 and 0.5 % increase than control, respectively.

The effect of tested agrochemicals on fiber bundle tensile (expressed as fiber strength and fiber elongation than the untreated check) was also insignificant (Table, 18). In terms of figures, the fiber strength changed from 31.5 g/tex (untreated check) to 32.0, 32.9, 31.6, 31.7 and 31.7 g/tex in cases of EM,

Table (18): Effect of different agrochemicals on certain measures of cotton fiber quality.

Treatments	Fiber length parameters				Fiber bundle tensile			
	Upper half mean		Uniformity index %		Fiber strength g/tex.		Fiber elongation	
	values	% increase	values	% increase	values	% increase	values	% increase
Control	29.0	-	86.3	-	31.5	-	7.0	0.0
EM	29.9	3	87.0	0.8	32.0	1.5	7.0	0.0
Mikrofol	30.0	3.4	88.4	2.4	32.9	4.4	7.1	1.4
Dipel	29.1	0.3	86.4	0.11	31.6	0.3	7.0	0.0
C. S. Program	29.1	0.3	86.8	0.5	31.7	0.6	7.0	0.0
Pleo	29.1	0.3	86.8	0.5	31.7	0.6	7.0	0.0

L.S.D at (0.5 %) for Upper half mean between treatments = 0.91
L.S.D at (0.5 %) for Uniformity index between treatments = 1.20
L.S.D at (0.5 %) for Fiber strength g between treatments = 0.89
L.S.D at (0.5 %) for Fiber elongation between treatments = 0.10

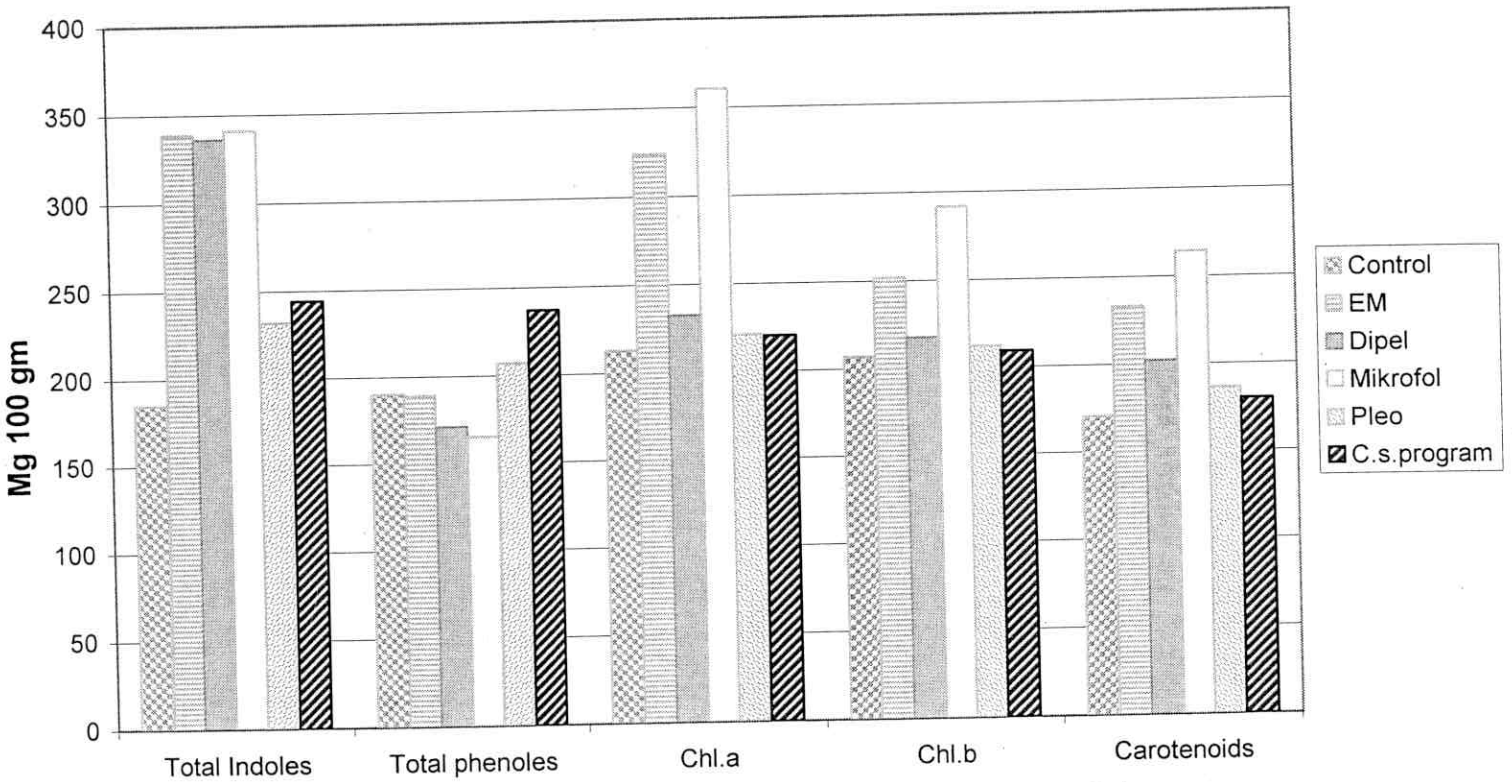


Fig (17): Effect of tested agrochemicals on the total indoles, phenols, chl.a & b and carotenoids.

Dipel, Mikrofol, Pleo and Conventional Spray Program, respectively. Also, no appreciable change was recorded with fiber elongation (Table, 18).

Such findings are in harmony with those obtained by many researchers, i.e **Butter and Sukhija (1987)** who tested fenvalerate in sprays at 30-75 g i.e./ha against *P. gossypiella* and *E.insulana* on cotton in the Punjab, India, for 3 consecutive years. Data showed significant reduction in bollworm damage and the highest dosage gave increased yields, but the fiber quality was unaffected by treatment. **Salem (2002)** recorded that foliar fertilizer (Mikrofol) increased the fiber length and fiber strength than the check, chemical insecticide (Herculis) and plant extraction (Neemazal).

Reviewing the aforementioned results, it could be concluded that Mikrofol treatment caused significant increase in cotton boll opening compared with the untreated check. EM showed insignificant increase in boll opening, while Dipel, Pleo and conventional spray program caused insignificant influences in this respect. The tested agrochemicals greatly increased the yield of seed cotton, but in various values due to the compound/program used. Pleo and conventional spray program showed the highest increase in cotton production compared with the other treatments as well as the untreated check.

The tested agrochemicals increased significantly nitrogen content of cotton bolls than the check. On the other hand, Mikrofol fertilizer proved the only agrochemical tested which caused significant increase in phosphorous content of cotton bolls. EM and Mikrofol treatments resulted in significant

increase in potassium content of cotton bolls, while Dipel, Pleo and Conventional Spray Program showed insignificant changes than check. Again, EM and Mikrofol were the tested effective agrochemicals influencing carbohydrate content of cotton bolls.

The tested agrochemicals increased significantly the total indoles content of cotton bolls than the check, while the contrary was recorded with phenols contents. Data indicated the occurrence of different influences by the tested agrochemicals on the detected photosynthetic pigments of green cotton bolls.

EM and Mikrofol treatment increased significantly chl.a and chl.b content in green cotton bolls than untreated check, while Dipel and Pleo caused insignificant changes in this respect. The tested agrochemicals caused significant increase in carotenoids content than the check, but in different values according to the tested compound.

Data, also, indicated the insignificant influences of the tested agrochemicals on the fiber quality of cotton expressed as length and fiber bundle tensile parameter.

Part-3

1. Seasonal abundance of total population of predaceous insects predators in cotton field:

1.1. Total counts of predators in cotton fields:

Sweeping net counting data are recorded in Tables (19-24). Data showed that the total populations of insect predators were generally higher in the untreated cotton field compared with treated field. Also, in untreated cotton field the population was, generally, higher during 2004 (469 individuals) than 2005 season (477 individuals; Table, 19).

Regarding, the weekly counts of predators on cotton plants, those were, in general, in high levels during July and August throughout the two seasons. In untreated cotton field, one peak of predators' abundance occurred at the 2nd week of August with 73 and 77 individuals/40 double sweep-net strokes during 2004 and 2005 seasons, respectively, (Table, 19 and Figs. 19 & 20). While, in EM treated cotton field, the population was higher during 2005 season (482 individuals) than 2004 (460 individuals) (Table, 20 and Figs. 21 & 22); the high levels during the 2nd week of August with 99 individuals/40 double net storkes during 2004 and during last week of July and 3rd week of August with 76 and 71 individuals /40 double net storkes, respectively during 2005 season, followed by, total number in field treated by fertilizer complex, data in Table (21 and Figs 23 & 24) showed that the population was higher during 2004 season (456 individuals) than 2005 season (440 individuals); the total number of predators was increased gradually until the high number in 2nd

Table (19): Counts of insect predators, estimated by insect sweeping net on untreated cotton plants during 2004 & 2005 seasons.

	2004							2005						
	Scymnus spp.	*Orius spp.*	*P. alfierii*	*C. Undecim punctata*	*C. carnea*	*Syrphus corollae*	Total	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecim punctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	4	4	3	5	3	3	22	3	3	4	6	4	4	24
8/7	5	6	5	7	4	4	31	4	5	4	9	4	5	31
15/7	7	6	5	9	6	5	38	5	6	8	11	7	7	44
22/7	10	9	8	13	6	7	53	9	7	8	12	9	7	52
29/7	10	11	9	14	8	7	59	11	8	8	16	9	7	59
5/8	10	10	9	14	9	8	60	9	7	11	15	11	10	63
12/8	12	21	9	15	7	9	73	20	20	11	15	10	10	86
19/8	24	13	11	13	4	5	70	10	10	13	15	10	10	68
26/8	11	10	10	19	5	8	63	10	7	12	14	4	3	50
Total	93	90	69	109	52	56	469	81	73	79	113	68	63	477
Mean	10.33	10.0	7.66	12.11	5.77	6.22		9.00	8.11	8.77	12.55	7.55	9.00	
%	19.83	19.2	14.7	23.24	11.09	11.94		16.98	15.30	16.56	23.69	14.25	13.20	

P. alfierii* = *Paederus alfierii
C. Undecimpunctata* = *Coccinella undecimpunctata
C. carnea* = *Chrysoperla carnea

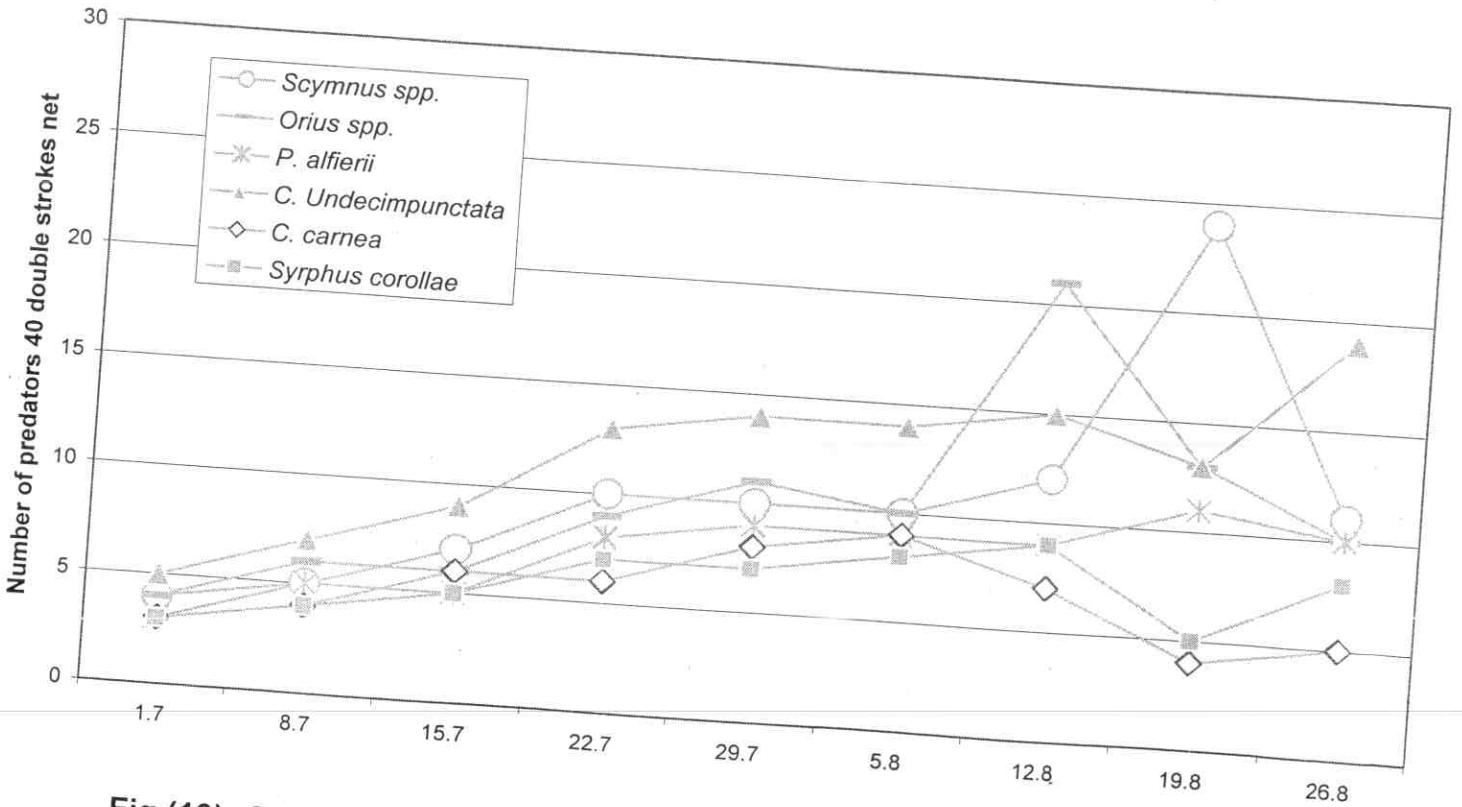


Fig (19): Counts of insect predators, estimated by insect sweeping net on untreated cotton plants during 2004 season.

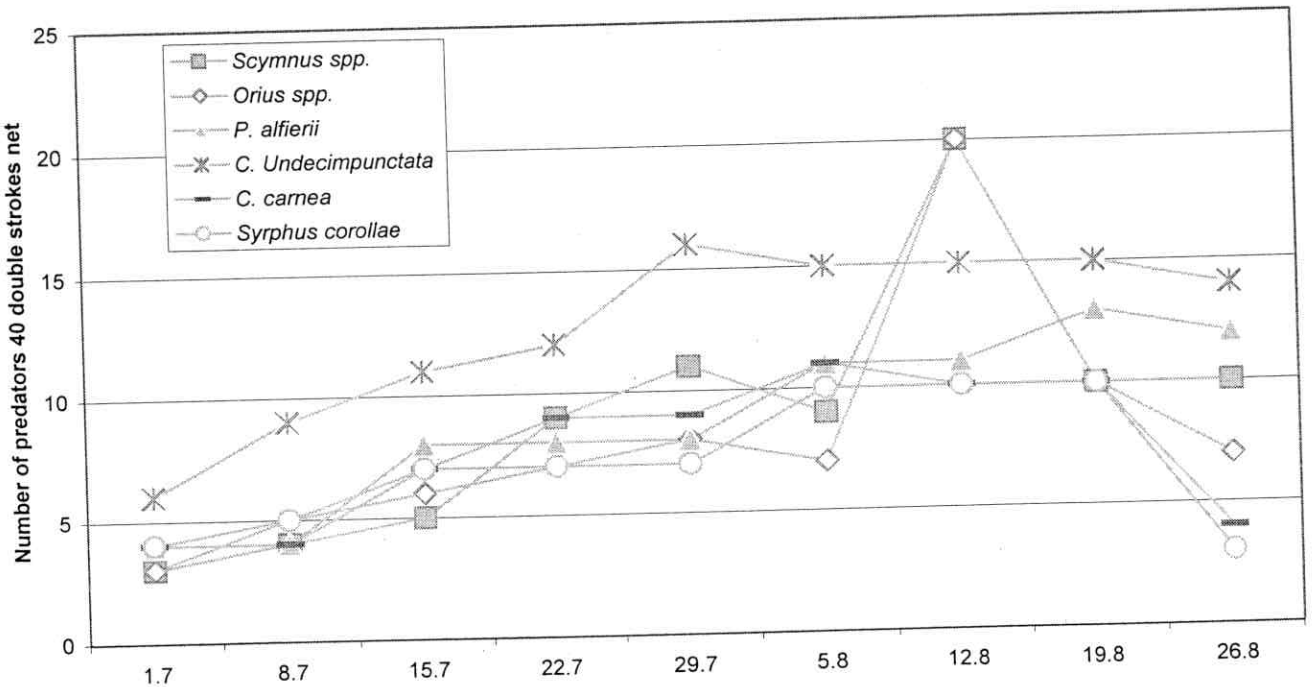


Fig (20): Numbers of predators, estimated by insect sweeping net on untreated cotton plants during 2005 seasons.

Table (20): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by effective microorganisms (EM) during 2004 & 2005 seasons.

	2004							2005						
	Scymnus spp.	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	5	5	4	4	4	4	26	6	5	6	7	5	4	33
8/7	6	7	5	7	5	5	35	7	6	6	6	8	5	38
15/7	8	7	5	7	5	5	37	7	8	8	12	7	7	49
22/7	9	7	7	8	5	5	41	8	9	7	12	7	8	51
29/7	10	10	9	10	8	6	53	8	18	11	13	19	7	76
5/8	10	9	8	14	8	9	58	8	7	9	13	9	7	53
12/8	19	20	22	19	10	9	99	9	9	11	17	8	9	63
19/8	8	9	10	16	10	9	62	19	10	10	15	9	8	71
26/8	7	7	8	14	7	6	49	7	8	9	10	7	7	48
Total	82	81	78	99	62	58	460	79	80	77	105	79	62	482
Mean	9.11	9.0	8.67	11.0	6.89	6.44		8.78	8.89	8.55	11.67	8.78	6.89	
%	17.83	17.61	16.96	21.52	13.48	12.61		16.39	16.60	15.98	21.78	16.39	12.86	

P. alfierii = Paederus alfierii
C. Undecimpunctata = Coccinella undecimpunctata
C. carnea = Chrysoperla carnea

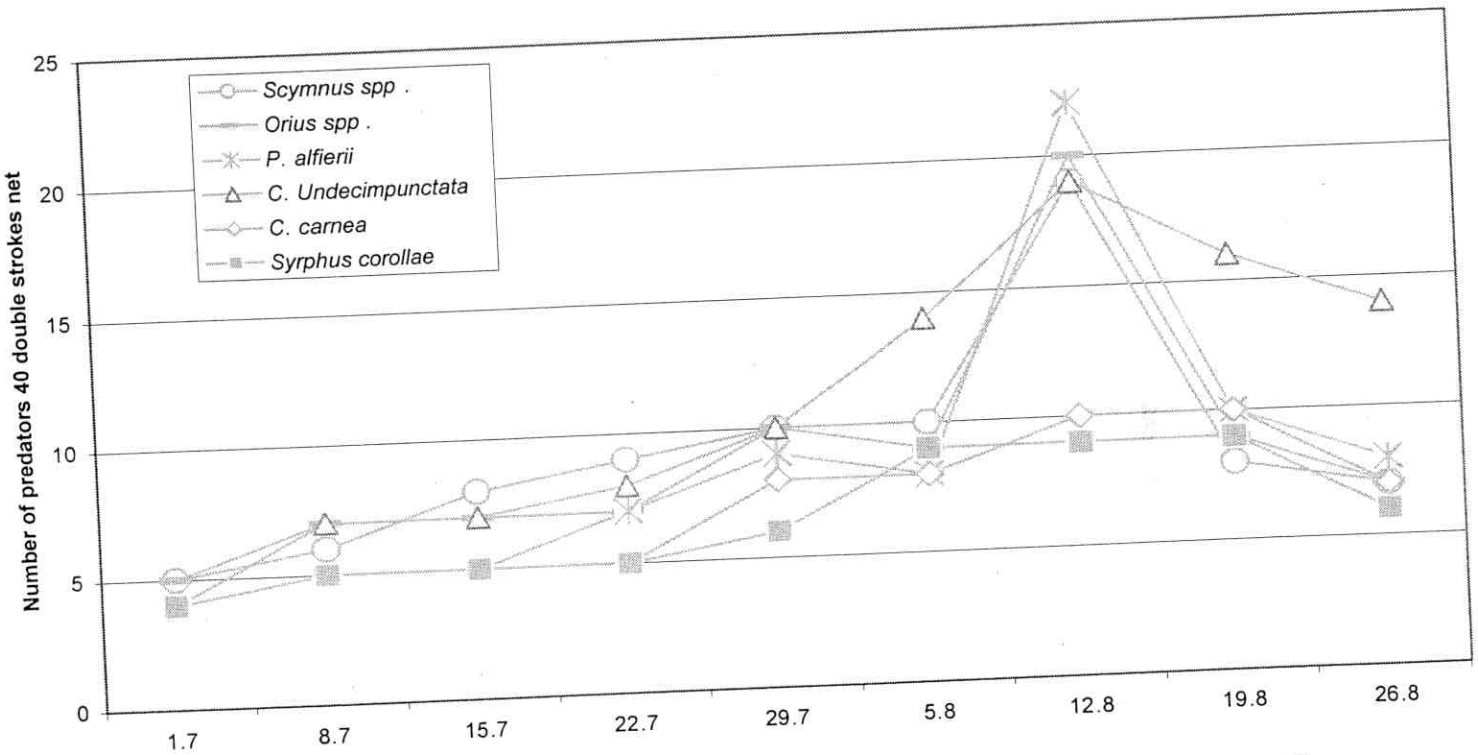


Fig (21): Counts of insect predators , estimated by insect sweeping net , on cotton plants treated by effective microorganisms (EM) during 2004 season .

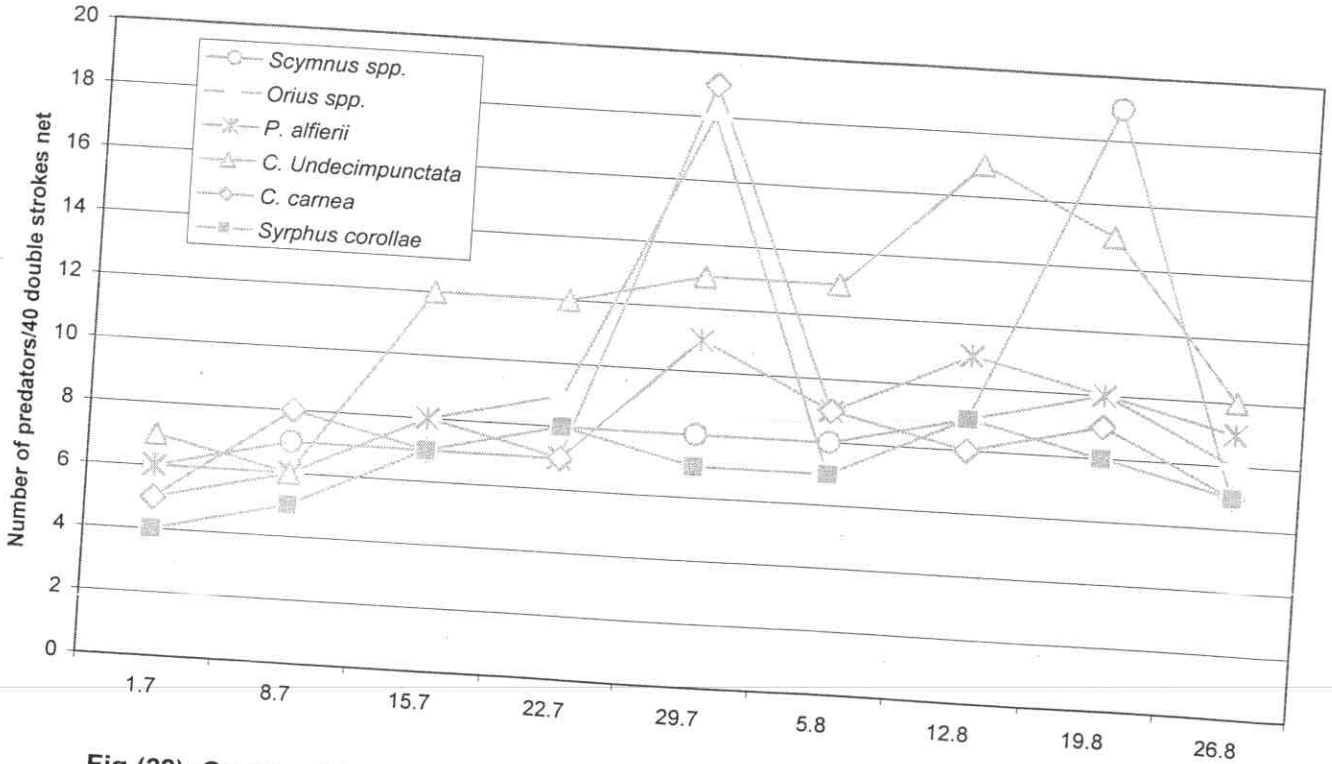


Fig (22): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by effective microorganisms (EM) during 2005 seasons.

Table (21): Counts of insect predators, estimated by insect sweeping net on cotton plants treated by foliar fertilizer (Mikrofol) during 2004 & 2005 seasons.

	2004							2005						
	Scymnus spp.	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	6	5	4	4	4	4	27	5	4	3	4	3	2	21
8/7	6	5	4	7	5	6	33	5	7	5	8	3	2	30
15/7	7	6	8	10	6	7	44	7	9	9	12	5	4	46
22/7	12	8	8	11	6	8	53	10	9	10	14	5	7	55
29/7	10	9	11	15	7	8	60	11	11	9	14	6	9	60
5/8	11	12	9	17	9	8	66	11	10	9	14	10	10	64
12/8	10	12	10	16	7	8	63	10	10	10	15	10	10	65
19/8	9	10	9	12	7	7	54	9	8	7	12	8	10	54
26/8	8	9	8	15	9	7	56	4	6	6	12	7	10	45
Total	79	76	71	107	60	63	456	72	74	68	105	57	64	440
Mean	8.78	7.84	7.89	11.89	6.67	7.0		8.0	8.22	7.55	11.67	6.33	7.11	
%	17.32	16.67	15.57	23.46	13.16	13.8		16.36	16.82	15.45	23.86	12.95	14.54	

P. alfierii* = *Paederus alfierii
C. Undecimpunctata* = *Coccinella undecimpunctata
C. carnea* = *Chrysoperla carnea

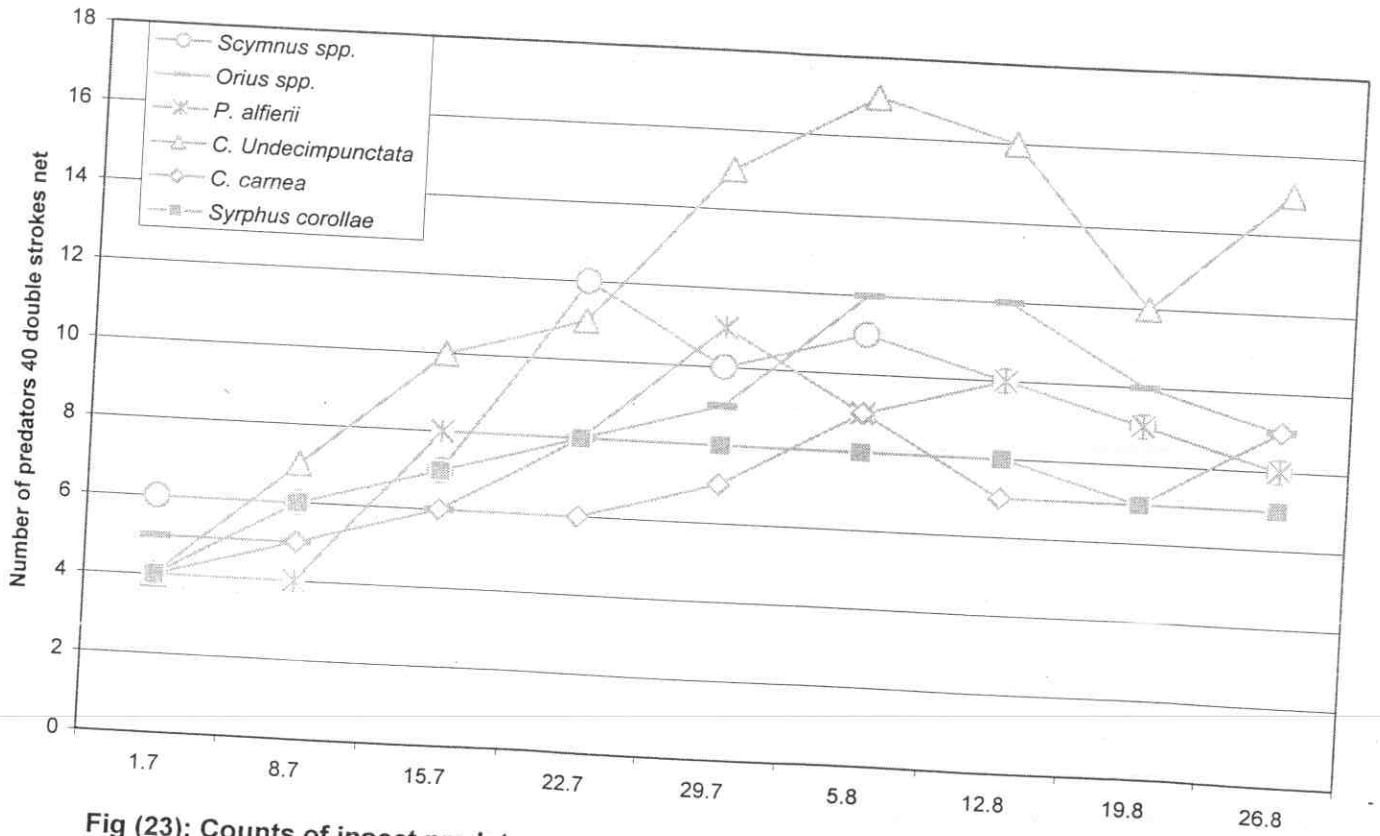


Fig (23): Counts of insect predators, estimated by insect sweeping net on untreated cotton plants treated by foliar fertilizer (Mikrofol) during 2004 season.

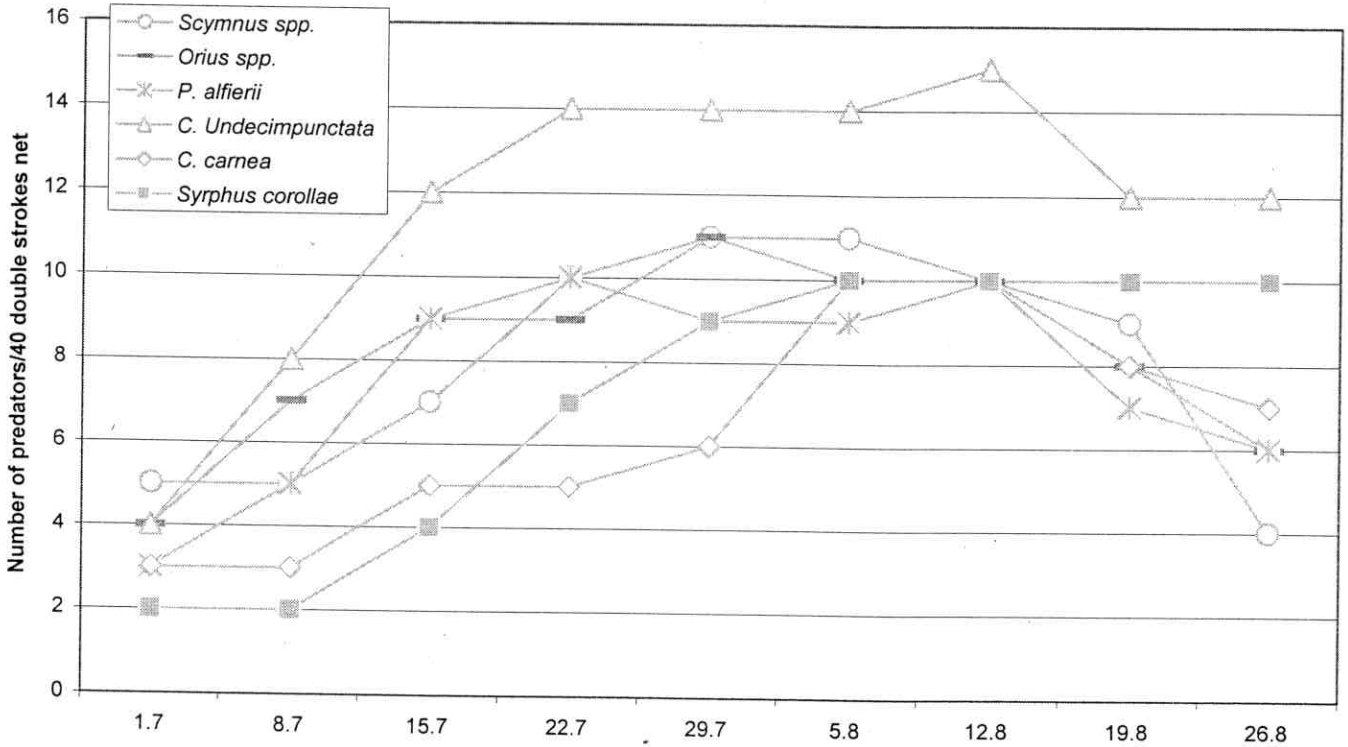


Fig (24): Counts of insect predators, estimated by insect sweeping net on untreated cotton plants treated by foliar fertilizer (Mikrofol) during 2005 season.

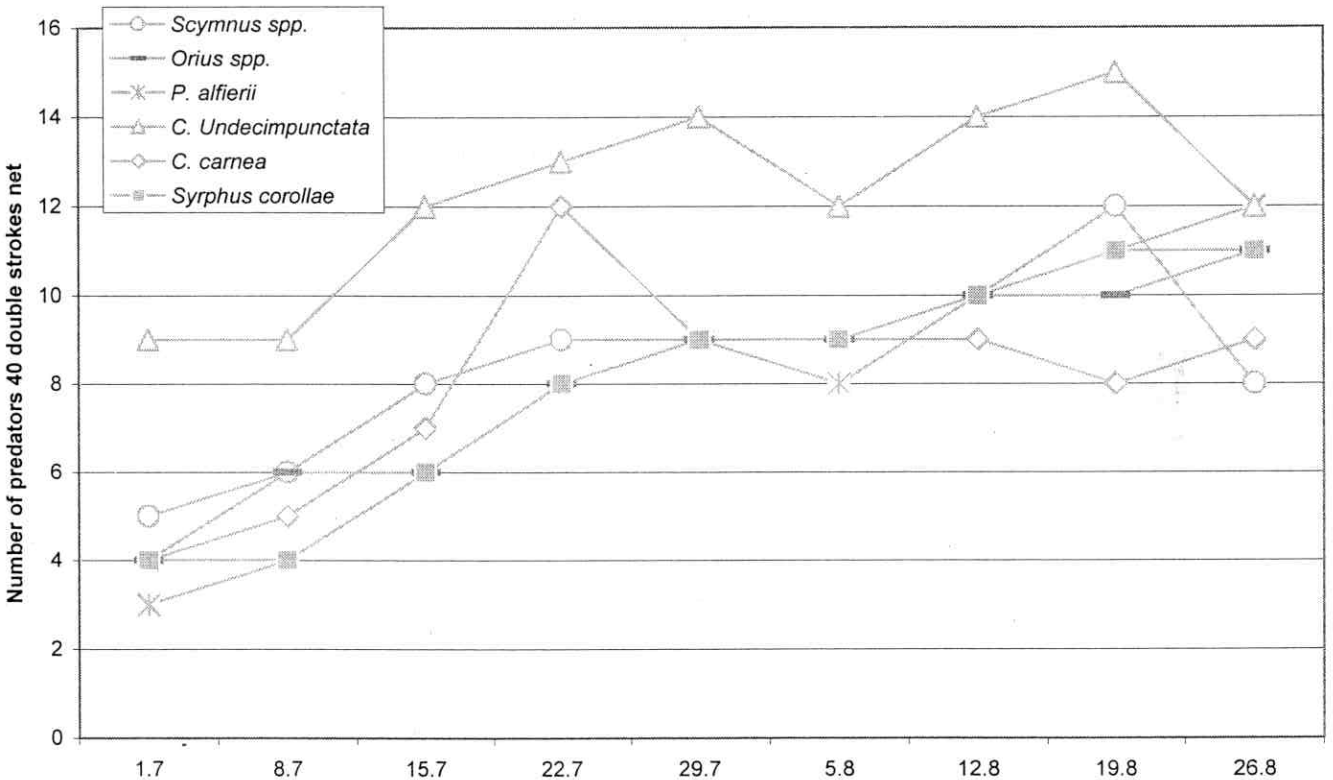
Table (22): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by bacterial bioinsecticide (Dipel -2X) during 2004 & 2005 seasons.

	2004							2005						
	Scymnus spp.	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	5	4	3	9	4	4	29	5	6	6	4	5	5	31
8/7	6	6	4	9	5	4	34	9	6	5	6	7	6	39
15/7	8	6	6	12	7	6	45	8	7	8	8	7	6	44
22/7	9	8	8	13	12	8	58	8	9	8	9	8	7	49
29/7	9	9	9	14	9	9	59	8	11	8	12	9	7	55
5/8	9	9	8	12	9	9	56	10	12	9	13	9	8	61
12/8	10	10	10	14	9	10	63	9	10	8	14	10	9	60
19/8	12	10	11	15	8	11	67	9	11	8	15	9	8	60
26/8	8	11	12	12	9	11	63	7	9	7	14	7	7	51
Total	76	73	71	110	72	72	474	73	81	67	95	71	63	450
Mean	8.44	8.11	7.89	12.22	8.0	8.0		8.11	9.0	7.44	10.55	7.89	7.0	
%	16.3	15.40	14.98	23.20	15.19	15.19		16.22	18.0	14.89	21.11	15.78	14.0	

P. alfierii = Paederus alfierii

C. Undecimpunctata = Coccinella undecimpunctata

C. carnea = Chrysoperla carnea



Fig(25): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by bacterial bioinsecticide (Dipel) during 2004 season.

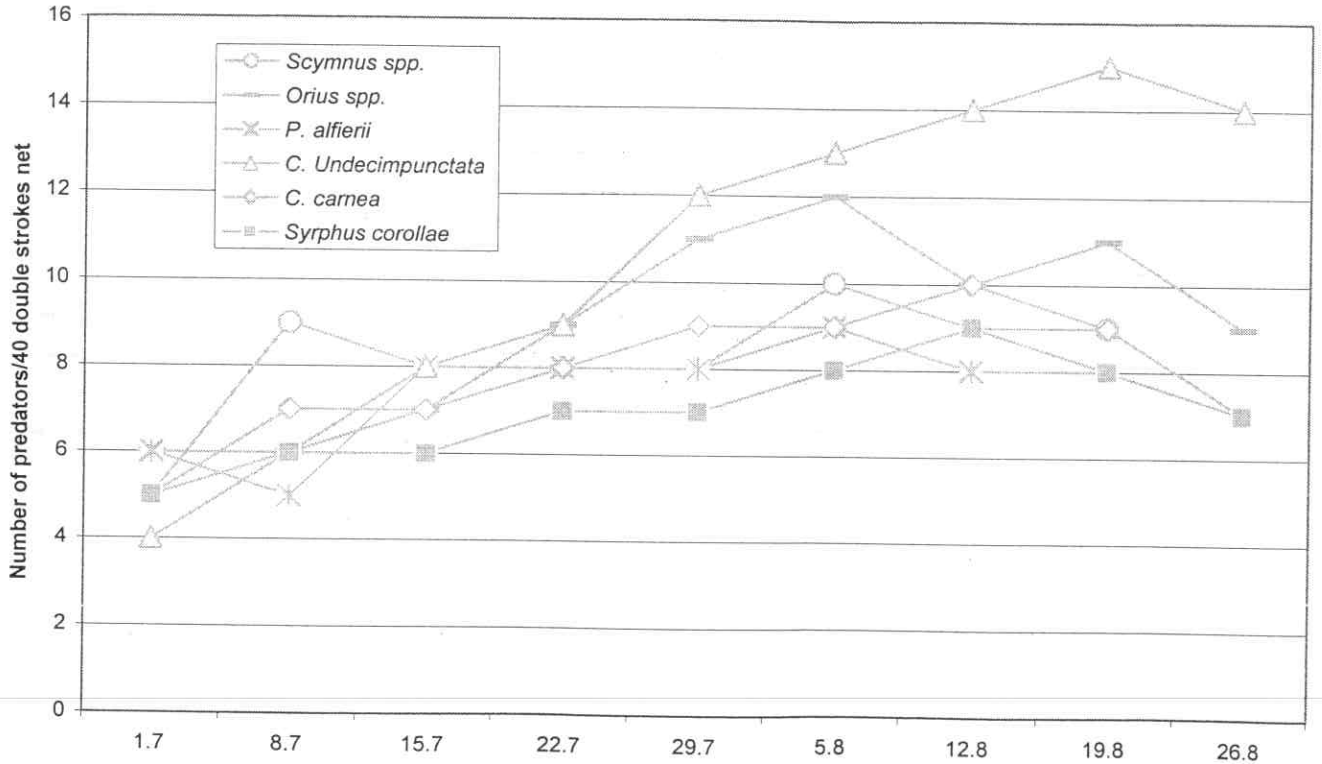


Fig (26): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by bacterial bioinsecticide (Dipel) during 2005 season.

Table (23): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by chemical insecticide (Pleo) during 2004 & 2005 seasons.

	2004							2005						
	Scymnus spp.	*Orius spp.*	*Paederus alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	6	5	4	5	3	1	24	5	4	4	6	5	5	29
8/7	1	1	1	1	1	2	7	1	1	1	1	1	1	6
15/7	2	2	3	3	2	3	15	2	3	2	3	2	1	13
22/7	2	1	2	3	3	1	12	1	1	1	3	2	1	9
29/7	2	1	2	3	4	2	14	3	2	2	2	3	2	14
5/8	2	2	2	4	2	1	13	2	2	1	3	2	1	11
12/8	3	3	3	4	2	3	18	2	2	3	3	2	2	14
19/8	4	5	4	5	4	2	24	3	4	5	4	4	2	22
26/8	4	7	5	4	6	3	29	2	4	5	6	4	3	24
Total	26	27	26	32	27	18	156	21	23	24	31	25	18	142
Mean	2.88	3.0	2.88	3.55	3.0	2.00		2.33	2.55	2.67	3.44	2.78	2.0	
%	16.17	17.30	16.17	20.51	17.30	11.54		14.79	16.20	16.90	21.83	17.60	12.68	

C. Undecimpunctata = Coccinella undecimpunctata

C. carnea = Chrysoperla carnea

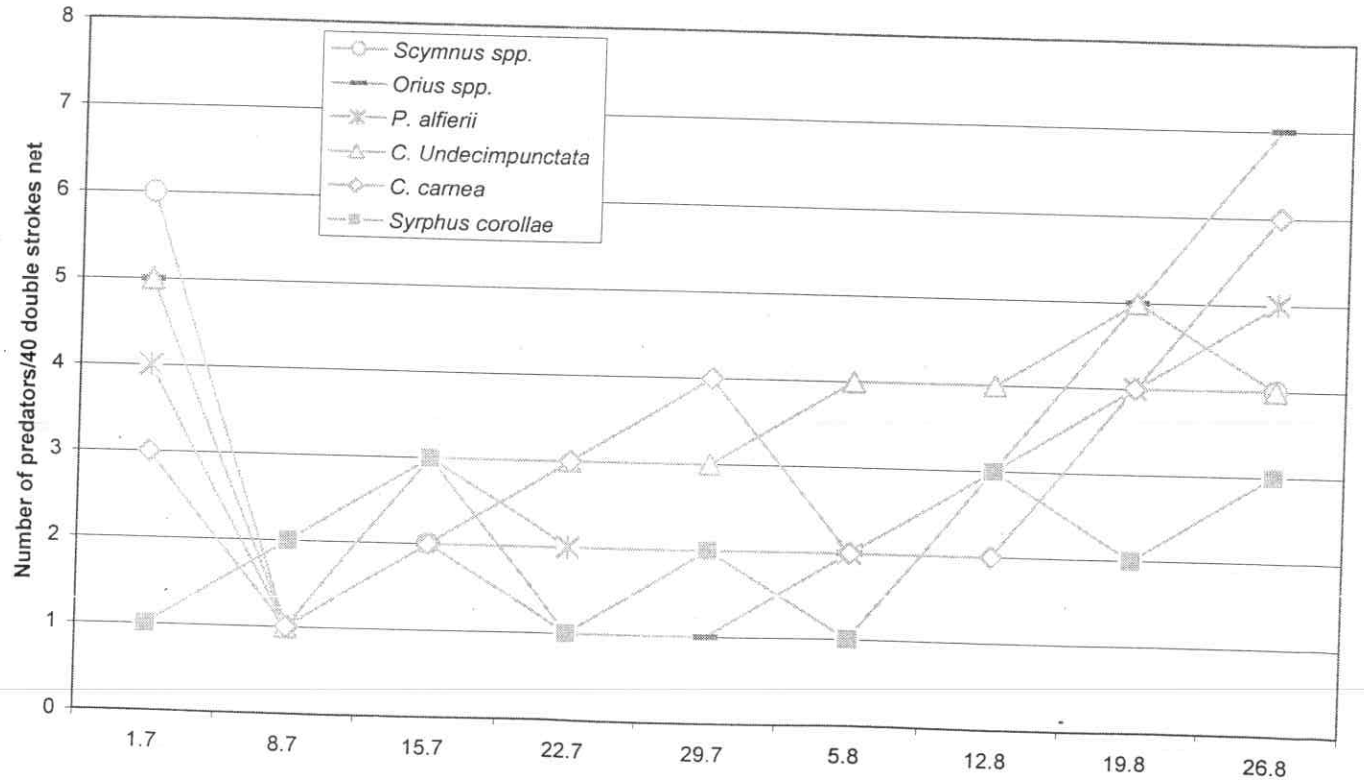


Fig (27): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by chemical insecticide (Pleo) during 2004 season.

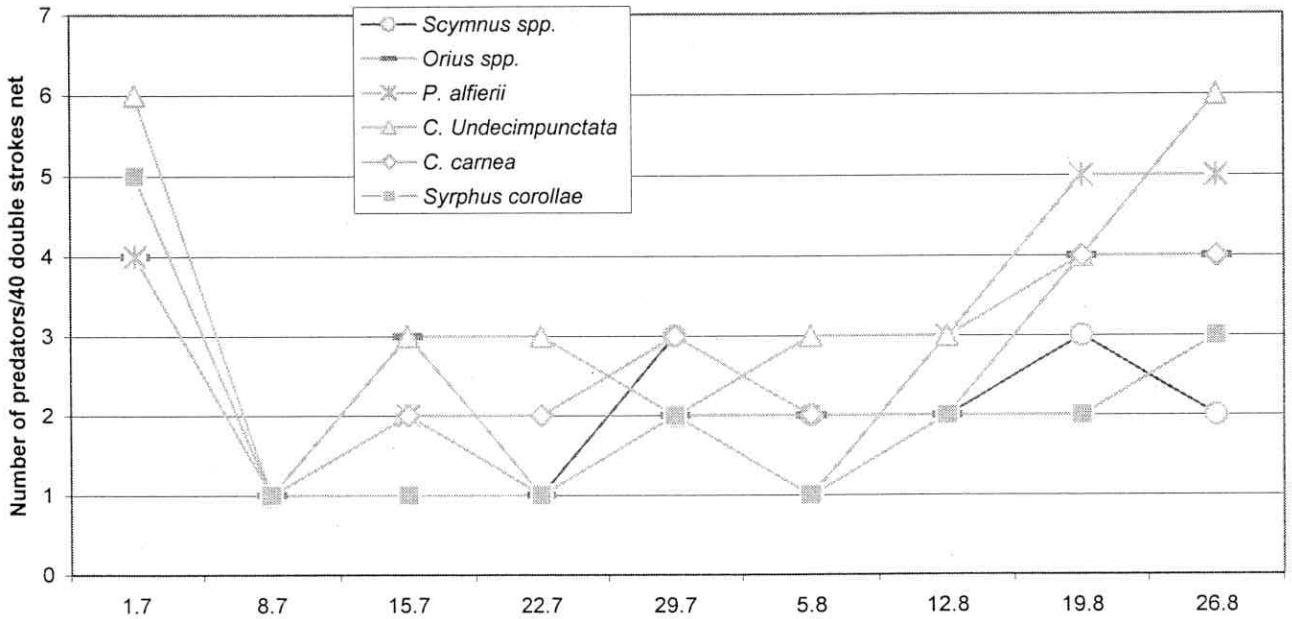


Fig (28): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by chemical insecticide (Pleo) during 2005 season.

Table (24): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by Conventional Spray Program during 2004 & 2005 seasons.

	2004							2005						
	Scymnus spp.	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	6	6	5	4	3	3	27	6	5	5	4	4	5	29
8/7	1	1	1	2	1	1	7	1	1	1	3	2	1	9
15/7	3	2	3	4	2	3	17	2	2	3	3	2	1	13
22/7	2	2	2	3	2	3	14	1	1	1	3	2	2	10
29/7	2	3	2	4	4	3	18	3	3	3	4	3	1	17
5/8	2	2	3	3	3	2	15	1	3	2	4	3	1	14
12/8	3	4	3	5	5	3	23	3	4	5	5	3	4	24
19/8	3	4	5	4	5	3	24	5	4	8	4	4	5	30
26/8	7	6	5	5	4	3	30	6	5	7	4	4	3	29
Total	29	30	29	34	29	24	175	28	28	35	34	27	23	175
Mean	3.22	3.33	3.22	4.0	3.22	2.67		3.11	3.11	3.89	3.78	3.0	2.55	
%	16.57	17.14	16.57	19.43	16.57	13.71		16.0	16.0	20.0	19.43	15.43	13.14	

P. alfierii = Paederus alfierii
C. Undecimpunctata = Coccinella undecimpunctata
C. carnea = Chrysoperla carnea

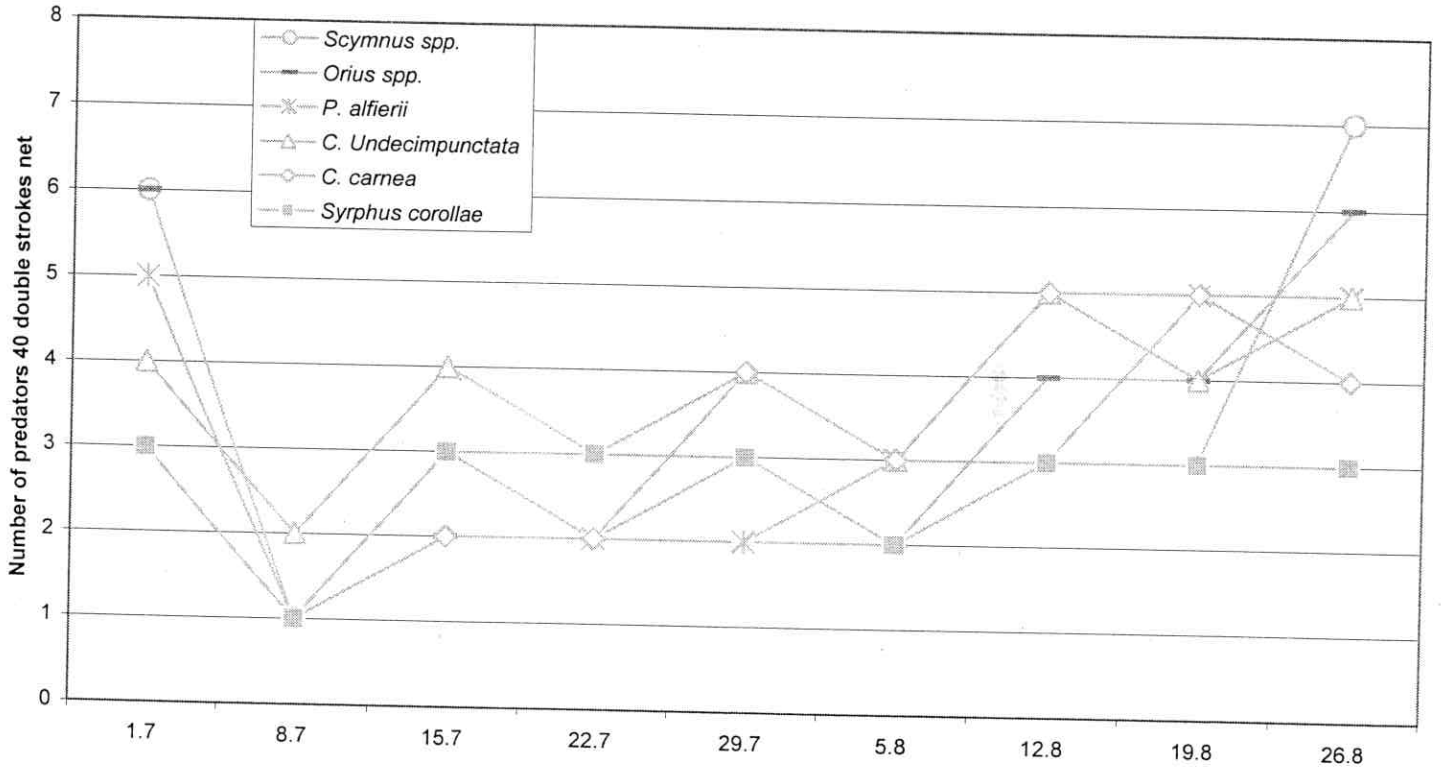


Fig (29): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by Conventional Spray Program during 2004 season.

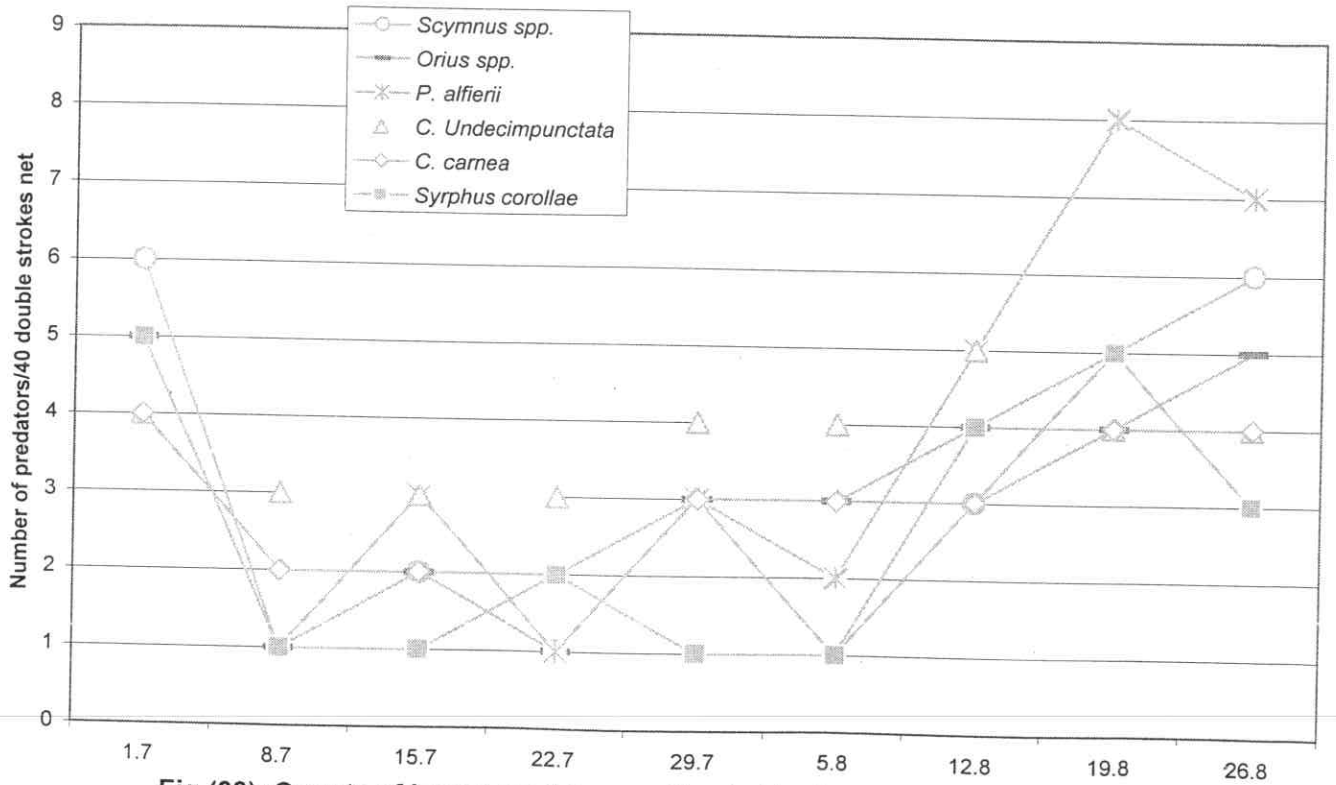


Fig (30): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by Conventional Spray Program during 2005 season.

week of August (66 individuals/40 double net strokes)during 2004 season and (65 individuals/40 double net storks). Also, when the field treated by bio insecticide Dipel, data in Table (22 and Figs 25 & 26) recorded that the total population of insect predators was higher during 2005 season (450 individuals) than (437 individuals) during 2004 season.

- Use of chemical insecticide Pyridalyl:

As for the role of the chemical insecticide Pleo that contains the active ingredient of pyridallyl and Conventional spray program, data in Table (23 & 24) and Figs. (29 - 32) indicate the great influence of this compound on the recorded numbers of predators in cotton fields.

Regarding, the weekly counts of all predators on cotton plants, predators were generally high before treatment 24 & 29 (Pleo) and 27 & 29 (C.S.Program) individuals/40 double net strokes during 2004 & 2005 seasons, respectively. This number decreased sharply to only 7 & 6 (Pleo) and 7 & 9 (C.S.Program) individuals during 2004 and 2005 seasons, respectively. As for the total seasonal count of predators in the Pleo treated cotton field, those were higher during 2004 season (156 individuals) than (142 individuals) during 2005 season, also, 175 individuals during two seasons in cotton field treated with conventional spray program. These total seasonal counts were, clearly, lower than those recorded from the remaining treatments (460, 474, 456 individuals in 2004 season, and 482, 450 and 440 individuals in 2005 cotton season from treatments by EM, Dipel and Mikrofol, respectively, opposed to 469 and 477 predators' individuals from untreated plots (Table, 25).

Table (25): Total seasonal counts of predators insect species in untreated cotton fields and in those treated with different agrochemicals in 2004 & 2005 seasons.

Tested Agrochemicals	2004							2005						
	Scymnus spp.	*Orius spp.*	*Paederus alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total	*Scymnus spp.*	*Orius spp.*	*Paederus alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	*Total*
EM	82	81	78	99	62	58	460	79	80	77	105	79	62	482
Dipel	76	73	71	110	72	72	474	73	81	67	95	71	63	450
Mikrofol	79	76	71	107	60	63	456	72	74	68	105	57	64	440
Pleo	26	27	26	32	27	18	156	21	23	24	31	25	18	142
C.S.Program	29	30	29	34	29	24	175	28	28	35	34	27	23	175
Control	93	90	69	109	52	56	469	81	73	79	113	68	63	477

C. Undecimpunctata = Coccinella undecimpunctata *C. carnea = Chrysoperla carnea*

As conclusion, the total numbers of predators collected from untreated cotton field were higher than those collected from fields treated with different agrochemical compounds.

It could be observed from the present results, that the general trends of changes of populations of different predators followed the same trend in the two seasons of study, but it varied between treated and untreated fields. Most of the collected predators belong to order Coleoptera, followed by Hemiptera and Neuroptera in untreated and treated fields.

In accordance to present results, **Hafez *et al.*, (1975)** found that the predators were present in cotton fields during April and reached their peak of abundance during June and July. **Habib *et al.*, (1976)** indicated that most of predators in untreated cotton fields reached their maximum abundance during July and August. **Nasef (1990)** found that the population of total predators fluctuated and three peaks of abundance were recorded during mid June, half of July and the 2nd half of August. **Ali (2003)** indicated that the total numbers of predators were, generally, of high abundance during June and first week of July. After this high population of adults, the population decreased throughout the rest of July and during August.

1.2. Abundance of existed predators in cotton fields:

The predaceous insects which were considered in this study belong to six genera of four families and four orders. Those were identified as three coleopteran insects, *Coccinella undecimpunctata, Scymnus spp.* and *Paederus alfierii;* a hemipteran insects, *Orius spp.* and a neuropteran insects;

Chrysoperlla carnea. These predators were found the most common in cotton fields and are well known to attack and feed on cotton pests.

The seasonal fluctuation of each of these predators was followed from the first week of July to the end of August. Predators' population densities were estimated by 40 double sweeping net strokes in treated and untreated cotton fields. To facilitate the presentation of the obtained data, each predator will be discussed separately in the following:

1.2.1. *Coccinella undecimpunctata*

The ladybird beetles of *Coccinella undecimpunctata* were found during the two cotton seasons 2004 and 2005.

As show in Table (25) and Figs. (19 - 26), the total numbers of captured *Coccinella undecimpunctata* on untreated cotton plants were 109 and 113 adults during the two studied seasons, respectively. Such total count represented 23.24 % and 23.69 % of the total predators throughout the two seasons in the untreated cotton fields. While, in treated cotton by microorganisms complex, EM, it reached 99 and 105 individuals throughout 2004 and 2005, respectively. Such total counts represented 21.52 % and 21.78 % of the total population in the same treatment (Table, 20). When the cotton field was treated by fertilizer complex, Mikrofol, the total numbers of captured *Coccinella undecimpunctata* were 107 and 105 adults, respectively, representing 23.46 % and 23.86 % of the total population during 2004 and 2005, respectively (Table, 21). Also, the same trend was recorded in cotton field treated by bio

insecticide, Dipel, where the ladybird predator was found in 110 and 95 adults, representing 23.20 % and 21.11 % of the total population during 2004 and 2005, respectively (Table, 22).

On other hand, when the field was treated by Pleo and Conventional Spray Program insecticides, data in Table (25) showed that the total numbers of captured *Coccinella undecimpunctata* on treated cotton plants reached 32 & 31 adults/season and 34 & 34 adults, representing 20.51% & 21.83% (Pleo) and 19.43 & 19.43 % (conventional spray program) of the total population during 2004 and 2005, respectively.

Regarding, the weekly counts of the predator *Coccinella undecimpunctata* on untreated cotton plants, it is clear that the counted numbers were, in general, few; ranging from 5 to 19 adults/40 double strokes and from 6 to 16 adults/40 double strokes during the two studied seasons. The highest counts were 19 & 16 adults/40 double strokes in untreated field during the last week of August and the last week of July during 2004 and 2005 seasons, respectively.

While, in treated field by EM, Mikrofol and Dipel, it ranged from 4 to 19 and 6 to 17 adults/40 double strokes in EM treated field; 4 to 17 and 4 to 15 adults/40 double strokes with Mikrofol and 7 to 15 and 4 to 15 adults/40 double strokes in case of Dipel treatment during the two studied seasons, respectively.

On the contrary, when cotton fields were treated by insecticide, Pleo and conventional spray program, the population of this predator was greatly decreased than in the untreated

check, begin generally in few numbers ranging from 1 to 5 and 1 to 6 adults/40 double strokes with Pleo and 2 to 6 and 3 to 5 adults/40 double strokes in case of conventional spray program in 2004 and 2005, respectively.

1.2.2. *Scymnus spp.*

Two species of *Scymnus* are well known to be present in Egypt; i.e. *S.syriacus* and *S.interrupts*.

Data in Table (19) showed that the total numbers of captured *Scymnus spp.* in untreated cotton field were 93 and 81 individuals/season representing 19.83 % and 16.98 % of total counts of all predators during 2004 and 2005 seasons, respectively.

In the EM treated cotton field, the total numbers of this predator averaged 82 and 79 adults/season, representing 17.83 % and 16.39 % of the total counts, respectively. In Mikrofol treated fields, the total numbers of this predator reached were 79 and 72 adults/season representing 17.32 and 16.36 % of total counts of all predators during 2004 and 2005 seasons, respectively. Also, it reached 76 and 73 adults/season in field treated with Dipel, representing 16.03 % and 16.22 % of total counts of predators in the same seasons, respectively.

While, when cotton fields were treated with the insecticides Pleo and conventional spray program, the total number of predator of *Scymnus spp.* adults were 26 & 21 and 29 & 28 adults/season, representing 16.17, 14.79 % and 16.57 and 16.0 % during 2004 and 2005 seasons, respectively.

Regarding, the weekly counts of relative populations of *Scymnus spp.* in untreated cotton field, data in Tables (19 - 22) indicated that the counted numbers ranged, in general, from 4 to 24 and 3 to 20 adults/40 double strokes in untreated fields, from 5 to 19 and 6 to 19 adults/40 double strokes with EM, 6 to 12 and 4 to 11 adults/40 double strokes with Mikrofol and from 5 to 12 and 5 to 10 adults/40 double strokes with Dipel treatment during two seasons 2004 and 2005, respectively.

While, when fields were treated with insecticides Pleo and conventional spray program, the numbers of this predator decreased than those recorded on the untreated plants and ranged from 1 to 6 & 1 to 5 adults/40 double strokes for Pleo treatment and from 1 to 7 & 1 to 6 adults/40 double strokes for conventional spray program during the two seasons 2004 and 2005, respectively (Table, 23 & 24).

1.2.3. *Paederus alfierii*

Data in Tables (19 - 22) indicated that *P. alfierii* was found during the two studied seasons 2004 and 2005 in untreated and treated cotton fields. The total number of captured *P. alfierii* in untreated cotton field were 69 and 79 individuals/season during the two cotton seasons 2004 and 2005, respectively (Table, 25).

Also, the total numbers recorded in treated field by EM reached 78 & 77 adults/season; 71 & 68 adults/ season with Mikrofol and 71 & 67 adults/season with Dipel treatments during the same seasons, respectively.

While, in field treated with Pleo and conventional spray program the total number of predator adults were 26 & 24 adults/ season and 29 & 35 adults/season during the two cotton seasons 2004 and 2005 respectively.

Regarding, the weekly counts of relative populations of *P. alfierii* in untreated cotton field, data in Table (19) indicated that one peak of adults population was recorded by 11 & 13 adults/40 double net storkes on the 3rd week of August during 2004 and 2005 seasons respectively.

While, in treated fields by EM one peak appeared at 2nd week of August (22 and 11 adults/40 double net storkes), from 4 to 11 & 3 to 10 adults/40 double storkes net with Mikrofol and from 3 to12 & 5 to 9 adults/40 double storkes net with Dipel treatment during 2004 and 2005, respectively. In cotton fields treated with Pleo and conventional spray program, the weekly numbers of this predator at weekly intervals were lower during the two seasons, ranged between 1 to 5 and 1 to 5 individuals/40 double net storkes and from 1 to 5 and 1 to 8 individuals/40 double storkes net, respectively.

In accordance to present results, **Habib *et al.*, (1976)** reported that the population density of *P. alfierii* was the highest during July and August. But, **Abbas and El-Deeb (1993)** found that the population density of *P. alfierii* was high in July then decreased gradually until the end of the cotton season.

1.2.4. *Orius spp.*

Total seasonal numbers of *Orius spp.* adults counted throughout 2004 & 2005 seasons from the untreated fields were

90 and 73 individuals, representing 19.28 and 15.30 % of total counts of all predators, respectively (Table, 19). In case of EM, Mikrofol and Dipel treatments, the total numbers were 81 & 80 individuals/season (EM), 76 & 74 individuals/season (Mikrofol) and 73 & 81 individuals/season, representing 17.61 & 16.60 % (EM), 16.67 & 16.82 % (Mikrofol) and 15.40 & 18.0 % (Dipel) of the total count predators in the cotton field, respectively (Tables, 20 -22).

While, in fields treated with Pleo and conventional spray program, these numbers of *Orius spp.* adults were lower than those reached in the former treatments. The total numbers were 27 & 23 individuals/ season and 30 & 28 individuals/ season, during the two seasons, respectively.

Ali (1998) found that total counts of *Orius spp.* in untreated cotton fields were higher on the early sown cotton than in case of the late sown cotton plants.

1.2.5. *Chrysoperla carnea Steph*:

Data in Table (19) indicated that the total numbers of *Chrysoperla carnea* found in untreated cotton field were 52 and 68 adults/season, representing 11.09 & 14.25 % of the total counts of predators collected allover the two studied seasons 2004 and 2005, respectively. In case of cotton field treated with the tested agrochemicals (Tables, 20 – 22), the total counts were 62 & 79 adults/season, representing 13.48 & 16.39 % of total counts of predators collected from (EM), 60 & 57 adults/season, representing 13.16 & 12.95 % (Mikrofol) and 72 & 71

adults/season, representing 15.19 & 15.78 % (Dipel) during 2004 and 2005, respectively.

In case of fields which were treated with Pleo and conventional spray program, the total counts were 27 & 25 adults/season and 29 & 27 adults/season, representing 17.30 & 17.60 % and 16.57 & 15.43 % during 2004 and 2005 seasons, respectively (Tables, 13 & 24).

Concerning, the weekly counts of relative populations of *C.carnea* in untreated and treated cotton fields during the two studied seasons, data in Table (19) indicated the appearance of one peak of abundance at the 1st week of August, recording 9 & 11 adults/40 double net storkes during the 2004 and 20005seasons, respectively.

In treated cotton field by EM (Table, 20) one peak appeared during 2004 and 2005, ten individuals were found during the 2nd and 3rd week of August, 2004, opposed to 19 individuals during the last week of July, 2005. In case of Mikrofol treatment, 10 adults were collected/10 double net strokes during each of the 4 weeks of August, 2005. While, two peaks were recorded at the 1st and last week of August, 2004 (9 adults/40 double net storkes).

Cotton field treated with Dipel showed one peak of *C. carnea* abundance during the two studied seasons at 3rd week of July and 2nd week of August, recording 12 and 10 adults/40 double net storkes, respectively.

Also, cotton field treated with Pleo and conventional spray program, showed that the total counts of *C.carnea*

throughout the two successive seasons were lower than the untreated check. The weekly counts of these predators/40 double net strokes ranged from 1 to 6 adults (season 2004) &, 1 to 5 adults (2005) in the former treatment (Table, 23) and 1 to 5 adults & 2 to 4 adults in the two seasons, respectively in the latter one (Tables, 23 & 24).

In accordance to present results, **Ali (2003)** found that *C.carnea* adults started by few numbers in early cotton season and the highest abundance of the predator occurred during June. Decreased numbers were detected during June, August and finally limited increase in the population abundance occurred by beginning of September.

1.2.6. *Syrphus corolla.*

Data in Tables (19) indicated that the total seasonal numbers of *Syrphus corollae* counted in untreated cotton field were 56 and 63 adults/season, representing 11.94 and 13.20 % of total counts of all predators during the two studied seasons, respectively. EM treatment showed the total numbers of 58 and 62 adults/season, representing 12.61 and 12.86 % of total counts of all predators (Table, 20). In case of the treated field with Mikrofol (Table, 21), the total numbers were 63 and 64 adults/season, representing 13.81 and 14.54 % of total counts of all predators. The corresponding numbers of Dipel treatment reached 72 and 63 adults/season, representing 15.19 and 14.0 % of the total counts of predators (Table, 22) during 2004 and 2005 seasons, respectively.

Also, cotton field treated with Pleo and conventional spray program, showed that the total counts of *Syrphus corollae* throughout the two successive seasons decreased than those of the former treatments, being 18.0 & 18.0 and 24 & 23 adults/season, representing 11.45 & 12.68 and 13.71 & 13.14 % of total counts of all predators during 2004 and 2005 seasons, respectively.

Reviewing the aforementioned results, it could be concluded that the total agrochemicals variously caused variable decreases in the populations of the existed predators in cotton fields than that of the untreated cotton, but the chemical insecticide Pleo and conventional spray program, were always of the severest effect.

Season 2006

Effect of tested agrochemicals on infestation and larval content of bollworms in cotton fields during 2006 season.

Data concerning the effect of tested agrochemicals, i.e. G (1) (Mikrofol, Pleo, Mikrofol and Mikrofol), G (2) (Mikrofol, Pleo, Mikrofol and Pleo), G (3) (Mikrofol, Mikrofol, Pleo and Pleo) in comparison with conventional spray program for bollworms control in cotton fields at Kaha, Kalubia governorate, on the infestation percent and larval content of pink and spiny bollworms during 2006 are presented in Tables (25-35) and illustrated in Figs. (31-46). To facilitate the presentation of data, each insect pest was considered separately in the followings:

1. Pink bollworm, *Pectinophora gossypiella*

1.1. Infestation percent

Data in Table (26) and Fig. (31) indicated the great role of the tested agrochemical schemes in the infestation percent of cotton bolls by the pink bollworm. Such reducing effect was pronounced within 2006 season. On the other hand, throughout the period after spraying, fluctuated infestation percentages were detected according to the tested spray sequential program, but in general, insect infestation was lowered than the untreated check. By the end of the season, the mean infestation percent by pink bollworm during 2006 reached 30.3 % (untreated), opposed to 10.27 % (G 1), 6.15 % (G 2) and 5.47 % (G 3), while conventional spray program for bollworms control led to the mean of 6.0 % infestation. Such figures of infestation percent are significantly different than the untreated check.

Table (26): Effect of tested agrochemicals on % infestation by pink bollworm during 2006 cotton season.

Treatments / Dates	Control	Group (1)	Group (2)	Group (3)	Conventional Spray Program
17/6 1st spray	0.5	0.5	0.5	0.5	0.5
24.6	1.0	1.0	1.0	1.0	1.0
1/7 2nd spray	5.0	4.0	4.0	4.0	4.0
8.7	12.5	2.0	2.5	4.0	3.9
15/7 3rd spray	19.0	3.0	3.5	4.5	5.3
22/7	27.6	7.0	5.3	4.5	5.1
29/7 4th spray	34.2	9.0	6.5	5.3	6.1
5/8	38.4	12.0	7.0	5.0	6.0
12/8	46.1	16.0	7.5	6.1	7.5
19/8	49.0	18.5	9.1	7.6	8.0
26/8	51.0	19.6	10.2	8.5	9.1
2/9	53.3	20.2	10.9	9.2	9.2
9/9	55.2	20.8	12.0	11.0	11.5
Mean	30.3	10.27	6.15	5.47	6.0

L.S.D. at (0.05%) between treatments = 0.61

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3= Mikrofol, Mikrofol, Pleo and Pleo

C.S. Program= Pestpan, Sumi-gold, Teleton and Pestpan

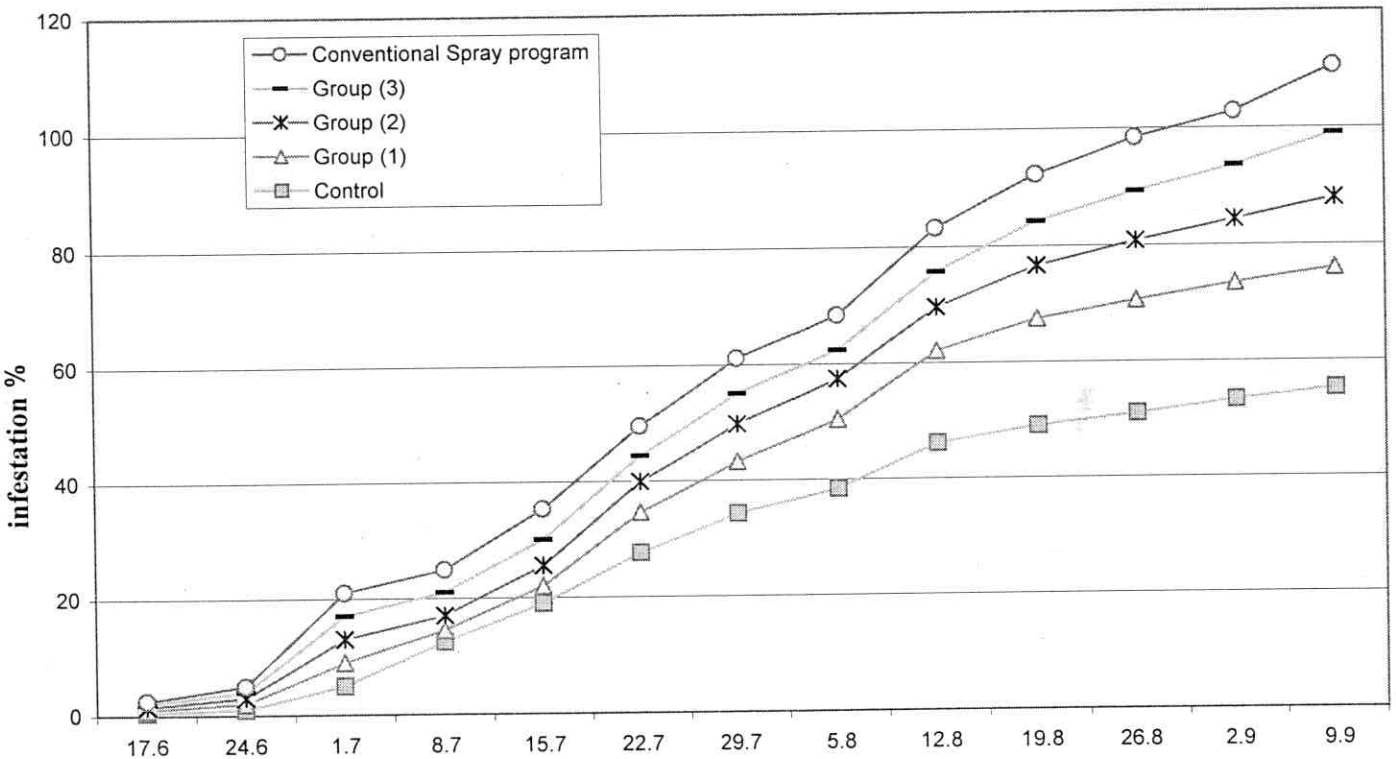


Fig (31): Effect of tested agrochemicals on % infestation by pink bollworm during 2006 season.

The percent reduction in infestation percent than the untreated ones reached 62.5, 76.5, 80.0 and 76.1 % in case of G (1), G (2), G (3) and conventional program, respectively.

As for the agrochemical spray - insect infestation relationship, data in Table (27) and Fig (32) indicated moderate reduction in pink bollworm infestation after the 1st spray than untreated check. The reduction percent reached 80.0, 75.0, 60.0 and 62.00 % with G (1), G (2), G (3) and conventional spray one week after spray, respectively. The corresponding values of infestation reduction were 81.0, 77.0, 69.0 and 70.0 % after two weeks from the 1st spray with the same agrochemicals schemes, respectively. The reduction of infestation two weeks after the 2nd sprays reached 67.0, 77.0, 81.0 and 78.0 %, respectively. Two weeks after the 3rd spray with the same compounds, the reduction percentages in pink bollworm infestation than control were 57.0, 80.0, 84.0 and 82.0 %, respectively.

The reduction in pink bollworm infestation by agrochemical sprays was reported by many investigators in Egypt and other countries. **Lohar and Nahyoon (1995)** evaluated the comparative effectiveness of three insecticides against cotton bollworms (mainly *Earias insulana, E. vittella* and *Pectinophora gossypiella*) at Sindh Agriculture University, Tandojam, Pakistan. Results indicated that the insecticide Hostathion [triazophos] caused maximum percentage reduction in population of bollworms, followed by Sumicidin [fenvalerate] and Sevin [carbaryl]. All the insecticides showed their highest efficacy against the three species of bollworms and resulted in significantly increased yields. Also, **Mahar et al., (2004)**

Table (27): Effect of tested agrochemicals on the percentage of reduction in infestation by pink bollworm during 2006 cotton season.

Treatments / Dates	Group (1)	Group (2)	Group (3)	Conventional Spray program
8/7	80.0	75.0	60.0	62
15/7	81.0	77.0	69.0	70
22/7	69.0	76.0	80.0	76
29/7	67.0	77.0	81.0	78
5/8	61.0	78.0	84.0	80
12/8	57.0	80.0	84.0	82
19/8	53.0	77.0	80.0	81
26/8	52.0	75.0	87.0	80
2/9	53.0	75.0	79.0	78
9/9	53.0	73.0	75.0	74
Mean	62.5	76.5	80.0	76.1

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3= Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

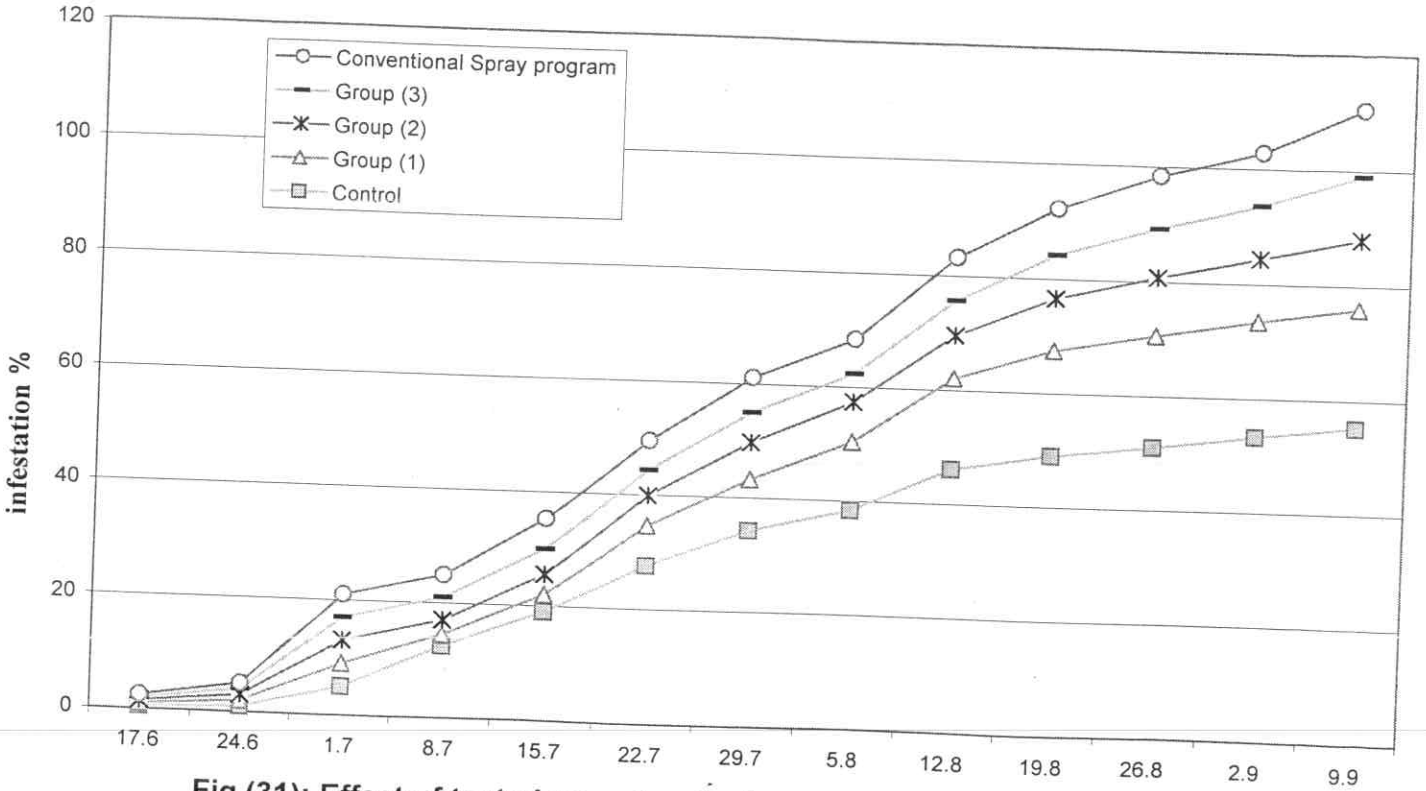


Fig (31): Effect of tested agrochemicals on % infestation by pink bollworm during 2006 season.

evaluated the three insecticides; fenpropathrin (Danitol 10EC), chlorpyrifos (Lorsban 40EC) and endosulfan (Thiodan 35EC) against cotton bollworm *Earias insulana* in Pakistan. Applications of the three insecticides were applied based on the threshold of spotted bollworms population. All three insecticides were effective against the spotted bollworm larvae. However, the maximum effectiveness was observed upon treatment with Danitol, followed by Lorsban and Thiodan treatments in one week. However, Lorsban exhibited effectiveness up to three weeks. The yield data showed a highly significant effect of insecticides. Also, **Hamed *et al.*, (2006)** reported that the efficacies of different insecticide mixtures belonging to different groups, i.e. Decis [deltamethrin] 2.5EC+Thiodan [endosulfan] 35EC, Decis 2.5EC+ Curacron [profenofos] 500EC, Decis 2.5EC+ Somialfa 110EC, Decis 2.5EC+Advantage [carbofuran] 20EC, Thiodan 35EC+Curacron 500EC and Thiodan 35EC+Somialfa 110EC were recorded using their field recommended doses against *H. armigera*. The percentage mortality was determined to compare the efficacy of mixtures and their probability of synergism. The organophosphates in combination with pyrethroids exhibited an enhanced toxicity showing the high probability of synergistic effects. Significantly high toxicity was shown by Decis 2.5EC+Curacron 500EC which caused 100% mortality to the insect followed by thiodan 35EC+Somialfa 110EC causing 83.3% mortality after 72 h of exposure. These findings on insecticide mixtures could serve as useful tool in the management of insecticide resistance.

1.1.2. Larval content:

Data in Table (28) and Fig (33) indicated the superior role of tested agrochemicals spray schemes in protecting cotton bolls from the attack by the pink bollworm. The count of larvae/100 bolls was 6.0 in untreated plots before the second spray. It is evident to notice the fluctuated increase in larval content by the progression of the growing season. Such finding was pronounced in untreated as well as treated plots. The seasonal mean number of larvae/100 bolls within the season reached 40.0 /100 bolls (untreated); opposed to 17.1, 10.6, 10.3, and 10.6 larvae in case of G1, G2, G3 and conventional spray program, respectively. The highest larval content in untreated bolls was recorded during the 2nd week of September (72.0 %). The same trend of results was obtained with G1 (36.00 %), G2 (22.0 %), G3 (17.0 %) and 19.8 % for conventional spray program.

Such findings are in accordance with the results obtained by **Lu-Zhengsong *et al.*, (1999)** who found that treated cotton plants with EM (effective microorganisms) preparations, 10 genera of bacteria (photosynthetic bacteria and lactic acid bacteria) and fungi (Actinomyces), showed decrease in numbers of bollworms than untreated plant. **Salem (2002)** recorded that chemical insecticide (Herculis) and foliar fertilizer (Mikrofol) decreased the infestation precent and number of pink bollworms, but Herculis showed highest efficacy in reducting the infestation and larval content in green cotton bolls.

Table (28):Effect of tested agrochemicals on numbers of pink bollworm larvae/100 cotton bolls during 2006 cotton season.

Treatments / Dates	Control	Group (1)	Group (2)	Group (3)	Conventional Spray Program
17/6 1st spray	0.5	0.5	0.5	0.5	0.5
24/6	1.0	1.0	1.0	1.0	1.0
1/7 2nd spray	6.0	5.0	5.0	5.0	5.0
8/7	19.0	5.0	4.0	7.0	6.0
15/7 3rd spray	29.0	7.0	5.0	9.0	7.2
22/7	38.0	10.0	7.0	10.0	9.0
29/7 4th spray	38.0	14.0	9.0	11.0	11.3
5/8	51.0	19.0	13.0	12.0	13.5
12/8	62.0	28.0	15.0	14.0	14.0
19/8	65.0	30.0	17.0	15.0	16.0
26/8	68.0	33.0	19.0	15.0	17.2
2/9	69.0	34.0	20.0	17.0	18.5
9/9	72.0	36.0	22.0	17.0	19.8
Mean	40.0	17.1	10.6	10.3	10.6

L.S.D. at (0.05%) between treatments = 0.72

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3 Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

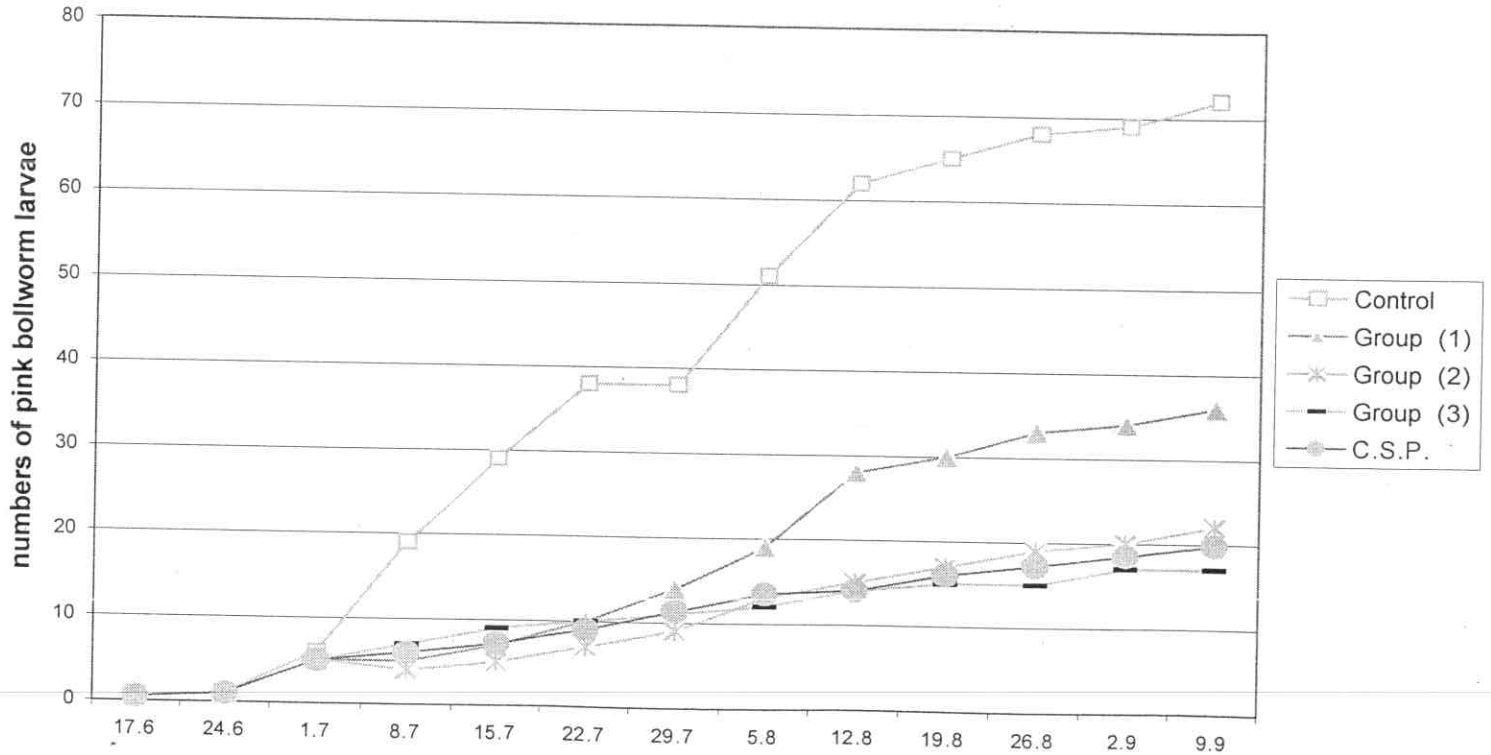


Fig (33): Effect of tested agrochemical on numbers of pink bollworm larvae /100 cotton bolls during 2006 season .

1.2. Spiny bollworm, *E. insulana*

1. 2.1. Infestation of cotton bolls

Data in Table (29) and Fig (34) indicated significant differences in infestation percent of cotton bolls by the spiny bollworm during 2006 between treatments. Infestation of bolls showed fluctuated values by the time elapsed from treatment as well as with untreated check. Pre treatment count of infested cotton bolls was 4.0 % as average in the experimental area. Untreated plots showed great increase in infestation % by the extension of the growing season until 2nd week of September. The percentages of infested cotton bolls of the untreated check during the successive inspections reached 0.4, 0.8, 4.0, 9.2, 17.0, 27.2, 38.2, 41.5, 45.5, 50.5, 54.0, 57.2 and 61.1 %, respectively. The same trend of results was obtained with tested chemical treatments, but in lower values than the untreated check. The mean percent of infested bolls reached 31.30 % (untreated check), 12.30, 8.72, 6.30 and 8.01 in case of G1, G2, G3 and conventional spray program, respectively.

Data concerning the reduction percentages in bolls infestation are tabulated in Table (30) and Fig. (35). It showed the same trend of results as for the infestation percent. The seasonal mean reduction percentages in infestation of bolls reached 60.7, 72.1, 79.9 and 74.4 % in case of G1, G2, G3 and conventional spray program, respectively. In terms of figures, the reduction in spiny bollworm infestation than the untreated check reached 57.0, 57.0, 43.0 and 57.0 % (1st week after 2nd spray); 60.0, 65.0, 61.0 and 77.0 % (2nd week after 2nd spray); 59.0, 72.0, 69.0 and 75.0 % (1st week after 3rd spray); 51.0,

Table (29): Effect of tested agrochemicals on % infestation by spiny bollworm during 2006 cotton season.

Treatments / Dates	Control	Group (1)	Group (2)	Group (3)	Conventional Spray program
17/6 1st spray	0.4	0.4	0.4	0.4	0.4
24/6	0.8	0.8	0.8	0.8	0.8
1/7 2nd spray	4.0	3.0	3.0	3.0	3.0
8/7	9.2	3.0	3.0	4.0	3.0
15/7 3rd spray	17.0	5.1	4.5	5.0	5.2
22/7	27.2	8.0	5.9	6.5	5.9
29/7 4th spray	38.2	9.1	8.1	7.4	8.5
5/8	41.5	10.0	9.5	8.3	9.0
12/8	45.5	12.9	11.5	8.8	11.2
19/8	50.5	19.2	13.5	9.5	12.5
26/8	54.0	26.8	16.6	10.3	14.2
2/9	57.2	30.5	17.1	10.9	14.6
9/9	61.1	30.9	19.5	11.3	15.1
Mean	31.30	12.30	8.72	6.30	8.01

L.S.D. at (0.05%) between treatments = 0.81

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3= Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

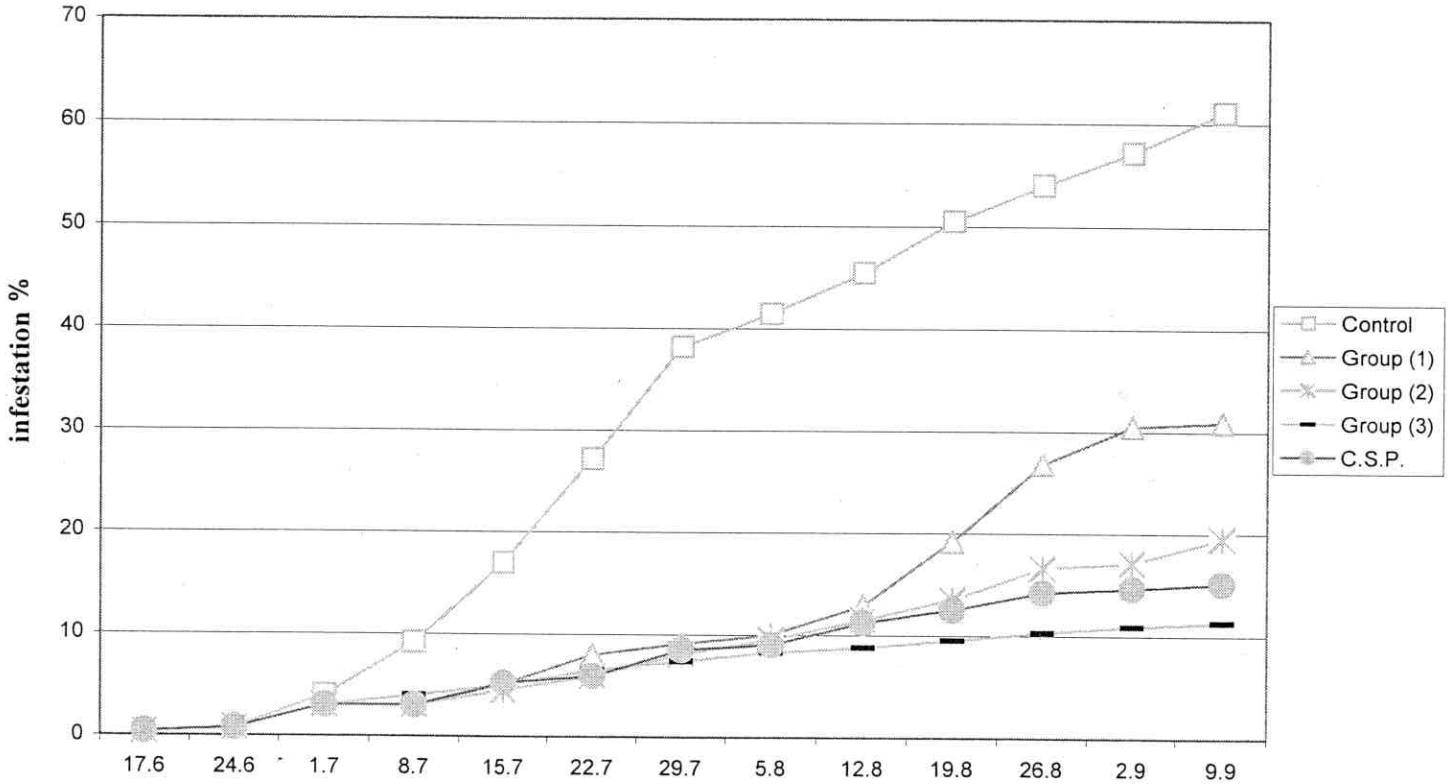


Fig (34): Effect of tested agrochemicals on % infestation by spiny bollworm during 2006 season.

Table (30): Effect of tested agrochemicals on the reduction percentages in infestation by spiny bollworm during 2006 cotton season.

Treatments / Dates	Group (1)	Group (2)	Group (3)	Conventional Spray program
8/7	57.0	57.0	43.0	57.0
15/7	60.0	65.0	61.0	77.0
22/7	59.0	72.0	69.0	75.0
29/7	51.0	72.0	75.0	79.0
5/8	68.0	70.0	74.0	73.0
12/8	63.0	67.0	75.0	70.0
19/8	50.0	65.0	75.0	71.0
26/8	34.0	61.0	75.0	70.0
2/9	30.0	61.0	75.0	67.0
9/9	33.0	58.0	76.0	64.0
Mean	60.7	72.1	79.9	74.4

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3= Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

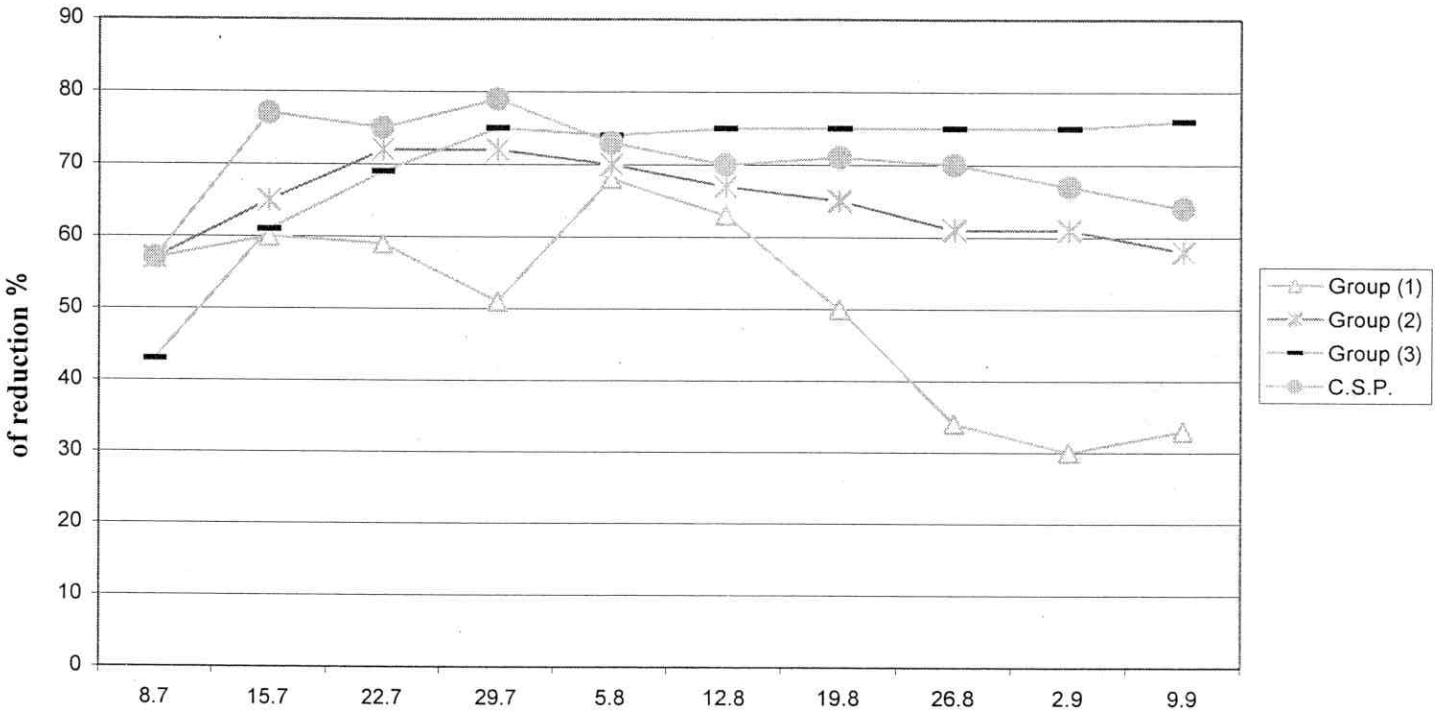


Fig (35):): Effect of tested agrochemicals on the percentage of reduction in infestation by spiny bollworm during 2006 season.

72.0, 75.0 and 79.0 % (2nd week after 3rd spray); 68.0, 70.0, 74.0 and 73.0 % (1st week, 4th spray) and 63.0, 67.0, 75.0 and 70.0 % (2nd week after 4th spray) in case of G1, G2, G3 and Conventional Spray Program, respectively.

Such results are in harmony with those obtained by several researchers; **Dhawan *et al.*, (1990)** studied the effectiveness of synthetic pyrethroid insecticide sprays with organophosphorus insecticide sprays to control *Pectinophora gossypiella, Earias insulana* and *E. vittella* on the cotton varieties F 414. Alternate spraying with organophosphorus and pyrethroid insecticides at10- to 15-day intervals reduced damage and increased productivity by the same level as that obtained by giving alternate sprays of organophosphorus and pyrethroid insecticides at 10-day intervals. **El-Gemeiy *et al.*, (1999)** studied the effectiveness of isometaphos (0.98, 1.95, 3.91, 7.81, 15.62 and 31.25%) and Ecotech-Pro (*Bacillus thuringiensis* subsp. *kurstaki*) in controlling *Pectinophora gossypiella* and *Earias insulana* in laboratory and field experiments conducted in Egypt during 1997-98. In field experiments, Ecotech-Pro was tested at 1 and 2 kg. Ecotech recorded lower LC50 values compared to isometaphos for both insect species, with the LC50 values being lower for *E. insulana*. A 100% reduction in the population of first instar larvae of *P. gossypiella* treated with 1 and 2 kg Ecotech-Pro, whereas a 75% reduction in the population of the pest was observed during 1997. The insecticide was more toxic to the first than the fourth instar larvae of both pests during both years. Also, **Jai-Singh and Sandhu (1995)** conducted field experiments in Ludhiana, Indian Punjab, India, during 1991-93

to study the control of *Earias vittella, E. insulana* and *Pectinophora gossypiella* based on infestation level in fruiting bodies of *Gossypium arboreum*. Fenvalerate (50 g a.i./ha) alternated with quinalphos (0.5 kg i.e. /ha) was used in all the treatments. Six sprays of these insecticides (given at 10-day intervals starting from squaring on 25% plants until 2 weeks before the 1st picking) controlled pests most efficiently and gave the highest seed cotton yield (1718 kg/ha) and net income (375 kg /ha). Applying insecticide sprays when the pest population was at 5% on freshly shed fruiting-bodies (5 sprays) was the 2nd most effective treatment. Sprays applied at two larvae /plant and 10% incidence on intact fruiting-bodies had little effect.

1.2.2. Larval content

Data in Table (31) and Fig. (36) indicated a pronounced role of the tested agrochemical spray schemes in protecting cotton bolls from the attack by the spiny bollworm. The pre spray count of larvae/100 bolls was 0.4 in untreated plots. It is evident to notice the fluctuated increase in larval content by the progression of the growing season. Such finding was evident in untreated as well as treated plots. The mean number of larvae/100 bolls within the season reached 42.0 % (untreated) and 21.7, 13.3, 12.6 and 12.8 % in case of G1, G2, G3 and conventional spray program, respectively. The highest larval content in untreated bolls was recorded during the 2nd week of September (81.3 %). The same trend of results was obtained with G1 (48.00 %), G2 (31.0 %), G3 (24.5 %) and 26.5 % for conventional spray program.

Table (31): Effect of tested agrochemicals on numbers of spiny bollworm larvae/100 cotton bolls during 2006, season.

Treatments / Dates	Control	Group (1)	Group (2)	Group (3)	Conventional Spray program
17/6 1st spray	0.4	0.4	0.4	0.4	0.4
24/6	0.8	0.8	0.8	0.8	0.8
1/7 2nd spray	5.0	3.0	3.0	3.0	3.0
8/7	12.0	4.0	4.0	5.0	5.0
15/7 3rd spray	23.0	9.0	7.0	8.0	7.5
22/7	35.0	12.0	10.0	11.0	9.8
29/7 4th spray	42.5	15.0	11.0	15.0	11.3
5/8	55.6	22.0	16.0	16.0	14.0
12/8	65.5	37.0	19.0	18.0	17.6
19/8	70.4	41.0	22.0	20.0	21.1
26/8	75.5	45.0	24.0	21.0	23.6
2/9	77.5	45.2	28.0	22.0	24.8
9/9	81.3	48.0	31.0	24.5	26.5
Mean	42.0	21.7	13.3	12.6	12.8

L.S.D. at (0.5) between treatments = 0.90

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3 Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

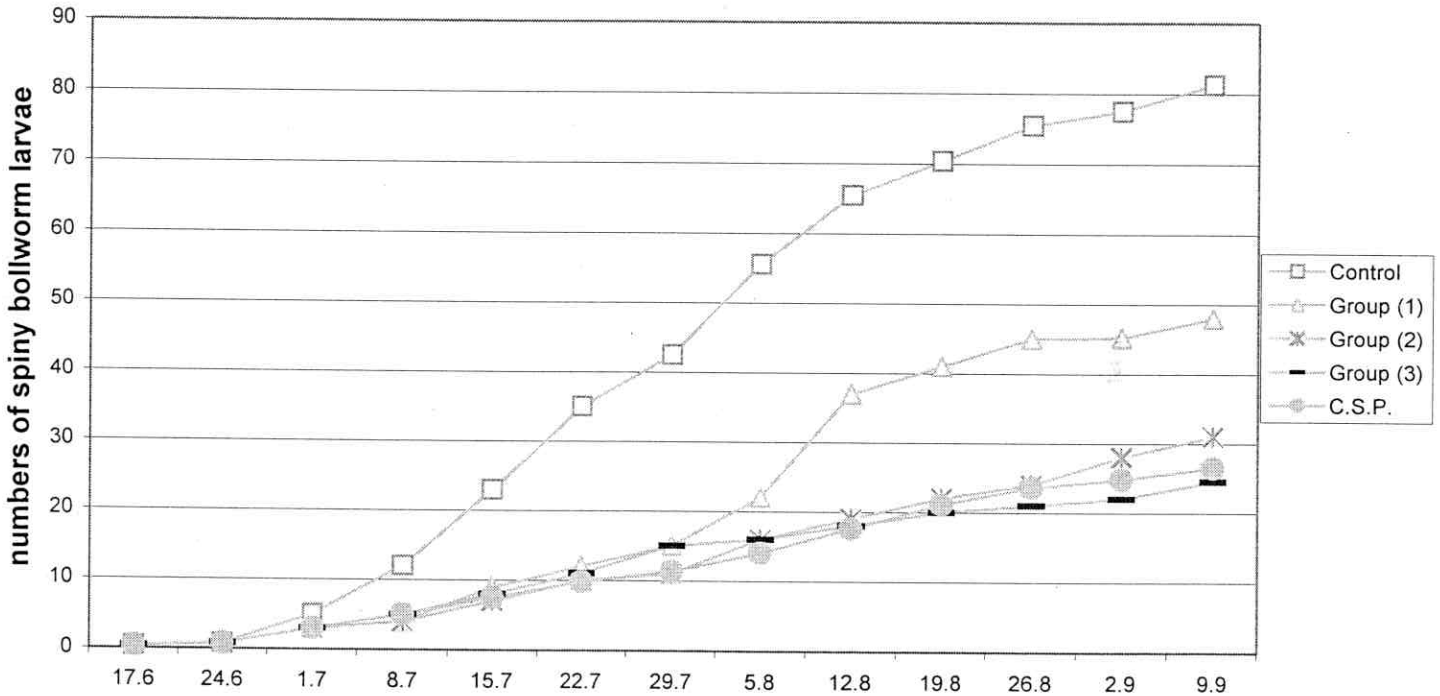


Fig (36): Effect of tested agrochemicals on numbers of spiny bollworm larvae/100 cotton bolls during 2006, season.

Reviewing the afore-mentioned results, it could be concluded the satisfactory control of both pink and spiny bollworms in fisting green cotton bolls by using the soft fertilizer/insecticide sequential spray programmes. The applied schemes indicated that G3 (Mikrofol, Mikrofol, Pleo and Pleo) showed better reduction in bollworms infestation and population reduction.

Effects of tested agrochemicals on bolls' opening, seeded cotton yield and lint properties of cotton during 2006 season.

Data concerning the effect of the tested agrochemicals regimes, i.e. G (1) (Mikrofol, Pleo, Mikrofol and Mikrofol), G (2) (Mikrofol, Pleo, Mikrofol and Pleo), G (3) (Mikrofol, Mikrofol, Pleo and Pleo) in comparison with the conventional spray program on boll opening, yield of seeded cotton, major nutrients (N, P, K and carbohydrate), allelochemicals (indoles & phenols) and photosynthetic pigments (chl.a, b and carotenoids) of cotton plants during the 2006 season are tabulated in Tables (32 to 35) and illustrated in Figs. (37 to 41). Examination of the obtained results indicated the important role of studied factors, i.e. agrochemical type, post treatment interval and cotton season in determining cotton productivity and bolls characters as well as biochemical components. To facilitate the presentation of data, each of the studied characters will be discussed separately as follows:

1. Opening of cotton bolls:

Data in Table (32) and Fig. (37) indicated the significant increase in bolls opening due to the treatments of G (1), G (2) and G (3) than the untreated check and conventional spray program. Such increase was pronounced during the 2006 cotton season, showing the mean percentage of opened bolls reached 38.1 (G1), 37.5 (G2) and 40.8 % (G3). The untreated check and Conventional Spray Program recorded 35.1 % and 35.3 % opened bolls, respectively.

The present findings agree with those obtained by several researchers; **Bishara (1968)** indicated that adding super phosphate before nitrates tend to cause a slight earliness in the bolling curve and a slight reduction in bollworm attack. **EL-Nawawy et al., (1983)** in Egypt, revealed that the foliar fertilizers Iral, Stemifol, Complesal and Bayfolan gave good protection of cotton bolls and also increase the numbers of bolls ripening and opening simultaneously. Also, **Salem (2002)** in Egypt, recorded that foliar fertilizer (Mikrofol) increased the number of opening bolls than the untreated check, chemical insecticide and plant extraction.

2. Yield of seed cotton:

Data in Table (33) and Fig. (38) indicated the significant role of tested agrochemicals in increasing the yield of seeded cotton than the untreated check. Such effects were pronounced within the 2006 season. In terms of figures, the cotton yield reached 1123.75 kg/fed (untreated check), 1710.0 kg/fed (G1), 2150.5 kg/fed (G2), 2188.0 kg/fed (G3) and 1805.5 kg/fed

Table (32): Effect of tested agrochemicals on opened bolls percent during 2006 cotton season.

Treatments / Dates	Control	G (1)	G (2)	G (3)	C.S. Program
29/7	0.8	0.9	0.9	1.4	0.9
5/8	5.3	5.5	5.6	6	5.5
12/8	14	15.8	15.5	17.0	14.3
19/8	24	26.2	26.0	28.4	24.5
26/8	34.7	37.5	36.1	40.5	34.5
2/9	55.3	59.5	58.6	63.2	55.0
9/9	68.5	75.3	74.5	81.0	68.9
16/9	78.5	83.5	82.7	88.4	78.6
Mean	35.1	38.1	37.5	40.8	35.3

L.S.D. at (0.5 %) between treatments = 1.9

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3 Mikrofol, Mikrofol, Pleo and Pleo

C.S. Program= Pestpan, Sumi-gold, Teleton and Pestpan

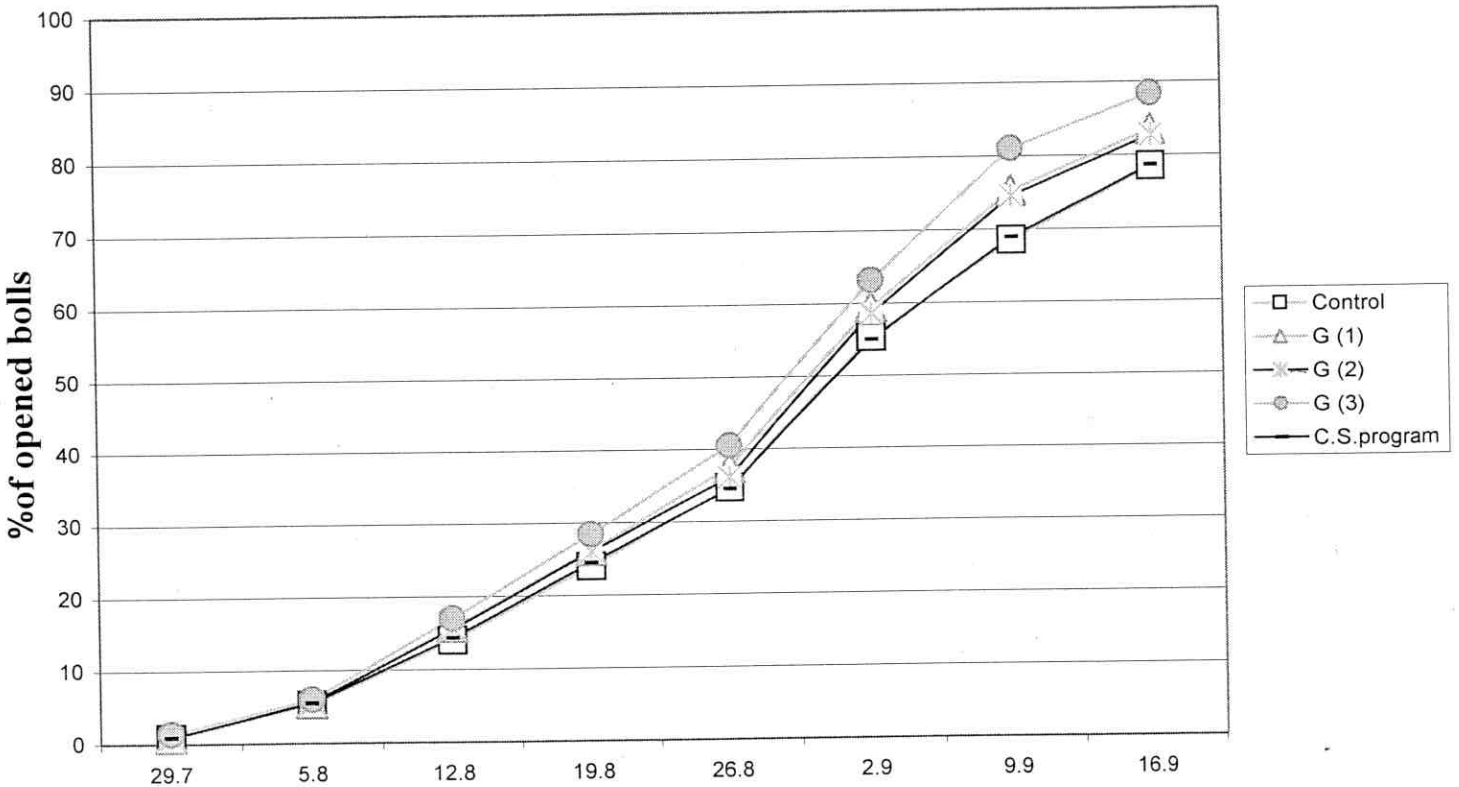


Fig (37): Effect of tested agrochemicals on percentage of opened bolls during 2006 season.

Table (33): Effect of tested agrochemicals on seeded cotton yield during 2006 season.

Seed cotton yield	Control	G (1)	G (2)	G (3)	C.S. Program
Production in kg/fed	1123.75	1710.0	2150.5	2188.0	1805.5
Increase % than control	-	52.1	91.3	94.7	60.7

L.S.D. at (0.5 %) between treatments = 90.5

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3 Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

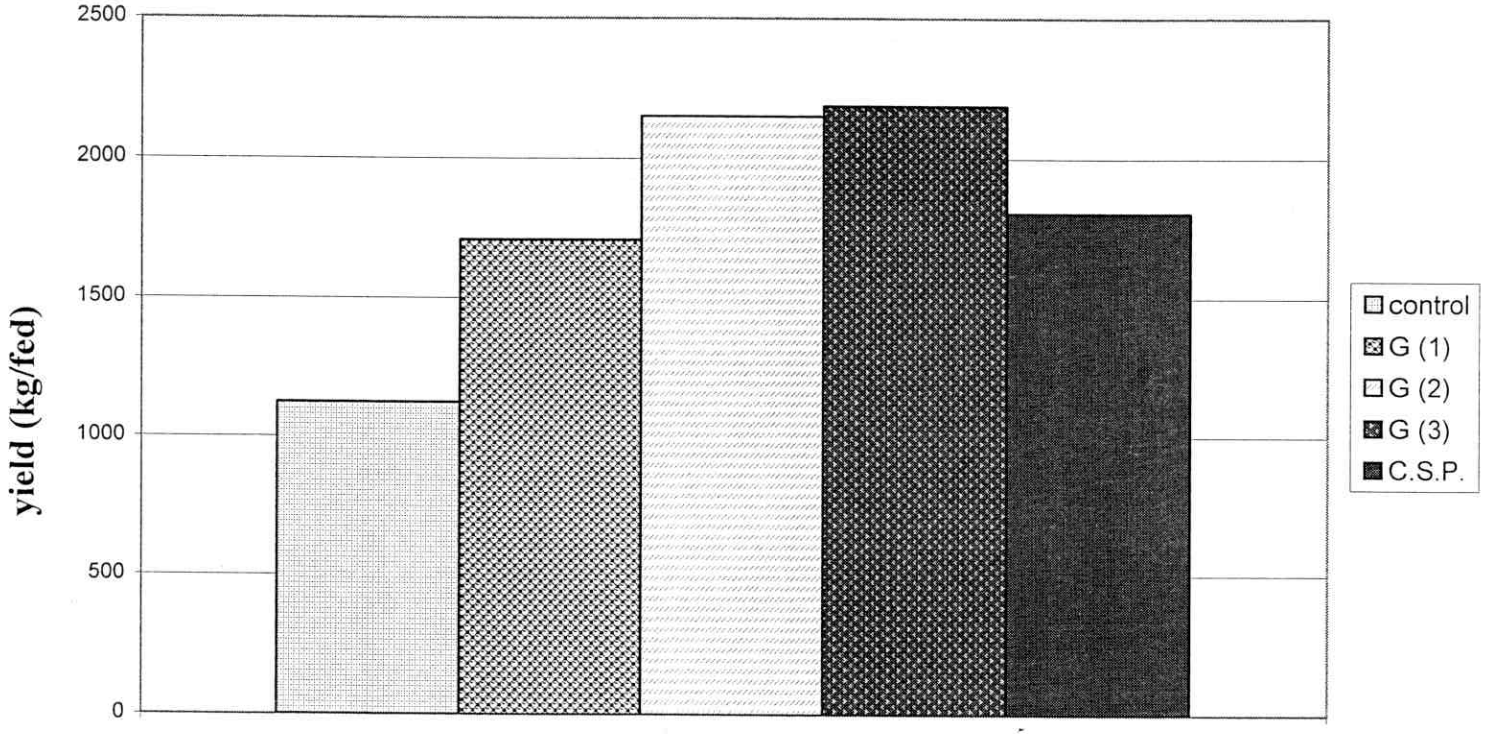


Fig (38): Effect of tested agrochemicals on seeded cotton production during 2006 season.

(Conventional Spray Program). The increase percent in seed cotton than the untreated check reached 52.1, 91.3, 94.7 and 60.7 % by applying G1, G2, G3 and Conventional spray program treatments, respectively. Such results are in accordance with those obtained by **Gupta *et al.* (1996)** who used *Bacillus thuringiensis* formulations and their combinations with synthetic insecticides against cotton bollworms, *P.gossypiella*, *E.insula* and *H.armigera*. The application of neem or *Bacillus thuringiensis* in a 4-sprays schedule gave effective control and increase in cotton yield. **Mahar et al., (2004)** evaluated the three insecticides fenpropathrin, chlorpyrifos (Lorsban 40EC) and endosulfan (Thiodan 35EC) against cotton bollworm *E. insulana* and *E. vitella*. Insecticidal applications were based on the threshold of spotted bollworms population. All three insecticides were effective against the spotted bollworm larvae. However, the maximum effectiveness was observed upon treatment with Danitol, followed by Lorsban and Thiodan treatments in one week. However, Lorsban exhibited effectiveness up to three weeks. The yield data showed a highly significant effect of insecticides.

3. Major nutrients and carbohydrates content in cotton bolls:

Data in Table (34) and Fig. (39) indicated the significant role of the tested agrochemical regimes in increasing the nitrogen content in bolls than the untreated check. The nitrogen percentages were 1.09 (untreated check); 3.32, 2.1, 2.88 and 1.42 % in cases of G1, G2, G3 and Conventional Spray Program, respectively. Phosphorous content increased also by the tested agrochemical regimes than the untreated check. The

Table (34): Effect of tested agrochemical compounds on N, P, K and carbohydrate content bolls during 2006, season.

	N%	P%	K%	Carbohydrates
Control	1.09	0.62	1.47	9.06
G (1)	3.32	0.81	3.0	17.0
G (2)	2.1	0.72	2.2	11.6
G (3)	2.88	0.74	2.76	14.6
C.S. Program	1.42	0.59	1.81	10.1

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3 Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

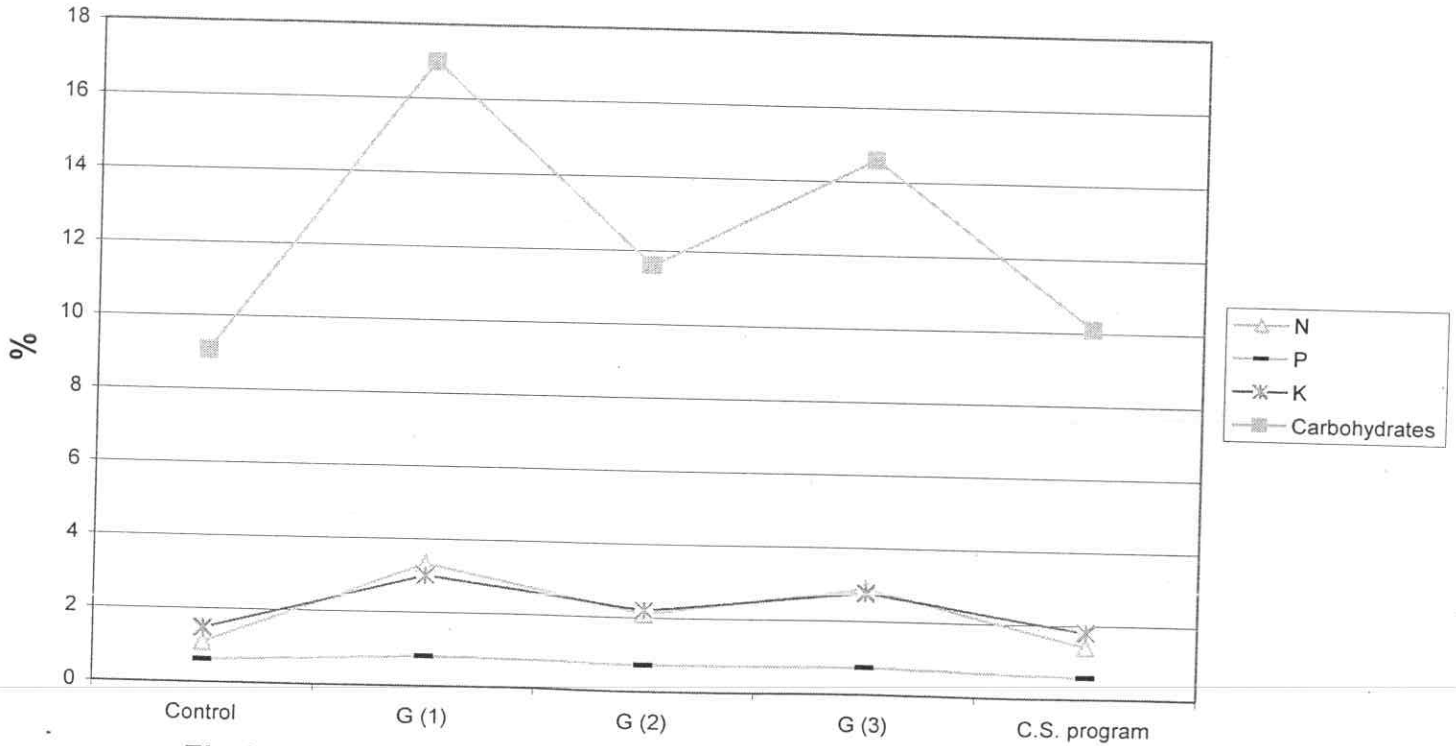


Fig (39): Effect of tested agrochemicals compound on the cotton bolls' comonents during 2006, season.

phosphorous percentage reached 0.62 (untreated check); 0.81, 0.72, 0.74 and 0.59 % in case of G1, G2, G3 and Conventional spray programs, respectively. Data also showed the significant increase in potassium content in bolls treated with G1, G2 and G3 spray regimes, while Conventional spray program showed insignificant changes in potassium content than the normal level. Potassium content reached 1.47, 3.0, 2.2, 2.76 and 1.81 % in case of untreated check, G1, G2, G3 and Conventional spray program, respectively.

As for carbohydrates content in cotton bolls, data in the same table indicate the significant increase in the amount of this biochemical component by application of G1, G2 and G3 treatments, while Conventional spray program showed insignificant role in this respect. The carbohydrate content reached 9.6 (untreated check), opposed to 17.0, 11.6, 14.6 and 10.1 % in case of G1, G2, G3 and Conventional spray programs, respectively.

As conclusion, data clearly indicated the significant role of G1, G2 and G3 spray program in increasing N, P, K and carbohydrate contents in cotton bolls than the normal levels. Such findings agree with **Salem (2002)** who showed significant increase in total carbohydrate and proteins in cotton bolls when the cotton plants were treated by Mikrosol (foliar fertilizer) than chemical insecticide, Herculis.

4. Effect of tested agrochemical regimes on total indoles, phenols and photosynthetic pigments of cotton bolls:

Data in Table (35) and Fig. (40) indicated the significant increase in total indoles of cotton bolls treated with the tested agrochemicals than the untreated check except conventional spray program, which showed insignificant increase in total indols. The total indoles reached 160.0 mg/100 g.f.w. (untreated check); while those were 342.0, 241.0, 272.0 and 199.0 mg/100 g.f.w. in case of G1, G2, G3 and Conventional spray programs, respectively. The percent increase than the untreated check were 113.0, 50.6, 70.0 and 24.0 % with the same treatments, respectively. Total phenols increased significantly with tested agrochemicals than the untreated check. The total phenols reached 158.0 mg/100 g.f.w. (untreated check) and 193.0, 234.0, 240.0 and 221 mg/100 g.f.w. The percent increase in total phenols than the check reached 22.15, 48.10, 51.89 and 39.87 % with G1, G2, G3 and Conventional spray programs, respectively.

The role of agrochemicals (including pesticides) on indoles and phenol contents in cotton bolls was extensively studied and proved by many investigators, **Paech and Tracey (1955)** found that alkaloids, even in very small amount, have physiological effects on living organisms. Alkaloids are widely distributing in plant families such as legumes and Solanaceae, they contain toxic substance which protect plants from insects attack. **Hango and Uthamasamy (1989)** found that total phenols content was decreased with an increase in boll age in both entries, declining from 0.98 to 0.42 mg/g in JK260 and from 0.80 to 0.31 mg/g in Sharada. Gossypol content, which is known

Table (35):Effect of tested agrochemical regimes on the total indoles, phenols, chl.a & b and carotenoids of cotton bolls during 2006 cotton season.

Treatments	Total Indoles Mg/100 g f.w	Total phenoles Mg/100 g f.w	Chl.a Mg/100 g f.w	Chl.b Mg/100 g f.w	Carotenoids
Control	160.0	158.0	200.0	193.0	181.0
G (1)	342.0	193.0	339.0	289.0	249.0
G (2)	241.0	234.0	301.0	250.0	200.0
G (3)	272.0	240.0	311.0	261.0	209.0
C.S. Program	199.0	221.0	212.0	193.7	184.0

G1= Mikrofol, Pleo, Mikrofol and Mikrofol

G2= Mikrofol, Pleo, Mikrofol and Pleo

G3 Mikrofol, Mikrofol, Pleo and Pleo

C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

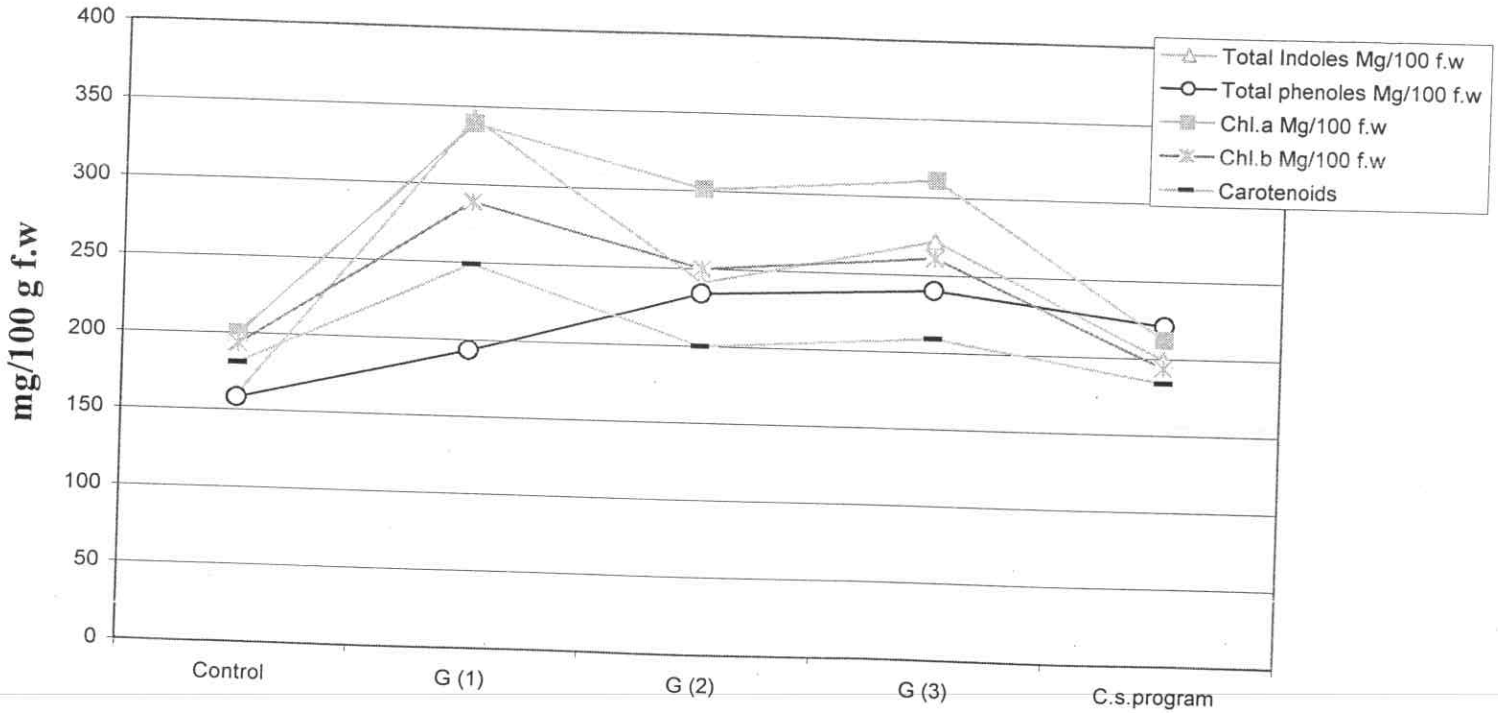


Fig (40): Effect of tested agrochemical compounds on the total indoles, phenols, chl.a & b and carotenoids during 2006 cotton season.

to be deleterious to bollworms, declined with boll age in both entries but was consistently higher in JK260. This, together with the higher total phenol and crude fiber contents, is thought to contribute to the greater resistance of JK260. **Kim and Oosterhuis (1998)** demonstrated that bollworm and boll weevil damage to developing cotton (*Gossypium hirsutum*) bolls declines dramatically at approximately 350 heat units after flower fertilization. Use was made of this phenomenon for timing the cessation of insecticide application to the cotton crop; a study was designed to explain this phenomenon by investigating physical, anatomical and biochemical changes in the capsule wall in relation to boll age and insect feeding. The effect of plant growth regulators, PIX and PCR-IV, on the development of the boll wall was also investigated. The greatest change in resistance to penetration occurred at 350 heat units. Light and electron microscopy showed massive lignifications of the endocarp cells of the boll wall at about 350 heat units which may be related to resistance to insect feeding. This study helps to explain the decline in attractiveness of the cotton boll with age to *H. zea* and *A. grandis*, and insecticidal application can be terminated at this stage.

Data in Table (35) indicated, also, the occurrence of different influences on the photosynthetic pigments, chl.a and chl.b in cotton bolls by the assayed agrochemicals. G1, G2 and G3 caused significant increases in these pigments, while conventional spray program treatments showed insignificant differences in chl.a and chl.b than the untreated check. In terms of figures, the chl.a contents were changed from 200.0 mg/100

g.f.w. (untreated check) to 339.0 mg/100 g.f.w. (G1), 301.0 mg/100 g.f.w. weight (G2), 311.0 and 212.0 mg/100 g.f.w. by application of G3 and conventional spray programs, respectively. The percentages of increase in chl.a content after agrochemical treatments than the check were 69.5, 50.5, 55.5 and 6.0 % in case of G1, G2, G3 and conventional spray programs, respectively. The same trend of results was recorded with chl.b, showing the amounts of 193.0 (untreated check), 289.0 mg/100 g.f.w. (G1), 250.0 mg/100 g.f.w. (G2), 261.0 mg/100 g.f.w. (G3) and 193.7 mg/100 g.f.w. (Conventional Spray Program). The increase percentages in chl.b content after agrochemical treatments than the check were 49.7, 29.5, 35.2 and 0.3 % in case of G1, G2, G3 and conventional spray program, respectively.

Data, also, indicated the significant role of tested agrochemicals regimes (G1, G2 and G3) in increasing the carotenoids content in cotton bolls, while conventional spray program treatments showed insignificant differences than the untreated check. Carotenoids content changed from 181.0 mg/100 g.f.w. (untreated check) to 249.0, 200.0, 209.0 and 184 mg/100 g.f.w. after G1, G2, G3 and Conventional Spray Program treatments, respectively. The increase percentages in carotenoids content by agrochemical treatments than the check reached 37.5, 10.4, 15.4 and 1.6 % with the same mentioned treatments, respectively.

5. Effect of tested agrochemical regimes on cotton fiber quality:

Data in Table (36) and Fig. (41) indicated the insignificant influences of the tested agrochemicals on the fiber quality of

Table (36): Effect of different agrochemicals on certain cotton fiber quality parameters during 2006, season.

	Fiber length parameters				Fiber bundle tensile			
	Upper half mean		Uniformity index %		Fiber strength g/tex.		Fiber elongation	
	values	% increase	values	% increase	values	% increase	values	% increase
Control	27.9	-	84.2	-	28.0	-	5.6	-
G (1)	29.0	3.9	85.4	1.43	29.5	5.4	6.2	10.7
G (2)	28.6	2.5	84.9	0.83	29.1	3.9	6.1	8.9
G (3)	28.9	3.5	85.1	1.06	29.4	5.0	6.2	10.7
C.S. Program	28.0	0.4	84.3	0.11	28.0	0.0	5.6	0.0

G1= Mikrofol, Pleo, Mikrofol and Mikrofol
G2= Mikrofol, Pleo, Mikrofol and Pleo
G3 Mikrofol, Mikrofol, Pleo and Pleo
C.S.Program= Pestpan, Sumi-gold, Teleton and Pestpan

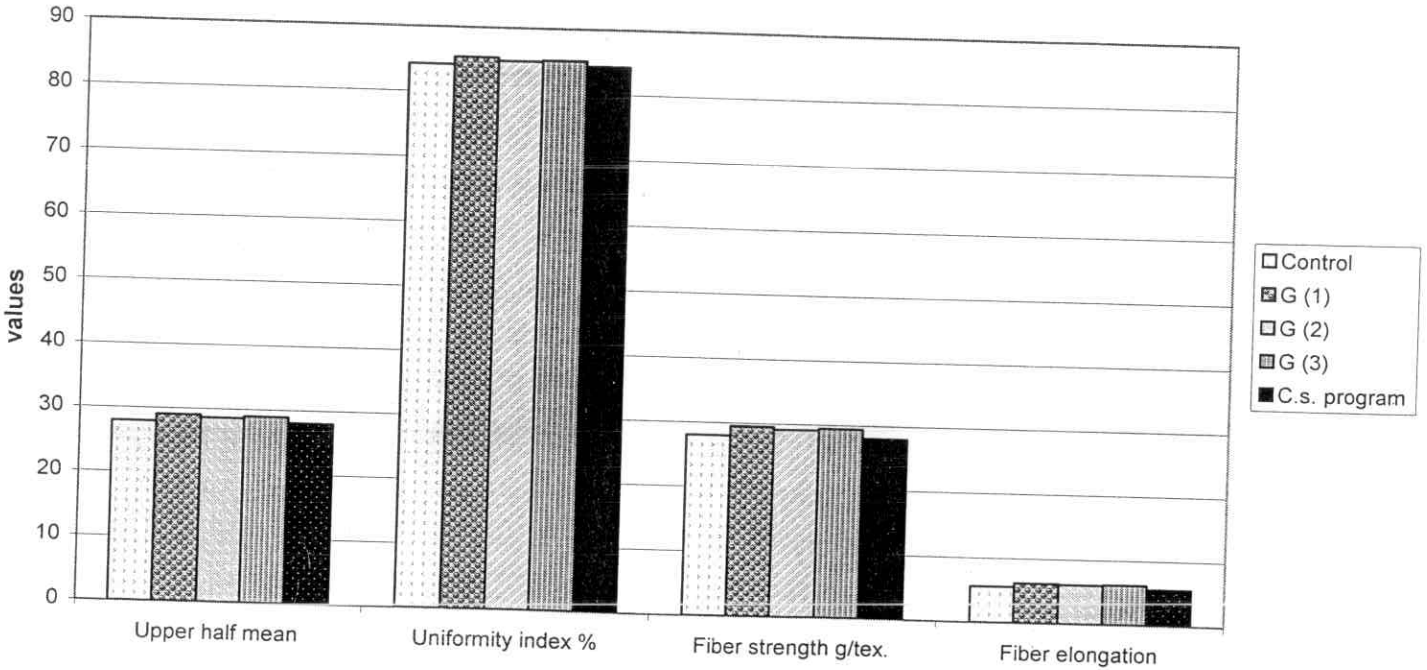


Fig (41): Effect of different agrochemicals on certain cotton fiber quality parameters during 2006, season.

cotton lint compared with the untreated check. In terms of figures, the upper half mean expressed on fiber length parameters changed from 27.9 (untreated check) to 29.0, 28.6, 28.9 and 28.0 with G1, G2, G3 and conventional spray programs, respectively. The percent increase than the check reached 3.9, 2.5, 3.5 and 0.4 %, respectively. The same trend of results was obtained with uniformity index which changed from 84.2 (untreated check), to 85.4, 84.9, 85.1 and 84.3 with the same treatments, respectively. The increase percentages than check reached 1.43, 0.83, 1.06 and 0.11%, respectively. Data in the mentioned table indicated the insignificant influence of the tested agrochemicals on fiber bundle tensile expressed as fiber strength and fiber elongation than the untreated check. In terms of figures, the fiber strength changed from 28.0 g/tex (untreated check) to 29.5, 29.1, 29.4 and 28.0 g/tex in case of G1, G2, G3 and Conventional spray programs, respectively. The same trend of results was recorded with fiber elongation; it changed from 5.6 (untreated check) to 6.2, 6.1, 6.2 and 5.6 with the same mentioned agrochemical treatments, respectively.

On contrary to the persent results, **Butter and Sukhija (1987)** showed that fenvalerate that was applied in sprays at 30-75 g a.i./ha against *P. gossypiella* and *E.insulana* on cotton in the Punjab, India, for 3 consecutive years caused significant reduction in bollworm damage and the highest dosage gave increased yields, but fiber quality was unaffected by treatment.

In agreement with the present results, **Salem (2002)** recorded that foliar fertilizer (Mikrofol) increased the fiber length and fiber strength than the check, chemical insecticide (Herculis) and plant extraction (Neemazal).

Reviewing the aforementioned results, it could be concluded that significant increases in cotton bolls opening occurred by the treatments of G1, G2 and G3 programs compared with the untreated check, while conventional spray program caused insignificant influences in this respect. The tested agrochemicals, greatly, increased the yield of seeded cotton, but in various values depending on the compound /program used. G2 and G3 spray regimes showed higher increase in cotton production compared with the other treatments as well as the untreated check.

The tested agrochemical regimes (G1, G2 and G3) caused significant increases in N.P.K. and carbohydrate content of cotton bolls than the check, while conventional spray program showed, again, insignificant changes than check. The tested agrochemical regimes (G1, G2 and G3) increased, significantly, the total indoles content of cotton bolls than the check, while conventional spray program showed insignificant changes than untreated check.

Data indicated the occurrence of different influences by the tested agrochemical regimes on the detected photosynthetic pigments of green cotton bolls. G1, G2 and G3 treatments caused significant increases of chl.a & chl.b and carotenoids content in green cotton bolls than untreated check, while conventional spray program showed insignificant changes in this respect.

Data, also, indicated the insignificant influences of the tested agrochemical regimes on the fiber quality of cotton expressed as length and fiber bundle tensile parameters.

1. Seasonal abundance of total population of predaceous insect predators in cotton field during 2006 cotton season:

1.1. Total counts of predators in cotton fields:

Sweeping net counting data are tabulated in Tables (37-41) and Figs. (42- 46). Data showed that the total population of insect predators was generally higher in untreated cotton field (467 individuals) compared with treated field.

Regarding, the weekly counts of predators on examined cotton plants, predators were found, in general, in high levels during July and August throughout 2006 cotton season. In untreated cotton field, the high levels were occurred at the 2nd, 3rd and the last weeks of August with 92, 104 and 113 individuals/ 40 double sweep-net strokes, respectively (Table, 37 and Fig. 42). But, in treated cotton field, the population was higher 468, 305, 271 and 227 individuals/ 40 double sweep-net strokes from field treated by G1, G2, G3 and Conventional Spray Program, treatments, respectively, Tables (38-42) and Figs (43-46).

In accordance to present results, **Hafez et al., (1975)** found that the predators appeared in cotton fields during April and reached their peak of abundance during June and July. **Habib et al., (1976)** indicated that most of predators in untreated cotton fields reached their maximum abundance during July and August. **Nasef (1990)** found that the population of total predators fluctuated and recorded three peaks during mid June, half of July and the 2nd half of August. While, **Ali (2003)** indicated that the

Table (37): Counts of insect predators, estimated by insect sweeping net on untreated cotton plants during 2006 cotton season.

Date	*Scymnus spp.*	*Orius spp.*	*P. Alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus Corollae*	Total
1/7	5	5	5	7	6	5	33
8/7	6	7	6	9	8	7	43
15/7	8	8	7	12	9	8	52
22/7	10	11	9	13	10	8	61
29/7	12	13	12	16	10	9	72
5/8	12	14	13	18	11	9	77
12/8	15	16	15	21	14	11	92
19/8	16	18	18	23	15	14	104
26/8	17	20	19	25	17	15	113
Total	101	112	104	144	100	86	647
Mean	11.22	12.44	11.55	16.0	11.11	9.55	
%	15.61	17.31	16.07	22.25	15.45	13.29	

P. alfierii = Paederus alfierii

C. Undecimpunctata = Coccinella undecimpunctata

C. carnea =Chrysoperla carnea

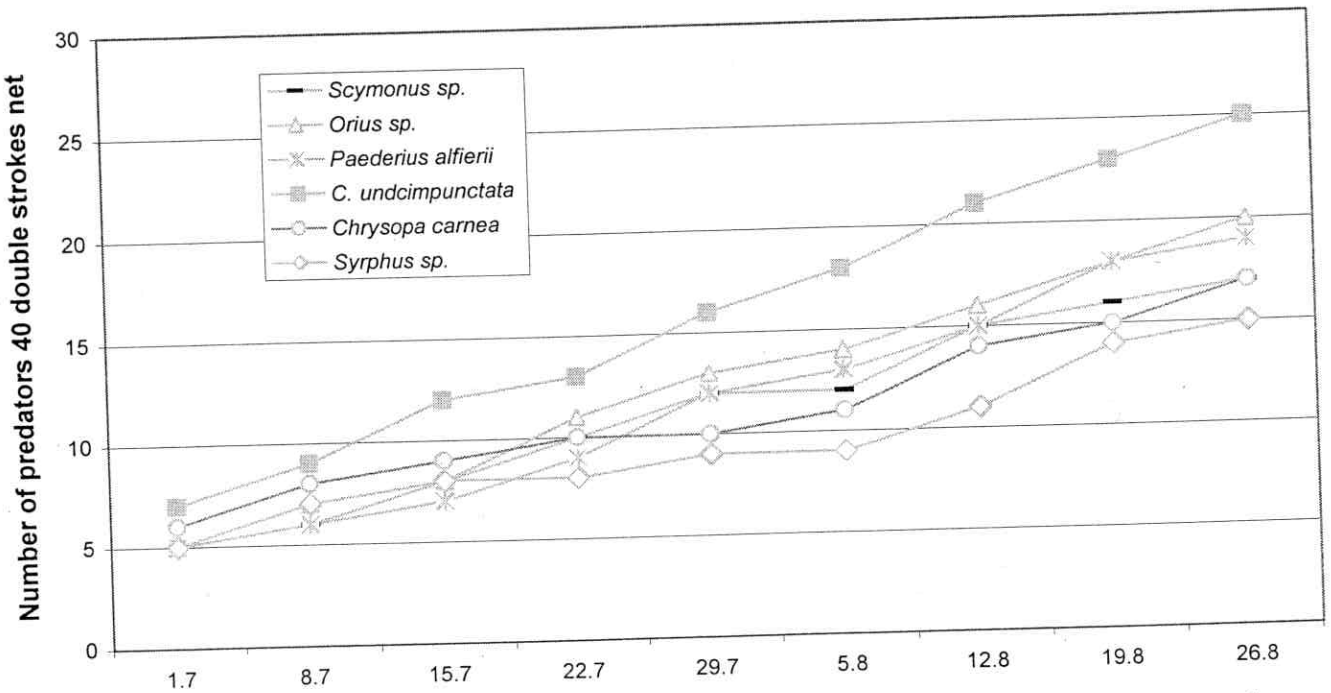


Fig (42): Counts of insect predators, estimated by insect sweeping net, on untreated cotton plants during 2006, season.

Table (38): Counts of insect predators, estimated by insect sweeping net on cotton plants treated by Group 1 of agrochemicals during 2006, season.

Dates	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	5	6	4	8	7	5	35
8/7	2	2	1	3	2	1	11
15/7	3	3	3	7	3	1	20
22/7	5	4	6	10	6	4	35
29/7	7	7	8	14	8	7	51
5/8	7	9	11	15	10	9	61
12/8	10	11	13	18	13	11	76
19/8	11	13	15	20	14	12	85
26/8	13	14	16	22	15	14	94
Total	63	69	77	117	78	64	468
Mean	7.0	7.7	8.5	13.0	8.7	7.1	
%	13.5	14.7	16.4	25.0	16.7	13.7	

Group 1= Mikrofol, Pleo, Mikrofol and Mikrofol

P. alfierii = Paederus alfierii

C. Undecimpunctata = Coccinella undecimpunctata

C. carnea= Chrysoperla carnea

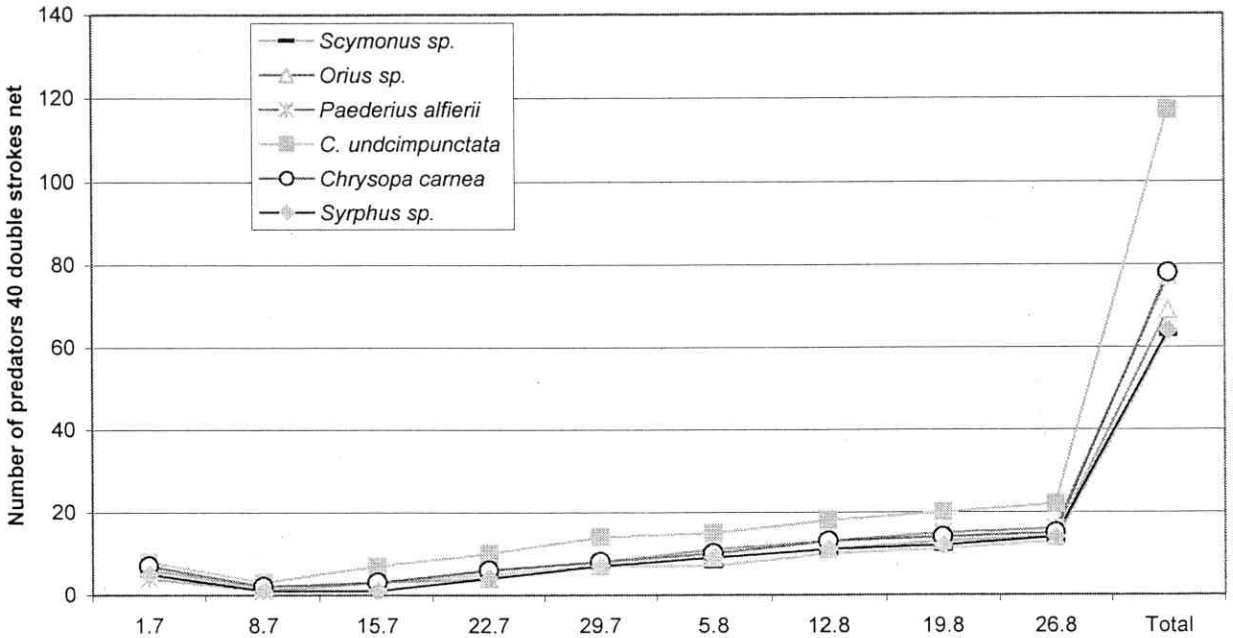


Fig (43): Effect of Group (1) of agrochemicals on total numbers of predators, estimated by insect sweeping net on cotton plant during 2006, season.

Table (39): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by Group 2 of agrochemicals during 2006, season.

Dates	*Scymnus spp.*	*Orius spp.*	*P. Alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	5	5	4	7	7	5	33
8/7	1	2	1	3	1	1	9
15/7	2	3	4	8	2	1	20
22/7	4	4	5	11	5	3	32
29/7	7	6	10	15	9	8	55
5/8	2	2	4	4	3	2	17
12/8	4	5	5	7	5	4	30
19/8	6	7	8	11	8	6	46
26/8	8	9	12	15	11	8	63
Total	39	43	53	81	51	38	305
Mean	4.3	4.8	5.9	9	5.7	4.2	
%	12.8	14.1	17.4	26.5	16.7	12.5	

Group 2= Mikrofol, Pleo, Mikrofol and Pleo

P. alfierii* = *Paederus alfierii

C. Undecimpunctata* = *Coccinella undecimpunctata

C. carnea*= *Chrysoperla carnea

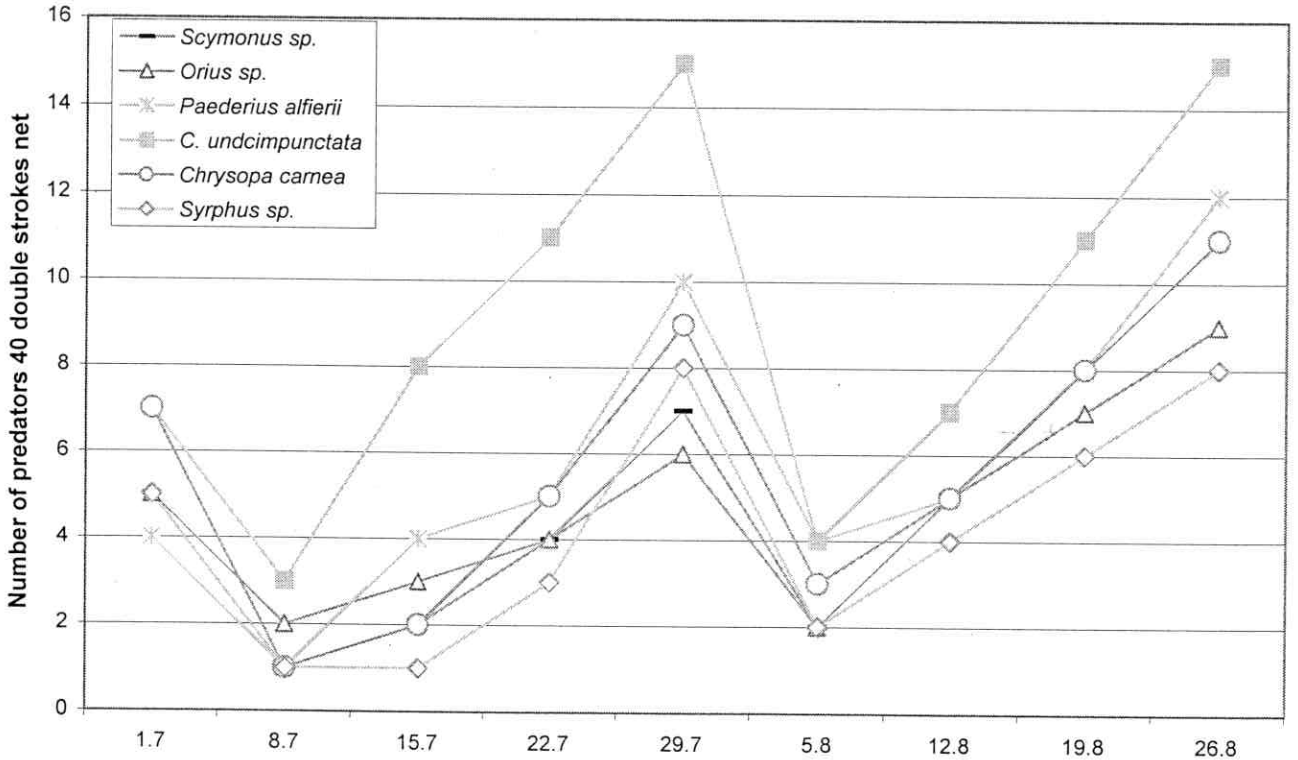


Fig (44): Effect of Group (2) of agrochemicals on total numbers of predators, estimated by insect sweeping net on cotton plant during 2006, season.

Table (40): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by Group 3 of agrochemicals during 2006, season.

Dates	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	5	5	5	8	7	5	35
8/7	7	6	6	9	9	7	44
15/7	8	8	7	13	10	9	55
22/7	2	1	1	3	2	2	11
29/7	3	3	3	5	5	4	23
5/8	1	1	1	3	2	1	9
12/8	2	2	3	5	3	3	18
19/8	4	3	4	8	5	5	29
26/8	7	6	7	12	8	7	47
Total	39	35	37	66	51	43	271
Mean	4.3	3.9	4.1	7.3	5.7	4.8	
%	14.4	12.9	13.6	24.5	18.8	15.9	

Group 3= Mikrofol, Mikrofol, Pleo and Pleo

P. alfierii = Paederus alfierii

C. Undecimpunctata = Coccinella undecimpunctata

C. carnea= Chrysoperla carnea

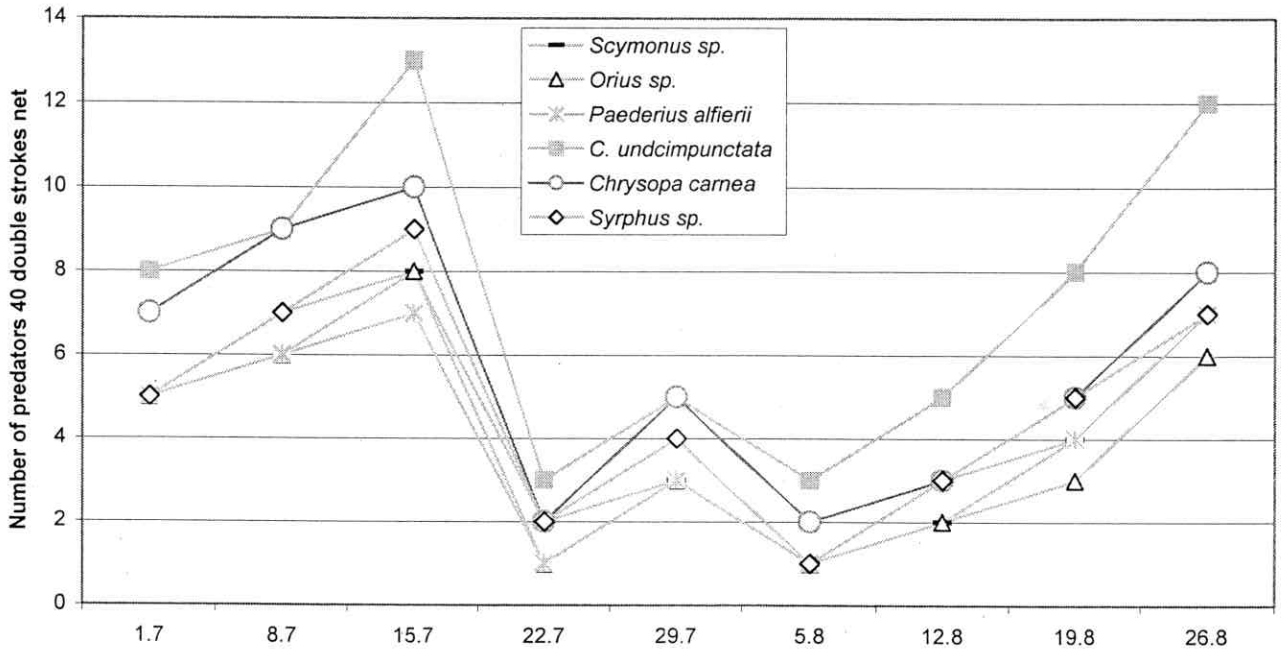


Fig (45): Effect of G (3) of agrochemicals on total numbers of predators, estimated by insect sweeping net on cotton plant during 2006 season.

Table (41): Counts of insect predators, estimated by insect sweeping net, on cotton plants treated by Conventional Spray Program during 2006, season.

Dates	*Scymnus spp.*	*Orius spp.*	*P. alfierii*	*C. Undecimpunctata*	*C. carnea*	*Syrphus corollae*	Total
1/7	7	6	4	8	5	5	35
8/7	1	2	1	3	2	1	10
15/7	2	3	5	7	3	1	21
22/7	1	1	1	3	2	2	10
29/7	3	3	3	8	3	2	22
5/8	2	1	2	4	2	1	12
12/8	3	3	5	8	3	3	25
19/8	6	5	8	11	4	5	39
26/8	8	7	9	14	8	7	53
Total	33	31	38	66	32	27	227
Mean	3.7	3.4	4.2	7.3	3.5	3	
%	14.5	13.6	16.7	29.0	14.0	11.9	

Conventional Spray Program = Pestpan, Sumi-gold, Teleton and Pestpan

P. alfierii = Paederus alfierii

C. Undecimpunctata = Coccinella undecimpunctata

C. carnea= Chrysoperla carnea

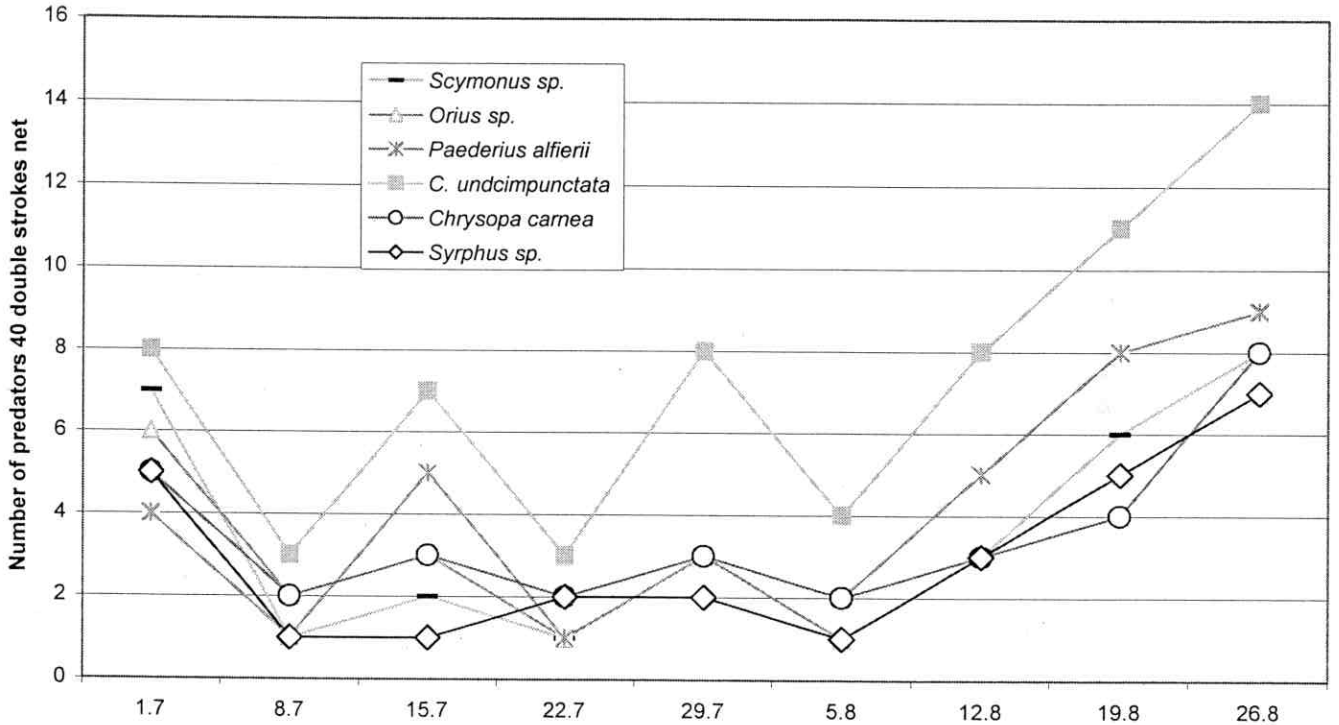


Fig (46): Effect of Conventional Spray Program on total numbers of predators, estimated by insect sweeping net on cotton plant during 2006 season.

total numbers of predators were generally, of high abundance during June and first week of July. After that, the population of adults decreased throughout the rest of July and during August.

1.2. Abundance of existed predators in cotton fields:

Six genera of predators belong to four families and four orders were surveyed in this study. The existed predators were identified as Coleopteran insects, *Coccinella undecimpunctata, Scymnus* spp. and *Paederus alfierii,* hemipteran insects, *Orius spp,* neuropteran insects, *Chrysoperlla carnea* and dipteran insects, *Syrphus corollae*. Those were found as the most common in cotton fields and are well know by their attack and feeding on cotton pests.

The seasonal fluctuation of each of these predators was estimated from the first week of July to the end of August in weekly samples captured by 40 double sweeping net strokes in treated and untreated cotton fields. To facilitate the presentation of the obtained data, each predator will be discussed separately in the following:

***1.2.1. Coccinella undecimpunctata*:**

The ladybird beetles *Coccinella undecimpunctata* adults were found during the three cotton seasons 2004, 2005 and 2006.

As show in Tables (37-41) and Figs. (42-46), the total numbers of captured *C. undecimpunctata* on untreated cotton plants were 144 adults/season. Such total count represented volume (22.25 %) of the total population in the untreated field; while, in cotton field the recieved the 4 regiemes of applied agrochemicals (G1, G2, G3 and C.S.P.), *C. undecimpunctata*

adults occupied 25, 26.5, 24.5 and 29 % of the total numbers of adults captured throughout the seasons (117, 81, 66 and 66 adults, respectively). It is clear that all treatments caused reductions in *C. undecimpunctata* adults counts than control, but the severest reduction (54.17 %) occued on cotton plants treaed by G3 regime (Mikrofol, Mikrofol, Pleo and Pleo) and Conventional Spray Program.

1.2.2. *Scymnus spp.*:

A total of 101 *Scymnus* spp. Adults were captured by the insect sweeping net on untreated cotton plants throughout 2006 season, opposed to 63, 39, 39 and 33 adults from cotton plants treated with G1, G2, G3 and Conventional Spray Program treatments. Thus indicating the harmful effect of spraying for bollworms' control in decreasing the population abundance of these beneficial cocinellid species. The severity in effect of different regimes on these predatory species varied, where G1 (Mikrofol, Pleo, Mikrofol and Mikrofol) was the safest, causing 37.6 % reduction in population of adults than control, while the C.S.P. was the severest (67.3 % reduction in total seasonal count of *Scymnus* spp adults.

1.2.3. *Paederus afire*:

Data in Tables (37) and Fig. (42) showed that the total numbers of captured *P. alfierii* in untreated cotton field were 104 adult individuals/season representing 16.07 % of total counts of all predators (647 indiviuals), ranking the third in population abundance among the 6 concerned predators. While those in Tables (38-41) and Figs. (43-46) show that the total seasonal

numbers of *P. alfierii* adults from cotton plants treated by the formerly mentioned regimes of agrochemicals were 77, 53, 37 and 38 adults, respectively.these data indicated that G3 and C.S.P. treatments had the severst effect in reducing population abundance of this beneficial predatory species. While, also G1 treatment (Mikrofol, Pleo, Mikrofol and Mikrofol) was the safest on population abundance of *P. alfierii* adults (25.96 % reduction in total seasonal population than control).

From results presented in Tables (37-41) and Figs. (42-46), it could be noticed that *P. alfierii* adults were of highest abundance on untreated cotton plants as well as treated plants, during the second half of August.

In this respect, **Habib et al., (1976)** reported that the population density of *P. afire* was the highest during July and August. **Abbas and El-Deeb (1993)** found that the population density of *P. alfierii* was high in July then decreased gradually until the end of cotton season.

1.2.4. *Orius spp.*:

As showen in Tables (37) and Fig. (42), a total of 112 *Orius* spp. Adults were counted by insect sweeping net technique on untreated cotton plants throughout 2006 season. This total number of adults represented (7.31 % of total collected predatory insects. Thus indicating that these *Orius* spp. ranked the second in seasonal population abundance after *C. undecimpunctata.*

After application by the four regimes of agrochemical treatments, the total seasonal numbers of *Orius* spp. adults captured by weekly sweeping net strokes were 69, 43, 35 and 31

adults, respectively, indicating reductions than the 112 adults counted from the control treatment by 38.39, 61.61, 86.75 and 72.32 % after applications of G1, G2, G3 and C.S.P., respectively (Tables, 38-41 and Figs. 43-46). These data confirmed that G1 treatment was always the safest, whle Conventional Spray Program was the severst against *Orius* spp. adults in cotton fields.

From Figs. (42-46), it could be observed that *Orius* spp.adults were highest population during the second half of August on the untreated and treated cotton plants. While, **Ali (1998)** found that total counts of *Orius* spp. were higher on the early sown cotton than in the late sown untreated cotton plant.

1.2.5. *Chrysoperla carnea Steph*:

Data in Tables (37-41) and Figs. (42- 46) showed that the total numbers of captured *C.carnea* adults in untreated cotton field were 100 individuals/season representing 15.45 % of total counts of all predators; while in treated cotton by G1 it reached were 78 adults/season, representing 16.7 % of the total predators' population. In the field treated with G2, the total number of captured *C.carnea* in cotton fields 51 adults (16.7 % of the total population). The total collected adults during 2006 seasons in cotton field were treated with G3 51 adults representing 18.8 % of the total population. While, this total count was the lowest (32 adults/season; 14 % of total count of all predators) in cotton field treated by the sequence of C.S.P. insecticides.

As occurred with the formerly mentioned predators, G1 treatment had the highest effect in reducing the total seasonal

population of *Ch. carnea* adults was G1 (252 % reduction than total count in control), while, C.S.P. treatments had the severest effect against this beneficial predatory insect, as it led to 68 % reduction in total seasonal population than control.

1.2.6. Syrphus corollae:

Throughout 2006 cotton season, a total of 86 *Syrphus corollae* adults were captured by weekly 40 double net strokes on untreated cotton plants (Table, 37). Thus total count represents 13.29 % of the total 647 individuals of all predators indicating that this predaceous species comprise the lowest total population among the concerned predators.

The total seasonal number of *S. corollae* adults decreased on cotton plants of all 4 applied treatments, being 64 (G1), 38 (G2), 43 (G3) and 27 adults on cotton plants sprayed by insecticides of the C.S.P. (Tables, 38-41). As usual, the reduction percentage in total seasonal population of *S. corollae* adults because of treatments, than that of the control, was the lowest (25.58 %) in G1 treatment which appeared the safest on this predaceous species. While, application of the Conventional Spray Program Insecticides caused the most effect (68.6 % reduction in total seasonal count).

Reviewing the aforementioned results, it could be, generally, stated that the application of different regimes of sequence of different agrochemicals for bollworms control had deleterious effects on the beneficial predaceous insect species concerned efficacy varied between the different regimes.

Generally, the Conventional Spray Programs recommended by the Egyptain Ministry of Agriculture for bollworms' control which depends on application of 3 chemical insecticides in 4 successive sprays (Pestban, Sumigold, Telethon and Pestban) had the severest effect in reducing the presence of predaceous insect species on cotton plants (64.91 % reduction in seasonal abundance of total population). On the contrary, the least effect (27.67 % reduction) resulted after treatment by G1 group of agrochemicals in sequence as Mikrofol, Pleo, Mikrofol and Mikrofol. The two other regimes applied caused also considerable deleterious effect on total seasonal population of all predators, as G2 treatment caused 52.86 % reduction, and G3 treatment caused 58.11 % reduction in total predators than control.