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SUMMARY

The field and semifield experiments were carried out at the Farm of Sakha Research Station at Kafr El-Sheikh during two successive cotton-seasons, 2003 and 2004 to evaluate the efficiency of different agents for controlling early season pests, cotton leaf worm and cotton bollworms as well as-non target pests such as sucking pests and some beneficial arthropods.

The obtained results could be summarized as main points as follows:

I. Population dynamics of some sucking pests and their associated predators:

In order to suggest the appropriate times to spray for the control of some sucking pests it was essential to learn something about their population dynamics under the field conditions at Kafr El-Sheikh Governorate. The data could be summarized in the following points:

I.1. Population dynamics of some sucking pests:

1. The population of thrips showed 2-3 sharp generations during the growing cotton-seasons. The first generation almost attack cotton seedlings during late April and continued till the first week of May. It had relatively no injurious effects on cotton plants due to availability of quick thinning during this period. The second generation of *T. tabaci* attacked cotton plant during late May (May 28, 2004) or late June (June 25, 2003). It attacked the flowering stage and caused few damage of squares and affect the yield.

2. The population dynamics of aphids recorded one peak of abundance only on April 24 (2003) and on May 7 (2004) in early season, while in mid to late season it reached its maximum level on September 3rd during 2003 and August 27 during 2004.
3. The population dynamics of jassids recorded three distinct moderate peaks noticed during 2003 cotton season, where these peaks occurred on June 4th, June 25 and August 20th, respectively, while the peaks were noticed during 2004 season occurred on May 28, June 18, July 30 and August 20th, respectively.
4. Concerning the number of *B. tabaci* adult-peaks, the data showed that two peaks were quite observed during 2003 cotton-season, occurred on August 20th and September 17th. With regards to the number of adult peaks recorded during 2004 season, the current results revealed that adult population increased slowly up to the first week of August, then the rate of increase of the population increased vigorously to reach its maximum peak on August 27th (858 adult/100 leaves/7 days). Therefore, a sharp drop in adult population was recorded with a mean of 323 individuals/100 leaves at the end of 2004 cotton season.
5. The population dynamics of the immature stages of whitefly showed three distinct peaks in each growing season. These peaks occurred during 2003 cotton-season on May 14th (119 individuals/100 cotton leaves), on August 6th (356 individuals/100 cotton leaves) and on September 17th (1082 individuals/100 cotton leaves), respectively. With regard to 2004 cotton-seasons, three peaks were also recorded on May 21

(233 individuals/100 cotton leaves), on July 23 (104 individuals/100 cotton leaves) and on August 20th (288 individuals/100 cotton leaves), respectively.

6. Regarding the population abundance of spider mites during 2003 season recorded three peaks on May 7, June and July 23, where as in 2004 season the population in early season recorded two peaks on April 30 and May 28, while the third peak observed on July 23.

I.2. Population dynamics of some associated predators:

The population dynamics of certain predators namely; *Coccinella* spp.; *Scymnus* spp.; *Paederus alfierii* (Koch) and true spiders were surveyed weekly and the data could be summarized in the following points:

1. The population of *Coccinella* spp. recorded two distinct peaks in each growing season. During 2003 season, the first peak occurred on August 20, showing a mean of 60 beetles/100 cotton plants; the second peak occurred on September 3rd with a mean of 130 beetles/100 plant/7 days. During 2004 cotton-season, 2 peaks also were recorded on August 13 and September 10 with a mean of 90 beetles/100 cotton plants in both peaks, respectively.
2. With regard to the population dynamics of lady bird beetles, *Scymnus* spp., two peaks were recorded in both cotton seasons. In 2003 cotton season, the first peak occurred on June 11 (85 beetles/100 cotton plants/7 days), while the second peak was observed on July 23 (295 beetles/100 cotton plants/7 days). As for the second season 2004, the

first peak was recorded on July 9th, while the second peak occurred in August 13 showing mean values of 230 and 60 beetles/100 cotton plants, respectively.

3. The population dynamics of *Paederus alfierii* recorded two distinct peaks in each growing season, in 2003 season the two peaks occurred on July 9th and August 13. With regards to 2004 season, the two peaks observed on July 16 and August 6, respectively.
4. Concerning the population abundance of the true spiders during 2003 season two peaks were recorded on June 11 and August 13. Regarding 2004 season, three peaks were recorded on June 11, July 9 and August 27, respectively.

II. The effects of prevailing predators and weathering factors on population dynamics of sucking pests:

The effects of prevailing predators and weathering factors on the seasonal abundance of sucking pests were studied under field conditions at Kafr El-Sheikh province during two successive cotton-seasons; 2003 and 2004. In both seasons, the study was extended from mid-April to the end of the season.

II.1. The effect of prevailing predators on the population dynamics of sucking pests:

1. Thrips, in both seasons, showed insignificant negative correlation with all tested predators.
2. *Coccinella* spp. exhibited high positive correlation with aphids and whitefly (adult and immature stages) with (r) values of (0.718, 0.822, 0.904) and (0.708, 0.761, 0.699) for 2003 and 2004 cotton seasons, respectively.

3. *Paederus alfierii* exhibited insignificant negative correlations between all tested sucking pests except spider mites which showed high positive correlations (r = 0.583, 0.609) in 2003 and 2004 seasons, respectively.
4. As for the true spiders, the data exhibited insignificant positive correlations with all tested sucking pests except thrips which showed insignificant negative correlations as mentioned before.

II.2. Effect of prevailing weather factors (temperature and relative humidity) on population dynamics of sucking pests).

1. The simple correlation coefficient between temperature and sucking pests differed according to the pest species. It was highly significant positive with whitefly (r = 0.553, 0.573); aphids (r = 0.513) in 2003 season while in 2004 season was highly significant, while insignificant positive with jassid, and sider mites with (r) values of 0.379 and 0.281, respectively.
2. High temperature encouraged the reproduction of whitefly, aphids, jassids and thrips and thus positive correlation were computed.
3. Relative humidity negatively affected thrips and positively affected on aphids, jassids and whitefly.
4. The joint effect between weather factors (temperature and relative humidity) and predators had the greatest effect on whitefly and aphids, but was of moderate effect on thrips and jassids.

III. Evaluation of insecticidal seed-treatments against some sucking pests with respect to their associated beneficial arthropods:

- The field trials were done to evaluate the insecticidal activity of imidacloprid (Gaucho) and thiamethoxam (Cruiser) as seed-treatments to protect cotton plants for a period of 8 weeks after sowing date against early season pests (ESP), during two successive growing cotton-seasons, 2003 and 2004.

III.1. Evaluation of insecticidal seed-treatment against some sucking pests:

1. Both imidacloprid and thiamethoxam had relatively fast initial effects with long residual action against thrips, aphids and immatures stages of whitefly but moderate effect on jassids and adults of whitefly.
2. The percentages of reduction in sucking pests population in all treatments including untreated control decreased gradually until 8 weeks after sowing.
3. Both compounds induced complete protection for cotton seedlings for four weeks from planting, the two compounds had fast initial effect, where the reduction in thrips population is more than 98%, but after seven weeks of planting efficiency was decreased to 90.67 and 87.77% reduction for Gaucho and Curiser, respectively.
4. Imidacloprid and thiamethoxam were not effective against spider mites, *Tetranychus* spp..
5. Imidacloprid and thiamethoxam could be considered specific insecticides for controlling sucking pests as they are highly

efficient against sucking pests with low toxicity against the biological agents.

6. Imidacloprid had relatively better efficiency against thrips than thiamethoxam.
7. The current results proved that both insecticides have systemic action with long residual effects against *Thrips tabaci*.
8. Imidaclopride, in general, is rather efficient in suppressing the population of some sucking insects on cotton seedlings and its residual effect lasted 7 weeks after application.

III.2. Evaluation of insecticidal seed-treatments against some main predators:

The beneficial arthropods play an important role in cotton IPM program, because they are one of the most limiting factors regulating and balancing with their host-pests which are mainly harmful pests. However, the insecticidal seed-treatments were evaluated against some main predators, and the results are summarized in the following points:

1. Both tested compounds, imidacloprid and thiamethoxam had, in general, low toxic effect on the population density of the beneficial arthropodes.
2. Both tested compounds could be considered specific insecticides for controlling sucking pests as they are highly efficient against suckng pests with low toxicity against the biological agents.
3. Based on the percent reduction of tested predators, the current data revealed that there is no significant difference between both tested compounds in this respect.

IV. Toxicity of tested compounds against 4th instar larvae of cotton leafworm, *Spodoptera littoralis* (Boisd.):

Cotton leafworm considered the most destructive insect which attack all parts of the cotton plants including greenbolls. Although chemical control still one of the most major techniques recommended to control such pests, but even the synthetic insecticides began to suffer from less potency for controlling this pest due to the increased rate of developing resistant strains. IGR's and biocides are considered new compounds which kill the insects through their interference with the moulting and some vital process.

The present work aims to evaluate the toxicity and latent effects of *Bacillus thuringiensis* (Agerin); chlorpyrifos and lufenuron at their recommended rate and their binary mixtures at half recommended rates against 4th instar *Spodoptera* larvae.

IV.1. Toxicity of tested compounds applied alone at their recommended rates as well as their side effects on some biological aspects:

IV.1.1. Toxicity of tested compounds applied alone at their recommended rates:

IV.1.1.a. Effect of *Bacillus thuringiensis* (Agerin) alone against 4th instar larvae of *S. littoralis* (Boisd.):

1. Agerin failed to exhibit any mortality after the first day of feeding on treated cotton leaves. Thus, Agerin should be

avoided in case of insect outbreak and in case of edible short-life vegetable infested with cotton leafworm.

2. Agerin had low residual effect on larvae, but it had superior effect on percentage of malformed pupae.
3. Agerin is considered less harmful to predators, thus it could be used in the spray programmes for the management of cotton pests.

IV.1.1.b. Effect of chlorpyrifos alone against 4th instar larvae of *S. littoralis* (Boisd.):

1. Chlorpyrifos had high initial kill (96%) one day after feeding. Moreover, the percent mortality increased steadily to reach 100% after 48 hours.
2. Chlorpyrifos had no direct hit on pupal formation since it induced zero% pupal mortality at zero time.
3. Chlorpyrifos had also moderate effect on both pupal malformation and adult emergence.

IV.1.1.c. Effect of Lufenuron (IGR) alone against 4th instar larvae of *S. littoralis* (Boisd.):

1. Lufenuron gave low mortality (6.1%) after first day of feeding on treated leaves, but thereafter, the mortality increased within the first period to reach 100% as initial activity.
2. A positive correlation was noticed between cumulative mortality and time elapsed after feeding.
3. Based on the percentage of larval mortality value (33.4 after 27 days) and the total average of residual activity (75.6%),

one could conclude that Lufenuron is a highly persistent compound and good enough to control cotton leafworm.

4. There is a positive correlation between percent pupation and time elapsed after spray, where 69.8% pupation was noticed after 27 days post treatment as compared with 95% for control.
5. Lufenuron caused significant reduction of adult emergence. In term of figures, the general mean of adult emergence in case of Lufenuron-treated group was 24.63% while the corresponding value is 91.7% for control.

IV.2. Effect of binary mixture of the tested compounds against 4th instar larvae of *S. littoralis* (Boisd.):

1. Lufenuron (Match) when applied at its recommended rate have high toxic potential against cotton leafworm, *S. littoralis* and it had long residual effect, where its persistence in the field was over 27 days after spraying.
2. Lufenuron can be used in combination with conventional insecticides, such as chlorpyrifos (Dursban) if there is a need to get a rapid initial kill.
3. Lufenuron could be included in the spray programmes for the management of cotton pests, rather than continuous application of conventional insecticides.
4. All tested compounds and their binary mixtures caused 0.0 pupation at zero time except Agerin.
5. Agerin was the least effective in reducing the percentage pupation and adult emergence, on contrary Agerin had superior effect on percentage malformed pupae.

6. There were significant differences between all tested compounds alone and their binary mixtures on the tested biometric measurements of *S. littoralis* (Boisd.).

V. Evaluation of some insecticidal sequences on cotton bollworms, cotton yield and sucking pests as well as their predators:

V.1. Evaluation of some insecticidal sequences on cotton bollworms:

The present work is an attempt to test three insecticides; carbaryl, chlorpyrifos and alpha-cypermethrin in alternative sequences against the two motorious cotton bollworms, *P. gossyiella* and *E. insulana* in nine different regimes during two successive cotton seasons, 2003 and 2004. The data could be summarized in the following points:

1. The infestation of cotton fields with both bollworms in both successive seasons started with few number of 1st and 2nd instar larvae on late July, but increased gradually till the end of each season.
2. The average percentage of bollworms infestation was higher in 2004 cotton-season than 2003 cotton season.
3. Insecticidal treatments if being done at the proper time in a protective control programme are the most effective agents for controlling both cotton bollworms.
4. Alpha-cypermethrin in three sprays was the best sequences in controlling bollworms, but it was not preferable to control the pests generally.

5. From the aforementioned results, synthetic pyrethroids were the most effective insecticides against bollworms followed carbamate compounds and O.P insecticides ere the least effective.
6. Generally, the schedule chlorpyrifos (alpha-cypermethrin) carbaryl is considered the most preferable treatment for controlling bollworms infestation.
7. Insecticides are the sole remedy one can trust in case of insect out break.
8. Based on cost/benefit ratio, the proper time for controlling bollworms should not be started before mid-July and continued till the end of September in order to give a direct hit to the newly hatched larvae before entering the green bolls and caused the damage.

V.2. Evaluation of some insecticidal sequences on cotton yield:

1. The results showed a high correlation between percentage of boll infestation along season and yield loss. In term of figures, the percent losses of yield are: 16.7, 14.4, 16.3, 8.2, 9.2, 10.1 and 65.5 for the following sequences: carbaryl – chlorpyrifos – alpha - cypermethrin; chlorpyrifos – carbaryl – alphacypermethrin; alpha – cypermethrin – carbaryl – chlorpyrifos; carbaryl – alpha – cypermethrin – chlorpyrifos; chlorpyrifos – alpha – cypermethrin – carbaryl; alpha – cypermethrin – chlorpyrifos – carbaryl and control treatment, respectively.

2. Conventional insecticides are some remedy one can trust in case of insect outbreak, they could be easily performed at the critical time of need.
3. Alpha-cypermethrin in 3 successive sprays showed the highest effect induced 4.38% losses in cotton yield, while schedules; carbaryl in 3 successive sprays; chlorpyrifos-alpha-cypermethrin-carbaryl and alpha-cypermethrin-chlorpyrifos-carbaryl causing the same percent yield losses ranged from 8.0-9.0% losses. schedule including carbaryl-alpha-cypermethrin-chlorpyrifos was the least effective as it induced 17.1% losses in cotton yield compared with 69.8% for control.
4. In general all tested treatments reduced the incidence of bollworms infestation on cotton, it decreased the percentage loss in cotton yield and exhibited good protection.

V.3. Evaluation of some insecticidal sequences on some sucking pests:

1. All tested treatments, in general, were effective against aphids after one week of spraying, while they exhibited weak effect or became ineffective after two weeks of every spray.
2. The sequences including carbaryl in 3 successive sprays or alpha-cyper methrin in 3 successive sprays exhibited the best effective treatments against jassids with percent reductions of 78.9 and 73.95, respectively. On the other hand, the sequence of spraying chlorpyrifos in 3 successive sprays exhibited slight effect against jassids with percent reduction of 27.2%.

3. With regards to the effect of tested sequences on whitefly (adult and immature stages) the results indicated that the two schedules including spraying alpha-cypermethrin in 3 replicative sprays and chlorpyrifos applied in 3 successive sprays are the best effective treatments exhibited 32-5% and 32.1% reduction of whitefly, respectively.

V.4. Evaluation of some insecticidal sequences on some predators:

This work essentially aims to evaluate the efficiency of insecticidal sequences (recommended for bollworm control) on the prevailing predators during two successive seasons, 2003 and 2004. The data are summarized in the following points.

1. Based on the general mean of reduction of the whole treatment (average of 3 sprays of each sequence), alpha-cypermethrin applied in 3 successive sprays was the most destructive treatment (74.6% reduction) against *Chrysopa carnea*.
2. The other tested treatments exhibited percent reduction in population density of *Chrysopa carnea* ranged between 47.2-65.7%.
3. The data also revealed that all tested treatment, in general, were very destructive to *Coccinella* spp., and *Scymnus* sp.
4. Based on the percent of reduction (%R), all tested insecticides significantly reduced the population densities of all tested predators.

VI. Evaluation of some insecticides against some sucking pests attacking cotton plants at late season with respect to some associated predators:

This experiment was carried out at Sakha Research Station, Kafr El-Sheikh in 2003 and 2004 cotton.

VI.1. Evaluation of some insecticides against sucking pests attacking cotton plants at late season:

This work essentially aims to evaluate the initial activity (% reduction 2 days after spray) and bio-residual activity (mean of % reduction 5, 8, 11, 14 days after spray) of the three tested compounds, imidacloprid (Confidor); diafenthiuron (Polo) and triazophos (Hostathion) on cotton aphids, jassids and whitefly (adult and immature stages) during 2003 and 2004 cotton-seasons. The data could be summarized in the following points:

1. Imidacloprid was proved to be the superior compound against aphids recording the highest initial activity ranged from 88.0-92.14%, for two successive seasons, triazophos came in the second order recording (75.94-83.1%), while the initial activity of diafenthiuron was (65.2-65.7%). The residual activity of the tested compounds could be arranged discendingly as follows: Imidacloprid (93.03-99.47%), diafenthiuron (84.07-89.1%) and triazophos (80.3-81.84%).
2. Concerning the efficiency of the tested compounds on jassids, both Imidacloprid and diafenthiuron are the most effective compounds against jassid, while traizophos was the least effective compound in this respect. Based on percent reduction of residual activity, the data showed that both

imidacloprid and diafenthiuron are equitoxic with percent reduction of (90.55-92.1%) and (87.52-91.25%), respectively, while traizophos is (22.71-25.38%). The data also showed that although there is no significant difference between imidacloprid and diafenthiuron but there is significant difference between both compounds and triazophos.

3. The population density of adult whitefly was higher in 2003 season than that of 2004 season. Based on the average general mean of % reduction for two seasons, imidacloprid showed the highest effect (75.78%) followed by diafenthiuron (52.57%), while traizophos recorded the lowest effect (27.64%) with significant difference between their efficiencies.
4. The tested compounds showed the same trend in both seasons on immature stages of whitefly. In 2004 season imidacloprid was the highest effective compound with initial kill of (68.95%), residual effect of (72.83%) and general mean of % reduction (72.05%), while the least effective compound was triazophos with initial kill of (60.11%), residual effect (42.81%) and general mean of % reduction (40.14%). Based on the general mean of % reduction during both seasons, the tested compounds could be arranged descendingly as follows: imidacloprid (72.53%), diafenthiruon (56.93%) and triazophos (36.27%).
5. Imidacloprid (Confidor) proved to be one of the superior compound against aphids, jassids and whitefly (adult and immature stages).
6. Triazophos (Hosslathion) was the lowest tested compound against aphids, jassids and whitefly.

7. The population abundance of jassids and whitefly (adult and immature stages) was higher during 2003 cotton season than that 2004 season, while the population density of aphids was higher in 2004 season than that 2003 season.

VI.2. Side-effects of the tested compounds on some main predators commonly found in cotton fields:

The beneficial arthropods play an important role in cotton IPM Program, because they are one of the most limiting factors regulating and balancing with their host-pests which are mainly harmful pests. The aim of this study is to evaluate the side-effects of imidacloprid, diafenthiuron and triazophos on some main predators commonly found in cotton fields during two successive seasons, 2003 and 2004. The data could be summarized as follows:

1. Triazophos was the superior compound on the population density of predators followed by imidacloprid and diafenthiruon.
2. The tested compounds were highly effective on sucking pests with moderate effect on their associated predators.
3. The three tested compounds differed significantly in their values on some main predators.
4. The chemical control must be used if the population density of sucking pests was reached to the economic threshold.