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INTEGRATED PEST MANAGEMENT OF SOME COTTON PESTS

By

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Field trials were conducted to study some factors which are responsible for the low and/or high yield of the cotton crop. Also, it could study an integrated pest management program to control or decrease some major cotton piercing-sucking pests under Economic Threshold Levels (ETLs). In addition to the relationship between two weathering factors [temperature and % relative humidity (RH%)] with population incidences of some cotton piercing-sucking pests and certain associated predators.

5.1. Impacts of Some Agricultural Practices on The Population Dynamics of Some Cotton Piercing-Sucking Pests and Associated Predators

The Field study was carried out at Sakha Agricultural Research Station, Kafr El- Sheikh Governorate, Egypt during 2016 season and at Kafr El-Shenhab village, Mansoura district, Dakahlia Governorate during 2017 season on cotton Giza 94 to study the effect of three different fertilizers units, leaf-foliage application and planting topping on the population densities of aphids, jassids, whitefly, spider mites and certain associated predators (Coccinella spp., *C. carnea* and T. spiders) during 2016 and 2017 seasons .

5.1.1 Effect of Different Fertilizer Ratios on Piercing-Sucking Pests' Incidences

Field experiments were conducted to evaluate the effects of three different N:P:K ratios in combination viz 67:15:24, 67:30:24, and 67:15:48 units /feddan on the population dynamics of some cotton piercing-sucking pests and their associated predators. The obtained results were briefed in the following points:

1. Aphids insects were appeared on cotton plants in the first and third week of July after seven and ten weeks from plant date in two seasons. Also, by comparative population densities of general means of aphids in all

fertilization treatments and topping practices, it could be concluded that topping practice was the highest population followed by N:2P:K, N:P:2K, leaf-foliage, and N:P:K fertilization ratios in descending order as follows: (562.06, 509.50, 478.67, 471.83 and 425.22) and (346.39, 332.83, 330.28, 280.89 and 235.44 aphid/ 100 leaves) in both 2016 and 2017 seasons respectively, by significant and insignificant differences in between. Also, the highest population number of aphids (general mean) was showed in topping practices while the lowest number was recorded in N:P:K fertilizer in both seasons.

2. Jassids population was observed during the third week of July on nine weeks old cotton plant and on the third week of June on five weeks old cotton plant in 2016 and 2017 seasons respectively. But, general means of jassid population numbers were recorded the highest population for treatment ratios and practices as the following: [(N:2P:K and topping), N:P:2K, (topping and N:2P:K), (N:P:K and leaf-foliage) and (leaf-foliage and N:P:K)] by (157.56 and 216.50), (152.33 and 205.39), (141.00 and 199.39) and (133.89 and 186.22) and (125.94 and 162.17) insect / 100 leaves in both 2016 and 2017 seasons respectively, with a significant difference in between and an insignificant difference in between. Finally, the highest population of jassid general mean (G.M.) was indicated in N:2P:K ratio and topping practice in 2016 and 2017 seasons respectively, while the lowest one was observed in N:P:K ratio in both seasons.

3. From the obtained results, spider mites infesting cotton plants throughout the first week of August in both seasons by very small numbers in all tested practices and treatments after twelve weeks from the sowing date. By comparative general means of fertilizer ratios, leaf-foliage and topping plants

practice for spider mites, it could be concluded that general mean values were ranged from 22.28 for N:P:K (least one) to 50.72 individuals / 100 leaves for N:2P:K (highest one) in 2016 season. But, they were recorded between 3.5 (least one) for N:P:K to 5.89 individuals / 100 leaves (highest one) for leaf-foliage applications in the 2017 season. Also, the highest mean of spider mites was noticed on N:2P:K fertilizer and leaf-foliage treatments in 2016 and 2017 seasons respectively. While the lowest means were showed in N:P:K fertilizer in both season

4. From the obtained results for general means of whitefly populations, it could be indicated that N:2P:K fertilizer had the highest one for adults followed by N:P:2K, leaf-foliage application, topping plant, and N:P:K ratio in descending order by (96.44, 87.50, 82.22, 74.83 and 72.50 adults / 100 leaves) respectively in 2016 season. While, N:P:2K fertilizer had the highest general mean population followed by topping plant, leaf-foliage, N:2P:K and N:P:K by (116.67, 116.22, 101.78, 99.61 and 95.50 adults / 100 leaves) respectively in 2017 season. Also, whitefly adults were infesting cotton plants in mid-July on eight weeks old cotton plant in the 2016 season. While adults infested cotton plants on 10 July after three weeks from the sowing date in 2017 season.

5. As for whitefly immature stages, data obtained for general means of different practices it could be indicated that N:P:2K fertilizer ratio was the highest general mean followed by N:2P:K, leaf-foliage, topping plants and N:P:K fertilizer by (129.17, 90.44, 87.33, 86.78 and 76.22 immatures / 100 leaves) respectively in 2016 season. While, data recorded in 2017 season abbreviated that whitefly immatures population under topping plants were the highest general mean followed by N:P:2K, N:2P:K, leaf-foliage and N:P:K fertilizer

ratio by (214.72, 197.61, 186.28, 177.39 and 141.39 immatures / 100 leaves) respectively. Whitefly immature stages were infested cotton plants in the fourth week of June (after five weeks from the sowing date). Also, the highest general mean was showed in N:P:2K and topping plants in 2016 and 2017 seasons respectively. While the lowest general means were recorded in N:P:K fertilizer in both seasons.

6. Population densities of associated predators were observed in the third and the first week of July in 2016 and 2017 seasons respectively, and the insects were recorded and differentiated that according to the type of treatment plots. Comparative of general mean for population densities in 2016 season indicated that leaf-foliage plots were the highest one followed by topping plant, N:2P:K, N:P:K and N:P:2K. But in 2017 season, predator population under N:P:2K plots was the highest one followed by leaf-foliage, N:2P:K, topping plants and N:P:K fertilizer ratios. Data also presented that the general means of populations were ranged from (21.22 to 28.89) and from (8.94 to 11.89 insects / 100 leaves) in 2016 and 2017 seasons, respectively.

5.2 Changement In Distribution and Population Densities of Cotton Piercing-Sucking Pests and Associated Predators at The Different Ratios of Fertilizer Units

Optimum utilization of fertilizer can play a vital role in pests controlling and increasing yield per unit area in combination with other common practices. Field studies were conducted to evaluate the influence of the ratios of fertilizer units on the population dynamics and distribution of some cotton pests and some associated predators during two cotton seasons (2016 and 2017). The studied ratios of nitrogen (N), phosphorus (P) and potassium (K) were (67:15:24), (67:30:24) and (67:15:48) named N:P:K, N:2P:K, N:P:2K respectively, and

other two plants treatments and application that were leaf-foliage and plant topping.

The recorded data were subjected to mean values of 100 cotton leaves and 20 cotton plants for one-week intervals for piercing-sucking pests and associated predators, respectively and was computed to general mean values for all weeks of scouting periods.

5.2.1. Population Densities Of Cotton Piercing-Sucking Pests And Associated Predators at Fertilizer Ratio N:P:K (Recommended Dose)

From the obtained results, aphid, jassid, and whitefly (adults) were infesting cotton plants from the mid of June to end of October after 4 and 5 weeks from planting date respectively, while spider mites, whitefly (immatures) and predators were observed in mid-July to October 11 after 12, 7 and 5 weeks from planting date. By the comparative population densities of general means, aphid's population was the highest one followed by jassids, whitefly (immatures), whitefly (adults), spider mites, and predators in descending order in two seasons.

5.2.2. Population Densities Of Cotton Piercing-Sucking Pests And Associated Predators At Fertilizer Ratios N:2P:K

From the aforementioned results, each of aphids, jassids, and whitefly (adults and immatures) were infesting cotton plants from mid-July to October (on eight weeks old cotton plants) in 2016 and 2017 seasons, while spider mites and predators were recorded at the end of July (ten weeks old cotton plants) by a small number in 2016 only. But in the 2017 season, both spider mites and predators were observed during scouting periods by fewer populations. By comparative population densities general means of scouting pests and predators

it must be indicated that aphid was the highest population followed by jassid, whitefly adults, whitefly immatures, spider mites, and predators in descending order in two scouting seasons.

5.2.3. Population Densities of Cotton Piercing-Sucking Pests and Associated Predators in Fertilizer Ratios Of N:P:2K

From the results obtained, it could be concluded that aphids, jassids, and whitefly (adults and immatures) populations were observed in cotton plants on the 1st of July and mid of June in 2016 and 2017 seasons respectively on 6- and 4-weeks old cotton plant respectively. While spider mites and associated predators were recorded at the end of July (10 weeks after sowing date) and 5 weeks old planting date in 2016 and 2017 seasons respectively by very small numbers. As for by comparative population densities general means of piercing-sucking pests and predators, aphid was the highest population followed by jassid, whitefly immatures and adults in both scouting seasons then spider mites and predators in descending order.

5.2.4. Population Densities of Piercing-Sucking Pests and Associated Predators at Leaf-Foliage Application

The results were obtained reported that aphid density was recorded in cotton plants in the 1st week of July and in the 2nd week of June in 2016 and 2017 seasons respectively on seven- and nine-weeks old cotton plants respectively. Jassids population appeared in the 3rd week of June in both seasons on 9 and 6 weeks after the sowing date in 2016 and 2017 respectively. But whitefly adults were observed in the 3rd and 2nd weeks of June in 2016 and 2017 seasons respectively on 5 weeks old cotton plant. While whitefly immatures were infested cotton plants in the first week of July and the last week of June in 2016 and 2017 respectively on seven weeks old plant on both seasons. Spider

mites individuals were recorded in the first week of August and in the 2nd week of July in 2016 and 2017 respectively on eleven and five weeks after planting date respectively. Predators insects were noticed in the 1st and 3rd week of July in 2016 and 2017 seasons respectively on seven and six weeks from planting date respectively. By comparative population densities of general means, aphid also was the highest population followed by jassid, whitefly (immatures then adults), spider mites, and predators in descending order (2016 season). But in 2017 season, the same trend and descending order were recorded except predator's population was relatively more than spider mite's population (the leaf-foliage application were treated at a later time, it is not responsible on the date of the first infestation by piercing-sucking pests.

5.2.5. Population Densities of Cotton Piercing-Sucking Pests and Associated Predators in Topping Practices

With respect to the recorded data, the topping practices application was conducted after 110 days from planting date, it is not responsible as a cause for the date of piercing-sucking pests' population were recorded. Also, by the observed results, the comparative population densities general means of cotton piercing-sucking pests and predators on cotton plants with topping practices, aphid was the highest population with significant differences with other scouting insects in both seasons followed by jassids, whitefly immatures, whitefly adults, spider mites and predators as a descending order at season 2016. But in 2017 season, aphid's population was the highest one and followed by the same trend were mentioned above except predators' general mean populations were coming before spider mite's general mean population as a descending order also.

5.3 Population Dynamics of Some Cotton Piercing-Sucking Pests in Relation to Some Weather Factors Under Different Treatments of Cotton Plants

Data on the effect of maximum and minimum temperature in addition to relative humidity on the population density of aphid, jassid, spider mites and whitefly (adult and immature stages) on cotton treated with different fertilizer ratios, leaf-foliage and topping under the field conditions were shown. The population of aphids was positively correlated with the maximum temperature in all tested treatments. In contrast, the correlation was negative and significant between aphid's population and the minimum temperature. Also, the multiple regression analysis indicated that the increase in the minimum temperature with 1°C caused a decrease in aphid population by 22.82, 15.62, 10.50, 10.52 and 10.48 insects per leaf under N:P:K, N:2P:K, N:P:2K, leaf-foliage and topping respectively. Also, the population of aphids was positively correlated with the relative humidity, where (r) values were ranged from (0.447 to 0.516) and an increase in relative humidity by 1% caused an increase in aphid population by 15.08, 10.15, 15.78, 17.92 and 18.68 insects per leaf under N:P:K, N:2P:K, N:P:2K, leaf-foliage and topping respectively. But the combined effect values showed that the maximum temperature, minimum temperature, and relative humidity were responsible for the change in population density of aphids.

As for the jassids population dynamics, results showed that the jassid population was significantly and positively correlated with the maximum temperature in all treatments with (r) values ranged from (0.367 to 0.464) and (b) values from (10.74 to 17.99). While the correlation and multiple regression between jassid and the minimum temperature were negative and highly significant under all the tested treatments. On the other side, the population density of jassids was significantly and positively correlated with relative

humidity with (r) values ranged from (0.555 to 0.606) and (b) values from (19.59 to 16.15) under tested treatments respectively. Also, the maximum and minimum temperature and R.H. as shown by combined effect analysis were affected for change in the jassid population from (50.75 to 56.05%) under the previous treatments.

Concerning spider mites, the population was positively correlated with maximum temperature with (r) values ranged from (0.029 to 0.246) under treatments of N:P:K, N:2P:K, N:P:2K leaf-foliage and topping respectively. According to the multiple regression (b) analysis, the increase in maximum temperature by 1°C resulted in an increase in the insect population by from (4.1 to 7.81) insects per leaf under previously mentioned treatments respectively. But the correlation between the minimum temperature and spider's population was negative and the increase in the minimum temperature by 1°C caused a decrease in the insect population by from (0.655 to 3.409) (b values) under treatment above respectively. Also, spider's population was positively and insignificantly correlated with R.H. with (r) ranged from (0.006 to 0.175) and (b) values of (1.209 to 2.828) under treatment above respectively. The combined effect indicated that the maximum and minimum temperature and R.H. were affected by the change in the spider mite's population by 10.30, 29.10, 23.45, 21.70, and 14.40% under the mentioned treatment, respectively.

The obtained results showed that whitefly adults were negatively correlated with maximum temperature and positively correlated with minimum temperature. While the immature stages were positively correlated with maximum temperature and negatively with minimum temperature. But, both adult and immature stages of whitefly were positively correlated with relative humidity. As for the combined effect values, the weather factors were

responsible for the change in the whitefly population from (43.10 to 45.60%) for adults and from (26.65 to 33.85) for immature stages under the previously mentioned treatment respectively.

5.4. Relationship Between Population Density of Aphids, Jassids, Whitefly and Certain Associated Predators Under Different Treatments

Data obtained indicated that the associated predators were positively correlated with aphids, jassids, spider mites, and whitefly immature stages by (r) values from (0.056 to 0.757), and negatively correlated with whitefly adults by (r) values between (-0.209 and -0.807) at the five tested treatments. Also, the certain predators recorded the highest and significant correlation with both aphids and whitefly immature stages at leaf-foliage treatment, whereas the predators were highly and significantly correlated with aphids only at N:2P:K and N:P:2K treatments. Multiple (b) regression analysis showed that an increase in the population of aphids, jassids, spider mites, and whitefly immature stages with one insect of each caused increase in the predators by a different individual from (0.003 to 1.38) per plant under different tested treatments. On the other side, the increase in whitefly adults by one individual resulted in a decrease in the predator's population by from (0.031 to 0.184) individual per plant under tested practices. As for combines effect, the studied pests were responsible for the change in the predators population by 56.2, 82.6, 79.6, 87.0, and 66.4% under N:P:K, N:2P:K, N:P:2K, leaf-foliage and topping, respectively.

5.5. Efficiency of Some Products on Some Cotton Piercing-Sucking Pests and Their Effects on Certain Associated Predators

The efficacy of five different products, two synthetic chemical insecticides (chlorpyrifos and methomyl), two biocides (abamectin and protecto) then one mineral oil (Kz oil) were tested under field condition in 2017 season against some major piercing-sucking pests [aphids, jassids, spider mites and whitefly (adults and immatures)] in addition to the side effects of these tested insecticides on associated predators to know which products more effective to piercing-sucking pests and more safety against predators. According to compute, the percentage of initial kill (I.K. % reduction after one day) beside both residual and general mean effects.

5.5.1. Efficiency of Tested Products Against Cotton Piercing-Sucking Pests

The obtained results could be summarized as follows:

1. It is indicated that both methomyl and chlorpyrifos were more effective against aphid by the highest initial kill (I.K. %) effect (72.2 and 68.9) respectively with insignificant differences in both. While, other tested products were showed relatively less I.K.% by reduction (45.6, 46.8, and 47.2) for abamectin, protecto, and Kz oil respectively with insignificant differences in between and with significant differences with the two products mentioned above. But for residual mean effect against aphids population each of abamectin, protecto, and Kz oil were relatively high as percentages of residual effect (R.E.) by (65.0, 63.1 and 61.6%) respectively with no significant differences in between. While both methomyl and chlorpyrifos showed moderate R.E (52.1 and 50.1%) respectively by an insignificant difference between both and significant differences with the first group.

While all tested products were attained a moderate general mean % effect ranged from (53.3 to 61.8%) with insignificant differences in between.

2. It is obvious that the tested products showed relatively moderate and less initial kill % for jassids by (40.6, 34.3, 48.8, and 48.9%) for abamectin, protecto, methomyl, and chlorpyrifos respectively with insignificant differences between them. While Kz oil was more effective (61.4%) with significant differences with previously mentioned products. Concerning residual mean effects on jassids, the observed results showed that Kz oil, protecto, and abamectin gave a moderate residual mean (R.E.) by (57.7, 51.14, and 50.30%) respectively with an insignificant difference in between. Where both chlorpyrifos and methomyl produced less and poor residual effects (31.78 and 10.18 %), respectively. On the other side, Kz oil, abamectin, and protecto were recorded a moderate effect against jassid populations as general mean % reduction as follows: (58.3, 48.7, and 48.3%) respectively. While methomyl and chlorpyrifos exhibited less efficacy (16.6 and 34.6%) general mean, respectively.

3. Concerning the efficacy to whitefly, results obtained indicated that methomyl, Kz oil, and chlorpyrifos were good and moderately effective against whitefly adult stages with initial kill (66.4, 53.9 and 51.9%) respectively but other two products (abamectin and protecto) showed fewer percentages of I.K. (44.0 and 32.2%) reduction respectively. Also, whitefly adult stages were influenced by the tested products as residual mean effects with a moderate effect for methomyl, Kz oil, abamectin and protecto as follows (50.6, 48.9, 48.0, and 47.1%) residual mean respectively. While chlorpyrifos elucidated more less residual mean effect (31.2%). As for the general mean of reduction % data showed that methomyl, Kz oil, abamectin,

and protecto were recorded a moderate % of general mean effect (53.2, 49.7, 47.4 and 44.6%) respectively in descending order with insignificant differences between them, but chlorpyrifos was relatively less effective (34.7%) general mean effect. Concerning whitefly immature stages, Kz oil, abamectin, and chlorpyrifos were the highest by moderate effect one day after application (I.K.%) as follows (45.2, 44.8, and 42.5%) respectively with an insignificant difference in between. While both protecto and methomyl were more less effective as an initial kill by (33.8 and 35.3%) respectively. As for residual mean (R.M.) and general mean (G.M.) effect for whitefly immatures, the highest values effect was recorded by (65.8 and 55.3%) and (62.3 and 51.7%) as residual mean and general mean effects for Kz oil and protecto respectively. While, the other three tested products, chlorpyrifos, abamectin, and methomyl were attained less effect (41.5, 35.8, and 31.5%) and (41.7, 37.3, and 32.1%) as residual mean and general mean effects respectively in descending order.

4. For the effect against spider mites, acaricide (abamectin) was the most effective one on spider mites as I.K. by (62.4%) reduction as compared with synthetic chemicals (methomyl ad chlorpyrifos) which recorded a moderate I.K. (53.9 and 45.1%) respectively with significant differences in between and with abamectin. While both protecto and Kz oil showed weak activity as I.K. on spider mites (34.7 and 38.5%) respectively. The results for residual and general mean percentages effect recorded that both abamectin and Kz oil indicated highly residual and general mean percentages effect (72.6 and 71.9%) and (71.0 and 66.4%) respectively, then protecto gave over moderate and moderate (60.0 and 55.8%) residual and general mean effect respectively. While the other two chemical products (chlorpyrifos and methomyl) were presented less and/or poor (40.6 and 29.8%) and (41.4 and

33.8%) as residual and general mean percentages effect respectively with insignificant differences in between and with the first mentioned products.

5.5.2 Efficiency of The Tested Products Against Associated Predators as a Side Effect

The aim of the present study was to evaluate the side effect of the five tested products on some associated predators, *Chrysoperla carnea* (adults and larvae), *Coccinella spp.* and true spiders. The obtained data recorded that both chemical insecticides, chlorpyrifos, and methomyl were more effective as percent reduction (initial kill) (78.9 and 60.1%) respectively. While Kz oil and biocides (abamectin and protecto) showed very poor effect by (12.5, 12.2, and 9.5%) respectively. On the other side, methomyl and chlorpyrifos showed high and moderate as a residual mean effect (78.0 and 48.9%) respectively. While abamectin, protecto, and Kz oil recorded very weak percentages of the residual mean as follows: (22.3, 33.3, and 17.9%), respectively. Also, the same trend was recorded as for the general mean effect as the following, both methomyl and chlorpyrifos were showed high and moderate percentages of the general mean (75.0 and 53.9%) respectively with significant differences in between. While abamectin, protecto, and Kz oil recorded weak and poor of general mean effect as the following (20.6, 29.4 and 17.0%), respectively with insignificant differences in between.