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Summary

Biological control of some maize pests

Maize (*Zea mays* L.) is one of the most important cereal crops in Egypt, which it conforms to wheat in the economic importance

The total cultivated area is about 2 million feddans for early (May-June) and late (July-August) plantings. The total national production of maize is about 5.3 million tons. About 2.0 million tons of maize are imported annually as the total consumption has reached 7.0 million tons.

The main objective of this work was to study the following aspects:

1- Survey of the major insect pests and mites that attack corn plants in Beni-Suif and Minia Governorates together with their associated natural enemies throughout two successive seasons 1999 and 2000.

2- Evaluation the relative susceptibility of certain maize hybrids to infestation with certain insect pests and mites and their natural enemies under natural infestation in Middle Egypt.

3- The role of the egg parasitoid, *Trichogramma evanescens* (Westwood) in suppressing the population of *Chilo agamemnon* Blesznkiy.

The obtained results are summarized as follows:

1- Surveying studies:

A survey of the insect pests and mites and associated natural enemies which were collected from maize plants during the study (1999 & 2000) in Middle Egypt.

II-Pests:

The following insect pests and mites were recorded in association with maize plants:

Agrotis ypsilon Huf., *Anacridium aegyptium*, *Chilo agamemnon* Bles., *Creontiades pallidus* Ramb., *Cryptoblabes gnidiella* Mill., *Earias insulana* Boisd., *Empoasca* spp., *Pentadon bispinosus* Kust., *Pseudonapomyza spicata* Mall.,

Gryllotalpa gryllotalpa L., *Gymnoscelis pumilata* Hb.,
Heliothis armigra Boisd., *Leucania (Mythimna) loreyi*
Dup., *Limothrips cerealium* Hal., *Nezara viridula* L., *Ostrinia*
nubilalis Hbn., *Pyroderces simplex* Wism., *Rhopalosiphum*
maidis Fitch, *Sesamia cretica* Led., *Spodoptera exigua* Hb.,
Spodoptera littoralis Boisd., *Thrips tabaci* Lind. and
Tetranychus urticae

II-Entomophagous insects:

The recorded parasitoids are:

Tachina larvarum (L.), *Lysiphlebus* sp., *Hemiptarsenus*
zilaniisebessi, *Diglyphus isaea*, *D. crassinervis*
Neochrysocharis formosa, *Haltecoptera* sp., *Conomorium*
eremita (Foerster), *Microphanurus megacephalus* (Ashmead),
Aphidencyrthus aphidivorus Mayr., *Epyris quinquecarinnatus*
Kieffer, *Phanerotoma* sp., *Apanteles ruficrus* Hal.,
Brachymeria erimtis (Fons.). *Bracon brevicornis* Wesm.,
B. hebtor Say., *Chelonus inanitus* L., *Chelonus* sp., *Meteorus*
gyrator Thun., *Meteorus* sp., *Microbracon kirkpatricki* Wikn.,
Microplitis rufiventris Kok. , *Micropletis* sp., *Pediobius*
bruchicida Rand., *Platytenomus hylas* Nixon,
Trichogramma spp.

While the predacious insects and mites insects including:

Aphidoletes aphidomyza, *Syrphus corollae* F., *Xanthogramma*
egyptium Wied., *Adonia varigata* Gueze, *Coccinella*
undecimpunctata L., *C. seppunctata* L., *Cydonia vicina*
isis Cr., *C. vicina nibtica* Cr., *Scymnus interruptus* Goeze., *S.*
syriacus Mars., *Stethorus* sp., *Peadrus alfeirii* Koch,
Phillonthus longicornis Steph., *Orius albidipennis* Reut.,
Orius laevigatus Fieb., *Chrysopa vulgaris* Schn., *Phytoseiolus*
macropilis (Banks) *Agistemus excertus*, *Steatoda triangulosa*
Walck., *Theridion spinitarse* Camb. , *Cheiracanthium jovium*
Denis , *Clubiona listeri* Audouin
Philodromus bigibbus Camb.

2-Susceptibility of maize hybrids to infestation with certain insect pests and mites and their natural enemies in Middle Egypt.

The relative susceptibility of 20 maize cultivars to infestation with certain insect pests and mites and their natural enemies were tested under natural infestation conditions at Beni-Suif and Minia Governorates in both 1999 and 2000.

1.1: Beni-Suif Governorate:

1.1.1.Single crosses:

a.C. agamemnon :

In 1999, the single crosses, 124, 129 and 155 were the most susceptible hybrids, however, the three hybrids, Bashair 13, S.C. 161 and Pioneer 3062 exhibited more resistance. During 2000, the hybrids, 124, B. 13 and 122 were the most susceptible hybrids, however, the six hybrids, 123, 155, 10, 129, 161, and Wataniah exhibited moderate resistance. On the other hand, the hybrid, Pioneer 3062 was the most resistance one.

b. O. nubilalis:

The hybrids, 161, Pioneer 3062, 129, 124 and Wataniah 4 were the most susceptible hybrids, while the hybrids, 155, 123 and B. 13 were fairly susceptible, on the other hand, the two hybrids 10 and 122 were resistant during 1999. In 2000 season, the hybrid, B. 13 was the most susceptible hybrid. The hybrids, 123, 155 and Wataniah 4 similar in the infestation level and were fairly susceptible hybrids, however, Pioneer 3062 and 161 receiving low numbers of insects. On the other hand, the three hybrids 10, 124 and 122 seem to be resistant.

c.R. maidis:

In 1999 season, the highest infestation was recorded on Pioneer 3062 followed by S.C. 155, 161, 123 and Wataniah 4. The lower infestation was recorded on the hybrids, 124, 129, 122, 10 and Bashair 13. During 2000, the highest infestation

by this pest was recorded on 161, followed by S.C. 129, Wataniah 4, 123, 122 and 124. The lower infestation was recorded on the hybrids, 10, Bashair 13 and Pioneer 3062.

d. *S. cretica*:

In 1999, the S.C., 124, 129, 123 and 161 were the most susceptible hybrids, while the four hybrids, 155, P.3062, 122 and W. 4 exhibited fairly resistance, on the other hand, the two hybrids viz., S.C. 10 and B. 13 exhibited more resistance. In 2000, the S.C., 155, 124, P.3062, Bashair 13 and 161 were the most susceptible hybrids, while the two hybrids, 129 and W. 4 exhibited fairly resistance, on the other hand, the three hybrids viz., S.C. 122, 10 and 123 exhibited more resistance.

e. *S. exigua*:

During 1999 season, S.C. 161 was the most susceptible variety to *S. exigua*. The hybrids, 155, W.4 and 122 were the least susceptible to infestation. In 2000 season, the hybrids, P. 3062, W.4, 129, 161 and 124 appeared the most susceptible to infestation, however, the hybrids, 123 and B.13 were the least susceptible to infestation.

f. *S. littoralis*:

The hybrids, 129, 161 and P. 3062 were the most susceptible to infestation. However, the hybrids, 123, 124, W.4 and 155 were fairly susceptible to infestation. On the other hand, the hybrids, 10, B.13 and 122 were the least susceptible to infestation in 1999 season. However in 2000 season, S.C. W.4 and 129 were the most susceptible varieties to the cotton leaf worm. S.C. 10, 122, 124, 155 and B.13 were moderately susceptible varieties. The hybrids, 123, 161 and P. 3062 were free from the infestation.

g. *T. urtica*:

In 1999 season, the hybrids, W. 4, 161 and 123 were highly susceptible to infestation with *T. urtica*. The hybrids 10 and 122 seem to be the least susceptible. While in 2000 season, the hybrids, 123, P. 3062, B. 13 and 161 were highly susceptible to infestation, however, the hybrids, 124, W. 4, 122

and 155 were fairly susceptible. Finally, the two hybrids 129 and 10 seem to be the least susceptible ones.

h. Parasitoids:

In 1999, the highest percentages of parasitism were recorded on the hybrids 122, 10 and 123. On the other hand, the least percentage of parasitism were recorded on the two hybrids P. 3062 and 161. During 2000, the highest parasitism was recorded on the hybrids 161, B. 13 and 155.

i. Predators:

In 1999, the single hybrids could be arranged according to the population of predators complex in the following descending order: B.13, S.C. 10, 122, 123, 124, P. 3062, 129, 161, 155 and W. 4. However, in 2000 season, the single hybrids could be arranged in the following descending order: 124, 161, 155, 123, W. 4, P. 3062, 10, 122, 129 and B.13.

1.1.2. Triple crosses:

a. *C. agamemnon* :

In 1999, the hybrids W.1 and T.C.352 were the most susceptible. On the other hand, the hybrids, T.C.322, P. 3056, 320, 321 and Nefertiti exhibited more resistance. During 2000, the hybrids, T.C.352, Nefertiti and P. 3056 received high densities. The hybrids, 310, W. 1, 323, 321 and 352 were moderately susceptible to infestation. The hybrids, 320 and 324 were the least susceptible to the infestation.

b. *O. nubilalis*:

In 1999, the hybrids, Wataniah 1, Nefertiti, 324 and 323 were the most susceptible hybrids. The hybrids, P.3056, 321 and 320 were fairly susceptible. The remained hybrids, 310, 322 and 352 seem to be resistant. During 2000, the hybrids, P.3056, Wataniah 1 and Nefertiti, 324 and were the most susceptible hybrids. The hybrids, 324, 320, 352, 322 and 310 were fairly susceptible to infestation, on the other hand, the two hybrids, 323 and 321 seem to be resistant.

c. *R. maidis*:

In 1999, T.C.324, W.1, 321, P. 3056 and 322 harbored the highest population of existed aphids. The least infestation by this pest was recorded on T.C. 352, 323, Nefertiti, 322 and 310. During 2000, T.C.322, Nefertiti and 320 harbored the highest population of existed aphids. The least population of maize aphid.

d.S. cretica:

In 1999, T.C., 323, 352 and 322 were the most susceptible hybrids. While, the four hybrids, W. 1, 321, 324 and P.3056 exhibited fairly resistance. On the other hand, the three hybrids namely, T.C. Nefertiti, 320 and 310 exhibited more resistance. During 2000, T.C., 324 and W. 1 were the most susceptible hybrids. While, the four hybrids, P.3056, 320, 321 and 322 exhibited fairly susceptible, on the other hand, the three hybrids namely, T.C. 310, 352 and Nefertiti exhibited more resistance.

e.S. exigua:

In 1999, the highest numbers of larvae were found on W.1. The lowest number was recorded on 320. The hybrids, 352, Nefertiti, 323 and 322, on the other hand, exhibited slightly higher numbers of larvae. However, the hybrids, 321, 310, P. 3056 and 324 harboured moderate numbers of insects. During 2000, the highest numbers of larvae were found on 323 and P. 3056. The hybrids, 322, W.1, 352, 321 and 320, on the other hand, exhibited slightly higher numbers of larvae. The lowest numbers were recorded on 310 and Nefertiti.

f. S. littoralis:

In 1999, the hybrids, 324, 323, 321, Nefertiti and 322 appeared the most susceptible to infestation. However, the hybrids, 352 and 310 were fairly susceptible to infestation. On the other hand, the hybrids, W.1, 320 and P. 3056 were the least susceptible to infestation. During 2000, the hybrids, 323, 352, 321 appeared the most susceptible to infestation. However, the hybrids, 321, 324, 320, 310 and P. 3056 were fairly

susceptible to infestation. On the other hand, the hybrids, W.1, 322 and Nefertiti were free from the infestation.

g. *T. urtica*:

In 1999, the tested triple hybrids could be arranged descendingly according to the population density of the two spotted spider mite as: 322,323, 310, 321, 320, 352, P. 3056, 324, Nefertiti and W.1. During 2000, the arrangement were as: hybrid 320, W.1, 352, 324, P. 3056, 323, Nefertiti, 321, 310 and 322

h. Parasitoids:

In 1999, the highest percentages of parasitism were recorded on the hybrids 320, 310 and 321. Whereas, the least percentages of parasitism were on the two hybrids 352 and Nefertiti. During 2000, the highest percentage of parasitism was recorded on the hybrids W.1 and 352. The percentages of parasitism of the hybrids P. 3056, Nefertiti, 324, 322, 310 and 321 were moderate.

i. Predators:

In 1999, the tested triple hybrids could be arranged according to the population of predators complex in the following descending order: 320, 310, 321, 323, 352, W.1, Nefertiti, P. 3056, 324 and 322. During 2000, the tested triple hybrids could be arranged the following descending order: 310, 352, 324, 320, P. 3056, W.1, 323, 321, Nefertiti and 322.

1.2: Minia Governorate:

1.2.1. Single crosses:

a. *C. agamemnon* :

In 1999, the single cross, 161 seem to be the most susceptible hybrid, however, the five hybrids, Wataniah 4, 124, Bashair 13, 155, Pioneer 3062 exhibited fairly resistance, on the other hand, the hybrids, 123, 10,129 and 122 the least susceptible. During 2000, Wataniah 4 was the most susceptible hybrid. On the contrary, 123 was highly resistance. However, both 129 and Pioneer 3062 ranked in the second class to

infestation, the remaining hybrids tested were moderate in their susceptibility to the infestation.

b. *O. nabilalis*:

In 1999, the hybrids, Pioneer 3062 and Wataniah 4 were the most susceptible hybrids, however the hybrids, B. 13, 155, 161 and 122 were fairly susceptible to infestation. On the other hand, the four hybrids, 129, 155, 10 and 123 seem to be resistant. During 2000, B. 13 and 161 the most susceptible hybrids, while, the hybrids, 122, 155 and Wataniah 4 ranked in the second class. On the other hand, 123, 129 and P. 3062 were moderate in their susceptibility. The two hybrids, 10 and 124 seem to be resistant.

c. *R. maidis*:

In 1999, the highest infestation by this pest was recorded on Pioneer 3062 followed by S.C. 124, 123, Wataniah 4, 155 and 129. The lower infestation was recorded on the hybrids, 161, 122, 10 and Bashair 13. During 2000, the highest infestation was recorded on Bashair 13, Wataniah 4 and 123 followed by S.C. 10, 124, 129, and 161. The lower infestation was recorded on the hybrids, P. 3062, 122 and 155.

d. *S. cretica*:

In 1999, the highest number the pink borer, *S. cretica* was recorded on the hybrids, B. 13 and W.4. However, the hybrids, 161, P.3062, 155 and 124 received moderate numbers. On the other hand, the four hybrids viz., S.C. 123, 129, 10 and 122 exhibited more resistance. During 2000, S.C. 10 and 155 were found harbored lower numbers. The highest number was recorded on the hybrids, B. 13, 129 and 122.

e. *S. exigua*:

In 1999, the S.C. B. 13 and 129 were the most susceptible hybrids. While, the four hybrids, 124, 155, 122 and P.3062 exhibited fairly resistance, on the other hand, the four hybrids, viz., S.C. 161, 123, W. 4 and 10 exhibited more resistance. During 2000, S.C., 161 was the most susceptible hybrid, while, the three hybrids, 124, W.4 and P.3062

exhibited fairly resistance. On the other hand, S.C. 123 appeared the least susceptible one to infestation.

f. *S. littoralis*:

In 1999, the hybrid, 124 was the most susceptible one. The hybrids, P. 3062, 155, 129, 123 and W.4 appeared fairly susceptible to infestation. However, the hybrids, 161 and B. 13 were less susceptible to infestation. On the other hand, the hybrids, 122 and 10 seemed to be resistance to the infestation. During 2000, the hybrids, 122, 161 and 124 were the most susceptible hybrids. The hybrids, 10 and 123 appeared fairly susceptible to infestation. However, the hybrids, P. 3062, B. 13 and 155 were less susceptible to infestation. On the other hand, the hybrids, 129 and W.4 seem to be resistance.

g. *T. urtica*:

In 1999, the hybrids, 124 and 161 were highly susceptible to infestation with the two spotted spider mite. The hybrids 123, 129, 10, W. 4, P. 3062 were fairly susceptible. Finally, the two hybrids 122 and B. 13 seemed to be the least susceptible ones. During 2000, B. 13, W. 4, P. 3062 and were highly susceptible to infestation with the two spotted mite. The hybrids 10 and 155 were fairly susceptible. Finally, the three hybrids 122, 126 and 123 and seem to be the least susceptible ones.

h. Parasitoids:

In 1999, the highest percentage of parasitism was noticed on the hybrids B. 13. The percentage of parasitism of the hybrids 122, 10, and 155 were moderate. On the other hand, the least percentage of parasitism were on the remaining hybrids. During 2000, the highest percentage of parasitism was observed on the hybrids 161 and 129. The percentage of parasitism of the key pests of the hybrids 155, 123, 10 and 122 were moderate. The remaining hybrids received the least percentage of parasitism .

i. Predators:

In 1999, the tested single hybrids could be arranged descendingly according to the population density of predators complex as: hybrid B. 13, 122, 10, 123, 155, P. 3062, W. 4, 129 and 124. During 2000, the predators highly recorded on B. 13, followed descendingly by P. 3062, 10 and 124. The remaining hybrids were found harbouring the least density.

Triple crosses:

a. *C. agamemnon* :

In 1999, the hybrids 324 and 323 received high densities of the lesser corn borer. The varieties coded as 310, 320, Wataniah 1 and Pioneer 3056 harbored moderate numbers. The varieties with lower density were 322, Nefertiti, 321 and 352. During 2000, T.C.322 seems to be the most susceptible hybrid, however, the four hybrids, 321, 323, 324 and 310 exhibited fairly resistance. On the other hand, the hybrids, Wataniah 1, Nefertiti, Pioneer 3056, 352 and 320 seem to be resistant,

b. *O. nubilalis*:

In 1999, the hybrids, 310, 323, 352 and Nefertiti were the most susceptible hybrids, however, the hybrids, 324 and 321 were fairly susceptible to infestation. On the other hand, the remaining hybrids, 322, P.3056, W.1 and 320 seem to be resistant. During 2000, T.C.324 was the most susceptible hybrid. The hybrids, 323, 352, Nefertiti, W.1, 322 and P.3056 were similar in their susceptibility to infestation. On the contrary, the three hybrids, 310, 320 and 321 were resistant to infestation.

c. *R. maidis*:

In 1999, the hybrids 352, 323, W.1, 323, P. 3056 and 324 received high densities of the maize aphids. The hybrids, Nefertiti, 321 and 310 were found harboured moderate numbers of the maize aphids. The least infestation was recorded on T.C. 320. During 2000, the hybrids 310, P. 3056, 324, 320 and W.1 received high densities of the maize aphids. In 2000 season, the hybrids, Nefertiti, 322, 321 and

352 were found harboured moderate numbers of the maize aphids. The least infestation by this pest was recorded on T.C. 323.

d.S. cretica:

In 1999, the mean numbers of the pink corn borer were high on T.C., 322, 310 and 324. While, the four hybrids, 352, Nefertiti, 320 and 323 exhibited fairly resistance, on the other hand, the three hybrids namely, T.C. 321, W. 1 and P.3056 exhibited more resistance. During 2000, the mean numbers of the pink corn borer were high in T.C., W. 1, 323, 320 and 322. While, the four hybrids, P.3056, Nefertiti, 321 and 310 exhibited fairly resistance. On the other hand, the two hybrids namely, T.C. 352 and 324 exhibited more resistance.

e.S. exigua:

In 1999, the highest numbers were found in W.1. The hybrids, 352, 323, Nefertiti, and 322, on the other hand, exhibited slightly higher numbers of larvae. The lowest numbers were in 321, 324, 310, 320 and P. 3056. During 2000, the highest numbers were found on 322 and W.1. The hybrids, 310 and 323, on the other hand, exhibited slightly and equal in their infestation level. On the contrary, the remaining hybrids were resistant to infestation.

f. S. littoralis:

In 1999, the hybrids, P. 3056, 322, 352 and 322 appeared the most susceptible to infestation. However, the hybrids, 320, 310, W. 1, 321, 324 with low numbers and were nearly similar on the infestation. During 2000, the hybrids, 352, Nefertiti, 320, 323, 310 and 324 appeared the most susceptible to infestation. However, the remaining hybrids were resistant.

g. T. urtica:

In 1999, the varieties coded as Nefertiti, 320 and P. 3056 harboured the highest numbers with *T. urtica*. The hybrids with moderate numbers were W.1, 321, 310, 352, and 323. The hybrids, 324 and 322 received lower density of the two spider mite. During 2000, the hybrids, W.1, 352 and Nefertiti

harboured the highest numbers of *T. urtica*. The hybrids with moderate numbers were 321, 324, 320 and P. 3056. The hybrids, 322, 310 and 323 receiving lower density.

h.Parasitoids:

In 1999, the highest percentage of parasitism was recorded on the hybrids 320, 310 and 321. The percentages of parasitism of the hybrids 322, 323, 324 and Nefertiti were moderate. On the other hand, the recorded percentages of parasitism on the key pests of the remaining hybrids P. 3056, 352 and W.1 were low. During 2000, the highest percentage of parasitism was recorded on the hybrids 352, W.1 and 324. The percentages of parasitism were moderate on the hybrids 323, P. 3056 and 310. On the other hand, the least percentages of parasitism were recorded on Nefertiti, 320 and 322.

i.Predators:

In 1999, the tested triple hybrids could be arranged in the following descending order: 320, 310, 321, 322, 323, 324, 352, Nefertiti, P. 3056 and W.1. During 2000, the tested triple hybrids could be arranged in the following descending order: 352, Nefertiti, 323, 320, 321, 324, 310, 322, P. 3056 and W.1.

3- The role of the egg parasitoid, *Trichogramma evanescens* (Westwood) in suppressing the population of *Chilo agamemnon* Blesznkiy

An experiment for releases of *T. evanescens* was carried out in maize Nili plantation. Just before release of *Trichogramma* parasitism % was 22.83 in the site of release and increased gradually to reach a maximum of 100 % in October, 1st 2000, on the other hand, parasitism % was 20.00 in the site free from release and increased gradually to reach a maximum of 49.43 % in September, 24th 2000. However, in the second year (2001) parasitism % was 20.65 in the site of release and increased gradually to reach a maximum of 100 % in September, 30th 2001, on the other hand, parasitism %

was 19.63 in the site free from release and increased gradually to reach a maximum of 53.31 % in September, 30th 2001. In parasitoid release area, there was an increase in the eggs categorized as parasitized and a decrease in the eggs hatching, due to increasing the natural role of the parasitoid. The overall percentages of parasitism were 70.95 opposed to 39.49 for control treatment, respectively, in 2000 season. Similar results were obtained in the subsequent season (2001), where that was 74.00 % in the *Trichogramma* release. The comparison value of control treatment was 44.16%.

Rate of infestation:

Maize plants of the sites free from release (check) received the highest mean numbers *C. agamemnon* larvae (59.33 and 82.0 larvae/ 40 plants in 2000 and 2001 Nili plantation, respectively). On the other hand, the opposite figures in case of the treatment by *T. evanescens* were 14.83 and 24.16 larvae/ 40 plants in the two years, respectively.