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## CHAPTER 5

### SUMMARY

Field experiments were carried out during two successive seasons of 2007 and 2008. In the growing season of 2007, the study was carried out in five field sites located in four Egyptian governorates: El-Shrouk-Noubaria (Behaira), Salhia (Esmailia), Bassyoun (Gharbia) (harvested for maize silage), 10-Bezour-Noubaria (Behaira) and Bdahel (Beni Swief) (harvested for maize grain). In the growing season of 2008, three planted locations were studied: 10-Bezour-Noubaria (Behaira), Bassyoun (Gharbia) and Bdahel (Beni-Swief) harvested for maize grain. In all locations, the *Bt* corn hybrid (MON 810 event: Ajeeb YG<sup>®</sup>) was compared with the non *Bt*-corn hybrid (Ajeeb<sup>®</sup>) as conventional plants. The recommended agricultural practices were followed during both seasons according to the recommendations of the Egyptian Ministry of Agriculture. So, this study aimed to evaluate the *Bt* hybrid plants (MON 810 event:Ajeeb YG<sup>®</sup>) under the Egyptian field conditions with the natural infestation by corn borers namely, *Sesamia cretica* Led., *Ostrinia nubilalis* (Hb.) and *Chilo agamemnon* (Bles.).

Therefore, experiments were established in the field at five locations in 2007 and three locations during 2008 planted with *Bt* and non -*Bt* varieties to study the effect of the encoding *Bt* gene in corn plants (Ajeeb YG<sup>®</sup>) as a genetically modified hybrid) and conventional non *Bt* hybrid (Ajeeb<sup>®</sup>) on the incidence of three corn borers, namely, the pink corn borer, *Sesamia cretica* Led., the purple-lined corn borer, *Chilo agamemnon* Bles. and the European corn borer, *Ostrinia nubilalis* Hbn. under Egyption field conditions, Also, the study included the ecological effects of the *Bt* corn on a certain beneficial non-target organisms such as the predaceous bug *Orius* spp. (as a naturally biological control agent) and soil micro- organism (via soil enzymes activity as an indicator of that effect). Also, the yield of grain and silage in *Bt* and non-*Bt* maize hybrids were determined. Economics, profits with reference to yield losses in *Bt* corn were also calculated and predicted. The results can be summarized as follows:

#### **5.1. Influence of the *Bt*-corn hybrid (MON 810 event:Ajeeb YG<sup>®</sup>) on the incidence of the three corn borers species in certain Egyptian governorates**

##### **5.1.1. During the growing season of 2007**

##### **5.1.1.1. The pink stem borer, *Sesamia cretica* Led.**

Generally, data indicated that there were significant differences between the infestation of *S. cretica* in *Bt* and the non *Bt* maize hybrids during the whole season in all locations. The *Bt*-plants of Ajeeb YG<sup>®</sup> hybrid gave a complete avoidance of *Sesamia cretica* infestation (0.00 larvae or pupae/plant) throughout the three growing stages of the tested corn plants in all locations, while the infestation of the pink borer *S. cretica* throughout the stage of 8-

leaves/plant in the non *Bt* hybrid was higher than the other two stages in all locations, except in El-Shrouk-Noubaria (Behaira).

During the pre-harvest stage, the mean number of larvae and/or pupae/plant in the non *Bt* hybrid was declined to 0.05, 0.68, 0.00, 0.00, 0.075 larvae/plant in 10-Bezour-Noubaria (Behaira), El-Shrouk-Noubaria (Behaira), Salhia (Esmailia), Bassyoun (Gharbia) and Bdahel (Beni Swief), in respect. Meanwhile, at the flowering stage, the mean number of living larvae and/or pupae/plant was 0.10, 1.05, 0.33, 0.15 and 1.15 in 10-Bezour-Noubaria (Behaira), El-Shrouk-Noubaria (Behaira), Salhia (Esmailia), Bassyoun (Gharbia) and Bdahel (Beni Swief), respectively. The relative high infestation of *S. cretica* at this stage of the non *Bt* hybrid was noticed at Beni Swif governorate (the only inspected location in the Upper Egypt).

#### **5.1.1.2. The purple-lined corn borer, *Chilo agamemnon* Bles.**

The living larvae or pupae/plant of *C. agamemnon* in the *Bt* hybrid throughout the whole season at the three inspected plant growing stages in all locations was 0.00. It was obvious that the infestation by this insect at the 8-leaves stage wasn't observed in all locations cultivated by both hybrids, except Bassyoun (Gharbia) that showed 0.18 living larvae or pupae/plant in the non *Bt* hybrid. In relation to the pre-harvest stage, a relatively decreased infestation was observed. The corresponding mean values were 0.48, 0.25 and 0.05 larvae or pupae/plant for 10-Bezour, Bdahel and El-Shrouk, respectively. No infestation evidence of *C. agamemnon* was recorded in this stage for Ajeeb<sup>®</sup> hybrid in Salhia and Bassyoun. However, the infestation of *C. agamemnon* at the flowering stage was significantly increased in the non *Bt* hybrid in all locations, except Salhia (Esmailia) and Bassyoun (Gharbia), where the infestation was 0.00%. The infestation was 1.28, 0.35 and 0.20 living larvae or pupae/plant for the field sites of 10-Bezour-Noubaria (Behaira), Bdahel (Beni Swief) and El-Shrouk-Noubaria (Behaira), respectively.

#### **5.1.1.3. The European corn borer, *Ostrinia nubilalis* Hbn.**

The *Bt*-plants of Ajeeb YG<sup>®</sup> hybrid gave a complete avoidance of *C. agamemnon* infestation (0.00 larvae or pupae/plant) throughout the three growing stages of the tested corn plants in all locations. The infestation of *O. nubilalis* in the conventional hybrids was the highest compared with *S. cretica* and *C. agamemnon*. In the flowering stage, (early infestation) infestation rates were 3.7, 1.95 and 0.45 living larvae or pupae/plant in Salhia, Bassyoun and bdahel, respectively. However, the infestation rate was also detected in all locations throughout the pre-harvest stage. The mean numbers of living larvae or pupae were 4.25, 2.78, 1.13, 0.60 and 0.58/plant in Salhia, Bassyoun, El-Shrouk, Bdahel and 10-Bezour, respectively.

#### **5.1.1.4. Summing up the infestation levels of each corn borer all over the whole season of 2007**

The *Bt* corn plants showed a complete defense to the infestation by the three corn borers due its content of *Bt* toxin throughout the whole season (0.00 larvae or pupae/plant) in all locations. Vice versa, the non *Bt* corn plants were more susceptible to the infestation of the three corn borers for the three inspected stages. The calculated total mean number of *S. cretica* all over the whole season were 2.54, 2.18, 1.95, 1.69 and 0.72/plant in Bdahel, El-Shrouk, Bassyoun, Salhia and 10-Bezour, respectively. Moreover, Salhia (Esmailia) and Bassyoun

(Gharbia) registered the highest infestation of 7.95 and 4.73 larvae or pupae of *O. nubilalis* /plant, respectively.

In respect to the infestation by *C. agamemnon*, 10 -Bezour-Noubaria (Behaira) showed the highest infestation (1.75 larvae or pupae/plant), while Salhia (Esmailia) was free from this insect pest.

The high infestation expressed as the mean number of the three corn borers together in the non *Bt* hybrid was 9.64 in Salhia, followed by 6.86, 4.24, 3.56 and 3.09 larvae or pupae/plant in Bassyoun , Bdahel , El-Shrouk-Noubaria and 10-Bezour-Noubaria ,respectively.

In general, the above mentioned data demonstrated that the non *Bt* corn was highly susceptible to the infestation with the three corn borers in all locations in different governorates especially Esmailia, Gharbia and Beni-Swief, while the *Bt* corn was totally free from the infestation with the three corn borers.

### **5.1.2. During the growing season of 2008.**

#### **5.1.2.1. The pink stem borer, *Sesamia cretica* Led.**

The *Bt* corn plants clarified a complete resistance to the infestation of *S. cretica* throughout the 8-leaves stage (0.00 larvae or pupae/plant) in all locations. On the other hand, the high mean rates of *S. cretica* infestation were observed at the 8-leaves stage of the tested non *Bt* hybrid (Ajeeb<sup>®</sup>) recording 0.60, 1.60 and 1.50 larvae or pupae/plant in 10-Bezour-Noubaria, Bassyoun and Bdahel , respectively. Slight infestation rate was observed in the flowering and/or the pre-harvest stages. The mean number of larvae or pupae/plant in the non *Bt* corn (Ajeeb<sup>®</sup>) in Behaira, Gharbia and Beni Swief governorates were 0.20, 0.10 and 0.00, respectively. In the pre-harvest stage, the infestation was only detected in 10-Bezour-Noubaria (Behaira) giving 0.13 larvae or pupae/plant.

#### **5.1.2.2. The purple-lined corn borer, *Chilo agamemnon* Bles.**

There was no infestation of *C. agamemnon* at the 8-leaves stage observed in the *Bt* and non *Bt* hybrids among the three locations (0.0 larvae/plant). There weren't any remarkable infestation symptoms in both *Bt* plants. The infestation of *C. agamemnon* has been started during the flowering stage and the mean numbers of larvae/plant in the non *Bt* corn (Ajeeb<sup>®</sup>) at Behaira, Gharbia and Beni- Swief were 0.93, 0.30 and 0.40, respectively. The mean number of *C. agamemnon* larvae/plant during the pre-harvest stage was 1.94 in Gharbia followed by 0.20 in Beni Swief.

#### **5.1.2.3. The European corn borer, *Ostrinia nubilalis* Hbn.**

The infestation rate of *O. nubilalis* in non *Bt* corn (Ajeeb<sup>®</sup>) was relatively higher in the pre-harvest stage than in the flowering one at all locations. The mean number of living larvae or pupae/plant in flowering stage was 0.13, 0.70 and 0.30 in 10-Bezour-Noubaria (Behaira), Bassyoun (Gharbia) and Bdahel (Beni Swief), respectively.

The infestation level increased gradually in the non *Bt* (Ajeeb<sup>®</sup>) with the progress of plant growing from flowering to pre-harvest stage whereas, the mean number of living larvae

or pupae/plant reached 1.00, 1.47 and 0.70 in Behaira, Gharbia and Beni Swief governorates, respectively.

#### **5.1.2.4. Summing up the infestation levels of each corn borer all over the whole season of 2008**

There were no any remarkable infestation symptoms has occurred in *Bt* plants showing 0.00 infestation rate for the two locations, 10-Bezour-Noubaria (Behaira) and Bassyoun (Gharbia), while a total of 0.025 larvae of *C.agamemnon* /plant was observed through the flowering stage at Bdahel (Beni Swief) . It was obvious also that a high infestation of *S. cretica*, *C. agamemnon* and *O. nubilalis* was detected in Bassyoun (Gharbia) giving 1.70, 2.24 and 2.17 larvae or pupae/plant, respectively.

The total of the mean numbers of larvae or pupae/plant in the three inspected periods at 10-Bezour-Noubaria (Behaira), Bassyoun (Gharbia) and Bdahel (Beni Swief) were 2.99, 6.11 and 3.10 for the same insects, respectively.

#### **5.1.2.5. The mean number of holes at the pre-harvest stage during both seasons (2007and 2008)**

The mean number of holes/plant was recorded only at the pre-harvest stage during both seasons (2007 and 2008) in both hybrids.

The mean number of holes/plant during the pre-harvest stage in the non *Bt* corn (Ajeeb<sup>®</sup>) was 5.95 at Salhia , followed in a descending order by 4.92 at Bassyoun , 4.30 at El-Shrouk-Noubaria , 3.82 at Bdahel and 3.60 at 10-Bezour-Noubaria. Generally, there were significant differences between *Bt* and the non *Bt* maize hybrids. No holes were observed in the *Bt* hybrid in all field sites. In the season of 2008, the *Bt* plants of Ajeeb YG<sup>®</sup> were found to be totally free from any holes in 10-Bezour-Noubaria (Behaira) and Bassyoun (Gharbia), while there was insignificant number ( 0.03 holes/plant) in Bdahel (Beni Swief). On the other side, the non *Bt* corn (Ajeeb<sup>®</sup>) showed 13.87 at Bassyoun (Gharbia), 3.40 at 10-Bezour-Noubaria (Behaira) and 0.80 holes/plant at Bdahel (Beni Swief).

## **5.2. Ecological effects of the *Bt* gene in the corn hybrid (Mon 810: Ajeeb YG<sup>®</sup>) on non-target organisms**

### **5.2.1. Effect of the *Bt* gene in the corn hybrid (Mon 810: Ajeeb YG<sup>®</sup>) on the inspected *Orius* spp. bug**

There are no side effects were observed in the abundance of *Orius* spp. in *Bt* maize (Ajeeb YG<sup>®</sup>) compared with the non-*Bt* maize (Ajeeb<sup>®</sup>) during both studied years in all sites except the site of El-Shrouk-Noubaria, (Behaira Gov.) in 2007 season. On the contrary, the numbers of the *Orius* adults were significantly increased in the *Bt* maize plants over those recorded in the non *Bt* plants among most of the studied sites. In general, Bdahel (Beni-Swief Gov.) recorded the highest mean number over all sites in *Bt* or non *Bt* hybrids along both seasons. However, 10- Bezour site recorded the least record in both seasons for both hybrids.

In the season of 2007, the mean numbers of *Orius* adults/ plant increased significantly in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) to be more than those in the non *Bt* corn hybrid (Ajeeb<sup>®</sup>) in three sites: Salhia (Esmailia Gov.), Bassyoun (Gharbia Gov.) and Bdahel (Beni-Swief Gov.) giving 3.0, 2.75 and 5.25 in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) versus 1.50, 0.75 and 3.50 adult/plant of the non *Bt* corn hybrid (Ajeeb<sup>®</sup>) in the three sites. There were insignificant differences between the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) in El-Shrouk site showing 2.25 adults/plant for both studied hybrids. The results suggest that *Bt* corn does not have a significant effect on the predator *O. insidiosus*.

The only exception was recorded in the 10- Bezour site, whereas, the *Orius* adults /plant were increased in the non *Bt* hybrid (0.50) more than those in the *Bt* hybrid (0.0).

In the second season of 2008, the mean numbers of *Orius* adults/ plant increased significantly in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) over those in the non *Bt* corn hybrid (Ajeeb<sup>®</sup>) in all studied sites. The mean numbers of *Orius* adults were 1.25 and 1.00/ plant for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non *Bt* corn hybrid (Ajeeb<sup>®</sup>), respectively in 10- Bezour.

In Bassyoun, the mean number of *Orius* adults was 2.25 in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) versus 1.50/ plant in the non *Bt* corn hybrid (Ajeeb<sup>®</sup>). The highest mean number (4.50 and 2.25 *Orius* adults/ plant) were inspected in Bdahel sit for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non *Bt* corn hybrid (Ajeeb<sup>®</sup>), in respect.

In general, the data indicated that the cultivation of the *Bt* corn plants didn't cause any side effects on the predator *Orius* spp., but it significantly increased the adults of *Orius* spp. in almost all sites.

### **5.2.2. Effect of the *Bt* gene in the corn hybrid (Mon 810: Ajeeb YG<sup>®</sup>) and insecticide-treated conventional plants (Ajeeb<sup>®</sup>) on the activity of soil enzymes (dehydrogenase, urease and phosphatase)**

The effect of the *Bt* corn (Ajeeb YG<sup>®</sup>) and the treated conventional corn plants (Ajeeb<sup>®</sup>) on the activity of different soil enzymes: dehydrogenase, urease, and phosphatase was studied in a clay and sandy loam soils throughout the season of 2007. Soil samples were collected after 30, 60 and 90 days post-sowing. Generally, there were no significant differences between the *Bt* and non *Bt* hybrids on the activity of urease and phosphatase enzymes throughout the three detected periods (30, 60 and 90 days) in both types of soil. Regarding the activity of dehydrogenase enzyme, the data show that there were no significant differences between the *Bt* and non *Bt* hybrids after 60 and 90 days post-sowing. However, the only significant differences were observed after 30 days in both clay and sandy soils. It was noticed that urease activity was higher in the clay soil compared with the sandy one. Also, in both soils and after 30 days post-planting, urease activity was higher in the soil planted with non-*Bt* corn (Ajeeb<sup>®</sup>). Contrary, urease activity was found to be higher in *Bt*-corn (Ajeeb YG<sup>®</sup>) soils when it was determined in both soils 60 and 90 days post-planting and compared with those soils planted with non-*Bt* corn (Ajeeb<sup>®</sup>). The lower urease activity in non *Bt* insecticide treated corn could be due to the side effect of the applied insecticide that has been used for controlling the corn borers.

### **5.3. Effect of the *Bt* gene in the corn hybrid (MON 810 event: Ajeeb YG<sup>®</sup>) on the yield components**

#### **5.3.1. Season 2007**

##### **5.3.1.1. Weight of plants with cobs, ear infestation, weight of dried grains, shelling, adjusted grain and the percentage of increase**

The mean weight of 10 corn plants with cobs (Kg) was highly significant in the Ajeeb YG<sup>®</sup> hybrid (MON810 event) compared with the treated conventional hybrid (Ajeeb<sup>®</sup>) in all locations. The mean weight with cobs was 14.42 in Ajeeb<sup>®</sup> and 16.00 Kg for Ajeeb YG<sup>®</sup> hybrid in El-Shrouk-Noubaria (Behaira Gov.). In Bassyoun (Gharbia Gov.), the mean weight of 10 corn plants with cobs was 15.17 and 12.17 Kg for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), respectively. The mean weight of 10 corn plants with cobs were 10.88 and 9.35 Kg for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) in Bdahel (Beni-Swief Gov.), successively.

No ears infestation was observed in the *Bt* hybrid (Ajeeb YG<sup>®</sup>) in all the assigned field sites. There were no any remarkable ear infestation symptoms in case of the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>), in the sense of 0.00% ear infestation. The ears infestation percentages were 27.06, 35.43 and 45.71 in the treated non-*Bt* hybrid (Ajeeb<sup>®</sup>) in Bdahel (Beni-Swief Gov.), Bassyoun (Gharbia Gov.) and El-Shrouk-Noubaria (Behaira Gov.), subsequently.

For corn grain purpose in Bdahel, there were significant differences between the mean dried weights (Kg) of *Bt* corn and the non-*Bt* corn hybrids yield. It was found that the dried grain yield significantly increased in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) giving 3.35 Kg/10 plants, versus 2.70 Kg/10 plants in the treated non-*Bt* hybrid (Ajeeb<sup>®</sup>).

Differences between *Bt* and the non-*Bt* corn hybrids were not significant for the shelling percentage in two locations: El-Shrouk- and Bassyoun. The mean weights of grain/10 plants were 1.45 and 1.54 Kg in the treated non-*Bt* hybrid (Ajeeb<sup>®</sup>) and the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>), respectively, in El-Shrouk. The mean weights of grain/10 plants were 1.17 and 1.06 Kg in the treated non-*Bt* hybrid (Ajeeb<sup>®</sup>) and the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) in Bassyoun, in respect.

For corn grain purpose, there were significant differences between *Bt* and the non-*Bt* corn hybrids concerning the shelling percentage in Bdahel, which was 85.03% in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and 82.82% in the non-*Bt* hybrid (Ajeeb<sup>®</sup>).

The percentage increase of silage yield for the *Bt* corn (Ajeeb YG<sup>®</sup>) represented by 10.95% to 24.65% more than the non-*Bt* hybrid (Ajeeb<sup>®</sup>) in El-Shrouk and Bassyoun localities, respectively. The percentage increase in grain for the *Bt* corn (Ajeeb YG<sup>®</sup>) was 18.77% more than that of the non-*Bt* hybrid (Ajeeb<sup>®</sup>). In short, encoding the *Bt* gene in a hybrid does not increase yield, but the increase might be due to the only aids in preventing the yield losses as a result of borers infestation.

Regarding the *Bt* corn for grain yield in Bdahel, the adjusted grain increased significantly in the *Bt* corn (Ajeeb YG<sup>®</sup>) over the treated non-*Bt* hybrid (Ajeeb<sup>®</sup>) and that



might owing to the influence of the *Bt* gene that subsequently affected the adjusted grain yield. The *Bt* hybrid (Ajeeb YG<sup>®</sup>) had the highest adjusted grain yield (2.53 kg/10 plants), while it was 2.13 kg/10 plants for the non-*Bt* hybrid (Ajeeb<sup>®</sup>). In both El-Shrouk and Bassyoun where corn plants were harvested for silage purpose, there were no significant differences between *Bt* and the non-*Bt* corn hybrids regarding the adjusted grain yield

### 5.3.2. Season 2008

#### 5.3.2.1. Number of ears/plant, percentage of ears infestation and dry weight of grain/10 plants

The increase number of ears/plant of *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) was significant over that the untreated non-*Bt* (Ajeeb<sup>®</sup>) and the treated non-*Bt*. The mean number of ears/plant in *Bt* corn was significantly more than that non-*Bt* corn. Moreover, the treated *Bt* corn: Ajeeb YG<sup>®</sup> - fenitrothion and Ajeeb YG<sup>®</sup> - chlorpyrifos methy had significantly more ears than the untreated non-*Bt* (Ajeeb<sup>®</sup>), Ajeeb<sup>®</sup> - fenitrothion and Ajeeb<sup>®</sup> - chlorpyrifos .

High differences occurred between the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) and the percentages of ears infestation were 30.00, 8.82 and 26.60 % in the treated non-*Bt* hybrid Ajeeb<sup>®</sup> - fenitrothion, Ajeeb<sup>®</sup> - chlorpyrifos and untreated non-*Bt* hybrid (Ajeeb<sup>®</sup>), respectively, while in *Bt* corn (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> - fenitrothion and Ajeeb YG<sup>®</sup> - chlorpyrifos , there were no any ear infestation symptoms.

There was a positive significant effect regarding *Bt* hybrid (Ajeeb YG<sup>®</sup>) in relation to the mean dry weights of grain/10 plants. The dry weights of grain were 1.37, 0.95, 0.89, 0.64, 0.55 and 0.50 Kg/10 plants for Ajeeb YG<sup>®</sup> - fenitrothion, *Bt* corn hybrid (Ajeeb YG<sup>®</sup>), Ajeeb<sup>®</sup> - fenitrothion, Ajeeb YG<sup>®</sup> - chlorpyrifos , Ajeeb<sup>®</sup> - chlorpyrifos and the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), in respect.

### 5.4. Effect of encoding *Bt* gene (Cry1 Ab) in the corn hybrid (MON 810 event: Ajeeb YG<sup>®</sup>) on the incidence of plants dead hearts

In 2008 season, the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) were planted in Alexandria Gov. to study the effect of encoding *Bt* gene in the corn hybrid (MON 810 event: Ajeeb YG<sup>®</sup>) and the efficacy of certain insecticides (fenitrothion and chlorpyrifos ) on the incidence of dead hearts as a result of *S. cretica* infestation and therefore the yield performance and yield loss were considered.

There were significant differences among all treatments on the incidence of the mean number of dead hearts/100 plants after the 1<sup>st</sup> spray, with no remarkable symptoms of the dead hearts have been occurred in the *Bt* plants (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> treated with fenitrothion and/or chlorpyrifos . The mean numbers of dead hearts were 10.00, 11.00 and 13.00 in Ajeeb<sup>®</sup> treated with fenitrothion, Ajeeb<sup>®</sup> treated with chlorpyrifos and the untreated Ajeeb<sup>®</sup>, respectively.

Regarding the reduction percentage after 21 days from the 1<sup>st</sup> spray, the *Bt* plants (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> treated with fenitrothion and Ajeeb YG<sup>®</sup> treated with chlorpyrifos gave

the highest reduction (100%), followed by Ajeeb<sup>®</sup> treated with fenitrothion (23.05%). Ajeeb<sup>®</sup> treated with chlorpyrifos was the least effective treatment giving 15.38% reduction of dead heart plants.

The mean number of dead hearts/100 plants after the 2<sup>nd</sup> spray were highly significant in the three treatments giving 10.66, 15.00 and 17.66 for Ajeeb<sup>®</sup> - fenitrothion, Ajeeb<sup>®</sup> - chlorpyrifos and the untreated Ajeeb<sup>®</sup>, respectively, while in the *Bt* corn there were no any remarkable dead hearts symptoms had occurred in the *Bt* hybrid (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> - fenitrothion and Ajeeb YG<sup>®</sup> - chlorpyrifos, which showed no dead hearts.

The reduction percentages of the mean number of dead hearts/100 plants were 100% for the *Bt* corn (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> - fenitrothion and Ajeeb YG<sup>®</sup> - chlorpyrifos. However, the insecticide treatments gave low reduction percentages of 39.64 and 15.07 for Ajeeb<sup>®</sup> - fenitrothion and Ajeeb<sup>®</sup> - chlorpyrifos, successively.

At harvesting, there were no any dead hearts plant had been noticed in the *Bt* hybrid (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> - fenitrothion and Ajeeb YG<sup>®</sup> - chlorpyrifos, while the mean number of dead hearts/100 plants were 10.00, 12.66 and 17.00 for the non-*Bt* corn (Ajeeb<sup>®</sup>) - fenitrothion, (Ajeeb<sup>®</sup>) - chlorpyrifos and the untreated check (Ajeeb<sup>®</sup>), in respect.

The yield loss percentage of plants was estimated on the basis of the mean number of dead hearts/100 plants in the field. Results showed no yield loss reductions in the treatments of the *Bt* hybrid (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> - fenitrothion and Ajeeb YG<sup>®</sup> - chlorpyrifos. In other words, the obtained results indicated positive increase of corn yield. In the non-*Bt* corn Ajeeb<sup>®</sup> - fenitrothion, Ajeeb<sup>®</sup> - chlorpyrifos and untreated (Ajeeb<sup>®</sup>), the yield loss percentages of plants were 10.00, 12.66 and 17.00%, subsequently.

## **5.5. Economics and profits of *Bt*-corn hybrid (MON 810 event: Ajeeb YG<sup>®</sup>)**

For the first time in Egypt, economics of the *Bt* corn hybrid (MON 810 event: Ajeeb YG<sup>®</sup>) have been studied. These economics are of great importance in turn for the extension officers who will guide the small holder growers.

### **5.5.1. Season of 2007**

#### **5.5.1.1. Bdahel (Beni-Swief Gov.)**

The gross income / fed were L.E 9000 and 7500 for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), respectively. The net returns were calculated on the grain yield wholesale price of L.E 1500 /ton. The total costs / fed. were L.E 540 and 650 for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), in respect. In the light of the obtained data, it was apparent that the maximum net returns were gained in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) giving L.E 8460/fed. The additional returns over the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) was L.E 1610 in the 2007 year. The profit of one Egyptian pound (L.E) investment in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) was L.E 2.99.

#### **5.5.1.2. Bassyoun (Gharbia Gov.)**

The economics and profits of *Bt*-corn hybrid plants (Ajeeb YG<sup>®</sup>) that harvested for silage purpose have been determined. The gross income / fed was L.E 9000 and 7200 for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), subsequently. The value for corn as silage was L.E 200/ton. The total costs / fed. were L.E 630 and 720 for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), successively.

The gained maximum net returns in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) were L.E 8370/fed. In general, it could be concluded that the corn yield increase in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and that due to the full protection from corn borers' infestation.

The additional return over the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) was L.E 1890/fed. in the 2007 year. The profit of one Egyptian pound investment in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) amounted to L.E 2.99.

#### **5.5.1.3. El-Shrouk- Noubaria (Behaira Gov.)**

Corn hybrid plants (Ajeeb YG<sup>®</sup>) that harvested for silage purpose gave a gross income / fed of L.E 9600 and L.E 8600 for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the insecticide treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), respectively. The total costs were L.E 630 & 720 / fed. for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), subsequently.

The gained maximum net returns in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) was L.E 8970/fed. The additional return over the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) was L.E 1090/fed. in the 2007 year. The profit of one Egyptian pound (L.E) investment in the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) gave rise to L.E 1.74.

#### **5.5.1.4. Relationship between the infestation of corn hybrids and the abovementioned particulars of the economics and profits.**

The gross income, net returns, the additional return and the profit of one Egyptian pound (L.E) of the *Bt*-corn hybrid (Ajeeb YG<sup>®</sup>) were generally higher than that of the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), when the corn borer infestation was high, but were either similar to the treated non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) when the corn borer infestation was low.

The increase in the *Bt* corn hybrid plants (Ajeeb YG<sup>®</sup>) which were harvested for silage was 9.00 metric ton/ fed. over the non- *Bt* corn hybrid (Ajeeb<sup>®</sup>) in El-Shrouk. On the other hand, that increase of the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) was 5.00 metric ton /fed. over the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) in Bassyoun site. These increases led to increases in gross income, net returns, the additional return and the profit of one Egyptian pound (L.E) of the *Bt*-corn hybrid (Ajeeb YG<sup>®</sup>). Gross income / fed were L.E 9600 & L.E 9000 in El-Shrouk and Bassyoun, in respect.

The additional returns were L.E 1890 & L.E 1090 and profits were L.E 3.00 & 1.74 for El-Shrouk & Bassyoun, respectively.

## 5.5.2. Season of 2008

### 5.5.2.1. Abis (Alexandria Gov.)

The economics and profits of *Bt* corn hybrid (Ajeeb YG<sup>®</sup>), Ajeeb YG<sup>®</sup> - fenitrothion, Ajeeb YG<sup>®</sup> - chlorpyrifos, non-*Bt* hybrid: Ajeeb<sup>®</sup> - fenitrothion and Ajeeb<sup>®</sup> - chlorpyrifos, were determined after the end of the growing season of 2008.

The gross incomes / fed were 2895, 4935, 1725, 2310, 3420 and 1494 L.E for Ajeeb<sup>®</sup> - fenitrothion, Ajeeb YG<sup>®</sup> - fenitrothion, Ajeeb<sup>®</sup> - chlorpyrifos, Ajeeb YG<sup>®</sup> - chlorpyrifos, *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), in respect. The grain value for corn grain was L.E 1500/ton and the total costs / fed. were L.E 640, 760, 650, 770, 540 and 420 L.E for Ajeeb<sup>®</sup> - fenitrothion, Ajeeb YG<sup>®</sup> - fenitrothion, Ajeeb<sup>®</sup> - chlorpyrifos, Ajeeb YG<sup>®</sup> - chlorpyrifos, *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), respectively.

The gained maximum net returns in Ajeeb<sup>®</sup> YG<sup>®</sup> - fenitrothion was L.E 4175/fed., followed by L.E 2880/fed and L.E 2255/fed. for the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and Ajeeb<sup>®</sup> YG<sup>®</sup> - chlorpyrifos. In the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), Ajeeb<sup>®</sup> - fenitrothion and Ajeeb<sup>®</sup> - chlorpyrifos, the maximum gained net returns were 1074, 2255 and 1075 L.E in respect. In this concept, Ajeeb YG<sup>®</sup> treated with fenitrothion gave more net returns than the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>). It could be included that the increase of net returns was also due to the effects of the used insecticide on the other coincided non-target pests (Aphid, Thrips and *Heliothis zea*).

The additional returns over the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>) were 1181, 3101, 1.00, 466 and 1806 L.E /fed for Ajeeb<sup>®</sup> - fenitrothion, Ajeeb YG<sup>®</sup> - fenitrothion, Ajeeb<sup>®</sup> - chlorpyrifos, Ajeeb YG<sup>®</sup> - chlorpyrifos, *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) and the non-*Bt* corn hybrid (Ajeeb<sup>®</sup>), in respect. The profits of one Egyptian pound (L.E) investment in the Ajeeb<sup>®</sup> - fenitrothion, Ajeeb YG<sup>®</sup> - fenitrothion, Ajeeb<sup>®</sup> - chlorpyrifos, Ajeeb YG<sup>®</sup> - chlorpyrifos and the *Bt* corn hybrid (Ajeeb YG<sup>®</sup>) were 1.85, 4.08, 0.002, 0.60 and 3.35 L.E, in respect.