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Ecological and biological studies on the main insect pests infesting sugar beet plants and their associated natural enemies

By

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5. SUMMARY

The present experiments were carried out at the experimental farm of Sakha Agricultural Research Station, Kafr El-Sheikh governorate during the two successive sugar beet seasons, 2018/19 and 2019/20.

The aim of the present studies were conducted to investigate the following objectives:

1. The population density of the main insect pests infesting sugar beet in different planting dates.
2. The relationship between the population density and the abiotic factors (temperature and relative humidity) during the two successive seasons.
3. The seasonal activity of the main associated predators.
4. The percentage of parasitism caused by the main insect parasitoids associated with the main insect pests.
5. The efficiency of some insecticides on certain sugar beet insect pests.
6. Effect of the host plants on the female fecundity and fertility, immature development and adult longevity of *P. mixta* and *P. hyoscami* under lab conditions.

The obtained results can be summarize as follow:

5.1. The main insect pests.

5.1.1. The cowpea aphids, *Aphis craccivora* Koch.

The cowpea aphid, *A. craccivora* reached the highest peak of abundance during the first season, 2018/19 (58, 27, 1264 and 5591 indiv./100 leaves) in August, September, October and November plantations, respectively. Meanwhile, during the second season, 2019/20 *A. craccivora* reached the highest peak of abundance which represented by 50, 35, 485 and 25027 indiv./100 leaves in the four plantations, respectively.

In respect to, the seasonal average number of *A. craccivora* in different sugar beet plantations, the obtained results revealed that, the highest seasonal average number recorded in November plantation (682.1±420.1 and 2232.1±1542.1 indiv.) followed by October plantation, and presented by 115.3±111.2 and 70.1±53.0 indiv., respectively during the two seasons. Statistical analysis revealed that, highly significant differences among different plantation during the two successive seasons 2018/19 and 2019/20.

In the first season, 2018/19, the mean temperature was effected positively significant on *A. craccivora* in all planting dates. The relationship between *A. craccivora* and relative humidity was a negative significant in August and November plantation. While in the second season 2019/20, temperature was effected negatively significant effects in August and September plantation, positively significant in November plantation. The relationship between *A. craccivora* in and relative humidity was a negative significant in October plantation.

5.1.2. The green peach aphids, *Myzus persicae* (Sulzer).

The green peach aphid, *M. persicae* reached the highest peak of abundance during the successive seasons (55, 47, 182 and 71 indiv./100 leaves) and (73, 49, 332 and 487 indiv./100 leaves), in August, September, October and November plantation, respectively.

Concerning the seasonal average number of *M. pesicae* in different sugar beet plantations, the obtained results revealed that, the highest seasonal average number recorded in October plantation (33.3±17.9 and 76.9±41.4 indiv.) followed by November represented by 21.2±6.2 and 63.3±48.6 indiv. during the two seasons, respectively .

During the first season, there is no effect of temperature as well as relative humidity in *M. persicae* population. While in the second season, *M. persicae* was a negatively correlated with temperature being highly

significant in September and November plantation and a negatively correlated being significant in October plantation. There was a significant correlated with relative humidity in October and November plantation.

5.1.3. The southern green stink bug, *Nezara viridula* (L.)

The southern green stink bug, *N. viridula* reached the highest peak of abundance during the first and the second seasons which represented by (13, 15 47 and 64 indiv./100 leaves) and (28, 28, 54 and 210 indiv./100 leaves) in August, September, October and November plantation, respectively.

Regarding the seasonal average number of *N. viridula* in different sugar beet plantations, the obtained results indicated that, the highest seasonal average number recorded in November plantation (19.8±7.2 and 39.6±26.7 indiv.) followed by October presented by 14.3±5.8 and 15.8±5.7 indiv. during the two seasons, respectively.

In the first season, the mean temperature was effected a highly positive significant on *N. viridula* in October and November plantation. Concerning to relative humidity, in November plantation it was a negative which was highly significant. While, in the second season, temperature effect positively significant in August, September and November plantation, Concerning to relative humidity, there was a highly significant negative effect in October and November plantation.

5.1.4. The cotton leafworm, *Spodoptera littoralis* (Boisd.)

The cotton leafworm, *S. littoralis* reached the highest peak of abundance during the two seasons of study represented by (108, 30, 23 and 25 larvae./100 leaves) and (356, 97, 66 and 33 larvae/100 leaves) in August, September, October and November plantation, respectively.

With regard to the seasonal average number of *S. littoralis* in different sugar beet plantations, it was obvious that, the highest seasonal average number recorded in August plantation (16.9±7.5 and 66.4±38.6

larvae.) followed by September presented by 8.5±4.2 and 19.4±10.4 larvae., during the two seasons, respectively.

There was a positive highly significant effects between *S. littoralis* and temperature in August and September plantation and was a negative highly significant in November plantation. On the other hand, the relationship between *S. littoralis* and relative humidity was significantly negative in August plantation during the first season. In the second season, there was a positive highly significant effects between *S. littoralis* and temperature in August and September plantation and a negative significant in November plantation. On the other hand, the relationship between *S. littoralis* and relative humidity was highly significantly positive in November plantation.

5.1.5. The cotton mealy bugs, *Phenococcus solenopsis* Tinsley

The cotton mealy bug, *P. solenopsis* reached the highest peak of abundance during the first and the second season (24, 45, 13 and 28 indiv./100 leaves) and (36, 32, 20 and 41 indiv./100 leaves) in August, September, October and November plantation, respectively.

Regarding to the seasonal average number of *P. solenopsis* in different sugar beet plantations, the obtained results indicated that, the highest seasonal average number recorded in August plantation (13.5±3.4 and 14.9±3.8 indiv.) followed by September represented by 11.9±5.5 and 12.7±2.9 indiv. during the two seasons, respectively.

There was a positive significant correlation between *P. solenopsis* and temperature in August and September plantation. But there was a highly negative significant correlation in November plantation. There was a highly positive significant correlation between *P. solenopsis* and relative humidity in November plantation during the first season. There was a highly positive significant correlation between *P. solenopsis* and temperature in August plantation and a highly negative significant

correlation in November plantation, in the second season. There was a positive significant correlation between *P. solenopsis* and relative humidity in September and November plantation, a negative significant correlation in August plantation, during the second season.

5.1.6. The sugar beet fly, *Pegomia mixta* Vill.

The sugar beet fly, *P. mixta* reached the highest peak of abundance during the first season 186, 367, 466 and 390 larvae/100 leaves in August, September, October and November plantations, respectively. Meanwhile, during the second season *P. mixta* reached the highest peak of abundance which represented by 220, 142, 253 and 400 larvae/100 leaves in the four plantations, respectively**.**

In respect to, the seasonal average number of *P. mixta* in different sugar beet plantations, the obtained results revealed that, the highest seasonal average number recorded in November plantation (181.4±44.4 and 138.2±40.2 larvae) during the two seasons followed by September, plantation and presented by 168.5±52.3 larvae in the first season and October plantation presented by 111.3±18.8 larvae in the second season.

There were a highly negative significant effects between *P. mixta* and the mean temperature in August, September and November plantation. The relationship between *P. mixta* and relative humidity was a positive significant in September and November plantation during the first season 2018/19. In the second season, there was no effect of Temperature in *P. mixta* population in all planting dates. The relationship between *P. mixta* and relative humidity was a negative significant in October plantation.

5.1.7. The sugar beet beetle, *Cassida vittata* Vill.

The sugar beet beetle, *C. vittata* reached the highest peak of abundance (224 and 128 indiv./100 leaves) and (216 and 199 indiv./100

leaves) in October and November plantations, during the two successive seasons, respectively.

In respect to, the seasonal average number of immature stages of *C. vittata* in different sugar beet plantations, the obtained results revealed that, the highest seasonal average number recorded in October plantation (30.6±29.0 indiv.) followed by November plantation (29.5±19.5 indiv.) during the first season. Moreover the highest seasonal average number of *Cassida vittata* recorded in November plantation (54.4±32.3 indiv.) followed by October plantation (35.1±30.3 indiv.) during the second season.

The relationship between *C. vittata* and temperature was a highly positive significant in October and November plantation. There was a highly negative significant effects between *C. vittata* and relative humidity in November plantation during the first season. While it As for the second season, temperature was a highly positive significant in November plantation. On the other hand, there was a highly negative significant effects between *C. vittata* and relative humidity in October and November plantation.

5.1.8. The sugar beet moth, *Scrobipalpa ocellatella* Boyd.

The sugar beet moth, *S. ocellatella* reached the highest peak of abundance during the two seasons, (10, 10, 35 and 24 larvae/ 5 plants) and (20, 11, 18 and 45 larvae/5 plants), in August, September, October and November plantation, respectively.

Regarding to the seasonal average number of *S. ocellatella* larvae in different sugar beet plantations, the obtained results revealed that, the highest seasonal average number recorded in October plantation (12.3±4.4 larvae) followed by November plantation presented by 9.5±3.5, larvae, respectively. Moreover, the highest seasonal average number of the larvae recorded in November plantation (8.1±4.0 larvae) followed by

October plantation represented by 4.7±2.3 larvae during the second season.

There was a negative significant correlation between *S. ocellatella* and temperature in August plantation. There was no effect of relative humidity on the pest during the first season. In the second season, there was a negative highly significant correlation with temperature in August plantation and positive significant correlation in November plantation. In respect to relative humidity, there was a negative significant in October and November plantation.

5.2. The associated insect predators.

November plantation exhibited the highest average number of the associated insect predators followed by August plantation during the two seasons. On the other hand, it can be noticed that, *C. carnea* and *C. undecimpunctata* were the most dominant insect predators during the two seasons. Analysis of variance showed that highly significant differences in different insect predators among the different plantation during seasons, 2018/19 and 2019/20.

5.3. The associated insect parasitoids.

5.3.1. The parasitoid of the beet fly *P. mixta, Opius nitidulator*:

The highest seasonal activity of *O. nitidulator* during the first season 2018/19 in September plantation represented by 113 indiv. in 7th of March 2019. Meanwhile, the lowest seasonal activity for the parasitoid recorded in October plantation with 67 indiv. in 28th of March. While in the second season, the highest seasonal activity of *O. nitidulator* in November plantation and represented by 72 in 4th of April. Meanwhile, the lowest seasonal activity for the parasitoid recorded in August plantation with 43 indiv. in 22nd of November 2019.

The highest average number of emerged parasitoid O. nitidulator recorded in September plantation during the first season and in November plantation during the second season and presented by 64.2±7.00 and 36.9±5.20 indiv., respectively.

The percentage of parasitism caused by *O. nitidulator* ranged between 18.3% in November plantation and 34.7% in September plantation during the first season. During the second season 2019/20, the percentage of parasitism caused by *O. nitidulator* ranged between 21.2% in August plantation and 35.9% in October plantation. The highest percentage of parasitism caused by *O. nitidulator* was recorded in September plantation and in October plantation during the two seasons, respectively.

5.3.2. The parasitoids of the toroise beetle, *Cassida vittata*

5.3.2.1. The egg parasitoid, *Monorthocheata nigra*

November plantation attractive *C. vittata* females to egg-laying the highest average number during the two seasons and presented by 55.1±18.98 and 21.8±7.68 eggs, respectively. Also the average number of parasitized eggs caused by *M. nigra* as well as the percentage of parasitism were the highest in November plantation during the two seasons and presented by 5.3±1.92 eggs (9.7%) and 2.0±0.70 eggs (9.2%), respectively.

5.3.2.2. The larval pupal parasitoid, *Tetrastichus* sp.

October plantation recorded the highest average number of the total full grown larvae and pupae (9.8±5.95 indiv.), while the highest average number of parasitized pupae and the highest percentage of parasitism recorded in November plantation during the first season and presented by 1.4±0.53 and 16.3%, respectively. While in the second season, November plantation recorded the highest average number of the total full grown larvae and pupae, the highest average number of parasitized pupae and

the highest percentage of parasitism during the second season and presented by 26.9±9.43, 2.9±1.00 and 11.0%, respectively. Statistical analysis revealed that, a significant difference occurred in these parameters according to the different plantations.

5.3.3. The parasitoids of the beet moth *S. ocellatella*.

5.3.3.1. The larval parasitoid *Agathis* sp.

The highest average number of the total *S. ocellatella* larvae and the highest average number of the healthy larvae were recorded in October plantation and presented by 20.1±1.75 and 14.4±1.68 indiv. On the other hand, the average number of the parasitized larvae caused by *Agathis* sp. was ranged between 0.3±0.33 indiv. in September plantation and 0.8±0.24 indiv.in November plantation during the first season. while in the second season, the highest average number of the total *S. ocellatella* larvae and the highest average number of the healthy larvae were recorded in August plantation and presented by 14.4±2.01 and 9.4±2.29 indiv. On the other hand, the average number of the parasitized larvae caused by *Agathis* sp. was ranged between 1.0±0.58 indiv. in September plantation and 1.6±0.40 indiv.in August plantation.

5.3.3.2. The pupal parasitoid, *Diadegma* sp.

The highest average number of the total *S. ocellatella* pupae and the highest average of emerged moth were recorded in October plantation and represented by 17.3±1.72 and 14.4±1.68 indiv. Furthermore, the average number of parasitized pupae caused by *Diadegma* sp. was ranged between 0.6±0.24 indiv. in August plantation and 2.5±0.42 indiv. in October plantation in the first season. While in the second season, the highest average number of the total *S. ocellatella* pupae and the highest average of emerged moth were recorded in August plantation and represented by 11.2±1.93 and 9.4±2.29 indiv. Furthermore, the average

number of parasitized pupae caused by *Diadegma* sp. was ranged between 0.7±0.67 indiv. in September plantation and 1.0±0.32 indiv. in August plantation.

5.3.4. The parasitoid of the southern green stink bugs, *Trissolcus basalis*

The highest percentage of parasitism recorded in August plantation (73.4%) during the first season and in September plantation (100%) during the second season. Moreover, the successful parasitism percentage were recorded in August plantation (60.1%) during the first season and in September plantation (91.6) during the second season.

5.4. Effect of different insecticides on certain sugar beet insect pests.

The anti-moulting compounds caused high reduction in *S. littoralis* larvae and *P.mixta* population, which was almost the same effect of the chemical insecticides, respectively. For *C. vittata* and *S. ocellatella*, the anti-moulting compounds (88.3% and 88.8%) and (88.3%), respectively. proved that to be less efficient in comparison to the chemical insecticides (97.3% and 98.8%) and (97.3% and 97.5%), respectively. The safest treatment on the considered predators was the anti-moulting compounds. The chemical insecticides proved to be the most toxic against the considered predators.

5.5. Biology of *P. mixta* and *P. hyoscami*.

The highest average number of egg-laying of *P. mixta* and *P. hyoscami* were recorded in sugar beet, followed by fodder beet plants. Also, the highest period of incubation were recorded in table beet plants followed by chard plants. The highest percentage of hatchability in *P. mixta* was in fodder beet plants. As for *P. hyoscami*, it was in sugar beet plants.

The shortest larval duration, pupal duration and the total immature stages recorded when reared *P. mixta* on sugar beet plants. While, when reared *P. mixta* in table beet recorded the highest larval, pupal and total immature stages. Also, for *P. hyoscami*, the shortest larval duration and pupal duration recorded when reared *P. hyoscami* on sugar beet plants, but the shortest total immature stages duration recorded when reared *P. hyoscami* on fodder beet. While, when reared *P. hyoscami* in table beet recorded the highest larval, pupal and total immature stages. Sugar beet and fodder beet recorded the longest adult longevity.

Analysis of variance showed that significant differences among the host plants in the biological aspects for both insect pests