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SUMMARY

A Field study was carried out in two plantation times of sorghum, maize and the intercropping of both crops at Shandaweel Research Station, Sohag Governorate during the growing seasons of 2004 and 2005. Survey, seasonal abundance and the infestation damage of pests attacked these crops; in addition to the predators collected from different tested crops were carried out. The relationship between the prevailing weather factors of the area and the population of the aphids infested the maize and sorghum crops were studied. Also, the relation between the population of aphid *R. maidis* and their predators was statistically analyzed and evaluated. Attention has been given, in the present study, to the hoverfly predator *Xanthogramma aegyptium* which preys on aphids. Therefore, laboratory studies were carried out to reveal its food consumption from aphids and its life duration. Moreover, *Nasonia vitripennis* (Walker) (Hymenoptera: Pteromalidae) was studied as a first recorded gregarious pupal endoparasitoid on *X. aegyptium*, in Egypt.

The results could be summarized as follows:

I. Field Experiments:

Survey, population density, seasonal occurrence and pests infestation rate:

Four important insect pests causing economic damage to the tested plants were detected. These are, the greater sugarcane borer *Sesamia cretica* Led., the defoliators (the cotton leaf worm *Spodoptera exigua*, the cotton earworm *Hliothis zea*) and the corn leaf aphid *Rhopalosiphum maidis.*

1. The greater sugarcane borer, *Sesamia cretica* Led.:

The mean number of *S. cretica* larvae was higher in monoculture maize plots than the intercropped maize ones; but it was lower in sorghum plots as compared to

those in the intercropped sorghum at the 1st plantation of the two seasons. For the 2nd plantation date at the seasons of 2004 and 2005, the highest mean number of *S. cretica* larvae was observed in sole sorghum plots. Also, the mean numbers of larvae in the intercropped plots were higher in sorghum than maize plots. Most of the cultivars sown on the late planting dates had higher numbers of *S. cretica* population than those sown on the earlier ones of the two tested seasons 2004 and 2005, except in the intercropping plots of 2005.

Dead heart (D.H.) and leaf feeding (L.F.) due to *S. cretica* larval infestation were estimated in maize, sorghum and their intercropped plots, after 35 days from each of the two planting dates at 2004 and 2005 seasons. The total number of damaged plants (L.F.+D.H.) was higher in sole plots as compared to their intercropping ones.

2. The lesser cotton leafworm, *Spodoptera exigua*:

The mean numbers of *S. exigua* larvae collected decreased in the sole plots than the intercropped plots at the two plantations and seasons.

The mean damage by the defoliating pests' rate was lower in maize plots of the intercropping systems than in sole maize plots for the two plantation dates at the seasons of 2004 and 2005.

3. The corn earworm, *Heliothis zea*:

During the 1st plantation of the two seasons, the highest mean number of *H. zea* was recorded in the two intercropped plots, but the lowest was in the monoculture plots. In the 2nd plantation, the mean numbers of *H. zea* larvae reached a maximum in the intercropping sorghum plots and sole maize crops at the two seasons, respectively; but the minimum one was in the intercropped maize plots of the two seasons.

4. The corn leaf aphid, *Rhopalosiphum maidis*:

R. padi and *S. graminum* were observed on the corners of different cultivated corn plots, but *R. maidis* was the most dominant pest recorded on the whole cultivations during the period of infestation. The mean numbers of *R. maidis* increased in the intercropped plants than those of the monoculture ones, during the 1st and 2nd plantations of the season 2004. At the season of 2005, the mean numbers of aphid decreased in the intercropped plots as compared to the sole plots at the 1st plantation, but it increased in sole than the intercropping sorghum plots, at 2nd plantation.

On the 1st plantation at the season of 2004, the occurrence of aphids, *R. maidis* maximized on late August but minimized on 3rd October, in the sole plots. For the intercropping plots, aphid numbers peaked on 19th September in maize and on 29th August in sorghum plots. At the season of 2005, aphid increased gradually reaching its maximum on September then decreased in October in monoculture maize plots. However, aphids peaked on August in sorghum monoculture plots and on September in the intercropping plots. In 2nd plantation of season 2004, the maximum of aphid numbers were on October in sole plots; but on September in the intercropping plots. Also, in 2005 the mean numbers of aphid maximized on September in the different cultivated sole and intercropped plots.

Effect of weather factors on the population abundance of the leaf corn aphid *R. maidis*

The combined effect of three weather factors (daily maximum, minimum night temperature and relative humidity) significantly influenced the abundance of *R. maidis* infesting maize, sorghum and intercropping crops planted during 2005 seasons, while these effects were only recorded on maize planted in mid July and intercropping sown in mid June 2004 (E.V. ranged between 48.93 to 87.87). The

climatic factors insignificantly affected and lost their efficiency on all crops cultivated during 2004 season, except maize that planted in mid July and intercropping maize sown in mid July (E.V. less 45.78)

II. Natural enemies:

II. 1. Predaceous species:

Nine predaceous species were collected during the two plantations of seasons 2004 and 2005. These were: four Coleopterous species, i.e. *Coccinella undecimpunctata* (larvae+adults), *Scymnus* spp. (*pallidivestis* Muls., *gilvifrons* Muls.) (larvae+adults) (Coccinellidae) and *Paederus alfierii* Koch. (Staphylinidae) (adults); two Hemipterous species, i.e. *Orius* spp. (*albidipennis* Reut. and *laevigatus* Fieb.) (adults) (Anthocoridae); Dipteran syrphid hover flies, i.e. *Xanthogramma aegyptium* and *Sphaerophoria flavicauda* Zett. (Syrphidae) and neuropteran *Chrysoperla carnea* Steph. (larvae) (Chrysopidae).

A. *C. undecimpunctata*:

The mean number of *C. undecimpunctata* larvae was lower for each of the intercropped plot than that of similar sole crops, for the two plantations and seasons. *C. undecimpunctata* larvae peak of abundance was detected in the 2nd week of September throughout the two plantation dates and seasons.

In the 1st plantation of the two seasons, the mean number of *C. undecimpunctata* adults collected from the intercropping plots was lower as compared to each of the sole ones, but it was higher at the 2nd platations.

B. *Scymnus* spp.:

In the 2nd plantation of 2004 and 1st plantation of 2005, the mean number of *Scymnus* spp. larvae collected from each of the intercropping plots was higher as compared to that of similar sole ones, but lower at the others two. *Scymnus* spp.

larvae were absent from the beginning of the season till the 2nd week of September at the 1st plantation, till the late of September for the 2nd plantation of the two seasons.

The existence of *Scymnus* spp. adults covered most of the collecting period of the different cultivated corn plants. Also, the lowest collected *Scymnus* spp. adult numbers were from the sole sorghum plots then the sole maize plots followed by the intercropping ones at the different plantation dates and seasons.

C. Syrphids:

Adult syrphid flies used to feed on pollen and nectar of flowers, while it is the larval stage that feeds on insects. For the 1st and 2nd plantation of the two seasons, Syrphid larvae as important predators of aphids have recorded the highest number under the intercropping systems of maize-sorghum as compared to the sole maize. In contrary the numerical dominance of Syrphid was noticed in sole sorghum plots than in the intercropping plots. However syrphid larvae started to appear from the late week of August and till the end of seasons during the two plantations.

D. *C. carnea*:

In the 1st plantation of 2004 season, the total numbers of the green lacewings, *C. carnea* larvae were almost the same in the two intercropping system as compared to the sole ones, while predator collected in the sole plots was higher than the intercropped ones at 2005. In the 2nd plantation, these numbers in the intercropping maize plots were higher than those of sole maize plots for the two seasons.

E. *Orius* spp.:

In the 1st and 2nd plantation dates of the two seasons, the total number of *Orius* spp. adults collected from sole maize were higher than those from the intercropping plots.

F. *P. alfierii*:

In the two plantations and seasons of 2004 and 2005, the number of *P. alfierii* adults was lower in the intercropping plots than in the sole maize plots, followed by those counted in the monocrop sorghum plots.

Throughout the season of 2004, *P. alfierii* was present in few numbers during August, while it started to increase in the 2nd week of September till the 1st week of October in the sole plots. In season of 2005, the collected *P. alfierii* adults from the different cultivated plots were few during July and August, while they started to increase in September 10th.

Population density, regression and correlation for *R. maidis* and its predators:

Results showed that the population density of the predators and its prey (*R. maidis*) was positively and significantly correlated over all planting dates and seasons. The most abundant predators were *Orius spp., Scymnus spp* and *C. undecimpunctata* which significantly increased with the increase of their prey. It is worthmentioning that *P. alferii* and syrphid predators increased on crops sown in mid July, while the lace wing predator increased on plants sown in mid June during both season of experiment.

II. Parasitoid attacked predator:

Syrphids are one of the most important factors in decreasing the number of aphid populations. Parasitoids that attack the syrphid predator reduce their numbers and negatively affect their function in controlling pests.

The numbers of Syrphid pupae collected were 54 and 120 from the last week of August till the first October for the seasons of 2004 and 2005, respectively. The collected syrphid species were identified to be *Xanthogramma aegyptium* and *Sphaerophoria flavicauda* Zett. (Sphyridae: Diptera). A single parasitoid species

was reared from the collected syrphids in the two seasons, which was identified as the gregarious endoparasitoid *Nasonia vitripennis* (Walker) (Hymenoptera: Pteromalidae). The rate of parasitization varied within the seasons of 2004 and 2005 from 42.59 to 51.67%, respectively.

III. Laboratory Experiments:

1. The syrphid, *X. aegyptium*:

a. Duration of all stages:

The incubation period of the syrphid, *X. aegyptium* eggs ranged 1–1.5 days with an average of 1.38 ± 0.05 days. For the larval duration, it was found that the average length of the 1st, 2nd and 3rd larval instars were 2± 0.13 (1.5–3), 1.5± 0.12 (1–3.5) and 4.25 ± 0.34 (3.5–7.5), respectively. Obviously from the larval results, the third larval instar occupied the longest period but the second one was always the shortest. However, the total larval period lasted 7.75± 0.41 (5.5–12.5). The duration of the pupal stage was 4.95± 0.11 (4–5.5). The total life cycle averaged 10.25± 0.18 (9.5–12) and 5.43± 0.14 (4–6) for females and males, respectively. The total duration of females averaged to 24.33± 0.71 (20–31.5) and for males averaged 19.5± 0.65 (14.5–25.5). The lifespan of males was shorter than females.

b. Food consumption:

X. aegyptius larvae are characterized by their high amount of preys to prey on. A single larva of *X. aegyptius* was observed to destroy as many as 335.05 aphids through its life. The larva of *X. aegyptium* for 1st, 2nd and 3rd instars consumed 73.75 (52–97), 41.8 (21– 65) and 219.5 (156–271) aphid adults, respectively.

2. The parasitoid, *N. vitripennis*:

a. Effects of Syrphid stages on parasitism by *N. vitripennis*:

- **Separate host stages:** The parasitization percent of Syrphid pupae 2 - day old (37%) was the highest, followed by pupae 1 - day old (24%) then the pre-pupae (13%) and

the pupae 3 - day old (11%) and finally the full-grown larvae (10%). The percent of emerged parasitoid adults were 90, 84.62, 90.91, 91.67 and 90.91% for the different parasitized host stages, respectively. In addition, the total numbers of these gregarious parasitoid emerged were 20, 51, 17, 62 and 18 from full-grown larvae, pre-pupae, pupae 1- day old, pupae 2 - day old and pupae 3 - day old, respectively.

- **Unseparate host stages exposed to the parasitoid:** The percent of parasitized host stages were 15, 20, 30 and 10% for the pre-pupae, pupae 1 - day old, pupae 2 - day old and pupae 3 - day old, respectively. The percent of emerged adult parasitoid were 86.67, 90, 93.33 and 90% for the different tested *X. aegyptium* stages, respectively. Also, the total numbers of the emerged parasitoid adults were 27, 79, 113 and 19for the different host stages, respectively

  In general, the results proved that the pupae of the syrphid 2 day old was the most preferred stage to be attacked and parasitized by this destructive endoparasitoid.

b. Life Span and adult sex ratio:

At laboratory temperature of 28°C ± 2, the duration of *N. vitripennis* from eggs to progeny emergnce from the tested host stage (pupae 2 - day old) reached 6.4 days. Starved parasitoid females lived longer (3.7 days) than males (2.3 days) in average. So, the mean total developmental period of female from eggs till its death reached to 10.1 days and for male 8.7 days. Also, the sex ratio of the parasitoid was 1: 1.65 for male: female.