

SEASONAL ABUNDANCES OF COMMON COCCINELLID SPECIES IN SOME ECONOMIC FIELD CROPS IN EGYPT

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ABSTRACT

A survey and monitoring seasonal abundances of common coccinellid predatory species associated with aphids in cotton & maize (as summer crops) and faba bean & Egyptian clover (as winter crops) representing some of the economic field crops in Egypt, were carried out at Qalubia Governorate during the successive seasons 2002/03 and 2003/04. Two sampling methods were practiced; direct counts on the plants in the fields of cotton, maize and faba bean and use of a sweeping net in case of the clover. *Coccinella 9 punctata*, *C. undecimpunctata* L., *Hippodamia convergens* Guer. and *Scymnus* spp. were the most common coccinellid species found on the four crops. Highest populations of the coccinellids (483 and 340 individuals/50 cotton plants), (200 and 303 individuals/ 50 maize plants), (50 & 60 adults /50 faba bean plants) and (371 and 305 individuals/50 double net strokes) were recorded in June in cotton, July and August in maize, February and March in faba bean and May in Egyptian clover fields in the 1st and 2nd seasons, respectively. Data were statistically analyzed.

INTRODUCTION

Cotton, maize, faba bean and Egyptian clover are, undoubtedly, of the most economic crops in Egypt, representing the main sources of farmers' income. Predators as one of the major groups of natural enemies play a noticeable role against different insect pests, especially small sap-sucking. So, workers in the field of biological control have diverted their efforts to encourage this role by maintaining proper habitats to attain their efficiency (Hafez, 1994). The extensive and repeated use of insecticides has disrupted the natural balance between sap sucking insect pests as favorable preys and their predators El-Heneidy *et al.* (1987). Awareness of the exact natural relationship between predators and their preys aids for determining the best timing for mass rearing and releasing of more effective predatory species in the fields, suffering from pests' attack, in the frame of Integrated Pest Management (IPM) strategies, side by side with other safe alternative control methods thus, getting more safe to man and his surrounding environments.

Predators belonging to family Coccinellidae, comprise one of the most active groups of predatory species, that feed on different sap-sucking pests including aphids, whiteflies, jassids and mites as well other small insects. This family gained an interested role as important group of predators in the biological control of insect pests attacking different crop plants. Many coccinellid species were recorded associated with the pests in different economic field crops (Bahy El-Din, 2007). The aphids, *Aphis craccivora*, *A. faba*, *A. gossypii* and *Myzus persicae* constitute the food essential for the majority of Coccinellidae (Saharaoui *et. al.*, 2001).

Many authors studied biological aspects of the coccinellids in Egypt: **Hamed and Hassanein (1984)** studied prey consumption of *Coccinella undecimpunctata* L. on aphids; **Mohamed and Mahmoud (1986)** assessed the rates of predation by field collected larvae of *C. septempunctata*, *C. novemnotata* and *C. undecimpunctata* on *Aphis faba* populations, **El-Batran et al. (1995)** studied the biological parameters of the coccinellid species, *Adalia bipunctata* on different preys and **Hafez (2001)** and **(El-Heneidy et al., 2008)** studied biological parameters and prey consumption of the two coccinellid species; *Hippodamia tredecimpunctata* Guer. and *C. undecimpunctata*.

The present study aimed to survey and monitoring seasonal abundances of common coccinellid predatory species associated with sap-sucking insect pests (especially aphids) in cotton & maize (as summer crops) and faba bean & Egyptian clover (as winter crops) representing some of the economic field crops in Egypt.

MATERIALS AND METHODS

Field studies were carried out in the two summer (cotton & maize) and winter (faba bean & Egyptian clover) crops in Qalubia Governorate, Egypt, for two successive seasons extending from 2002 to 2004. An area of about one feddan/crop was annually selected for surveying both the most common sap sucking insects attacking each crop (particularly aphids), as well their associated coccinellid predatory species. Experimental areas received all regular agricultural practices except absence of chemical insecticidal application.

Cotton, maize and faba bean crops were weekly sampled by inspection of each of 50 random plants. Population of aphids and their associated coccinellid species on those plants were identified and directly counted under field conditions and their numbers were recorded. In case of the Egyptian clover weekly, 50 double strokes of an insect sweeping net (Diameters 15th) were practiced. Collected insect pests and predatory species were placed in paper bags and transferred to the laboratory for identification and counting. Sampling started about two weeks post germination. Sampling dates in each crop were: from mid-June to early September for maize, seasons 2002 and 2003; from early May to late August for cotton, seasons 2003 and 2004; from mid-November to early April for faba bean, season 2002/03 and 2003/04 and from early November to late May for Egyptian clover, seasons 2002/03 and 2003/04. Temperature and relative humidity data were obtained from the Meteorological Station of the A. R. C. (Agricultural Res. Center) at Shebin El-Kanater, Qalubia Governorate.

Statistical analysis of the data was carried out using ANOVA.

RESULTS AND DISCUSSION

1- Cotton

1.1. Survey and seasonal abundance of aphid on cotton plants:

A. gossypii was found as the common aphid species recorded in cotton fields. In agreement with this observation, **Hafez and El-Khyat (1996)** reported that *A. gossypii* was the only aphid species found infested cotton plants in Moshtohor region (Qalubia Governorate, Egypt). The highest mean populations of the aphids (987.8±515.5 and 1099.8±471.8 individuals/50 cotton plants) were recorded during

August in 2003 and 2004 seasons, respectively (Fig. 1). Statistical analysis of 2003 cotton season 2003 data showed, significant and a positive correlation between numbers of aphids and R. H. ($R= 0.5713$). In season 2004, significantly positive correlation between number of aphids and interaction between R. H. and temperature ($R= 0.5314$). No significant difference between numbers of aphids and number of predators was found.

1.2- Survey and seasonal abundance of coccinellid species:

Field survey revealed the presence of the coccinellids; *Coccinella 9 punctata*, *Coccinella undecimpunctata* L., *Hippodamia convergens* Guer. and *Scymnus* spp. as well some other non coccinellid predatory species belonging to other families and orders were observed. As shown in Fig. (1),

- *C. 9 punctata* was present in cotton fields in a few numbers.
- *C. undecimpunctata* populations peaked (68 and 41 adults/50 cotton plants) during the 1st and 4th weeks of June 2003 and 2004 seasons, respectively. The predatory species represented 26.9 and 29.96 % of the total number of the coccinellids surveyed in the cotton fields in the two seasons.
- *H. convergens* population peaked (79 and 45 adults/50 cotton plants) during the 1st and 4th weeks of June in the two seasons, respectively. Total counts represented 28.32 and 27.98% of the total numbers of all coccinellids surveyed in the cotton fields in the two seasons.
- *Scymnus* spp. Two population peaks (74 and 50 individuals/50 cotton plants) were recorded during season 2003 (1st week of June and 3rd week of July). In season 2004, those peaked (50 individual/50 plants) during the 4th week of June. *Sycmnus* spp. represented 44.41 and 41.7 % of the total counts of the coccinellids surveyed in the cotton fields in the two seasons.

Total monthly counts of coccinellids recorded in season 2003 was highest during June (483 individuals) followed by July (128 individuals). While the lowest number (18 individuals) was recorded during August. Respective numbers in 2004 cotton season were 340 and 135 individuals in June and July, respectively. While the lowest numbers (15 and 0 individuals) were recorded during May and August, respectively. Generally, the total number of coccinellids counted in the cotton fields throughout the first season 2003 (858 adults) exceeded that recorded in the subsequent season (504 adults) by about 70.24% (Fig. 1).

Statistical analysis of data in cotton fields; season 2003 showed significantly positive correlations between means of R. H. and number of each of *C. undecimpunctata*, *H. convergens* and total coccinellids, ($R= 0.5880$, 0.6187 and 0.5512 , respectively). Interaction between R. H. and temp. showed significantly positive correlation with the number of each of *C. undecimpunctata* and *H. convergens* ($R= 0.6019$ and 0.6344 , respectively). In season 2004, highly significantly correlations between means of R. H. and numbers of each of *C. undecimpunctata*, *H. convergens*, *Scymnus* spp. and total coccinellids ($R= 0.8040$, 0.7432 , 0.7668 and 0.78687), respectively were recorded. Interaction between R. H. and temp. showed highly significantly positive correlations with the numbers of each of *C. undecimpunctat*, *H. convergens*, *Scymnus* spp. and total coccinellids ($R= 0.8643$, 0.8040 , 0.8231 and 0.8468), respectively.

C. undecimpunctata was recorded on the cotton plants as a predator associated with several cotton pests by El-Heneidy *et al.* (1987); Moawad *et al.* (1991) and Abu-Elhagag (1998). Kares *et al.* (1988) found that *C. undecimpunctata* reached its peak during the 2nd week of July (108 individuals/50 cotton plants) in Moshtohor region, Qalubia Governorate, Egypt. Abu-El-Hagag (1998) reported that the peak population of *C. undecimpunctata* on cotton plants occurred by late June and during July, 1996 and 1997 in Southern Egypt. Khalifa (2005) reported that on the cotton plants, adults and larvae of *C. undecimpunctata* were mainly recorded during June and July, while *S. interruptus* reached its highest abundance (16 individuals/20 plants) during the 3rd week of August at Kafr El-Sheikh Governorate, Egypt. Vinson and Scarborough (1989) indicated that adults and 3rd instar larvae of *H. convergens* were effective in reducing the populations of *A. gossypii* on cotton plants in Florida, USA.

2- Maize

2.1- Survey and seasonal abundance of maize aphids:

Three cereal aphid species were surveyed in maize fields; *Rhopalosiphum maidis* Fitch and *R. padi* L. and *Schizaphis graminum* (Rond.). Highest population of aphids on maize plants was recorded during August in 2002 and 2003 seasons. The mean numbers of aphids during the month of August were 278.8 and 398.3 individuals/50 maize plants, respectively (Fig. 2). This period is usually synchronized with the maize plant flowering growth stage. Statistical analysis of maize field data showed significant and a positive correlation between number of aphids and temperature only ($R = 0.4845$). But no significant correlation was found between number of aphids and that of predators.

Darwish and Ali (1991) found that the aphids, *S. graminum* and *R. maidis* reached their maximum abundance (406 and 518/plant) in Upper Egypt in the 4th week of August, when the plants were in their reproductive stage. El-Wekeel (1997) reported that at El-Gharbia Governorate, the highest number of *R. maidis* (84 aphids/20 square inch) was recorded on August 5th 1994 (at 32.8 °C and 68.9 % R. H.) while at Giza Governorate it was (141 individuals/20 square inch) on July 31st 1994 .

2.2- Survey and seasonal abundances of predatory species:

Field survey revealed the presence of the following coccinellids, *C. 9 punctata*, *C. undecimpunctata*, *H. convergens*, *Scymnus* spp. as well some other non coccinellid predatory species. As shown in Fig. (2), regardless to the species, coccinellid larvae peaked (86 and 21 individuals/50 maize plants) during the 1st and 3rd weeks of August 2002 and 2003, respectively.

Adult stage:

- *Cydonia vicina* var. *isis* was found by very few numbers in maize fields during both seasons of the study. The predatory species represented only 0.95 and 0.56 % of the total number of coccinellids surveyed on maize plants in the two seasons of the study, respectively.
- *C. 9 punctata* was also recorded with very few numbers of adults in maize fields. Its total numbers represented 0.95 and 0.93 % of those of all coccinellids surveyed, respectively.
- *C. undecimpunctata* populations reached (36 and 57 adults /50 maize plants) during the 1st week of August 2002 and 2003 seasons, respectively. Total adults' numbers represented 22.3 and 25.8 % of those of all coccinellids surveyed, respectively.

- *H. convergens* was found in very low population during the two seasons. Total adult counts represented 1.18 and 0.93 % of the total counts of coccinellid adults surveyed in 2002 and 2003 maize seasons, respectively.
- *Scymnus* spp. were the most abundant predatory species counted on maize plants. Adult counts peaked to 54 and 95 individual adults/50 maize plants during the 2nd week of July and the 1st week of August in seasons 2002 and 2003, respectively. *Scymnus* spp. adults represented 74.6 and 71.7 % of the total count of coccinellids surveyed in seasons 2002 and 2003, respectively.

In general, highest total number of coccinellid adults on maize plants were recorded during July (200 individuals/month) followed by August (177 individuals) in the 1st season. In the 2nd season, it was (303 individuals) during August followed by (210 individuals) during July. Generally, total coccinellid counts represented 50.1 and 56.9% of the total numbers of the predatory species recorded on maize plants in the two seasons of the study (Fig. 2).

Statistical analysis of 2002 maize fields' data showed significantly positive correlation between means of temperature and number of *C. 9-punctat* ($R= 0.5966$). Relative Humidity (R. H.) showed also significant positive correlation with the numbers of each of *Cydonia v. isis*, *C. undecimpunctata* and total coccinellids ($R=0.6520$, 0.5886 and 0.6231 , respectively). Relative Humidity showed significant correlation with the numbers of each of coccinellids larvae and *C. undecimpunctata* ($R= 0.5889$ and 0.5621 , respectively) and highly significant correlation with *Scymnus* spp. and total coccinellids ($R= 0.7488$ and 0.7303 , respectively). Also, significant difference was found between the interaction of R. H. and temperature and total coccinellids ($R= 0.7495$).

Hesler *et al.* (2004) found that *H. convergens* was the most abundant predator encountered on maize plant in U.S.A. El-Wekeel (1997) found that the maximum numbers of *S. interruptus* were 19 and 25 beetles/20 maize plants by mid-July 1994 (at 30.7°C and 69.9% R. H.) and on August 4th 1995 (at 32.4°C and 73.0% R. H.) at El-Gharbia Governorate, Egypt. In agreement with the present results, Ebaid (2004) reported that *Scymnus* spp. was the highest in numbers among the other surveyed predators on maize plants. El-Sapagh (1998) detected the highest counts of coccinellids on August 15th (385 individuals/50 maize plants) at Moshtohor, Qalubia Governorate. Paulian (1999) found that, the coccinellids constituted 39% of the total predators on maize plants in Romania. Elliott *et al.* (2002) found that the abundance of aphids in maize fields was affected by the abundance of coccinellids adults in USA.

3- Faba bean

3.1- Survey and seasonal abundance of aphids:

The cowpea aphid, *Aphis craccivora* Koch. was the most dominant species among all the encountered aphid species on faba bean plants. Two peaks of aphids' abundance were recorded, the first of 243 individuals/50 plants detected during the 4th week of December, 2002 and the second, was (284 individuals) detected during the 4th week of January, 2003. Also, two peaks of abundance were recorded in season 2003/04, the first (315 individuals/50 plants) during the 1st week of January 2004, and the second occurred during the 4th week of the same month (Fig. 3). Statistical analysis of 2002/03 season's data showed highly significantly positive correlation

between mean of R. H. and number of aphids ($R= 0.6167$) and between means of interaction (Temp. and R. H. %) and aphids' population ($R= 0.6728$). Significantly positive correlation was also evident between aphids' numbers and number of each of *C. 9 punctata* and total coccinellids ($R= 0.8101$ and 0.8160), respectively. In the following season, highly significantly positive correlation between temp. and number of aphids ($R= 0.6402$) was found.

El-Defrawi et al. (2000) recorded two main periods of *A. craccivora* activity on faba bean in Egypt, with highest counts by mid-December and from mid-February to mid-March. **El-Khawas et al. (2004)** recorded the maximum total number of *A. craccivora* adults and nymphs at Moshtohor region (Qaluobia Governorate) in the 1st week of March and the lowest in the 3rd week of January.

3.2- Survey and seasonal abundance of predatory species:

Field survey revealed the presence of the coccinellids: *C. 9 punctata*, *C. undecimpunctata*, *H. convergens* and *Scymnus* spp. as well some other non coccinellid predatory species. As shown in Fig. (3), regardless to the species, in season 2002/03, coccinellids larvae were detected from the 1st to the 4th week of February (4, 3, 5 and 2 larvae/50 plants, respectively). In season 2003/04, the larvae were found during the 1st, 3rd and 4th week of February (1, 1 and 20 larvae/50 plants, respectively). The total number of larvae per season was 22 larvae.

Adult stage:

- *Coccinella 9- punctata* adults were presented in faba bean field in very low population. The total seasonal counts of the predatory species represented 1.4 and 3.2 % of the total seasonal counts of all coccinellids in 2002/03 and 2003/04 faba bean seasons, respectively.
- *C. undecimpunctata* was the most abundant predaceous coccinellid species on faba bean plants. Its populations peaked (15 and 27 individuals/50 faba bean plants) during the 1st and 3rd weeks of March in seasons 2002/03 and 2003/04, respectively.
- *H. convergens* populations peaked (10 and 11 individuals/50 faba bean plants) during the 3rd week of March of the two seasons, respectively (Fig. 5).
- *Scymnus* spp. total counts represented 5 and 3.2 % of the total coccinellids in seasons 2002/03 and 2003/04, respectively.

Highest numbers of coccinellid adult were recorded during February and March (50 & 60 adults in the 1st season and 33 & 81 adults 2nd season), respectively (Fig. 3). Statistical analysis 2002/03 season's data showed highly significantly positive correlation between means of temperature and numbers of each of *C. undecimpunctata* and total coccinellids ($R= 0.6957$ and 0.6459 , respectively). R. H. showed also significant positive correlation with numbers of *H. convergens* ($R= 0.4822$). In case of interaction between temperature and R. H.% data showed highly significantly positive correlation with *C. undecimpunctata* numbers, ($R= 0.7057$), respectively.

Abu-El-Hagag (1998) stated that *C. undecimpunctata* occurred on faba bean plants in Assiut, Egypt during the 2nd and 4th weeks of December. The peak of population of this species was observed by mid-March. **El-Defrawi et al. (2000)** stated that, *S. interruptus* was one of the common predators observed in faba bean fields in Egypt. While, **El-Khawas et al. 2004** recorded only one individual of

Scymnus spp. during the last week of February on faba bean plants at Moshtohor region, Qaluobia Governorate, Egypt.

4- Egyptian clover (Berseem)

4.1- Survey and seasonal abundance of aphids:

Different aphid species were found in the present study in the Egyptian clover fields. Aphids population reached its peak (393 individuals/50 double net strokes) in the 2nd week of April, 2003 in the 1st season and (297 individuals/50 double net strokes) in the 1st week of April, 2004 in the 2nd season. April represented the month of higher abundance of aphids on Egyptian clover plants (mean numbers of 186.5 and 137.8 aphid individuals/50 double net strokes/month was recorded in 2002/03 and 2003/04 seasons, respectively) (Fig. 4). Statistical analysis of 2002/03 season's data showed significantly positive correlation between numbers of aphids and temperature ($R = 0.5866$). While, non significant correlation between numbers of aphids and those of predators was found. Three aphid species were surveyed by Tawfik *et al.* (1976) in Egyptian clover fields at Giza region, Egypt, being *A. gossypii*, *Aphis laburni* Kalt and *Macrosiphum pisi* Harris.

4.2- Survey and seasonal abundance of predatory species:

Field survey in 2002/03 and 2003/04 seasons revealed that *C. undecimpunctata*, *H. convergens* and *Scymnus* spp. as well some other non coccinellid predatory species were present. As shown in Fig. (4),

- *C. undecimpunctata* adults' population peaked (41 and 27 adults/50 double net strokes) during the 4th week of May in the two seasons. The total seasonal count of *C. undecimpunctata* adults (143 and 97 adults) represented 33.6 and 27 % of the total coccinellids counted, respectively.
- *H. convergens* peaks of adults' abundance (62 and 64 adults/50 double net strokes) were recorded during the 4th week of May in the two seasons (Fig. 5).
- *Scymnus* spp. peaks (44 and 37 adults /50 double net strokes) were found also during the 4th week of May in the two seasons of study.

Statistical analysis of 2002/03 season's data showed highly significantly positive correlation between means of temperature and number of each of *C. undecimpunctata*, *H. convergens*, *Scymnus* spp. and total coccinellids ($R = 0.7184$, 0.7616 , 0.6669 and 0.7485 , respectively). In the second season, data showed that significantly positive correlation between means of R. H. and numbers of each of *C. undecimpunctata* and *H. convergens* ($R = 0.4411$ and 0.3837 , respectively).

Tawfik *et al.* (1976) found that *C. undecimpunctata* reached its peaks on Egyptian clover plants in April and May. El-Heneidy *et al.* (1979) reported that insect predators reached a peak of 69 individuals/100 net strokes by 3rd week of March and reached the highest peak of 86 individuals by the 1st week of June in Egyptian clover fields at Fayoum Governorate, Egypt. Abdel-Galil (1982) found that the maximum density of *C. undecimpunctata* and *S. interruptus* on Egyptian clover occurred from mid-April to mid-May at Assiut Governorate, Egypt.

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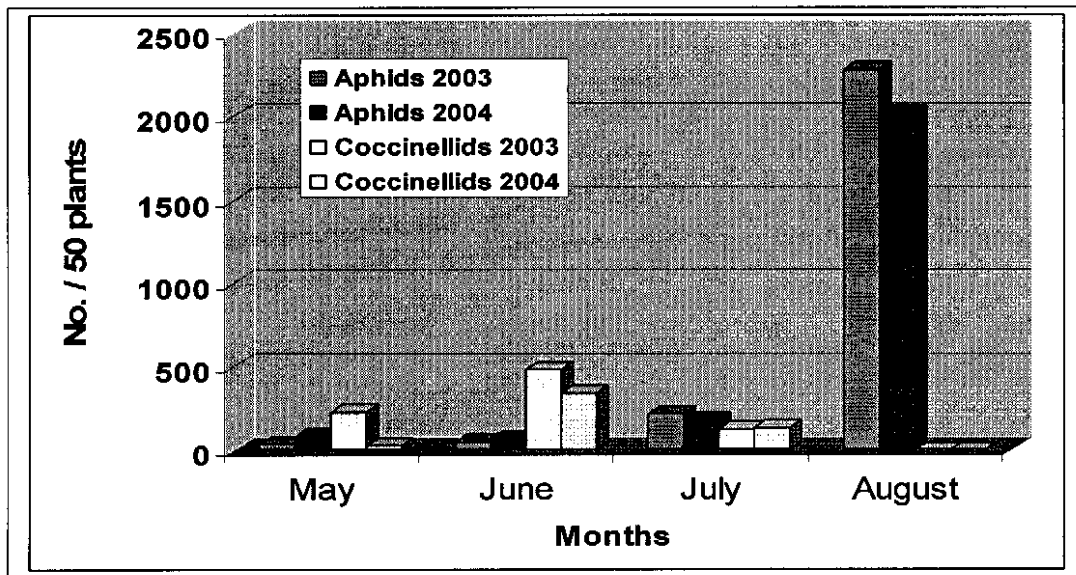


Fig. (1): Monthly mean numbers of aphids and associated coccinellid species in cotton fields at Qalubia Governorate, Egypt during seasons 2003 and 2004

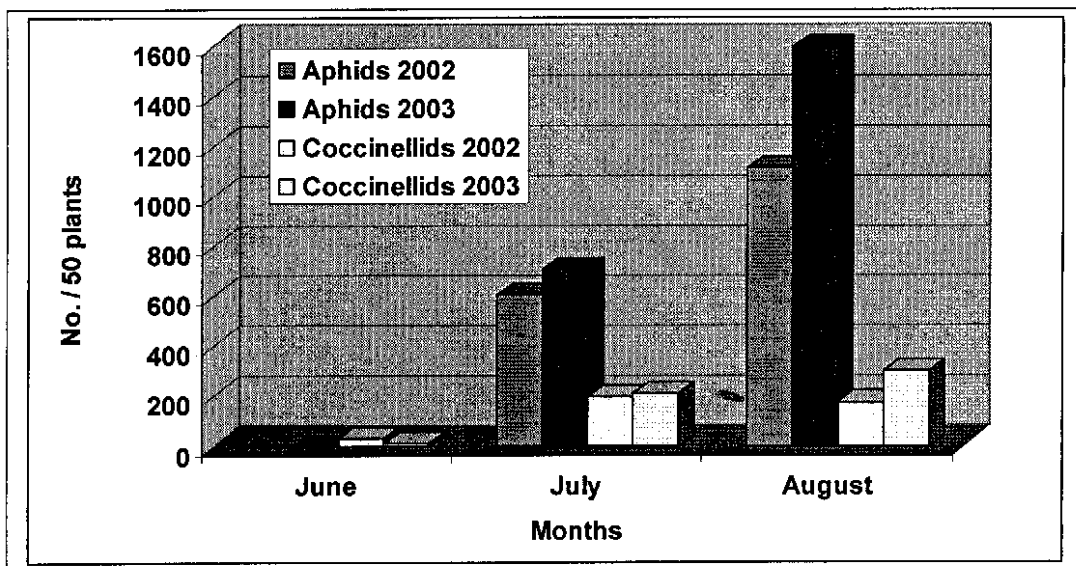


Fig. (2): Monthly mean numbers of aphids and associated coccinellid species in maize fields at Qalubia Governorate, Egypt during seasons 2002 and 2003

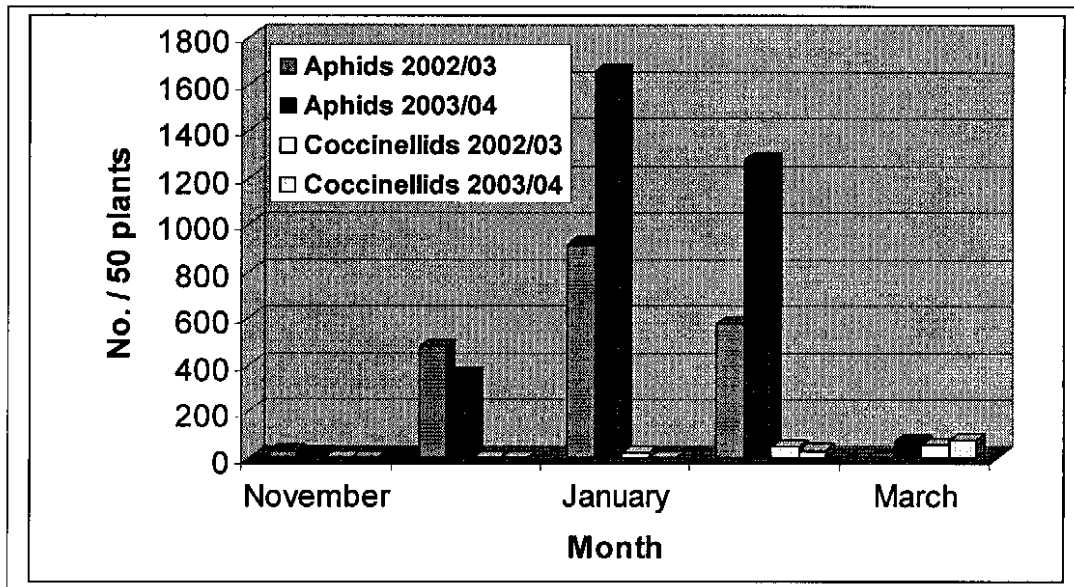


Fig. (3): Monthly mean numbers of aphids and associated coccinellid species in Faba bean fields at Qalubia Governorate, Egypt during seasons 2002/03 and 2003/04

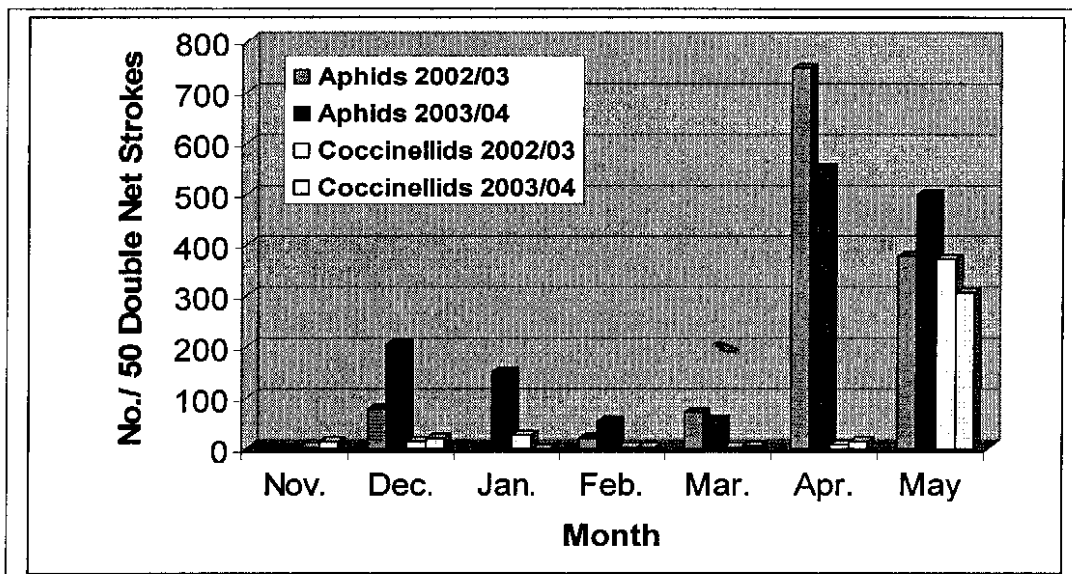


Fig. (4): Monthly mean numbers of aphids and associated coccinellid species in Egyptian clover fields at Qalubia Governorate, Egypt during seasons 2002/03 and 2003/04

التغيرات الموسمية لغزارة التعداد للأشواوع الشائعة من خنافس أبى العيد فى حقول بعض المحاصيل الاقتصادية فى مصر

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تم الحصر ودراسة تغيرات التعداد للأشواوع الشائعة المفترسة من خنافس أبى العيد المرتبطة بحشرات الممن فى حقول كل من القطن والذرة (كمحصولين صيفيين) والفول البلدى والبرسيم المصرى (كمحصولين شتويين) كمثلة للمحاصيل ذات الأهمية الاقتصادية فى مصر، وذلك بمحافظة القليوبية خلال الفترة من عام ٢٠٠٢ وحتى عام ٢٠٠٣ . تم أخذ العينات أسبوعيا عن طريق العد المباشر/٥٠ نبات عشوائيا على المحاصيل الثلاث الأولى وكذلك عن طريق الضرب المباشر بـ ٥٠ ضربة مزدوجة لشبكة الجمع على نباتات البرسيم المصرى. كانت الأشواوع أبى العيد ٩ نقط، أبى العيد ١١ نقطة، أبى العيد ١٣ نقطة وأبى العيد إسكمنس هى أكثر أنواع أبى العيد شيوعا على المحاصيل الأربعة . سجل أعلى تعدادات لخنافس أبى العيد (٤٨٣ و ٣٤٠ فردا/٥٠ نبات قطن)، (٢٠٠ و ٣٠٣ فردا/٥٠ نبات ذرة)، (٥٠ و ٦٠ فردا/٥٠ نبات فول بلدى) و(٣٧١ و ٣٠٥ فردا/ ٥٠ ضربة مزدوجة على البرسيم المصرى)، وذلك فى شهر يونيو على القطن، يوليو وأغسطس على الذرة، فبراير ومارس على الفول البلدى وفى شهر مايو على البرسيم المصرى، على التوالي. تم التحليل الإحصائي للنتائج المتحصل عليها.