

Population density of aphids infesting some citrus trees species and its predators and parasitoids in recently reclaimed areas in Skarkia province, Egypt

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ABSTRACT: The goal of the current study was to evaluate the efficiency of parasitoids and predators as biocontrol agents against aphids infesting citrus trees (Navel orange, Mandarin, and Valencia orange) in the growing seasons of 2019 and 2020.

The following aphid species were recorded *Aphis gossypii* (Glover), *Aphis craccivora* Koch, *Aphis citricola* (van D.Goot) and *Myzus persicae* (Sulzer). The common predators caught on citrus trees were: *Orius albidipennis* Reut, *Chrysoperla carnea* Steph., *Coccinella undecimpunctata* L., and *Metasyrphus corolla* F, while one parasitoid was *Diaeretiella rapae* (M'Intosh).

The overall number of aphids observed on navel orange, mandarin, and Valencia orange trees throughout the 2019 and 2020 seasons was highest for *A. gossypii* and lowest for *M. persicae*.

In case of predators *Coccinella undecimpunctata* recorded the highest number while, *Orius albidipennis* had the lowest number during 2019 and 2020 seasons.

KEYWORDS: Aphid, Predators, Parasitoid, Citrus species

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I. INTRODUCTION

Citrus orchards have important role in the national economic in Egypt (El- Kassas 1984). Citrus trees (navel orange, mandarin and Valencia orange) are considered of the most important crops.

The most harmful pests in Egypt are citrus insects, which harm citrus harvests Hegab et al. (2003). On citrus trees, about 20 different aphid species have been identified globally (Barbagallo and Patti 1985; Blackman and Eastop 2006) while, *Aphis gossypii*, *Aphis spiraeicola*, *Toxoptera aurantii* and *Toxoptera citricidus* are the most harmful species (Hermoso et al., 2006; Marroquin et al., 2004; Tena and Garcia 2011). The cotton aphid, *Aphis gossypii* Glover, colonizes N600 host plants and spreads N50 plant viruses, making it an important pest in agriculture (Blackman and Eastop, 2006; Ebert and Cartwright, 1997). Aphids can harm plants directly by draining the sap from them or indirectly by spreading various virus infections to the host plants. The honey dew excreted by the aphids on the leaf collect dust particles is associated with different species of black-fungi (Ismail et al., 1991; Hegab et al., 2003; Ali 2008 and Murati et al., 2013). Due to their propensity of predators to prey on other biological control agents and non-target species, biological control by predators is an effective program (Symondson et al. 2002). *Chrysoperla carnea* is one of the most common entomophogus predators in many crops and natural habitats (Tauber et al., 2000; McEwen et al., 2001; Medina et al., 2003 and El-Wakel et al. 2013), the larvae consume a variety of phytophagous insects, including mites, thrips, psyllids, white flies, and eggs and larva of Lepidoptera, as well as aphids (McEwen et al., 2001; Golmohammadi & Hejazi, 2014). Using insecticides to control aphids causes a number of issues, including the development of aphid strains that are more resistant to the chemicals as well as environmental contamination and disruption of the natural order (El-Maghraby 1993; Ail-Catzim et al. 2015). Little attention have been paid by investigator in Egypt to study the population density of aphids infesting citrus trees and its predators and parasitoids in the recently reclaimed areas in Sharkia province. So the present studies were carried out to show the role of predators and parasitoids insects in suppressing the population of aphids infesting citrus trees cultivated in Al-Salhia district Sharkia province, Egypt.

II. MATERIALS AND METHODS

The present study carried out at Al-Salhia district, Sharkia province, Egypt during two successive years, 2019 and 2020 in citrus orchards. The three citrus varieties trees are navel orange (*Citrus sinensis*), mandarin (*Citrus reticulata*) and Valencia orange.

Survey and population density of aphids infesting some citrus trees species and its predators and parasitoids.

The samples were taken biweekly from the three citrus trees species, where five citrus trees have the same size and vegetation were selected at random from each variety. The plant sample technique (25 leaves\ tree) were picked from the main directions (north, south, east and west). Samples were placed in paper bags and brought to the lab for stereoscopic microscope analysis. The number of aphids were directly counted and recorded. Predator adults were typically counted immediately in the field, albeit in a few rare instances, laboratory rearing was required for the immature stages until the emergence of adults, who were then identified and recorded. Mummies on the leaves taken to the laboratory and kept in pitri dishes until the emergency and identification the species of parasitoids by biological control department, Plant Protection Institute. Maximum and minimum temperatures, as well as the mean relative humidity, were supplied by the Agricultural Research Center's Meteorological Central Laboratory for Agricultural Climate.

III.RESULTS

1- Survey population density of aphid species and its predators and parasitoids on some citrus trees.

Citrus trees were attacked by four species of aphids, *Aphis gossypii*, *Aphis citricola*, *Aphis cracivora* and *Myzops persicae*. Also, four Predators were found *Orius albidipennis*, *Chrysoperla carnea*, *Coccinella undecimpunctata* and *Syrphus corollae*, while one parasitoid was *Diaeretiella rapae*.

1.1- Navel orange.

1.1.1- Aphids

Table (1) shows that, the full count of aphids on navel orange trees was higher in 2019 season than 2020 season with 8604 and 4980, respectively. *A. gossypii* was the greatest amount on navel orange trees during 2019 and 2020 seasons with 3804 and 2239 individual by percentage 44.21% and 44.96 % from the total number of aphids, respectively, followed by *A. citricola* 1922 and 1089 by percentage 22.34% and 21.87% from the total number of aphids, respectively. *A. cracivora* recorded 1787 individual by percentage 20.77% in 2019 season, while 760 by 15.26% in 2020 season. *M. persicae* was the fewest in quantity in 2019 where was presented in 1091 with 12.68% and was 892 individual by percentage 17.91% in 2020 seasons.

1.1.2- Predators.

Data in table (1) show that *C.undecimpunctata* was the greatest number in both seasons where recorded 127 by percentage 38.49% of how many predators there were overall in the 1st season, while was 126 by percentage 42.43% of the total number in the 2nd season. The second predator's number was *Chrysoperla carnea* which was 117 by percentage 35.45% from total number of predators in 2019, while was 88 by percentage 29.62% in 2020. *Orius albidipennis* recorded 43 and 41 by percentage 13.03% and 13.80% in 2019 and 2020, respectively. *Syrphus corollae*'s number was 43 by 13.03% percentage in the 1st season and 42 by 14.14% percentage in the 2nd season.

1.1.3- Parasitoids.

Table (1) clears that, *Diaeretiella rapae* was higher in 2020 than 2019 where recorded 133 and 105 individual, respectively.

1.2. Mandarin

1.2.1- Aphids.

Table (1) shows that the full count of aphid on mandarin trees was higher in 2019 season than 2020 season with 7244 and 3850 individual, respectively. The number of *A. gossypii*, *A. citricola*, *A. cracivora* and *M. persicae* was 3991 and 1971 individual by percentage 55.09 % and 51.19%, 1515 and 844 individual by percentage 20.91% and 21.92%, 937 and 478 individual by percentage 12.94% and 12.42% and 801 and 557 individual by percentage 11.06% and 14.47% of the total aphids number in 2019 and 2020 seasons, respectively.

1.2.2- Predators.

Table (1)'s data demonstrate that *C.undecimpunctata* was the greatest amount in both seasons where recorded 124 predator by percentage 40.39% of the total number in the 1st season while was 80 by percentage 35.24% of the total number in the 2nd season. The second predator's number was *Chrysoperla carnea* which was 86 by percentage 28.01% from total number of predators in 2019, while was 77 by percentage of 33.92% in 2020. *Orius albidipennis* recorded 51 and 36 individual by percentage 16.61% and 15.86% in 2019 and 2020, respectively. *Syrphus corolla* was the lowest in predator's number which was 46 and 34 with 14.99% and 14.98% from total predator numbers in 2019 and 2020, respectively.

1.2.3- Parasitoids.

Table (1)'s data demonstrate that *Diaeretiella rapae* was discovered during both seasons were 119 and 116 individual in 2019 and 2020, respectively.

1.3- Valencia trees.

1.3.1- Aphids.

Data in table (1) evidently, the number of *A. gossypii*, *A. citricola*, *A. craccivora* and *M. persicae* was 3947, 2011, 1554 and 901 with percentage 46.92%, 23.90%, 18.47% and 10.71% in 2019 season, while was 1893, 1041, 524 and 527 with percentage 47.50%, 26.12%, 13.5% and 13.23% in 2020 season. From these data it clear that 2019 season was higher in population density than 2020 season.

1.3.2- Predators.

Orius albidipennis, *Chrysoperla carnea*, *Coccinella undecimpunctata* and *Syrphus corolla* number in table (1) in the 1st season of study was 41, 89, 113 and 49 with 14.04, 30.48, 38.70 and 16.78 % from the total Predator number, while 45, 79, 101 and 48 with 16.48, 28.94, 37.00 and 17.58 % in 2020 season.

1.3.3- Parasitoids

Table (1) clear that *Diaeretiella rapae* was 101 and 91 in 2019 and 2020, respectively.

2- Seasonal abundance of aphids infesting citrus trees and its predators and parasitoids.

2.1- Navel orange trees:-

2.1.1- Aphids

2.1.1.1- *Aphis gossypii*

The obtained results in Fig. (1&2) clear that the population density of *A. gossypii* have three peaks of activity during the 1st season, the first one was noticed at the 4th week of March with 555 individual at mean temp. 18.48°C with 53.55% RH., the second peak, which included 490 individual, was noted in the 2nd week of June at mean temp. 28.92°C at mean RH 48.81%, while the third was noticed at the 2nd week of Sep. with 461 individual at mean temp. 28.61°C and mean RH 57.29%. During the 2nd season, two peaks were recorded, at the 4th week of April with 411 individual at mean temp. 20.71 °C and mean RH 49.61%, and at the 2nd week of Sep. with 391 individual at mean temp. 28.61 °C and mean RH 57.28%.

2.1.1.2- *Aphis citricola*

Data in Fig. (1&2) show that *A. citricola* have three peaks of activity, firstly at the 2nd week of April with 321 individual at mean temp. 21.02 °C and RH. 47.50%, secondly at the 2nd week of June with 291 count at mean temp. 28.92 °C and mean RH 48.81%, and finally at the 4th week of Sep. with 298 individual at mean temp. 27.37°C and mean RH 58.60% in the 2019 season. During 2020 season, two peaks were recorded at the 4th week of April and the 2nd week of Sep. with 201 and 188 individual at mean temp. 20.71°C and 28.61°C with mean RH 49.61% and 57.28%, respectively.

2.1.1.3- *Aphis craccivora*

Three activity peaks were noted in 1st season of the study at the 2nd week of April with 294 individual at mean temp. 21.02 °C with mean RH. 47.50 %, at the 2nd week of June recorded 207 individual at mean temp. 28.92°C and mean RH. 48.81%, and finally at the 4th week of Sep. with 305 individual at mean temp. 27.37 °C and mean RH. 58.60 %. In the 2nd season, two peaks were noted; the first was at 2nd week of May with 112 individual of activity, at mean temp. 25.31 °C and mean RH. 39.17%, while the second was at 4th week of Sep. with 101 individual at mean temp. 27.37°C and mean RH. 58.59%.

2.1.1.4- *Myzus persicae*

Myzus persicae have two peaks in the both seasons. During the 1st season two peaks were recorded at 2nd week of April and the 4th week of activity of Sep. with 191 and 181 individual at mean temp. 21.02°C and 27.37 °C at mean RH 47.50 % and 58.60, respectively. While, in the 2nd season, the recorded peaks were at the 4th week of April with 101 individual at mean temp. 20.71°C and at mean RH. 49.61%, and at the 2nd week of Sep. with 96 individual at mean temp. and RH. 28.61°C and 57.28%, Fig. (1&2).

2.1.2- Predators

2.1.2.1- *Orius albidipennis*

As seen in Fig. (1&2) there is no activity peaks were recorded during the both seasons of 2019 and 2020.

2.1.2.2- *Chrysoperla carnea*

Three activity peaks were recorded in the 1st season as seen in Fig. (1), at the 2nd week of April with 12 individual at mean temp. 21.02 °C and mean RH. 47.50 %, at the 4th week of June with 15 individual at mean temp. 30.13°C and at mean RH. 47.01%, and at the 4th week of Sep. with 12 individual at mean temp. 27.37 °C with 58.60 % of mean RH. The 2nd season has two activity peaks as seen in Fig. (2), at the 2nd week of May and 4th week of Sep. by 12 and 10 individual at mean temp. 25.31 °C and 27.37 °C and at mean RH 39.17% and 58.59%.

2.1.2.3- *Coccinella undecimpunctata*.

Data in Fig. (1&2) show that *C. undecimpunctata* recorded three peaks in the 1st season 2019 at the 2nd week of April with 14 individual at mean temp. 21.02 °C and mean RH. 47.50 %, at the 4th week of June with 13 individual at mean temp. 30.13 °C and mean RH 50.01%, and at the 4th week of Sep. recorded the highest in number 17 individual at mean temp. 27.37 °C and mean RH 58.60 %. During the 2nd season as seen in Fig. (2), two activity peaks were recorded at the 2nd week of May and at the 4th week of Sep. with 18 and 16 individual at mean temp. 25.31 °C and 27.37 °C and at mean RH 39.17% and 58.59%, respectively.

2.1.3- Parasitoids

According to Fig. (1), during 2019 season, three population maxima were reported at the 2nd week of April, the 2nd week of June and the 4th week of Sep. which considered the highest peak with 14 individual at mean temp. 27.37°C and at mean RH 58.60%. During the 2nd season, as shown in Fig. (2), the parasitoid recorded two peaks, the first at the 4th week of May with 15 individual at mean temp. 29. 06 °C and at mean RH 37%, while the second was at the 4th week of Sep. with 18 individual at mean temp. 27.37 °C and at mean RH 58.59%.

Table (1): Total number and percentage of aphid species infesting leaves of navel orange, mandarine and Valencia orange trees and associated predators and parasitoids during 2019 and 2020 season in recently reclaimed areas of Al-Salhia district Sharkia province, Egypt.

Citrus trees	Navel orange trees				Mandarin trees				Valencia orange trees			
	2019		2020		2019		2020		2019		2020	
Aphid speacis:	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<i>Aphis. gossypii</i>	3804	44.21	2239	44.96	3991	55.09	1971	51.19	3947	46.92	1893	7.50
<i>Aphis. citricolla</i>	1922	22.34	1089	21.87	1515	20.91	844	21.92	2011	23.90	1041	6.12
<i>Myzus. persicae</i>	1091	12.68	892	17.91	801	11.06	557	14.47	901	10.71	527	3.23
<i>Aphis. craccivora</i>	1787	20.77	760	15.26	937	12.94	478	12.42	1554	18.47	524	3.15
Total	8604	100	4980	100	7244	100	3850	100	8413	100	3985	00
Predator:												
<i>Chrysoperlla. carnea</i>	117	35.45	88	29.63	86	28.01	77	33.92	89	30.48	79	8.94
<i>Coccinella.undecimpuncta</i>	127	38.49	126	42.43	124	40.39	80	35.24	113	38.70	101	7.00
<i>Syrphus. corollae</i>	43	13.03	42	14.14	46	14.99	34	14.98	49	16.78	48	7.58
<i>Oruis albidipennis</i>	43	13.03	41	13.80	51	16.61	36	15.86	41	14.04	45	6.48
Total	330	100	297	100	307	100	227	100	292	100	273	00
Parasitoid:												
<i>Diaeretiella. rapae</i>	105		133		119		116		101		91	

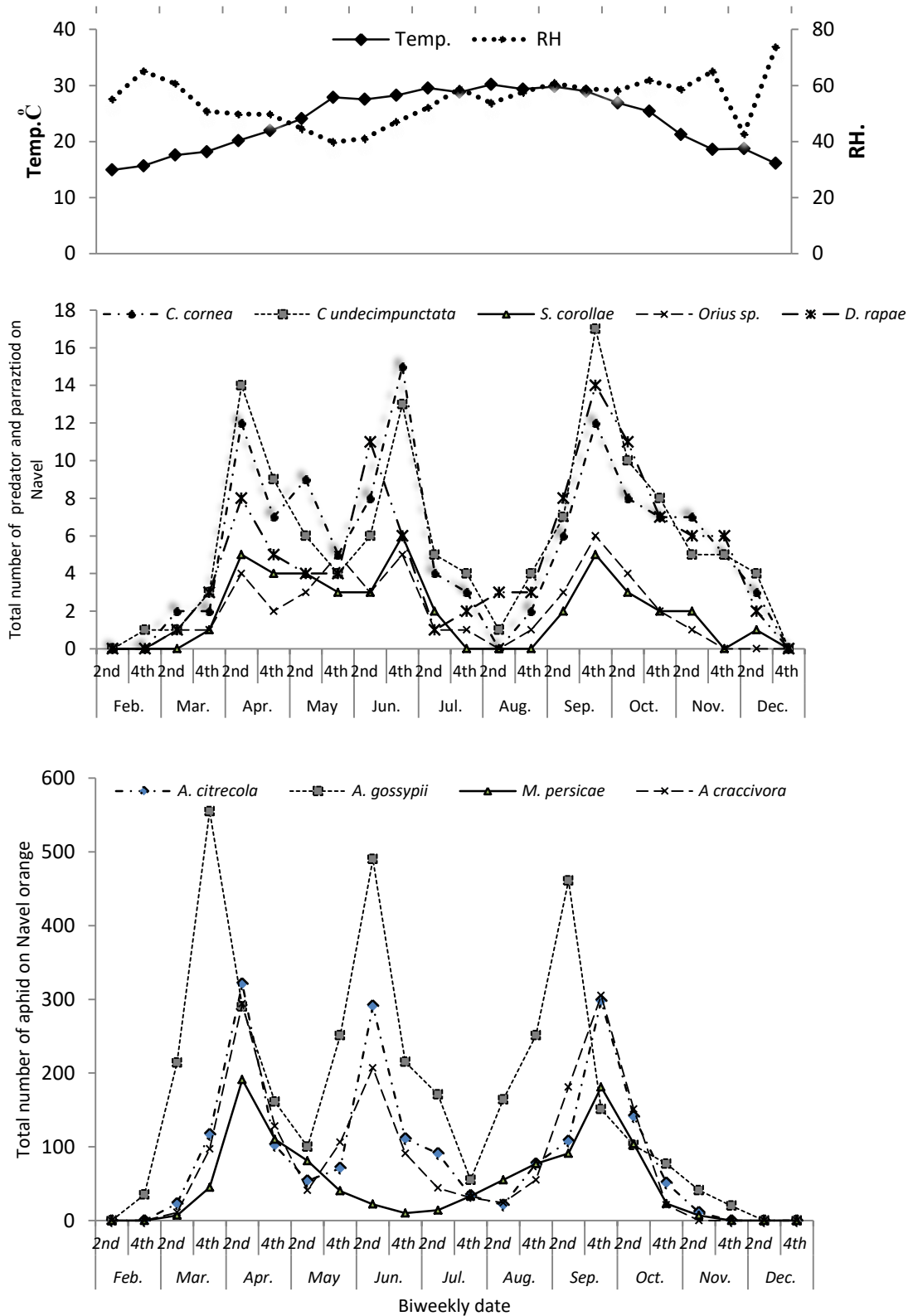


Fig. (1): Seasonal abundance of aphids / sample infesting leaves of Navel orange trees and associated, predators and parasitoid during 2019 season in the recently reclaimed areas in Sharkia Province, Egypt.

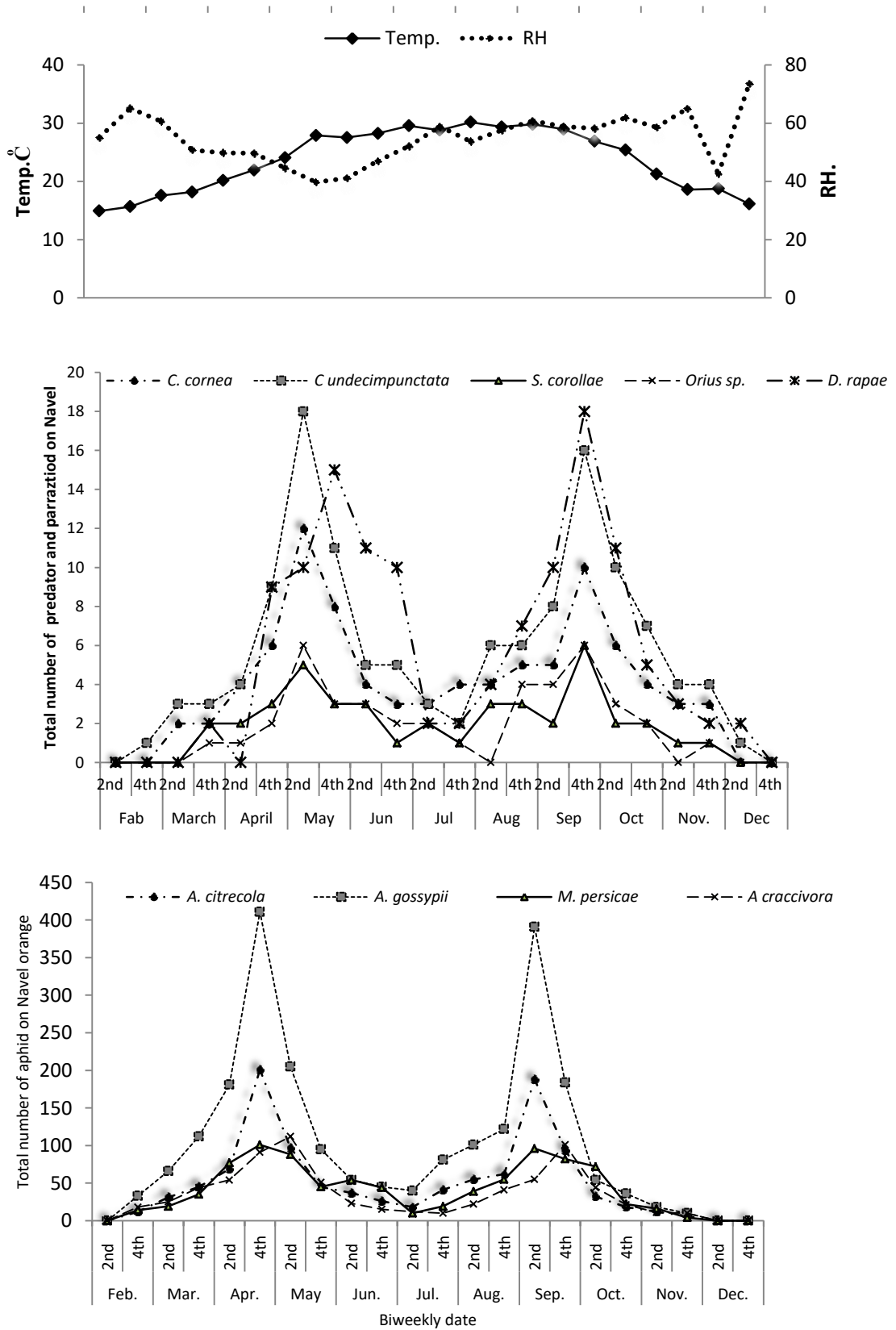


Fig. (2): Seasonal abundance of aphids / sample infesting leaves of Navel orange trees and associated, predators and parasitoid during 2020 season in the recently reclaimed areas in Sharkia Province, Egypt.

2.2–Mandarin trees:-

2.2.1- Aphids

2.2.1.1- Aphis gossypii

The obtained results in Fig. (3) clear that the population density of *A. gossypii* recorded three population activity peaks in the 1st season, the first was noticed the highest peak at the 4th week of March with 610 individual at mean temp. 18.17 °C with 50.76% RH., In the 2nd week of June, the second peak was observed, with 470 individual at mean temp. 27.53 °C at mean RH 41.095%, in the fourth week of Sep., while the third was observed with 514 individual at mean temp. 28.96 °C and mean RH 58.82%. Two population density peaks in the 2nd season were noted, the first was at the 4th week of April with 420 individual at mean temp. 20.71 °C and mean RH 49.61%, while the final one was noted during the 4th week of Sep. with 302 individual at mean temp. 27.37 °C and mean RH 58.59%, Fig. (4).

2.2.1.2- Aphis citricola

Data in Fig. (3) show that *A. citricola* have three recorded activity peaks, the first was at the 2nd week of April with 287 individual at mean temp. 20.16 °C and at mean RH. 49.78%. The second peak was at the 4th week of June with 151 individual at mean temp. 28.24 °C and mean RH 47.01%, while the third one was at the 2nd week of Oct. with 181 individual at mean temp. 26.89 °C and mean RH 58.19% in the 2019 season. In 2020 season, two peaks were recorded at the 4th week of April and the 4th week of Sep. with 181 and 109 individual at mean temp. 20.71 °C and 27.37 °C with mean RH 49.61% and 58.59%, respectively, Fig. (4).

2.2.1.3- Aphis craccivora

Three peaks were recorded in the 1st season of the study, at the 2nd week of April first peak existed with 171 individual at mean temp. 20.16 °C with mean RH. 49.78%, at the 4th week of June, the second peak recorded 109 individual at mean temp. 28.24 °C and mean RH. 47.01%. The third peak existed in the 4th week of Sep. with 129 individual at mean temp. 28.96 °C and mean RH. 58.82%, Fig. (3). In the 2nd season, two peaks of population density were recorded the first at 4th week of April with 122 individual at mean temp. 20.71 °C and mean RH. 49.61%, while the second peak at 4th week of Sep. was with 88 individual at mean temp. 27.37 °C and mean RH. 58.59%, Fig. (4).

2.2.1.4- Myzus persicae

Fig. (3) shows that *M. persicae* recorded two peaks in each season, the 1st season showed two peaks at the 2nd week of April and the 4th week of Sep. with 154 and 109 individual at mean temp. 20.16 °C and 28.96 °C at mean RH 49.78% and 58.82, respectively. The two peaks of the 2nd season, according to Fig. (4) were at the 4th week of April with 115 individual at mean temp. 20.71 °C and at mean RH. 49.61%, and the 4th week of Sep. with 105 individual at mean temp. and RH. 27.37 °C and 58.59%, respectively.

2.2.3- Predators

2.2.3.1- Orius albidipennis

As seen from Fig. (3), two population density peaks were recorded during the 1st season, at the 2nd week of May with 8 predators and at the 4th week of Sep. with 7 individual. There was only one peak at the 2nd week of May with 6 predators in the 2nd season, Fig. (4).

2.2.3.2- Chrysoperla carnea

Fig. (3) shows that *C. carnea* was recorded via two peaks of population activity during the 1st season, at the 2nd week of May with 11 individual at mean temp. 24.08 °C and mean RH. 44.60%, the second peak at the 4th week of Sep. with 10 predators at mean temp. 28.96 °C and at mean RH. 58.82%. During the 2nd season as seen in Fig. (4), *C. carnea* has two activity peaks, at the 2nd week of May and 4th week of Oct. by 13 and 10 individual at mean temp. 25.31 °C and 25.11 °C and at mean RH 39.17% and 61.78%, respectively.

2.2.3.3- Coccinella undecimpunctata

Data in Fig. (3) show that *C. undecimpunctata* recorded two peaks of population density in the 1st season, at the 2nd of week of May with 18 individual at mean temp. 24.08 °C and mean RH. 44.60%, the second peak at the 4th week of Sep. with 14 individual at mean temp. 28.96 °C and mean RH 58.82%. In the 2nd season as in Fig (4), the predator recorded two peaks at the 2nd week of May and at the 4th week of Oct. with 10 and 8 individual at mean temp. 25.31 °C and 25.11 °C and at mean RH 39.17% and 61.78%, respectively.

2.2.3.4- Metasyrphus corollae

Fig. (3) records one peak of population density of *Syrphus corolla* at the 2nd week of May with 7 individual at mean temp. 24.08 °C and mean RH. 44.60%. In the 2nd season no recorded activity peaks in the present study.

2.2.4- Parasitoids

Data from Fig. (3) record three parasitoid population density peaks, at the 2nd week of April, the 4th week of June and the 2nd week of Oct. which considered as the highest peak with 19 individual. Also, during the 2nd season, as shown in Fig. (4) three parasitoid peaks were recorded, the first was at the 4th week of Apr. with 13 individual at mean temp. 20.71 °C and at mean RH 49.61%, the second was at the 2nd week of Oct. with 15

individual at mean temp. 27.26 °C and at mean RH 55.37%, the final was at the 2nd week of Nov. with 14 individual at mean temp. 24.12 °C and at mean RH 60.94%.

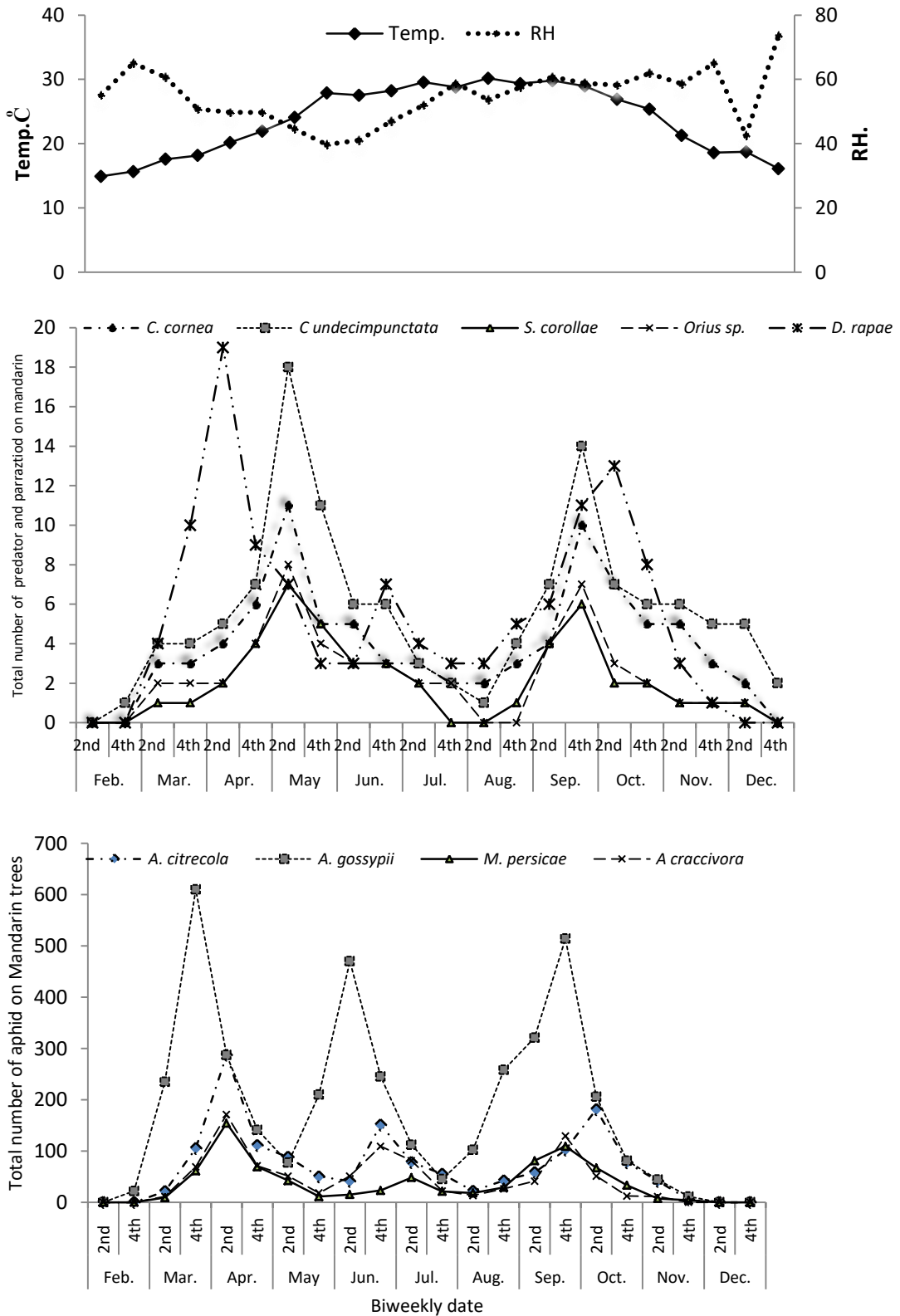


Fig. (3): Seasonal abundance of aphids / sample infesting leaves of mandarin trees and associated, predators and parasitoid during 2019 season in the recently reclaimed areas in Sharkia Province, Egypt.

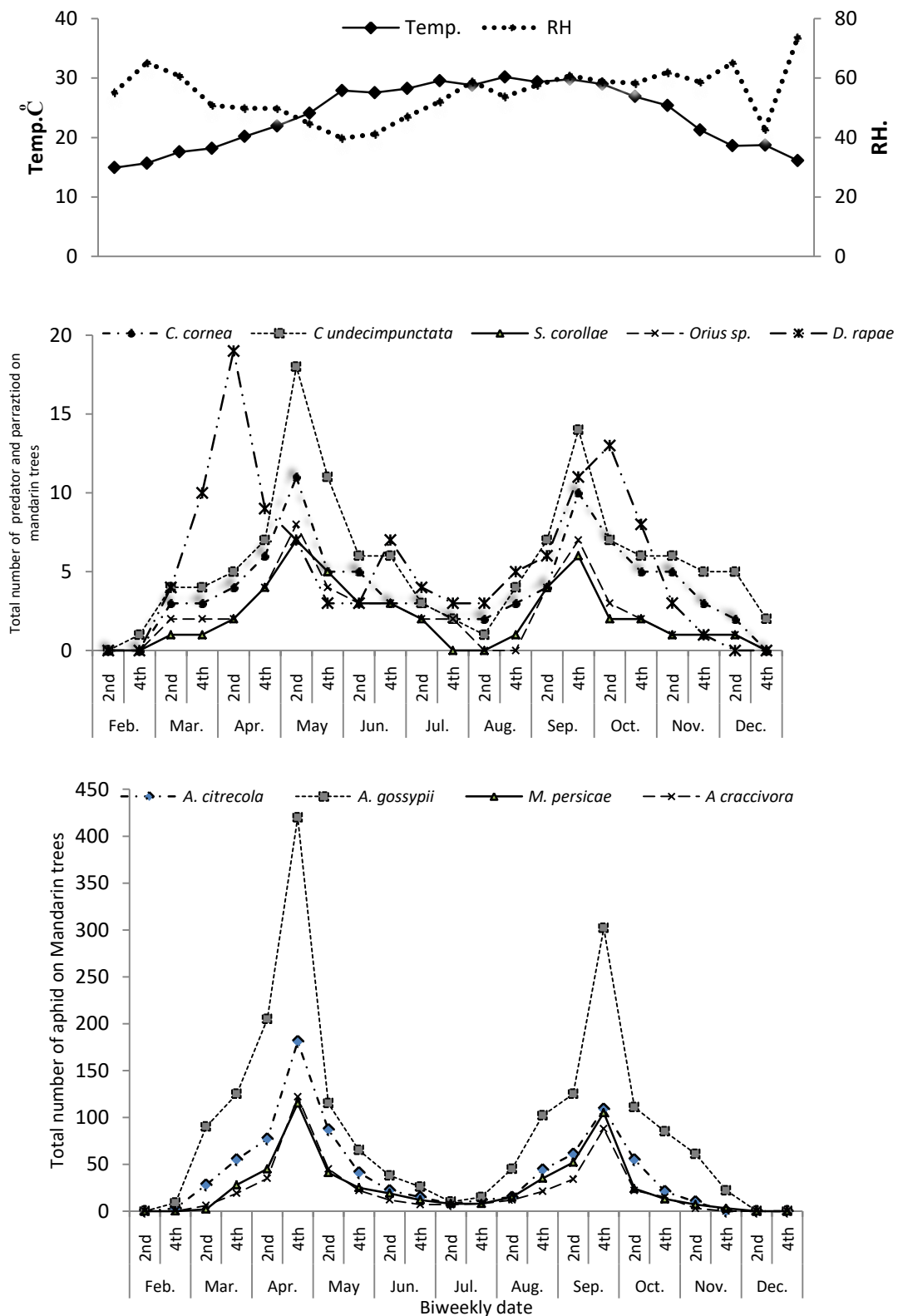


Fig. (4): Seasonal abundance of aphids / sample infesting leaves of mandarin trees and associated, predators and parasitoid during 2020 season in the recently reclaimed areas in Sharkia Province, Egypt.

2.3.–Valencia orange trees:-

2.3.1- Aphids

2.3.1.1- Aphis gossypii

The obtained results in Fig. (5) clear that the population density of *A. gossypii* recorded three peaks of population activity in the 1st season, the first one was the highest peak at the 4th week of March with 625 individual at mean temp. 18.17 °C with 50.76% RH., the second was at the 2nd week of June with 415 individual at mean temp. 27.53 °C at mean RH 41.095%, while the third one was noticed at the 2nd week of Sep. with 512 individual at mean temp. 29.8 °C and mean RH 60.75%. In the 2nd season as seen in Fig. (6) two peaks were recorded, the first was at the 4th week of April with 405 individual at mean temp. 20.71 °C and mean RH 49.61%, while the second was at the 4th week of Sep. with 312 individual at mean temp. 27.37 °C and mean RH 58.59%.

2.3.1.2- Aphis citricola

Data in Fig. (5) show that *A. citricola* recoded three peaks of population activity, the first was at the 4th week of March with 318 individual at mean temp. 18.17 °C and at mean RH. 5076%. The second was at the 2th week of June with 281 individual at mean temp. 27.53 °C and mean RH 41.09%, while the third one was at the 2nd week of Sep. with 305 individual at mean temp. 29.8 °C and mean RH 60.75% in the 2019 season. In 2020 season, Fig (6), two peaks of the population activity were recorded at the 4th week of both April and Sep. with 199 and 180 individual at mean temp. 20.71 °C and 27.37 °C with mean RH 49.61% and 58.59%, respectively Fig. (5).

2.3.1.3- Aphis craccivora

Three peaks were recorded in the 1st season of the study as seen in Fig. (5) at the 2nd week of April with 251 individual at mean temp. 20.16°C with mean RH. 49.78%, the second was at the 4th week of June recording 157 individual at mean temp. 28.24 °C and mean RH. 47.01%, the third one was at the 4th week of Sep. with 234 individual at mean temp. 28.94°C and RH. 58.82%. In Fig. (6), during the 2nd season, two peaks of population density were recorded at 4th week of April with 99 individual at mean temp. 20.71 °C and mean RH. 49.61%, and at 4th week of Sep. with 71 individual at mean temp. 27.37 °C and mean RH. 58.59% Fig. (5).

2.3.1.4- Myzus persicae

Fig. (5 and 6) showed that *M. persicae* was recorded via two peaks in every season. In the 1st season, the two peaks were at the 2nd week of April and the 4th week of Sep. with 181 and 144 individual at mean temp. 20.16 °C and 28.96 °C and mean RH. 49.78 and 58.82 %, respectively. In the 2nd season there were at the 4th week of April with 77 individual at mean temp. 20.71 °C and mean RH. 49.61% and at the 4th week of Sep. with 81 individual at mean temp. 27.37°C and mean RH. 58.59%.

2.3.2- Predators

2.3.2.1- Orius albidipennis

As seen in Fig. (5), one peak was noticed at the 2nd week of Oct. with 7 predators at mean temp. 26.89 °C and at mean RH 58.19%, no recorded peaks in the other season.

2.3.2.2- Chrysoperla carnea

Fig. (5) records two activity peaks in the 1st season, at the 2nd week of April with 10 individual at mean temp. 20.16 °C and mean RH. 49.78%, and at the 4th week of June with 11 predators at mean temp. 28.24 °C and at mean RH. 47.01%. In the 2nd season, as seen in Fig. (6) *C. carnea* was recorded via two activity peaks at 2nd week of both May and Oct. with 11 and 9 individual at mean temp. 25.31 °C and 27.26 °C and at mean RH 39.17% and 55.37%, respectively.

2.3.2.3- Coccinella undecimpunctata

Data in Fig (5) record three population density peaks of *C.undecimpunctata* in the 1st season at the 2nd week of April with 14 individual at mean temp. 20.16 °C and mean RH. 49.78%, and at the 4th week of June with 15 individual at mean temp. 28.24 °C and mean RH 47.01%, while the third one was recorded at the 2nd week of Oct. with 16 individual at mean temp. 26.89 °C and mean RH. 58.19%. During the 2nd season, as shown in Fig. (6), two peaks were noticed in the 2nd week of both May and Oct. with 14 and 13 individual at mean temp. 25.31 °C and 27.26 °C and at mean RH 39.17% and 55.37%, respectively.

2.3.2.4- MetaSyrphus corollae

Syrphus corollae in Fig. (5) recorded two peaks of population density at the 4th week of June with 6 individual at mean temp. 28.24 °C and mean RH. 47.01%, and at the 2nd week of Oct. with 8 individual at mean temp. 26.89 °C and at mean RH 58.19%. During the 2nd season as in Fig. (6), one peak of activity was recorded at the 2nd week of May with 6 predators at mean temp. 25.31°C and at mean RH 39.17%.

2.3.3- Parasitoids

Data from Fig. (5) show that two peaks were recorded at the 2nd week of June and the 4th week of Sep. with 10 and 14 individual, respectively. While, in the 2nd season as shown in Fig. (6), the parasitoid recorded two peaks, were at the 2nd week of both May and Oct. with 9 and 16 individual, respectively.

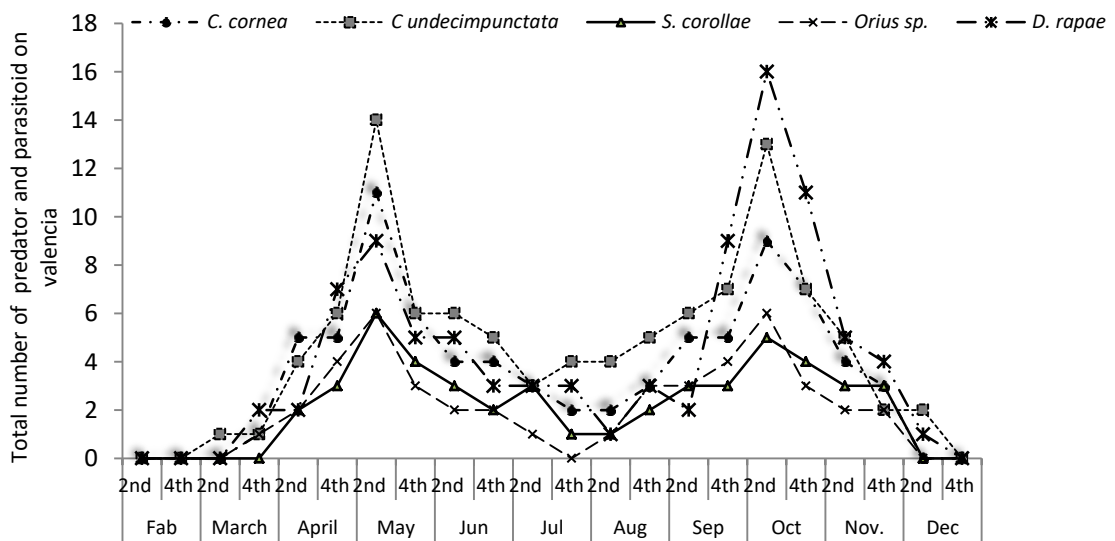
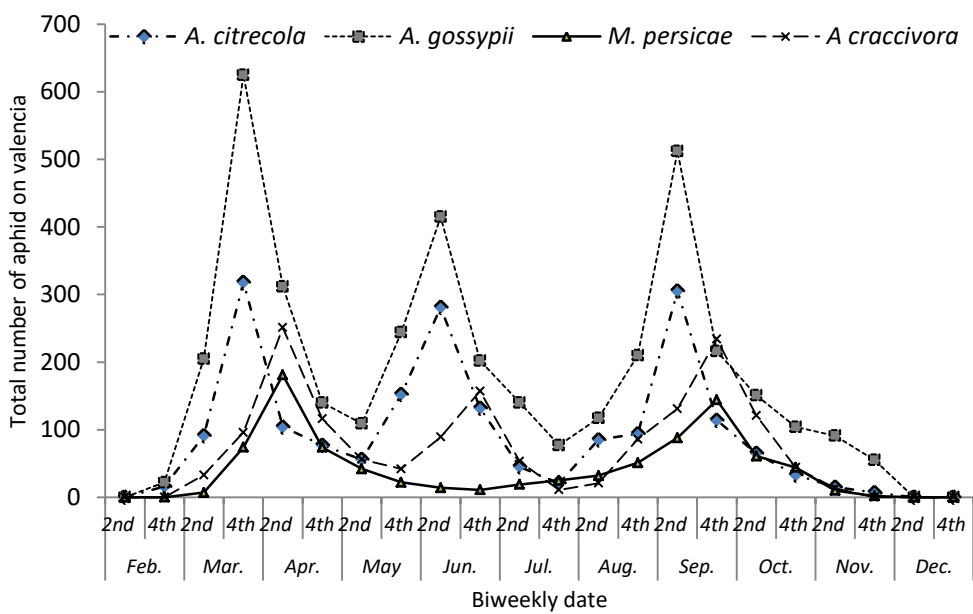
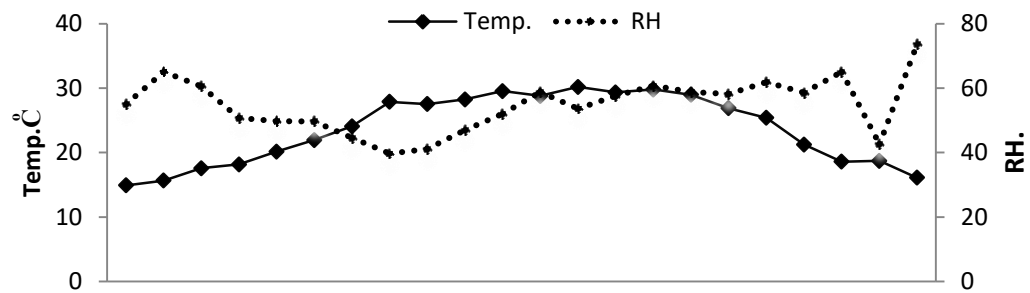


Fig. (5): Seasonal abundance of aphids / sample infesting leaves of Valencia orange trees and associated, predators and parasitoid during 2019 season in the recently reclaimed areas in Sharkia Province, Egypt.

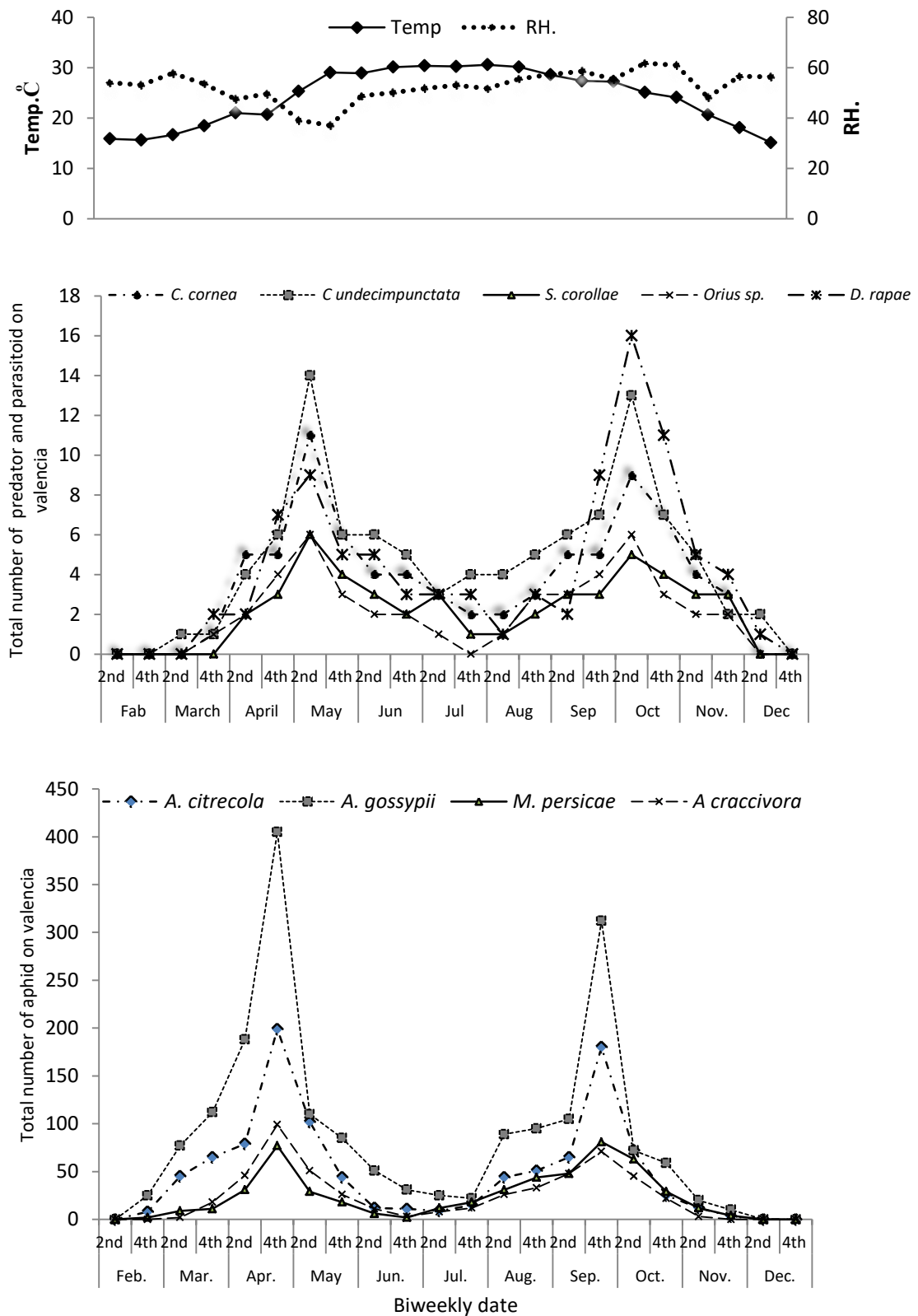


Fig. (6): Seasonal abundance of aphids / sample infesting leaves of Valencia orange trees and associated, predators and parasitoid during 2020 season in the recently reclaimed areas in Sharkia Province, Egypt.

DISCUSSION

Aphis gossypii (Glover), *Aphis citricola* (van der Goot), *Myzus persicae* (Sulzer) and *Aphis craccivora* Koch were found on navel orange aphid during two seasons 2019 and 2020. The common aphids caught in the navel orange trees were: *A. citricola*, *A. gossypii* and *A. craccivora* has infesting navel orange, three peaks in 2019 while two peaks during 2020 respectively, while two peak in *M. persicae* has infesting in navel orange, two peaks in 2019 and 2020 respectively, on navel orange trees, mandarin trees and valencia orange trees.

The outcomes are consistent with those of Ali (2008), Kalaitzaki et al. (2019) and Youssif et al. (2021). They stated that there were several bugs attacking navel orange trees. Aphid's *A. gossypii*, *A. citricola*, *M. persicae*, *A. craccivora*, *Aphis nerii* (Boyer), and *Macrosiphum euphorbiae* were the most harmful. In contrast, *Toxoptera aurantii* and *T. citricida* were the most common citrus aphids in the South East of Asia, attacking orange, mandarin, and other species (Bayhan et al. 2006).

Data present in this study are in agreement with Labdaoui and Guena (2015) investigated six aphid species on mandarin trees *Aphis gossypii*, *Aphis spiraeicola*, *Toxoptera aurantii*, *Aphis craccivora*, *Myzus persicae* and *Aphis fabae*. In the same trend Lebbal and Laamary (2016) who recorded four aphids species on mandarin trees *Aphis spiraeicola*, *Aphis gossypii*, *Myzus persicae* and *Aphis nerii*. On the contrary one species of aphids, *Toxoptera aurantii* was recorded by Abdel-Elghaffar et al. (2018). Our results in the same parallel with Bertolini et al. (2004) and El-Gindy and Hegab (2007) they showed that *A. gossypii*, *A. citricola*, *M. persicae* and *A. craccivora* were infesting citrus trees.

The common predators caught in the navel orange trees were: *Orius albidipennis*, *Chrysoperla carnea*, *Coccinella undecimpunctata* and *Syrphus corollae*, while one parasitoid was *Diaeretiella rapae*. These findings are in keeping with Günçan et al. (2008), who claimed that *C. undecimpunctata*, *C. carnea*, *A. aphidimyza*, and *S. corolla* were the most imported predators attacking navel orange trees covered in citrus aphids. According to the same tendency, Ali (2008) discovered five insect predators that were associated with the aphids infesting the navel orange leaves, coming from four orders and four families. They were *C. undecimpunctata*, *A. aphidimyza*, *O. albidipennis*, *C. carnea* and *M. corolla*. Our findings concur with those of Abdel-Elghaffar et al. (2018), who saw *Scymnus interruptus*, *Carnea carnea*, and *Carnea undecimpunctata* on mandarin trees.

Results disagree with Lebbal and Laamary (2016) they recorded primary parasitoids, *Lysiphlebus fabarum* (Marshall) and *Lysiphlebus confusus* on mandarin trees. This study showed that *Chrysoperla carnea* on citrus trees was more abundant during 2019 and 2020. According to the obtained results in general the population density of, *Coccinella undecimpunctata*, *Syrphus corollae* and *Orius albidipennis* has predators on aphid insects on navel orange, mandarin and valencia orange trees, two peaks during in 2019 and 2020, respectively.

The acquired results concur with those of the aforementioned researchers. In the 3rd week of June, according to Ali (2008) in Egypt, Aphid's population density reached its peak. According to Lebbal and Laamary (2016), the months of May and July saw the highest aphid population densities on navel orange plants. According to Kalaitzaki et al. (2019), the 3rd week of May saw the start of the aphid infestation on navel orange trees.

The population peaked the 4th week of June and then vanished by the end of August. According to Mohsen (2019), *A. gossypii* populations peaked in Egypt over two distinct seasons in the last week of April and the first part of May. These findings were in agreement with those of Abd-Elghaffar et al. (2018) and Youssif et al. Results in general concerning the population density of predators on navel orange trees show clearly that these species have two peaks on navel orange, respectively.

Meanwhile, the common parasitoid caught in the navel orange trees was *Diaeretiella rapae*. *D. rapae* recorded two peaks in 2019 season and one peak in 2020 on navel orange, mandarin and valencia orange trees. Our results in parallel with Youssif et al. (2021) who proved that *Diaeretiella rapae* was the most parasitoids on navel orange trees. But, in contrast with Tomanović et al. (2009) who made the claim that navel orange trees were being attacked by *Ephedrus* sp. citrus aphid. *D. rapae* recorded two peaks in 2019 season and one peak in 2020. Meanwhile, Youssif et al. (2021) recorded that *D. rapae* had six peaks the highest one was occurred in the 4th week of June at means of 28.9°C and 61.9% RH.

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