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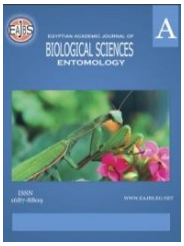

Community Structure of Coccinellids in New Valley Governorate, Egypt

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ABSTRACT

A study for tribe Coccinellini (Coleopteran: Coccinellidae) was conducted in the New Valley Governorate of Egypt. Members of this tripe are important for biological control because they are primary predators of aphids. The identification of this tribe in the New Valley constitutes the basis for future biological studies to determine the extent to which it can be used in preparing biological control programs.This study aimed to study the community structure of Coccinellids in New Valley Governorate. The adult Coccinellids were collected from Agriculture and thenatural ecosystem from three sites; El-Kharga, El-DaKhla and Paris during the period from January 2018 till the end December 2019. The results revealed the presence of 4 species (*Coccinella septempunctata*,*Coccinella undecimpunctata*,*Cheilomenespropinqu anilotica*, and *Cheilomenes propinqua vicina*), the investigation included their abundance and distribution in the New Valley Governorate. The species *Ch. propinquanilotica* was recorded in the New Valley for the first time. The ladybirds, *C. Sempunctata* and *C. undsempunctata* were the commonest species and the most abundant ones. The maximal numbers and percentage of coccinellids were recorded during spring months. The species richness and diversity of thecoccinellids community reach the maximum level in spring and summer seasons. El-Dakhla recorded the highest value (0.629) of Margalef's index for species richness, while El-Kharga and Paris recorded the lowest values (0.479 and 0.524, respectively). The coccinellids composition ismostly related to air temperature followed by wind velocity.

INTRODUCTION

The common name of Coccinellids (Coleoptera: Coccinellidae) is ladybugs, lady beetles, or ladybirds. They consist of more than 6.000 identified species worldwide, include 360 different genera and 42 tribes (Nedved and Kovar, 2012; Zazycki*et al.,* 2015, Kaçar and Koca2020). Coccinellidae family is the largest family in the superfamily Coccinelloidea (Robertson *et al.,* 2015), It has some of the larger, more noticeably colored members of lady beetle fauna, and can be easily recognized (El-Saeady *et al.,* 2020). They are very beneficial insects, their adults and larvae feed on pests, mainly on aphids, mitesand scale insects while, a few species of this family are pests (Dobzhansky, 1933; Abdolahi Mesbah *et al.,* 2016). In Egypt, 59 Coccinellid species have been recorded (Al Akkad 1979; Al Ansi*et al.,* 2020).

The New Valley Governorate is the largest Governorate in Egypt, representing about 44% of the total area. New Valley Governorate islocatedin the southern section of The Egyptian western desert. It receives less than 2 mm/year of rainfall therefore

vegetations mainly depend on groundwater (Kröpelin 2006). Despite the great area of this Governorate, alittle study had been carried out on the abundance of insects (Mahbob and Mahmoud, 2013). However, the study of Coleopteran diversity of various species has been studied at different parts of Egypt (El-Morsy*et al.*, 2001; Abdel-Wahab and El-Akkad, 1998).

In Egypt, many authors are concerned with family Coccinellidae, or some species (Boehm, 1908; Ibrahim in 1953; El-Akkad, 1979; Badrawy, 2009; Atif, 2016, and Bedewy, 2016; Abu El-Ghiet, 2019; El-Saeady*et al.*, 2020). These studies were fragment and scattered. Therefore, this study aimed to study the community structure of Coccinellids in the New Valley Governorate which isconsidered predatory to aphids. The identification of this tribe in the New Valley constitutes the basis for future biological studies to determine the extent to which it can be used in preparing biological control programs.

MATERIALS AND METHODS

The study was conducted in three locations in the New Valley, all of which will be the governorate of the New Valley, namely Kharga, Dakhla, and Paris (Fig. 1). Coccinellid samples were collected during two years representing four different seasons, starting from January 2018 to December 2019, when three visits were made per month to the farms at each study site. The large adult insects were collected using the canopy, which is a circular piece of cloth with a metal frame, 54 cm in diameter. They were placed under the branches, and then the branches were beaten lightly with a 50 cm long wooden stick. Then the insects were collected by vacuum and by hand. Also, hand collecting, net trap and sweeping net were used to collect samples from field crops.

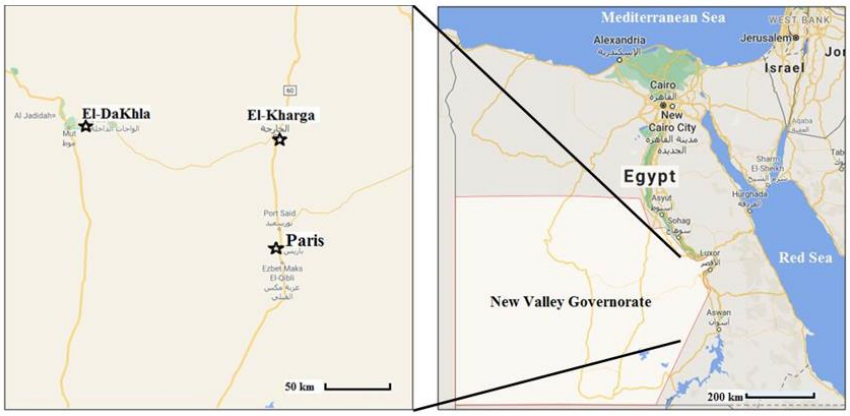

Fig. 1, Maps showing the three study sites in New Valley Governorate, Egypt.

The samples were transferred by placing them in small tubes to the laboratory at the Faculty of Science, New Valley University. The specimens were classified and defined as most of them were placed after killing themusing ethyl alcohol at a concentration of 70% in sealed tubes 1 cm in diameter and 7 cm in length with a drop of glycerin. They were examined under a binocular microscope and the species were identified based on the following references: Iablokoff and Khnzorian, (1982); Fürsch, (1979); Hodek, (1973); Dauguet, (1949); Hard and Kearns, (1989); Raimundo van Harten, (2000) and El-Saeady et al. (2020). The identified species were revised at the Taxonomy Browser website (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/ wwwtax.cgi)

The collected data were statistically analyzed using SPSS software package (version 17) (SYSTAT statistical program) and Microsoft Office Excel (2010). Analysis of variance (ANOVA) was used to examine spatial and seasonal differences of means. Duncan test was used to detect the distinct variances between means. The program Canoco

for windows 4.5 was used for canonical corresponded analysis (CCA) to analyze the response of the ladybugs' community composition to weather factors. Program Primer5 was used to calculate diversity indices, which includes Shannon–Wiener diversity index, Shannon equitability and species richness, to estimate the species diversity across the study season and sites.

RESULTS AND DISCUSSION

The numbers of specimens sampled were 2517 distributed in the three studied sites. Four species of coccinellids namely *Coccinella septempunctata* Linnaeus, 1758, *Coccinella undecimpunctata* Linnaeus, 1758, *Cheilomenes propinqua nilotica* Mulsant, 1850, and *Cheilomenes propinqua vicina* Mulsant, 1850 were recorded. All of these species belonging to the familyCoccinellidae, subfamily Coccinellinae and tribe Coccinellini. The two species *C. septempunctata* and *C. undecimpunctata* recorded the highest percentage of species composition in the study area (874 and 877specimens, respectively) constituting 35% of the total specimens while the lowest percentage was recorded for *Ch. Propinquanilotica* and *Ch. propinqua vicina* (449 and 317specimens, respectively) constituting 18% and 13%, of specimens, respectively (Table 1). The species *Ch. propinquanilotica* (L.) was recorded in the New Valley for the first time.

Table 1, Total number, and percentage of coccinellids secrecies collected from the investigated sites.

Sites	El-Kharga		El-DaKhla		Paris		Total	
Species	No	%	No	%	No	%	No	%
C. septempunctata	318	36	266	30	290	33	**874**	35
C. undecimpunctata	302	34	304	35	271	31	**877**	35
Ch. Propinquanilotica	169	38	142	32	138	31	**449**	18
Ch. propinqua vicina	79	25	128	40	110	35	**317**	13
Total	**868**		**840**		**809**		**2517**	

Coccinellids community showed different species composition in investigated sites during study years. All recorded coccinellids were represented in all studied sites by adifferent percentage while in 2018 *Ch. propinqua vicina* was not recorded in El-Kharga site (Fig. 2).

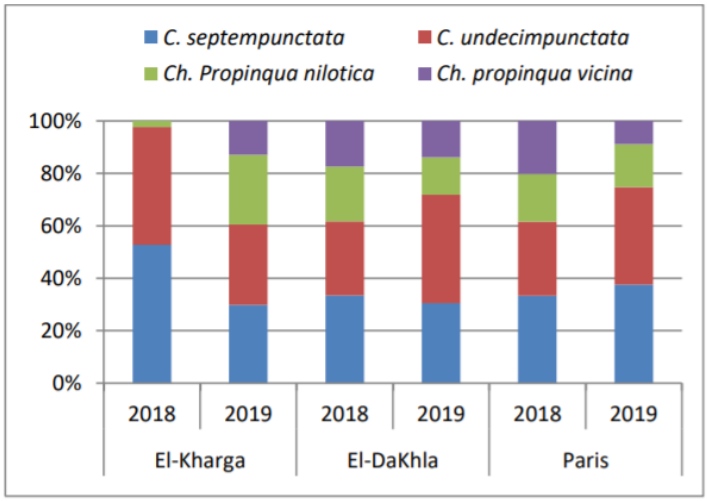

Fig. 2: The percentage composition of coccinellids at studied sites during investigated years.

A difference in the total number of coccinellids was noticed during the studied months. As shown in Fig. (3), coccinellids abundance has seasonal fluctuations. The total catch of the investigated species showed significant differences between months in case of *C. septempunctata* (F= 2.432, *P*= 0,007) and *Ch. Propinquanilotica* (F= 1.869, *P*= 0,054). In case of *C. undecimpunctata* and *Ch. propinqua vicina*, the monthly fluctuation was not significant. In general, the number of investigated coccinellids wasincreasing gradually from winter months to reach the maximum during spring season then decreased gradually to increase again during autumn season (Fig. 3). This general trend was recorded in all studied sites with maximal numbers and percentages of coccinellids during spring months (Table 2). Similar results were recorded by (Abu El-Ghiet, 2019) who mentioned that *C. septempunctata* increased during spring and autumn and sharply decreased during winter months.

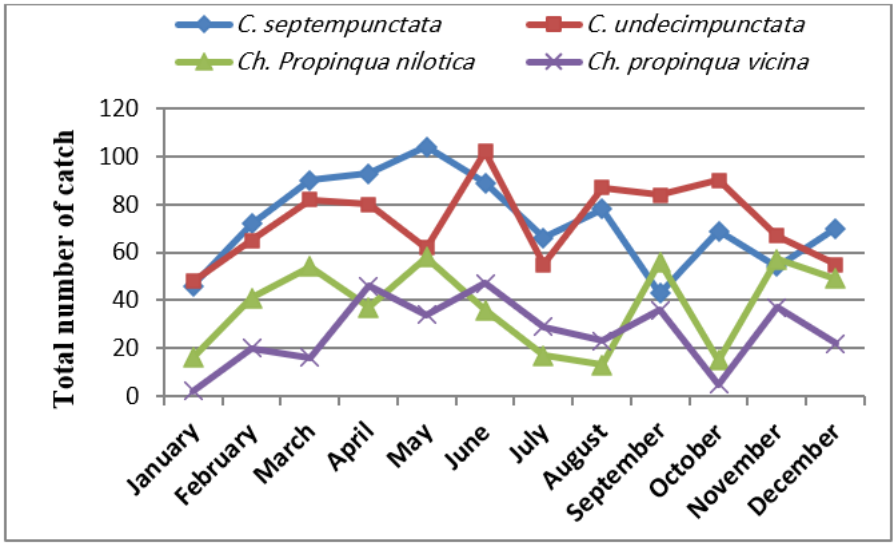

Fig. 3: Monthly fluctuations of the total number of the collected coccinellids during the period of investigation.

Table 2, Monthly abundance and percentage of the total number of the collected coccinellids at study sites during the period of investigation.

Sites	El-Kharga		El-DaKhla		Paris		Total	
	No.	%	No.	%	No.	%	No.	%
January	20	2	44	5	48	6	112	4
February	62	7	85	10	51	6	198	8
March	73	8	86	10	83	10	242	10
April	81	9	85	10	90	11	256	10
May	66	8	128	15	64	8	258	10
June	108	12	108	13	58	7	274	11
July	66	8	35	4	66	8	167	7
August	77	9	76	9	48	6	201	8
September	77	9	79	9	63	8	219	9
October	67	8	41	5	71	9	179	7
November	81	9	42	5	92	11	215	9
December	90	10	31	4	75	9	196	8

Figure (4) represents species changes of species diversity of coccinellids at different sites. These variations were statistically not significant. In general, the species richness and diversity of the coccinellids community reach the maximum level in spring and summer

seasons. Margalef's index for Richness showed significant differences between study sites (F=4.766, P= 0.012), while no significant geographical differences between the different study sites in Shannon diversity and equitability.El-Dakhla recorded the significant highest value (0.629) of Margalef's index for species richness, while El-Kharga and Paris recorded the lowest values (0.479 and 0.524, respectively).

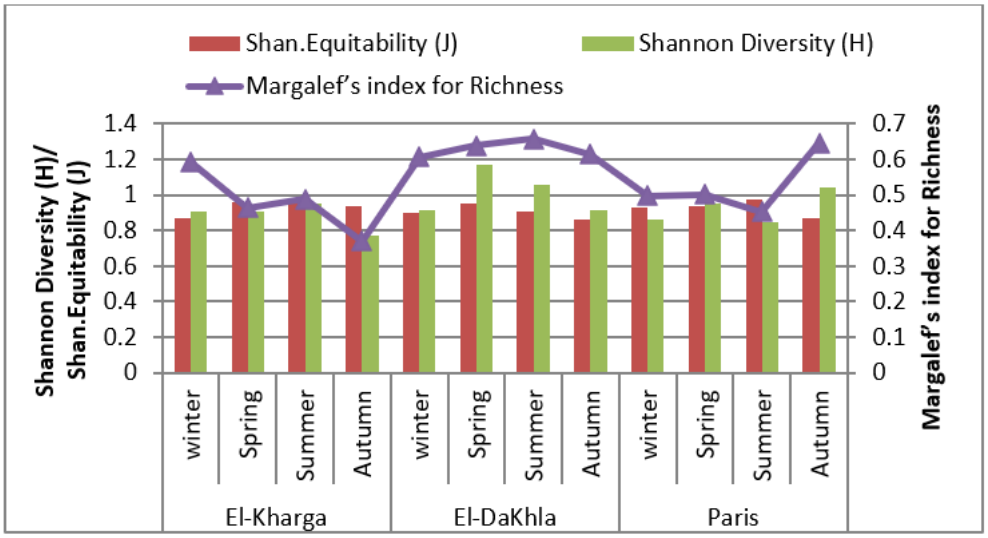

Fig. 4, Seasonal variations of Margalef's index for Richness, Shannon diversity (H) and Shannon Equitability (J) of coccinellids species collected from investigated sites during the period of study.

Table (3) shows the seasonal variations of weather factors (air temperature, humidity and Wind Velocity) at investigated sites during the period of study.It was noticed that the seasonally variations of weather factors at each study site, while these variations were not statistically significant.However, the studied weather factors show asignificantdifference between investigated sites. Paris recorded the lowest air temperature (F= 3.3, P=0.39) and the highest Humidity (F=28.988, P< 0.001) and Wind Velocity (F= 28.149, P< 0.001).

The results of canonical correspondence analysis (CCA) ordination were performed on coccinellids species and the correspondingstudied weather factors (air temperature, humidity and wind velocity) for the collected samples during the period of investigation. Diagram of canonical correspondence analyses is shown in Figure 5. The first two CCA axestogether account for approximately 66% of therelations between coccinellids and weather factors data. The results of CCA reveal that the coccinellidscomposition ismostly related to air temperaturefollowed by wind velocity. Humidity has relatively small effects oncoccinellids. Air temperature and wind velocityshow a positive correlation with thefirst canonical axis, while humidity indicated anegative correlation.*C. septempunctata* and *Ch. propinqua vicina* show a positive correlation with air temperature and wind velocity and negatively with humidity. In reverse *Ch. Propinquanilotica* shows apositive correlation with humidity and anegative correlation with air temperature and wind velocity (Fig. 5).

Table 3, Mean ± standard deviation (SD) of weather factors for studied seasons at investigated sites and statistical results between sites. (The similar characters for each factor show no significant difference).

Weather factors		Temperature (° C)						Humidity (%)						Wind Velocity (m sec-1)					
Year		2018			2019			2018			2019			2018			2019		
Sites	Seasons	M	±	SD	M	±	SD	M	±	SD	M	±	SD	M	±	SD	M	±	SD
El-Kharga	Winter	16.7	±	3.9	16.7	±	3.7	44.1	±	10.1	45.9	±	8.9	4.6	±	1.8	4.8	±	1.7
	Spring	26.7	±	6.3	26.7	±	6.0	23.4	±	9.3	26.4	±	8.6	6.2	±	1.8	5.1	±	1.8
	Summer	34.5	±	1.9	34.8	±	1.8	27.9	±	5.1	26.2	±	4.9	7.1	±	1.8	7.0	±	1.8
	Autumn	25.5	±	5.4	26.4	±	5.2	39.4	±	8.1	37.4	±	8.7	6.2	±	2.1	6.0	±	2.1
	Mean	**25.9±7.8 a**						**34±11.4 b**						**5.8±2 b**					
El-DaKhla	Winter	16.1	±	3.1	17.7	±	3.2	48.0	±	6.6	39.7	±	11.1	3.9	±	1.6	3.8	±	1.9
	Spring	28.1	±	6.5	26.3	±	5.9	23.9	±	6.9	24.8	±	6.1	6.4	±	1.9	6.3	±	2.3
	Summer	34.1	±	2.1	34.3	±	1.5	27.2	±	4.1	25.0	±	2.8	6.1	±	1.5	4.5	±	1.3
	Autumn	27.3	±	7.0	27.6	±	4.9	37.4	±	7.6	34.3	±	10.2	4.9	±	1.8	6.4	±	2.2
	Mean	**26.3±7.7 a**						**32±10.9 b**						**5.2±2.1 b**					
Paris	Winter	15.2	±	5.2	13.1	±	1.8	57.4	±	15.5	57.2	±	7.2	6.2	±	2.3	6.6	±	2.0
	Spring	25.6	±	5.6	23.1	±	6.1	34.1	±	13.0	39.9	±	7.5	8.4	±	2.9	9.4	±	1.7
	Summer	30.8	±	1.5	31.9	±	1.3	41.8	±	10.1	35.7	±	3.2	8.9	±	1.7	7.6	±	2.4
	Autumn	23.7	±	4.4	23.9	±	4.4	49.0	±	4.8	52.5	±	8.1	7.2	±	2.1	8.1	±	1.5
	Mean	**23.3±7.4 b**						**46.1±12.7 a**						**7.8±2.3 a**					

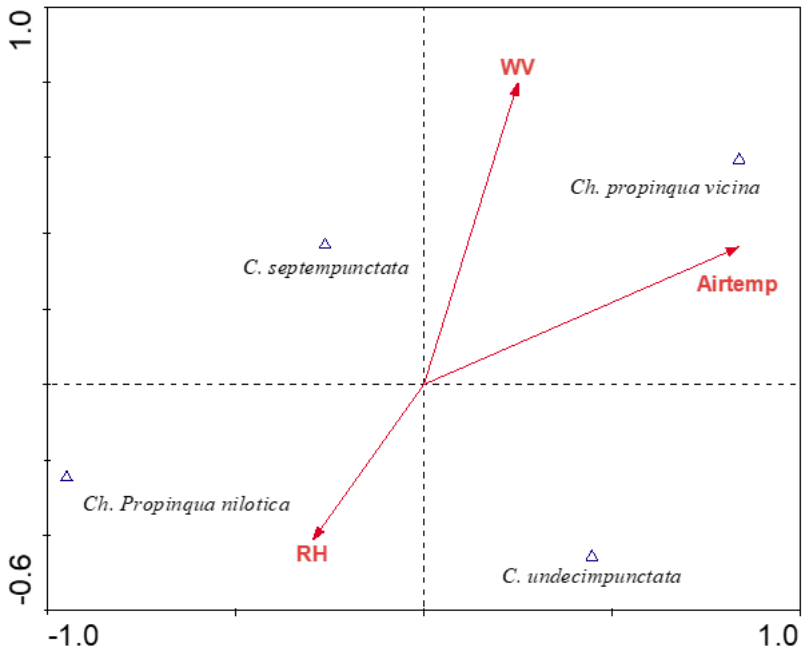

Fig. 5, Ordination diagrams of canonical correspondence analyses (CCA) of coccinellids species abundance data and corresponding weather factors sampled fromthree sites in New Valley Governorate during theperiod of study. Weather factors notation: Airtemp – air temperature (° C), RH- humidity (%), WV- Wind Velocity (m sec-1).

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