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(Original Article)

Abundance and Spatial Distribution Pattern of *Chrysoperla carnea* (Stephens) and Aphids Inhabiting Pomegranate Orchards in Assiut, Egypt.

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Abstract

Green lacewing *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) has been recorded as an effective generalist predator, especially aphids. A study was carried out to determine the population fluctuations and dispersion of green lacewings and aphids inhabiting pomegranate orchards in Assiut, Northern Upper Egypt, during the 2021 and 2022 growing seasons. A yellow sticky trap was used, and five directions corresponding to the cardinal directions and center were selected. The population density of the green lacewings and aphids recorded three peaks in both growing seasons. Statistically, the correlation coefficient (r) value between the average number of adult green lacewings and aphids was negative and non-significant (r= -0.08834, P= 0.2135) and the coefficient of determination (R^2) was 30.97% during 2021 growing season. However, the correlation coefficient (r) was positive and highly significant (r= 0.30901, P= < 0.0001), and the coefficient of determination (R^2) was 12.92 % during the 2022 growing season. The correlation coefficient (r) values between the average number of adult green lacewings and ambient weather factors differed in both seasons. In both seasons, the maximum average number of adult green lacewings was in the center. The maximum average number of aphids was in the east during the 2021 season and in the north during the 2022 season. The most preferred direction for green lacewing adults was the east northern side in both seasons. Aphids preferred the east northern side and the northern east side during 2021 and 2022, respectively. In conclusion, determining natural enemy fluctuations and preferred directions are important for the successful Integrated Pest Management (IPM) approach.

Keywords: *Green lacewing, Chrysoperla carnea (Stephens), Pomegranate Orchards.*

Introduction

Predacious insects of the order Neuroptera are of great importance as naturally occurring biological control agents (NOBCA). Neuropteran species are excellent indicators of environmental and habitat transformation. They are ideal subjects for scientific research owing to their diverse, cryptic lifestyles, restricted distributions, and phenology of endemic species, (Mansell, 2002). Members of the

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family Chrysopidae are called green lacewings, have a nearly cosmopolitan distribution, and encompass a great many species (Shalaby *et al*., 2008). The common green lacewing, *Chrysoperla carnea* (Stephens), is one of several significant species of predatory insects that belong to the genus *Chrysoperla*. This species has been recorded as an effective generalist predator of piercing and sucking pests, including aphids (Singh and Manoj, 2000; Zaki and Gesraha, 2001). Many factors, some connected to the plant that insects choose as a host and others related to the environmental circumstances, were reported to have an impact on the occurrence of green lacewings. Examples related to plants include the plant structure, height and orientation, the sensory contact with the leaf surface of a chosen plant, plant architecture, and the scent of the plant and the prey. Also, other factors concerning related to the environmental circumstances include temperature, humidity, photoperiod, and wind (Ahmad, 1987; Ahmad and Ali, 1989; Sajap, *et al*., 1997; Clark and Messina, 1998; Zhu *et al*., 2005; and Pappas *et al*., 2008).

Pomegranates are one of the most significant crops in Egypt, and they are also one of the main sources of revenue for farmers, particularly in Upper Egypt (Abu Omira, 2022). The significance of pomegranate in medicine is undisputed, with medical establishments worldwide incorporating the fruit into treatment programs due to the numerous therapeutic advantages it offers (Marzooq and Al-Iraqi, 2015).

Aphids are one of the most serious sucking insect pests attacking pomegranate plantations since leaf buds tell harvesting the crop, reducing the pomegranate yield, and putting farmers through hardship (Abd-Ella, 2015).

A full background on green lacewing's (*Chrysoperla carnea*) dispersion, conservation, density, and efficiency as a biological control agent in Integrated Pest Management (IPM) is in crucial need. Consequently, the present work has been initiated to determine the population fluctuations and spatial distribution patterns of green lacewing and aphids to partially fulfill the above-named.

Materials and Methods

Experimental site

The study was conducted in the Experimental Farm, Faculty of Agriculture, Assiut University, Assiut (27° 10' 48.4824" N., 31° 11' 21.4188" E.), Egypt during two successive growing seasons (2021 and 2022). A total of 200 trees (22 years old) of mixed cultivars in pomegranate orchards were chosen for the present study. The Pomegranate orchards was surrounded by clusters of several plantations, such as grape, mango and date palm trees. The farm was divided into five directions (North, South, East, West, and Center).

Population fluctuations of green lacewings and aphids inhabiting pomegranate orchards

A comprehensive survey was conducted to determine population trends and dispersal of green lacewings and aphids in pomegranate orchards. A yellow sticky trap designed with strong glue was used, which was designed with environmentally friendly materials that are not toxic to humans. Sticky yellow traps (30×20 cm) were hung on a tree in one of the five directions to determine the population density of green lacewings and aphids as described by El-Wakeil and Volkmar, (2013) and Abdel-Galil *et al*. (2021). Population data from orchards of cultivated cultivars were recorded at weekly intervals during 2021 and 2022, for 10 months to estimate population size.

Spatial distribution of green lacewings and aphids inhabiting pomegranate orchards

Five locations that correspond to the cardinal directions and center were selected for the present study. The sticky trap was set up in each direction after three trees were located from each angle and the orchards was visited once a week. The traps were adjusted, and green lacewing adults and aphids were counted during each visit. Using the pomegranate computational formula presented by Hassan (1998), El-Sheikh and El-Kenway (2020), Mousa (2023), it is possible to anticipate and estimate the preference of green lacewings and aphids for the cardinal directions of pomegranate groves.

The Formula:

$$\mathbf{H= \sqrt{F1^2 + F2^2 + 2(F1 \,.\, F2\ CosQ)}}$$

Where

H = power summation.

F1 = The population in the north direction minus the population in the south direction if the former is higher and the reverse is applied if the population in the south direction is higher.

F2 = The population in the east direction minus the population in the west direction if the former is higher and is reversed if the latter is higher.

F1= N-S, F2= E-W

Cos Q = Cosine of the angle between the two directions.

Weather Factors

The weather factors measured in the study were the maximum temperature (MaxT) and minimum temperature (MinT) in Celsius degrees (°C), relative humidity (RH %), and maximum wind speed (MaxWS) and minimum wind speed (MinWS) in (km/hr). The meteorological data were obtained from Weather Underground. (https://www.wunderground.com/).

Data Analysis

SAS 9.1 (2008) software was used to statistically analyze the data and to determine the ANOVA, correlation coefficient (r-value), and coefficient of determination (R^2 value). The numbers in the specimen were reported as log (n+1).

Results and Discussion

Samples were collected from the sticky trap, counted, and identified, green lacewings adults *Chrysoperla carnea* and aphids *Aphis punicae* (Passerini). Obtained results are explained as fellow:

Population fluctuation of adult green lacewings and aphids

Data in Fig. 1 and 2 show the average numbers of green lacewing adults and aphids caught by yellow sticky traps on pomegranate per week and ambient weather factors during the 2021 and 2022 growing seasons.

Data for season 2021 indicate that the first appearance of aphids was early on March 22nd with an average number of 71 individuals/ trap. However, the adult green lacewing's first appearance was later on April 6th with an average number of 0.60 individual/ trap. The maximum number of green lacewings recorded on April 28th with an average of4.80 individuals/ trap, and for aphids, it was on March 28th with an average of 91 individuals/ trap.

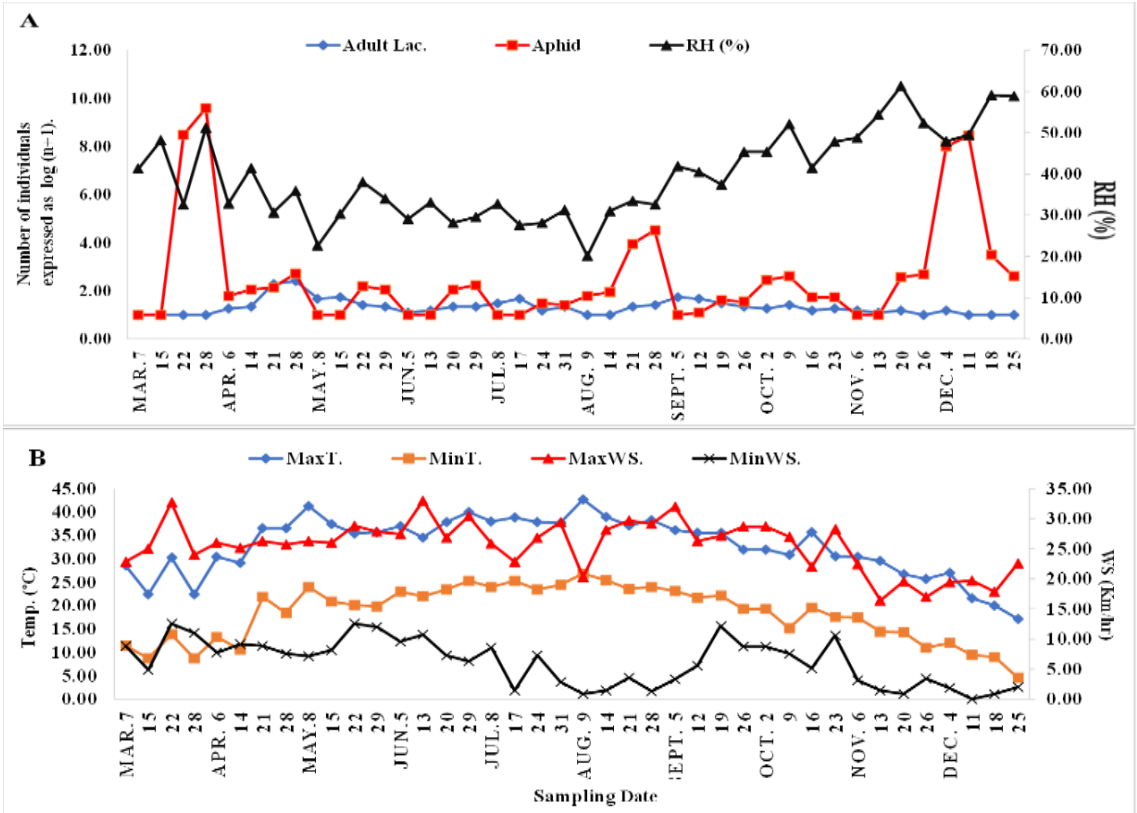

Fig. 1. The average number of " log (n+1) " of adult green lacewings, aphids, and ambient weather factors during the 2021 growing season. A) Average number of adult green lacewings, aphids, and Relative Humidity (RH) (%), B) MaxT= Maximum Temperature (°C), MinT= Minimum Temperature (°C), and MaxWS= Maximum Wind Speed (km/h), MinT= Minimum Wind Speed (km/h).

As shown in Fig.1 A, green lacewing adults sharply increased to record their first peak with average numbers of 4.80 individuals/ trap on April 28th. Then, the averages fluctuated gradually from the previous peak in April until the end of August. The second peak was recorded on July 17th with average number of 1.8 individuals/ trap. The third peak was recorded on September 5th, with average number of 2.00 individuals/ trap.

Aphids recorded their first peak with average number of 91.00 individuals/ trap on March 28th. The second peak with average number of 19.4 individuals/ trap was on August 28th. The third peak recorded average numbers of 70.4 individuals/ trap on December 11th.

Statistical analysis of the data during the 2021 growing season indicates that the correlation coefficient (r) value between the average number of adults of green lacewings and aphids was -0.08834 (P= 0.2135), and the coefficient of determination (R^2) value was 30.97%. Also, the correlation coefficient (r) values between the average numbers of green lacewing adults and the ambient weather factors were highly significant except the minimum wind speed was significant (r= 0.14850, P= 0.0359). However, the coefficient of determination (R2) values between the population density of green lacewings and the ambient weather factors were Temp max=19.69, Temp min=9.59, MaxWS=13.78, MinWS=19.36 and RH%= 18.56.

Data for season 2022 indicate that the first appearance of aphids was early on March 7th (54 individuals/ trap). However, adult green lacewing first appeared on March 21st with an average number of 0.40 individual/ trap. The maximum number of green lacewings was recorded on October 11th with an average of 3.40 individuals/ trap and for aphids, it was on April 27th with an average of 111 individuals/ trap.

As shown in Fig. 2 A, the adult green lacewings sharply increased to record their first peak on April 27th with an average number of 2.20 individuals/ trap. Then, the averages fluctuated gradually from the previous peak in April until the end of August. The second peak was recorded on August 25th, with an average number of 2.60 individuals/ trap. The third peak was recorded on October 11th, with an average number of 3.40 individual/ trap.

Aphids recorded their first peak on March 27th with an average number of 111.00 individuals/ trap. The second peak was recorded on October 4th with an average number of72.00 individuals/ trap. The third peak was recorded on November 1st with an average number of 57.20 individuals/ trap).

Statistical analysis of the data during the 2022 growing season indicates that the correlation coefficient (r) value between the average number of adult green lacewings and aphids was 0.30901 (P= .0001), with a coefficient of determination (R^2) value of 12.92%. Also, correlation coefficient (r) values between the average number of adult green lacewing and ambient weather factors were non-significant except RH% was significant (r= 0.14575, P= 0.0395). However, the coefficient of determination (R^2) values between the population density of green lacewing and

ambient weather factor were as follows: Temp max=0.001, Temp min=0.10, wind speed max=0.94, wind speed min=1.09 and RH= 4.50%.

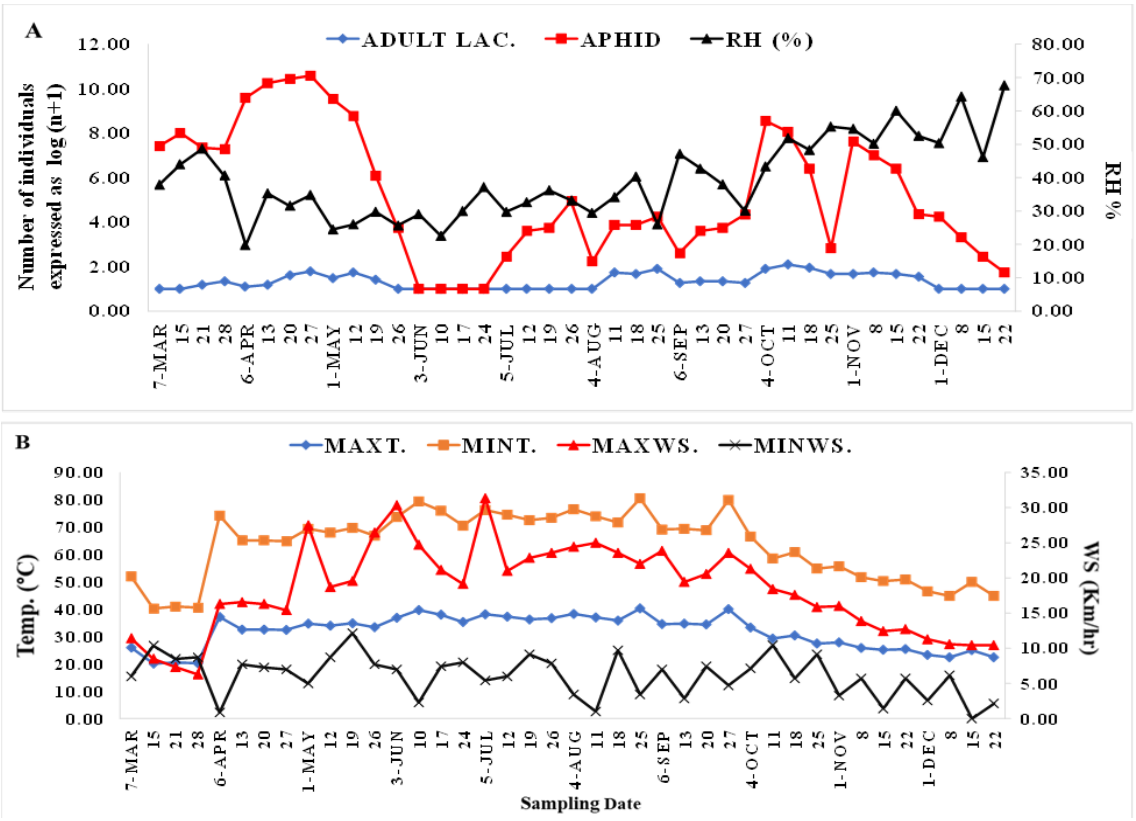

Fig. 2. The average number of " log (n+1) " of adult green lacewing and aphids counted with ambient weather factors during the 2022 growing season. A) Average number of adult green lacewings, aphids, and Relative Humidity (RH) (%), B) MaxT= Maximum Temperature (°C), MinT= Minimum Temperature (°C), and MaxWS= Maximum Wind Speed (km/h), MinT= Minimum Wind Speed (km/h).

The above-mentioned results indicated that aphids appear early at the beginning of the pomegranate season. This may be attributed to the feeding habits of aphids on the sap of new pomegranate tree buds, as reported by Abdel-Galil *et al*. (2023). It was also noted that green lacewing appeared late, due to its presence on other plant hosts such as alfalfa and cotton at that time, according to Abdel-Galil (1971).

The average number of green lacewings in both years (0.58 and 0.95) was less than that of aphids (10.35 and 34.55) (Table 1). This finding may refer to the feeding habits of the green lacewings. Also, the green lacewing *Chrysoperla carnea* was recorded in Egypt as a predator of aphids, aphids, scale insects, mealy bugs, and newly hatched larvae of cotton leaf worm (Megahed *et al*., 1982 and Abdel-Galil *et al*., 1991).

The population density of the green lacewings and aphids recorded three peaks in both growing seasons. Analysis of the data in Table (1) indicates that the differences in aphids' population density between the two growing seasons were highly significant and led to the differences in green lacewing peaks. Thus, differences in the population density of lacewings had a relation with aphids that

Chrysoperla carnea may locate aphids by sniffing their pheromone (Koczor *et al*., 2015).

So, the above-mentioned results are of great importance to employ green lacewing populations as biological control agent to reduce aphid populations below the Economic Injury Levels (EIL) in Integrated Pest Management (IPM) approach.

Table1. Monthly average number of green lacewing adults and aphids in pomegranate orchards during the 2021 and 2022 growing seasons

Monthly	Adult green lacewing		Aphid	
	2021	2022	2021	2022
March	0.00	0.30	40.50	55.50
April	2.6	1.10	3.85	103.50
May	1.4	1.05	1.75	53.75
June	0.55	0.00	1.80	0.00
July	1.05	0.00	0.55	13.35
August	0.45	1.60	9.75	12.25
September	1.45	0.70	0.80	12.15
October	0.65	2.65	3.70	45.75
November	0.25	1.75	2.95	40.80
December	0.10	0.00	37.60	8.50
Average year	0.58	0.95	10.35	34.55
F value of Two seasons	**1.18^{ns}**		**206.31****	

*= Significant at 0.05 level of probability, **= Highly significant at 0.01 level of probability, and ns= non-significant

Distribution pattern of adult green lacewing and aphids collected by yellow stick trap inhabiting pomegranate orchards

Adult green lacewing

Spatial distribution in cardinal directions and center

Data in Table 2 show the monthly average of adult number/trap of green lacewings in cardinal directions and center in pomegranate orchards during the 2021 and 2022 growing seasons. Statistical analysis of the data indicates that the maximum average number of green lacewing adults was 1.33 and 1.23 adults/ trap in the center during both seasons. F values between directions were non-significant (2.06^{ns}) in 2021 and highly significant (9.04^{**}) for the season 2022.

Figure 3 illustrates the maximum percentage of collected adult green lacewing was 31% in the center of the pomegranate orchards during the 2021 season. It was followed by 25, 18, 15, and 14% in the east, north, west, and south directions, respectively. During 2022 the maximum percentage of adult green lacewing was 28% in the center of the pomegranate orchards. It was followed by 22, 19, 17, and 14% in the east, north, west, and south directions, respectively.

Table 2. Monthly average number of green lacewings collected by yellow stick trap in cardinal directions and center in the pomegranate orchards

Inspection Date	Avg. Adult No. ()									
	2021					2022				
	North	South	East	West	Center	North	South	East	West	Center
March	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.50	0.25
April	3.50	1.50	3.75	2.00	2.25	0.75	0.75	1.00	2.00	1.00
May	1.00	1.00	2.50	1.00	1.50	0.50	1.00	1.50	1.00	1.25
June	1.00	0.50	0.25	0.25	0.75	0.00	0.00	0.00	0.00	0.00
July	0.25	0.50	0.25	1.00	3.25	0.00	0.00	0.00	0.00	0.00
August	1.00	0.00	0.00	0.00	1.25	1.00	1.00	1.25	0.00	4.75
September	0.50	1.50	0.75	1.25	3.25	0.00	0.00	0.75	1.00	1.75
October	0.25	0.50	0.75	0.75	1.00	3.75	2.00	3.00	2.25	2.25
November	0.25	0.25	0.75	0.00	0.00	2.00	1.50	2.25	2.00	1.00
December	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Average Year	$0.78^{ab\#}$	0.58^{b}	0.93^{ab}	0.65^{b}	1.33^{a}	0.83^{ab}	0.65^{b}	1.00^{ab}	0.88^{ab}	1.23^{a}
F value	2.06^{ns}					9.04^{**}				
Two seasons Average	N= 0.7625^{b}		S= 0.61^{b}		E=0.9625^{ab}		W= 0.7625^{b}		C=1.275^{a}	
F value of Two seasons	3.50^{ns}									

() = Avg. Adult No. based adults/trap/direction weekly. *= significant at 0.05 level of probability, **= highly significant at 0.01 level of probability, and ns= Non-significant

#Average having the same letter in each column is not significant at a 5% level of probability, according to Duncan's multiple range test.

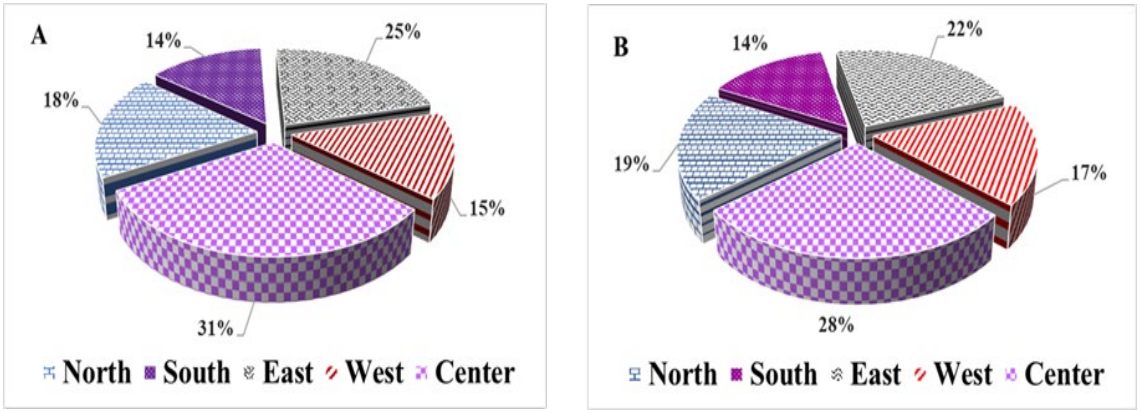

Fig 3. The contribution of each direction with adult green lacewing collected by yellow sticky trap during 2021 (A) and 2022 (B) in the pomegranate orchards.

Preferable Spatial distribution in cardinal directions on pomegranate orchards

Data in Table 3 show that green lacewings adult preferred the east northern direction in pomegranate orchards cultivars. The east direction had the highest numbers (37 and 40). As shown in Fig. 4 A and B, the most preferable direction for adult green lacewings was the east northern side during the 2021 and 2022 growing seasons, specifically at the angle of 27º11´04"during both growing seasons.

These results may be due to the same abiotic factors or may be explained by the green lacewing's behaviour. Females must lay their eggs in a certain area on

the plant to assure the nourishment of their offspring's. According to Ballal and Singh (1999), the host plant and ovipositional preferences of chrysopid predators determine the efficiency of the predators on various host plants which might be concentrated in these specific directions or other unknown factors.

Table 3. Expected adult green lacewing at cardinal directions preferred in the pomegranate orchards

Season	North	South	East	West	Total	Mean	F1	F2	Cos.Q	H	Site
2021	31$^{ab\#}$	23^{b}	37^{ab}	25^{b}	116	29	8	12	0.829	41.41	27º11´04"
2022	33^{ab}	25^{b}	40^{ab}	31^{ab}	129	32.25	8	9	0.776	35.996	27º11´04"

#Average having the same letter in each column are not significant at a 5% level of probability, according to Duncan's multiple range test

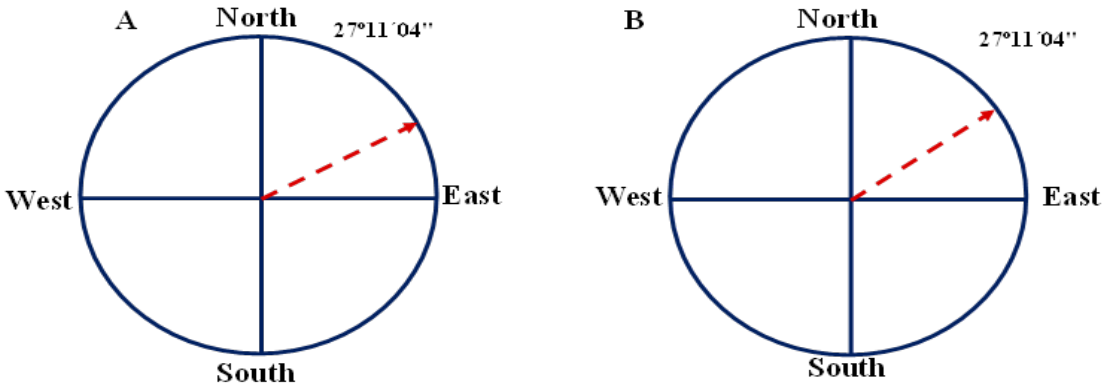

Fig 4. Preferable direction to adult green lacewing by yellow sticky trap in pomegranate orchards cultivar during 2021 (A) and 2022 (B) growing seasons in Experimental Farm of Faculty of Agriculture, Assiut University, Egypt2.2. Aphids

Spatial distribution in cardinal directions and center

Data in Table 4 show the monthly average number of aphids in the cardinal directions and the center in the pomegranate orchards during the 2021 and 2022 growing seasons. Statistical analysis of the data indicates that the maximum average number of aphids was 22.45 individuals in the east direction during the 2021 growing season. It was followed by west, center, north, and south directions, 8.85, 8.75, 6.28 and 5.30, respectively.

However, the maximum average number of aphids was 38.30 individuals in the north direction during the 2022 growing season. It was followed by east, center, west, and south (37.88, 34.63, 32.68 and 29.30), respectively. F values between the directions were highly significant (3.65** and 9.22**) in the 2021 and 2022 seasons, respectively.

Figure 5 illustrates the maximum percentage of aphids which was 43.36% in the east direction during the 2021 growing season. It was followed by 17.09, 16.90, 12.12 and 10.53% in the west, center, north, and south directions, respectively. During the 2022 growing season, the maximum percentage of aphids was 22.17%

in the north direction, followed by 21.92, 20.04, 17 and 14% in the east, west, center, and south directions, respectively.

Table 4. Monthly average number of Aphids collected by yellow stick trap in cardinal directions and center in the pomegranate orchards

Inspection Date	Avg. Aphid No. ()									
	2021					2022				
	North	South	East	West	Center	North	South	East	West	Center
March	25.00	25.00	50.00	50.00	52.50	53.75	56.25	43.75	46.25	77.50
April	4.25	2.50	7.50	5.00	0.00	123.75	70.00	130.00	91.25	102.50
May	1.25	1.25	1.25	2.50	2.50	68.75	28.75	70.00	42.50	58.75
June	2.25	1.25	2.50	1.00	2.00	0.00	0.00	0.00	0.00	0.00
July	1.75	0.50	0.50	0.00	0.00	6.75	17.50	2.50	27.50	12.50
August	12.00	3.00	16.25	2.50	15.00	6.25	6.25	5.00	37.50	6.25
September	0.00	0.00	0.25	3.75	0.00	12.50	21.50	11.25	14.25	1.25
October	2.50	1.00	5.00	5.00	5.00	32.50	38.75	78.75	43.75	35.00
November	7.50	1.00	2.50	1.25	2.50	76.25	41.50	30.00	20.00	36.25
December	6.25	17.50	138.75	17.50	8.00	2.50	12.50	7.50	3.75	16.25
Average Year	6.28$^{b\#}$	5.30^{b}	22.45^{a}	8.85^{ab}	8.75^{ab}	38.30^{a}	29.30^{a}	37.88^{a}	32.68^{a}	34.63^{a}
F value	3.65**					9.22**				
Two seasons Average	N=22.29^{a}		S=17.30^{a}		E= 30.16^{a}		W=20.76^{a}		C=21.69^{a}	
F value of Two seasons	1.18^{ns}									

() = Avg. Adult No. based adults/trap/direction weekly. *= Significant at 0.05 level of probability, **= Highly significant at 0.01 level of probability, and ns= Non-significant

#Average having the same letter in each column is not significant at a 5% level of probability, according to Duncan's multiple range test.

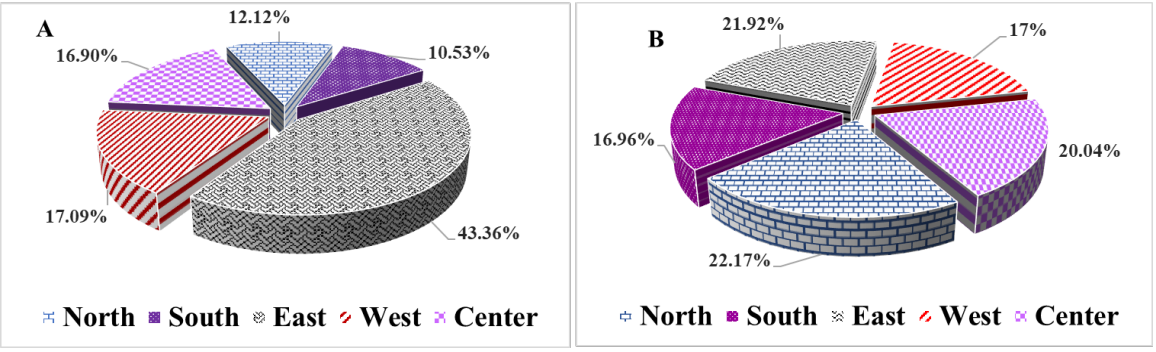

Fig. 5. The contribution of each direction with aphids collected by yellow sticky trap during 2021 (A) and 2022 (B) in the pomegranate orchards.

Preferable Spatial distribution in cardinal directions

Data in Table 5 show that the east direction had the highest density of aphids during the 2021 season, 898 individuals. However, the north direction had the highest population of aphids during the 2022 season, 1532 individuals. The most preferable direction for the aphids was the East northern side during 2021 season, while the most preferable direction for aphid was the northern east side during the 2022 season. The pomegranate orchards in the east northern and northern east sides

making angles (27º11´03"and 27º11´04") during the 2021and 2022 growing seasons, respectively as shown in (Fig.6 A and B). These results could be explained by the effect of the meteorological factors on aphids' activity. This results in disagreement with Goyal *et al*. (2017) who found that due to altered microenvironments, aphid presence rates decreased in an N-S direction. The aphid population was positively connected with RH and negatively correlated with mean profile temperature. This difference may refer to the difference in the plantation's nature and climate.

Table 5. Expected aphid at cardinal directions preferred in the pomegranate orchards

Season	North	South	East	West	Total	Mean	F1	F2	Cos.Q	H	Site
2021	251$^{b\#}$	218^{b}	898^{a}	354^{ab}	1721	430.25	33	544	0.996	41.41	27º11´03"
2022	1532^{a}	1172^{a}	1515^{a}	1307^{a}	5526	1381.5	360	208	0.5	35.996	27º11´04"

#Average having the same letter in each column are not significant at a 5% level of probability, according to Duncan's multiple range test

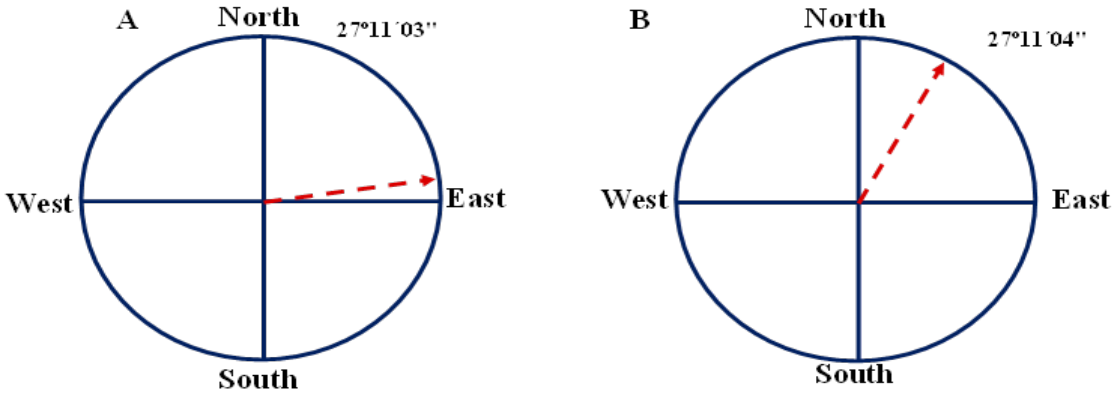

Fig. 6. Preferable direction to aphids by yellow sticky trap in pomegranate orchards cultivar during 2021 (A) and 2022 (B) growing seasons in the Experimental Farmer of Faculty of Agriculture, Assiut University, Egypt

Generally, the above-mentioned results indicated that the maximum average number of adult green lacewing/trap was in the center of the pomegranate orchards in both seasons. The maximum percentages of adult green lacewing were in the center during both seasons and recorded 31% and 28% during 2021 and 2022, respectively. The most preferable direction for adult green lacewing was the east northern side during both growing seasons. This finding can be attributed to the predator behavior for choosing the center area to aggregate and spread to the other directions for the egg deposition.

Concerning the maximum average number of aphids was in the east direction during 2021 and north direction during 2022 growing season. The maximum percentages of aphids were 43.36% in the east direction during 2021 and 22.17% in the north direction during 2022 growing season. The most preferable direction for aphids was the east northern side during 2021 season. In during 2022 season the most preferable direction for aphid was the Northern East side. It is of interest

to point herein that differences in the abundance of aphids in the east and north directions from year to year may be attributed to the optimum conditions preferred for ablate aphids for landing in suitable directions.

Finally, understanding the population dynamics and the dispersion of important natural enemies like *Chrysoperla carnea* contributes to the significance of integrated pest management. This research will aid in the development of precise management strategies to strengthen this predator in the field. More research is required to determine the effects of the other parameters on its effectiveness.

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التواجد وانماط التوزيع المكاني لأسد المنّ والمنّ القاطنة في بساتين الرمان بأسيوط، مصر

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الملخص

سجل أسد المن (Stephens) *Chrysoperla carnea* التابع لرتبة شبكية الاجنحة كمفترسًا عامًا وفعالًا خاصةً على حشرات المن. تمت الدراسة لتحديد التذبذبات في التعداد للمفترس وحشرة المن القاطنة في بستان منزرع بالرمان بمزرعة كلية الزراعة جامعة أسيوط بأسيوط شمال صعيد مصر، وذلك خلال موسمي النمو 2021 و2022م باستخدام المصيدة اللاصقة الصفراء. تم اختيار خمس اتجاهات مطابقة للاتجاهات الأساسية ومنتصف البستان.

سجلت الكثافة العددية لأسد المن والمن ثلاثة قمم في كلا موسمي النمو. اظهر التحليل الاحصائي للنتائج ان قيم معامل الارتباط (r) بين متوسط عدد الحشرات الكاملة لأسد المن كانت سالبة وغير معنوية (P = 0.2135، r = -0.08834) بمعامل تأثير قدره (R^2=30.97%) خلال موسم النمو 2021م. بينما كانت خلال موسم 2022م موجبة ومعنوية جداً (P =< 0.0001، r = 0.30901) بمعامل قدره (R^2=12.92%). اختلفت قيم معامل الارتباط (r) بين متوسط عدد الحشرات الكاملة لأسد المن وعوامل الطقس المتاحة في كلا الموسمين.

أقصى كثافة عددية لأسد المن تركزت في منتصف البستان خلال موسمي الدراسة. كان الحد الأقصى لمتوسط عدد حشرات المن في الشرق خلال موسم 2021م، بينما كان في الشمال خلال موسم 2022. كان الاتجاه الأكثر تفضيلاً للحشرات الكاملة لأسد المن هو الجانب الشرقي الشمالي في كلا الموسمين. بينما فضلت حشرات المن الجانب الشرقي الشمالي والجانب الشمالي الشرقي خلال عامي 2021 و2022م على التوالي.

في الختام، يعد تحديد التقلبات الطبيعية للمفترس والاتجاهات المفضلة له أمرًا مهمًا لنجاح برامج الإدارة المتكاملة لمكافحة الآفات (IPM).