Assiut Journal of Agricultural Sciences 55 (1) 2024 (120-135)
ISSN: 1110-0486 / EISSN: 2356-9840
Website: http://ajas.journals.ekb.eg/
E-mail: ajas@aun.edu.eg

(Original Article)

Seasonal Abundance of Forensic Insects Encountered on Rabbit Cadavers in Assiut Governorate Egypt

Farouk A. Abdel-Galil[1*]; Safaa M. George[2]; Mohamed A.I. Ahmed[1]; Rasha R. Wadea[1]; Sara E. Mousa[1]and Mervat M. Khalifa[3]

[1]Department of Plant Protection, Faculty of Agriculture, Assiut University, Assiut, Egypt
[2]Forensic Medicine and Clinical Toxicology Department, Faculty of Medicine, Assiut University, Assiut, Egypt
[3]Medical Parasitology Department, Faculty of Medicine, Assiut University, Egypt.

Correspondence: faagalil@aun.edu.eg
DOI: 10.21608/AJAS.2024.237505.1295

Abstract

Forensic entomology is considered the science that applies insect biology to criminal investigations, using insects and other arthropods to uncover the circumstances of criminal cases. Herein, we recorded the seasonal abundance of forensic insects encountered on rabbits' cadavers during four seasons (2021-2022) in Egypt under Assiut conditions. As a result, numerous forensic insects were attracted to cadavers during the four seasons (2021-2022). Plus, ten adult insects were observed belonging to seven families under two orders, Coleoptera and Diptera. Four coleopteran insects belonging to 4 families were monitored, "i.e." Carabidae (*Harpalus rufipes*), Histeridae (*Saprinus blanchei*), Staphylinidiae (*Creophillus maxillosus*), Dermestidae (*Dermestes frischii*). Six dipteran insects belonging to 3 families were determined, namely Calliphoridae *(Calliphora vicine, Lucilia sericata, Chrysomya refifacies,* and *Chrysomya albiceps*), Muscidae (*Musca domestica*), and Sarcophagidae (*Sarcophaga carnaria*). Also, the taxon of order Diptera emerged early from day one immediately after death on cadavers followed by the taxon of order Coleoptera that popped up lately. This study sheds light on forensic entomology science which is considered very limited in Egypt. In addition, an investigation must be carried out to benefit from this study, which will help us to remove confusion in critical issues in the future.

Keywords: *Forensic Entomology, Insects Encountered, and Postmortem Interval.*

Introduction

Forensic entomology is the science of collecting and analyzing insect evidence to aid in forensic investigations (Zaidi, 2017). Forensic entomology science has become synonymous with medicolegal entomology, and it involves the use of insects in legal and criminal investigations. The sequence of insect colonization of a body is predictable and can be studied from controlled experiments (Byrd and Castner, 2010).

Even though the processes of breakdown and insect invasion are continuous, they are frequently defined in terms of distinct stages, each of which is

Received: 19 September 2023/ Accepted: 31 December 2023/ Published online: 25 January 2023

characterized by insect activity. The following steps of breakdown are described: Stages include fresh, bloated, active, advanced, and post-decay (dry) stages (El-Samad and Youssef, 2016).

Researchers have been able to separate the volatile compounds emitted at various stages of the body's disintegration. The volatile chemicals emitted at each stage have the potential to change the insect's behavior (LeBlanc and Logan, 2009; Joseph, *et al*., 2011).

The biogeoclimatic zone is one of the most significant effects on the insect species that relate to carrion and the timeframes at which they first colonize. The biogeoclimatic zone identifies the habitat, vegetation, soil type, and weather in the region that significantly influence species of insects that are there, as well as their seasonal availability. (Byrd and Castner, 2010).

There are two primary phases in insect relationships with carrion: the pre-colonization period and the post-colonization interval (Tomberlin *et al*., 2011).

The pre-colonization period starts at the time of death and comprises "exposure," during which no insects have yet found the corpse, "detection," during which they do, and "acceptance," during which they judge the resource's suitability as a prospective oviposition site. The period following colonization includes the "consumption phase" and "dispersal phase," during which the insects colonize and eat the corpse until all nutrients are gone (Tomberlin *et al*.,2011; Tantawi *et al*., 2018).

So, this study was initiated with the aim of recording and identifying the seasonal abundance of forensic insects encountered on decomposing rabbits in four seasons (Summer, Autumn, Winter, and Spring); to provide entomological data that can be employed in forensic case investigations in Egypt.

Materials and Methods

Study site

According to the National Institute of Health guidelines for animal care followed within the Faculty of Medicine, Assiut University, the experiments were conducted in Assiut City. The experiments were carried out in an area with all-day length sun exposure and sheltered from the wind.

(www.climate-charts.com/Countries/Egypt. html).

Experimental design

In the present work domestic healthy male rabbits, *Oryctolagus cuniculus* L., weighing about 1.25kg obtained from the animal house of the Faculty of Medicine were used. Rabbits were used about twelve and were kept in plastic cages with wire mesh covers and maintained under conditions of 20±1°C, 50±10% RH, and L 14:D 10 photoperiod. The experiment was repeated in the four seasons of the year, as shown in Table 1.

Table 1. Experimental duration, maximum and minimum temperature, and average relative humidity for collecting forensic insects during the four seasons of 2021-2022

Season	Experiment duration	Temperature °C	Average relative humidity
Summer 2021	9 Days (15-23Aug.)	max 45°C min 22°C	30%
Fall (Autumn) 2021	21 Days (07-27Dec.)	max 24°C min 2°C	57%
Winter 2022	24 Days (04-27Feb.)	max 27°C min 5°C	53%
Spring 2022	11 Days (11-21Apr.)	max 42°C min 10°C	29%

The living rabbits were taken to the study site and killed with a blow on the head. To prevent external bleeding care was taken. Animals were immediately placed after death into mesh cages measured 100cm×80cm×15cm to prevent scavenging by large vertebrates and left exposed to natural conditions. To minimize the interactions between the odors and the interactions of insect collections all cages were separated from each other by about 15 meters. Under each cage sand was placed to facilitate the collection of larvae leaving cadavers to pupate (Dautartas, 2009). Ambient weather factors were obtained from the meteorological station of Google Weather.

(*https://weather.com/weather/today/l/27.32,30.98?par=google*)

Collection and sampling

After death cadavers were visited at six-hour, and they were visited once daily when the cadavers reached the dry stage. Insect species encountered inside and beneath the cadavers were collected and recorded. For each of the species encountered records of arrival, departure, and abundance of the attracted insects were made and photographed. Care was taken, not to disturb the attracted fauna, and collected larvae were put either directly into a preservative ethanol 80%, or 95%, and dead insect's preservative in 70–95% ethanol (Amendt *et al*., 2007).

Identification of specimens and Classification key

Using specialized taxonomic keys established by Wells *et al*. (1999), Carvalho and Mello-Patiu (2008), Gabre *et al*. (2005), and Zeariya *et al*. (2015). Identification and taxonomic determinations were made. According to Thomas (2000) and Yones *et al*. (2010), the genera and/or species of adult beetles were identified. Efforts were made to identify Diptera and Coleoptera at the species level for forensic importance.

Identification of inspected adult beetles of the Order Coleoptera was conducted using special identification keys for each family including Peacock (1993); Gennard (2012).

Also, all collected adult flies of Order Diptera were initially sorted into family, genus, and species using Greenberg (1971), Hall and Smith (1993), Deeming (1996), and Setyaningrum and Al Dhafer (2014) for Calliphoridae; Greenberg (1971), Hall and Smith (1993) for Sarcophagidae (Gennard, 2012).

Carcass decomposition

Carcasses were examined twice daily; in the morning and afternoon to determine the duration of each decomposition stage. Images of carcasses throughout the decomposition study were captured using a digital camera (Canon PowerShot ELPH115).

Larval and pupal examination method

A light microscope (LM) was used to examine the third-instar larvae. Specimens were washed several times with normal saline solution and killed by transferring them into a beaker containing nearly boiling water for ≈5min. larvae were macerated for 24hrs in a cold solution of 10% KOH.

Dead larvae were cut at two sites. The position of the first cut site was through the mesothorax (third body segment) to produce an anterior body portion for viewing the cephalon pharyngeal skeleton and the anterior spiracles. The second cut site was through the 11^{th} body segment to produce a posterior body portion conducive to positioning for optimal viewing of the morphology of the posterior spiracles.

Immature stages (larvae) were collected and reared till adults to confirm identification in the laboratory of the Parasitology Department, Faculty of Medicine, Assiut University, using fresh cow liver that was provided as a larval food source.

Insect succession tables

Combining data from yellow sticky traps and hand collections were developed in tables. According to the decomposition stages of cadavers “i.e.” postmortem interval (PMI) giving their numbers, the different insect species that were collected from each cadaver were distributed.

Statistical analysis

Complete randomized design (CRD)was used with three replications for each treatment. Analysis of variance (ANOVA) was carried out using Proc Mixed of SAS package version 9.2 (SAS 2008) and means were expressed as mean ± Standard deviation (SD) and compared by Duncan test at 5% level of significance (Steel and Torrie, 1981).

Results

Although the processes of decomposition and insect invasion are continuous, they are often described by discrete stages, which are characterized by insect activity at each decomposition point. The following decomposition stages are described as: {Fresh stage, Bloated stage, Active decay stage, Advanced decay, post-decay (dry) stage (Skeletal stage)} (Figure 1). All these stages differ in duration according to the season. In Summer it lasted nine days, in Fall twenty-one days, in Winter twenty-four days, while in Spring eleven days, that was depending on the temperature and humidity average in each season, as shown in Table 1.

These stages correlated with the succession of insects and the appearance of larvae in different seasons.

Figure 1. Decomposition stages of carcasses rabbits: A) Fresh stage, B) Bloat stage, C) Active decay stage, D) Advanced decay stage, and E) Post-decay (dry) stage (Skeletal stage).

Data in (Table 2) show the incidence of forensic insects attracted to cadavers during four seasons (2021-2022). Ten adult insects recorded belong to seven families under two orders Coleoptera and Diptera. Four coleopteran insects belonging to four families have been recorded including Carabidae (*Harpalus rufipes* (Degeer, 1774)), Histeridae (*Saprinus blanchei* Marseul, 1855), Staphylinidiae (*Creophilus maxillosus* (Linnaeus, 1758)), Dermestidae (*Dermestes frischii* Kugelann, 1792). Six dipteran insects belonging to three families have been recorded including Calliphoridae *(Calliphora vicina* Robineau-Desvoidy, 1830*, Lucilia sericata* (Meigen, 1826)*, Chrysomya rufifacies* (Macquart, 1842), and *C. albiceps* (Wiedemann, 1819)), Muscidae (*Musca domestica* Linnaeus, 1758), and Sarcophagidae (*Sarcophaga carnaria* (Linnaeus, 1758)), (Figures 2, 3 and 4).

The larval stage was an encounter with four insect species including *L. sericata, C. refifacies, C. albiceps*, and *S. carnaria* (Figure 5).

The pupal stage was inspected in three species including *L. sericata, C. refifacies,* and *C. albiceps.* It is interesting to point out herein that the eggs are so tiny and delicate, that it is frequently challenging to extract them from the remnants. Additionally, masses of eggs, which are typically off-white in color, were seen on the corpse shortly after death around the mouth, neck, eyes, ears, and skin folds.

Table 2. Incidence of forensic insects attracted to cadavers to rabbits during four seasons of 2021-2022 under the experimental area of Assiut

Order Family Scientific name Common name	Seasons											
	Summer 2021			Fall 2021			Winter 2022			Spring 2022		
	*A	L	P	A	L	P	A	L	P	A	L	P
Coleoptera 1-Carabidae *Harpalus rufipes* Ground beetles	#+			+			+			+		
2-Histeridae *Saprinus blanchei* Clown beetles	+			+			+			+		
3-Staphylinidiae *Creophillus maxillosus* Hairy rove beetle							+					
4-Dermestidae *Dermestes frischii* Skin beetles	+			+			+			+		
Diptera 1-Calliphoridae *Lucilia sericata* Green fly							+	+	+			
Calliphora vicine Blow fly				+								
Chrysomya refifacies Blow fly	+	+	+	+	+	+	+	+	+	+	+	+
Chrysomya albiceps Blow fly	+	+	+	+	+	+	+	+	+	+	+	+
2-Muscidae *Musca domestica* House fly	+			+			+			+		
3-Sarcophagidae *Sarcophaga carnaria* Flesh fly	+	+		+	+		+	+		+	+	

*Insect stage: A= Adult, L=Larva and P= Pupa. #Insect Incidence= +

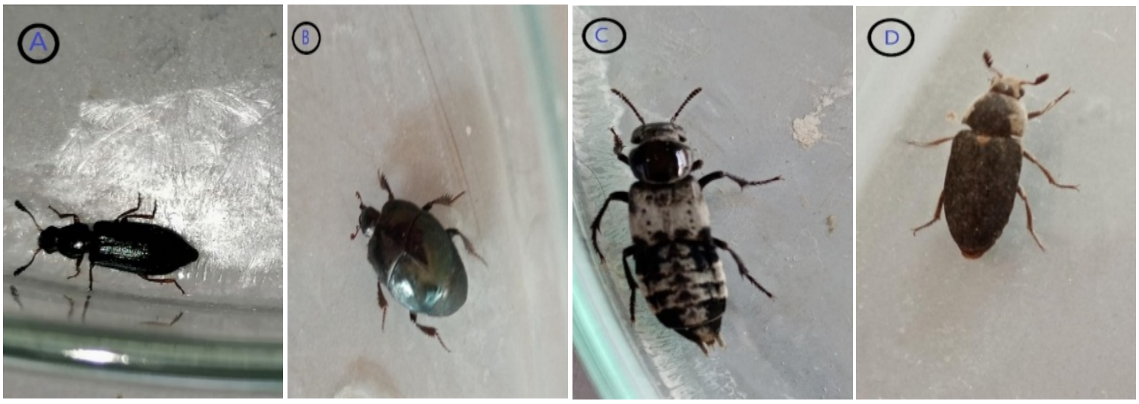

Figure 2. Species of insect adults appeared on rabbit's carcasses
A) *Harpalus rufipes*, B) *Saprinus blanchei*, C) *Creophillus maxillosus,* and D) *Dermestes frischii.*

Figure 3. Species of insects appeared on rabbit's carcasses: A) *Calliphora vicine,* B) *Lucilia sericata*, C) *Chrysomya refifacies,* D) *Chrysomya albiceps*, E) *Musca domestica*, and F) *Sarcophaga carnaria*.

Figure 4. Identification with anterior respiratory spiracles: A) *Lucilia sericata* and B) *Chrysomya* sp.

Figure 5. Identification with posterior respiratory spiracles: A) *Lucilia sericata,* B) *Chrysomya* sp., and C) *Sarcophaga carnaria*

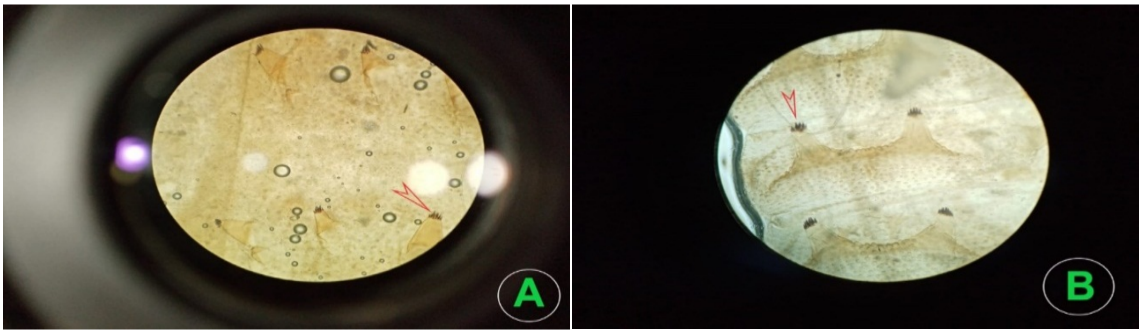

Figure 6. Apical spines on tubercles: A) *Chrysomya refifacies* and B) *Chrysomya albiceps*

As shown in Table 3, during the Summer of 2021, the insect taxa were represented as Coleoptera (3 families, 3 genera, and 3 species) and Diptera (3 families, 5 genera, and 5 species). The first abundance of insects from death is *C. refifacies*, *C. albiceps*, and *Musca domestica* and the last abundance of insects from death is *S. blanchei*.

While, during Fall 2021 season, insect taxa include Coleoptera (3 families, 3 genera, and 3 species). Diptera (3 families, 5 genera, and 5 species). The first abundance of insects from death includes *H. rufipes*, *C. refifacies*, and *M. domestica* and the last abundance of insects from death was *S. blanchei*.

In Winter 2022, the insect taxa encounters were Coleoptera (4 families, 4 genera, and 4 species) and Diptera (3 families, 5 genera, and 5 species). However, the first abundance of insects from death included *L. sericata* and *C. refifacies* and the last abundance of insects from death was *S. blanchei*.

Insect taxa in Spring 2022, were represented by Coleoptera (3 families, 3 genera, and 3 species). The first abundance of insects from death were *C. refifacies*, *C. albiceps*, and *Musca domestica* and the last abundance of insects from death were *S. blanchei*.

Data in Table 4 indicate that there was a highly significant difference (**) among seasons on the abundance date of *H. rufipes* and Duncan test shows that the latest appearance (16.33days) was recorded in winter 2022. There was an insignificant difference (ns) among seasons on average insects' population of the same insect.

In Fall 2021 there was a highly significant difference (**) among seasons on the abundance date of *S. blanchei* and the Duncan test concluded that the latest appearance (21days) was recorded and there was an insignificant difference among seasons on average of insect population of the same insect.

Also, there was an insignificant difference among seasons on the abundance date of *C. albiceps* and there was an insignificant difference among seasons on average of insect population of the same insect.

Table 3. Inspection date and average number of forensic insects attracted to rabbit cadavers during four experimental seasons of 2021-2022

		Harpalus rufipes	*Saprinus blanchei*	*Creophillus maxillosus*	*Dermestes frischii*	*Lucilia sericata*			*Calliphora vicine*	*Chrysomya refifacies*			*Chrysomya albiceps*				*Musca domestica*	*Sarcophaga carnaria*	
		*A	A	A	A	A	L	P	A	A	L	P	A	E	L	P	A	A	L
Summer 2021	First Abundance (Days from death)	5	10		2					1	3	4	1	2	4	5	1	2	4
	Last Abundance (Days from death)	8	11		3					2	3	5	1	3	6	7	2	2	4
	Total population (No. of insects)	12	5		25					15	108	68	14	ND	93	78	28	2	23
	Average±SD	4.3±1.53	2.00±1.00		8.3±0.58					5.00±1.00	36.00±1.00	22.67±2.52	4.67±0.58		32.00±1.00	29.00±1.00	9.67±1.53	1.00±0.00	8.00±0.00
Fall 2021	First Abundance (Days from death)	1	21		2				3	1	9	14	1	3	9	14	1	3	9
	Last Abundance (Days from death)	6	21		6				3	2	13	19	1	6	13	19	2	3	9
	Total population (No. of insects)	8	2		19				1	7	63	57	10	ND	57	53	19	1	6
	Average±SD	2.00±1.00	1.00±0.00		6.33±1.15				0.33±0.58	2.33±1.53	21.00±3.61	19.00±2.65	3.33±1.53		20.00±7.00	18.33±4.93	6.33±2.52	0.33±0.58	2.00±1.23
Winter 2022	First Abundance (Days from death)	17	14	10	8	1	6	19		1	7	18	1	3	7	13	1	7	9
	Last Abundance (Days from death)	18	16	10	9	3	7	20		1	12	24	1	6	13	19	3	8	10
	Total population (No. of insects)	6	5	1	13	6	30	39		5	70	50	7	ND	67	47	14	3	36
	Average ±SD	2.00±1.00	2.00±1.00	0.33±0.58	4.33±2.31	2.00±1.00	10.00±1.00	9.67±6.51		1.67±1.15	23.00±1.73	16.67±1.15	2.33±0.58		23.00±1.73	15.67±2.08	4.64±1.15	1.00±0.00	12.00±1.00
Spring 2022	First Abundance (Days from death)	9	10		8					1	7	9	1	3	7	9	1	3	4
	Last Abundance (Days from death)	10	10		9					4	9	11	2	6	9	11	7	3	4
	Total population (No. of insects)	10	2		13					9	53	38	13	ND	50	39	7	3	4
	Average ±SD	3.33±0.58	1.67±0.58		4.33±1.53					3.00±1.00	17.00±1.73	12.67±1.53	4.33±2.52		16.67±3.79	13.00±1.00	2.33±0.58	1.00±1.00	1.33±1.51

*Insect stage: A= Adult, L=Larva and P= Pupa. #FA= First Abundance (Days from death), LA= Last Abundance (Days from death), TP= Total population (No. of insects).

Table 4 First abundance date and the average of forensic insect population adults attracted to rabbit cadavers during four seasons (2021-2022) in Assiut, Egypt

Scientific name	Seasons													
	Summer 2021	Fall 2021	Winter 2022	Spring 2022	Total	LSD 0.05	F. Test	Summer 2021	Fall 2021	Winter 2022	Spring 2022	Total	LSD 0.05	F. Test
	First Abundance date (Based on 3 replicas)							Insect population (Based on 3 replicas)						
Harpalus rufipes	7.00$^{c\#}$	8.33^{bc}	16.33^{a}	9.67^{b}	41.33	2.3	***	4.33 ^{a}	2.66 ^{ab}	2 ^{ab}	3.33 ^{ab}	12.32	-	Ns
Saprinus blanchei	10^{c}	21^{a}	15^{b}	10^{c}	56	0.94	***	2 ^{a}	1 ^{b}	2 ^{a}	1.66 ^{ab}	6.66	-	Ns
Dermestes frischii	2^{d}	3.66^{b}	13.33^{b}	8.33^{c}	27.32	4.14	**	8.33 ^{a}	6.33 ^{ab}	4.33 ^{bc}	4.33 ^{bc}	23.33	2.48	**
Chrysomya refifacies	1^{b}	1.33^{ab}	1^{b}	1.6^{a}	4.93	-	Ns	5 ^{a}	2.33 ^{b}	1.66 ^{a}	3 ^{b}	11.99	2.1	*
Chrysomya albiceps	1^{a}	1^{a}	1^{a}	1.33^{a}	4.33	-	Ns	4.66 ^{a}	3.33 ^{a}	2.33 ^{a}	4.33 ^{a}	14.65	-	Ns
Musca domestica	1^{b}	1.33^{b}	1.66^{b}	2.33^{a}	6.33	-	Ns	9.66 ^{a}	6.33 ^{b}	4.66 ^{bc}	2.33 ^{c}	22.98	2.73	**
Sarcophaga carnaria	2 ^{c}	3 ^{b}	7.33^{a}	2.66^{bc}	14.99	0.76	**	0.66 ^{a}	0.66 ^{a}	1^{a}	1^{a}	3.32	-	Ns

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

Table 5. First abundance date and the average of forensic insect population larvae attracted to rabbit cadavers during four seasons (2021-2022) in Assiut, Egypt

Scientific name	Summer 2021	Fall 2021	Winter 2022	Spring 2022	total	LSD 0.05	F. Test	Summer 2021	Fall 2021	Winter 2022	Spring 2022	total	LSD 0.05	F. Test
	Abundance date							Insect population						
Chrysomya refifacies	3 d#	9 b	7 c	7 c	6	4.19	**	36 a	21 b	23.33 b	17 c	97.33	4.12	**
Chrysomya albiceps	4 d	9 b	7 c	7 c	27	1.71	* *	31 a	20 bc	23 bc	16.66 c	90.66	7.01	**
Sarcophaga carnaria	4 c	9 b		3 d	16	7.93	**	7.66 b	3 c		2 c	16.66	1.71	**

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

Table 6. First abundance date, an average of forensic insect population pupae attracted to rabbit cadavers during four seasons (2021-2022) in Assiut, Egypt

Scientific name	Summer 2021	Fall 2021	Winter 2022	Spring 2022	total	LSD 0.05	F. Test	Summer 2021	Fall 2021	Winter 2022	Spring 2022	total	LSD 0.05	F. Test
	Abundance date							Insect population						
Chrysomya refifacies	3c	14a	13ab	9b	39	-	NS	22.66 a	19 ab	16.66 bc	12.66 c	70.32	5.71	**
Chrysomya albiceps	5 c	14 a	13 ab	9 b	41	7.66	**	29 a	18.33 bc	15.66 c	13 c	75.99	6.03	**

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

As per these data, there was also an insignificant difference among seasons on the abundance date of *M. domestica* and the Duncan test show that the latest appearance (2.33 days) was recorded in Spring 2022. In addition, there was a significant (*) difference among seasons on average of insect population of the same insect and the Duncan test indicates that (9.66insects) Summer 2021 was the highest in the insect population.

The data in Table 4 also confirm that there was a highly significant (**) difference among seasons on the abundance date of *S. carnaria* and the Duncan test shows that the latest appearance (7.33 days) was recorded in Summer 2022 and there was an insignificant difference among seasons on average of insect population of the same insect.

Additionally, there was a highly significant (**) difference among seasons on the abundance date of *D. frischii* and the Duncan test shows that the last appearance (13.33 days) was recorded in winter 2022. Moreover, there was a significant difference among seasons on average of insect population of the same insect and the Duncan test indicates that (8.33 insects) Summer 2021 was the highest in insect population.

Furthermore, there was an insignificant (ns) difference among seasons on abundance date of *C. refifacies*, and there was a significant difference among seasons on average of insects' population of the same insect and the Duncan test indicates that (5insects) Summer 2021 was the highest in insect population.

On the other hand, the Data in Table 5 show that there was a high scientific difference among seasons on the abundance date of *C. refifacies* (larvae) and the Duncan test indicates that the last appearance (9 days) was recorded in Fall 2021. also, there was a high scientific difference among seasons on average of insect populations of the same interest and Duncan test confirmed that (36 larvae) in Summer 2021 was the highest in the insect population.

As per these data, there was a high scientific difference among seasons on the abundance date of *C. albiceps* (larvae) and the Duncan test indicates that the last appearance (9 days) was recorded in Fall 2021. Also, there was a scientific difference among seasons on average of insect population of the same insect and the Duncan test testifies that (31 larvae) Summer 2021 was the highest in the insect population.

The data in Table 5 present that there was a high scientific difference among seasons on abundance date of *S. carnaria* (larvae) and the Duncan test shows that the last appearance (9 days) was recorded in Fall 2021. Also, there was a scientific difference among seasons on average of insect population of the same insect and the Duncan test confirmed that (7.66 larvae) Summer 2021 was the highest in the insect population.

The data in Table 6 indicated that there was a high scientific difference among seasons on the abundance date of *C. refifacies* (pupae) and the Duncan test show that the last appearance (4 days) was recorded in Fall 2021. Also, there was a high scientific difference among seasons on average of insect population of the same insect and the Duncan test clarifies that (22.66 pupae) Summer 2021 was the highest in the insect population. In addition, manifested that there was a high scientific difference among seasons on the abundance date of *C. albiceps* pupae and the Duncan test shows that the last appearance (4 days) was recorded in Fall 2021. Moreover, there was a high scientific difference among seasons on average of insect population of the same insect and the Duncan test presents that (29 pupae) Summer 2021 was the highest in the insect population.

Discussion

In several parts of the world, many studies were conducted to detect species composition and the successive arthropod waves on cadavers (Goff, *et al*., 2000; Vairo, *et al*., 2015). According to Özdemir and Sert (2009), the decay process is a natural and necessary way that is responsible for the return of the organic material to the ecosystem. In the present study, the first appearance and population density of forensic insects attracted to rabbit cadavers were considered in four seasons during 2021-2022. The duration of different stages of decomposition was proportional to the temperature, which agrees with the study of Özdemir and Sert (2009). The carcasses exposed to the sun decayed faster in the presence of higher temperatures than in cooler and darker conditions of winter, which was also recorded by Joy *et al*., (2006).

Generally, carcasses during the summer season were decomposed quicker because of the large attraction of insects to bodies in warmer climates. As reported, de la Fuente *et al*. (2006), Temperature affects the insect population dynamics and activity due to its control of growth and reproduction.

Many researchers including Payne (1965); Abell *et al*. (1982) and Anderson and Van Laerhoven (1996) observed that there is an inter-dependence between insect colonization and the decomposition rate. This could explain why the cadaver took more time to decompose in winter rather than in other seasons.

The present results indicate that the maximum number of forensic insect species was represented by the dipterous insects (6 species). However, the second important forensic insect order was represented by Coleoptera (4 species).

The insects, according to the species forensic importance, recorded in this study mainly included the greatest number of necrophagous individuals that fed directly on the cadaver. The most important necrophagous species were represented by *Harpalus rufipes*, *Saprinus blanchei*, *Creophillus maxillosus*, *Dermestes frischii*, *Calliphora vicine*, *Lucilia sericata*, *Chrysomya refifacies*, *Chrysomya albiceps*, *Musca domestica* and *Sarcophaga carnaria*. These results are consistent with the results presented by Tantawi *et al*. (1996) and Pérez *et al*. (2005).

Also, Calliphorid and Sarcophagid flies were the first colonizers to arrive and breed on rabbit carcasses. This finding was in harmony with the results of other studies in different geographic areas including Monteiro-Filho and Penereiro (1987); Anderson and Van Laerhoven (1996), and Hall and Huntington (2001).

The above-mentioned flies are strong fliers that can follow an odor plume over long distances and easily arrive and enter corpses as reported by Erzinclioglu (1996).

Results in the present study indicate that *Chrysomya albiceps* larvae were the most important component of insect succession on rabbit cadavers during all seasons because it was the most abundant species in all seasons. these results agree with the results presented by Abd El-Bar *et al*. (2016).

Conclusion

To sum up, from a forensic insect point of view, the taxa of the order Diptera appeared early from the first day after death on cadavers followed by the taxa of the order Coleoptera, which appeared later.

Acknowledgment

We are grateful to express our gratitude to the technical and staff members of, the Forensic Medicine and Clinical Toxicology Department and the Medical Parasitology Department, Faculty of Medicine. We are also deeply grateful for the support of the Veterinary Medicine Hospital and the Biological Control Unite, Plant Protection Department at the Faculty of Agriculture, Assiut University, for the facilities they introduced to accomplish the present research.

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الوفرة الموســـمية لحشـــرات الطب الشـــرعي التي تم العثور عليها على جثث الارانـب في محافظة أسيوط، مصر

فاروق عبد القوي عبدالجليل[1]*، صفاء ماهر جورج[2]، محمد أحمد ابراهيم أحمد[1]، رشا رزق وديع[1]، ساره محمد عصام الدين موسى[1]، مرفت مصطفى خليفة[3]

[1]قسم وقاية النبات، كلية الزراعة، جامعة أسيوط، أسيوط، مصر.
[2]قسم الطب الشرعي والسموم الاكلينيكية، كلية الطب، جامعة أسيوط، أسيوط، مصر.
[3]قسم الطفيليات، كلية الطب، جامعة أسيوط، أسيوط، مصر.

الملخص

يعتبر علم حشـرات الطب الشـرعي هو العلم الذي يطبق بيولوجيا الحشـرات في التحقيقات الجنائية، باستخدام الحشرات ومفصليات الأرجل الأخرى للكشف عن ظروف القضايا الجنائية. في هذه الدراسـة، قد سـجلنا وفرة الحشـرات بحسـب الموسـم، التي تم العثور عليها على جثث الأرانب خلال المواسم الأربعة (2021-2022) في مصر تحت ظروف محافظة أسيوط.

لقـــد انجذبت العديد من الحشرات إلى الجثث خلال المواسم الأربعة (2021-2022)، تنتمي عشـر حشـرات بالغة تمت ملاحظتها إلى سـبع عائلات تحت رتبتي غمدية الاجنحة Coleoptera وذات الجناحين Diptera. تم ملاحظة اربعة من حشرات ال coleopteran والتي تنتمي الي أربع عائلات، وهم

Carabidae (*Harpalus rufipes*), Histeridae (*Saprinus blanchei*), Staphylinidiae (*Creophillus maxillosus*), Dermestidae (*Dermestes frischii*).

كما تم ملاحظة ستة من حشرات ال dipteran والتي تنتمي الي ثلاث عائلات، وهم

Calliphoridae (*Calliphora vicine*, *Lucilia sericata*, *Chrysomya refifacies* and *Chrysomya albiceps*), Muscidae (*Musca domestica*), and Sarcophagidae (*Sarcophaga carnaria*).

بالإضـافة الي ذلك، لقد تلاحظ ظهور الحشرات من رتبة Diptera وتصنيفاتها على الجثث، مبكراً من اليوم الاول مباشرة بعد الموت متبوعة بعد ذلك بظهور الحشرات من رتبة Coleoptera وتصنيفاتها والتي ظهرت لاحقاً.

تسلط هذه الدراسـة الضـوء على علم حشـرات الطب الشـرعي الذي يعتبر محدوداً للغاية في مصر ودراسته غير واسعة الانتشار. يجب إجراء مزيد من التحقيق للاستفادة من مثل هذه الدراسة وذلك سوف يساعد في إزالة الالتباس في القضايا المعقدة في المستقبل.

الكلمـــات المفتاحيـــة: *علم حشرات الطب الشرعي، الحشرات المتواجدة وفترة ما بعد الوفاة*