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Dominance and Frequency of Mite Species Associated with Poultry Droppings

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Abstract

The present study was carried out onAl-Saqlawiya poultry farm's soil (Anbar, Iraq) for the period of 8 months (November 2018- June 2019). A total of 75 samples of poultry droppings were collectedrandomly. 552 individuals of mite,belonging to 3 orders and 8 families representing 15 species, were found. These species were: *Acarus gracilis, Acarus siro, Caloglyphus berlesi, Androlaelaps casalis, Sejus temperaticus, Parasitus paraconsanguineus, Eugamasus butleri, Macrocheles medarius, Macrocheles glaber, Macrocheles muscaedomesticae, Macrocheles matrius, Kleemannia plumosus, Cheyletus eruditus, Cheyletus malaccensis,* and *Pyemotes herfsi*.

The highest population density belonged to order Astigmata, followed by orders Mesostigmata and Prostigmata, respectively. The dominance and frequency of mite species were linked to the availability of appropriate conditions in terms of food source and temperatures registered in theIraqi Meteorological Directorate. Thehighest mite population densities were recorded during the winter months compared to the summer months.

Keywords: Acari, Dominance,Frequency, Mites, Poultry droppings.

السيادة والتكرار لأنواع الحَلَمْ المرتبط مع مخلفات الدواجن

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الخلاصه

أجريت الدراسة الحالية على تربة مخلفات الدواجن في الصقلاوية (الأنبار ، العراق) لمدة 8 أشهر (نوفمبر 2018– يونيو 2019). تم جمع 75 عينة من فضلات الدواجن وتم العثور على 552 فردا من الحَلَمْ ، تعود إلى 3 رتب و 8 عوائل تتضمن 15 نوعا، الانواع هي :

Acarus gracilis, Acarus siro, Caloglyphus berlesi, Androlaelaps casalis, Sejus temperaticus, Parasitus paraconsanguineus, Eugamasus butleri, Macrocheles medarius, Macrocheles glaber, Macrocheles muscaedomesticae, Macrocheles matrius, Kleemannia plumosus, Cheyletus eruditus, Cheyletus malaccensis, Pyemotes herfsi.

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كانت أعلى كثافة سكانية تنتمي إلى رتبة Astigmata خلال اوقات معينة تليها الرتب Mesostigmata و Prostigmata، على التوالي.ارتبطت سيادة أنواع الحَلَمْ وتكرارها بتوفر الظروف المناسبة لها من حيث مصدر الغذاء ودرجات الحرارة المسجلة في دائرة الانواء الجوية العراقية. الكثافة السكانية لأفراد الحَلَمْ المسجلة كانت مرتفعة خلال اشهر الشتاء مقارنة بالكثافة السكانية المسجلة خلال اشهر الصيف.

Introduction

Many organisms are found in animal feces,including arthropods such as insects and mites, of which hundreds species belonging to 25 families were recorded. Some of these species are predatory on other species of mites or other arthropods such as insects. On the other hand, some species feed on organic materials, fungi, and bacteria in the poultry droppings [1, 2].

It is well known that soil arthropods are one of themajor contributors to biological fertility of the soil. Their activity contributes greatly to the synthesis of humus, organic decomposition, the restitution of biogenic elements, and the stimulation of bacterial and fungal metabolism [3].

Mites are one of the most diverseorganisms in nature. Mites who live in organic materials play an important role in the biological cycle of normal and cultivated soil. Dung fauna is very important to understand function, dynamics, and structure of an ecosystem.The presence and diversity of arthropods, especially insects and mites, was reported in places where animal droppings are collected,including poultry droppings which are important for the stability of different ecosystems and natural balance [4, 5].

The most serious health risks tohuman life happen either from inhaling the fungal spores of infectious organisms which grow in the nutrient-affluent accumulations of poultry droppings or from direct contact.Poultry droppings can transport over 60 diseases,many of them are airborne and can be transferred to humans just by being around them [6].

Mites, as a group of population, are widespread; some of them feed on their neighborhoods. Many of these neighborhoods infect plants with their various parts and cause significant economic damage, whereassome of them feed on stored food to which they cancause damages.Other mites infect humans and cause different diseases such as scabies, typhus itch, skin allergies, and respiratory or asthma diseases in some people who have hypersensitivity [7].

The mites of small arthropods rangein length between 0.1 and7.0 mm. They are one of the most diverse arthropods in biological terms. Mites lack the phenomenon of external division, which is considered as a characteristic of arthropods; these arthropods possess four pairs of legs in full phase and therefore can be easily distinguished from insects. Mites are generally characterized by theirability to spread and live in different environments,including all aquatic and terrestrial environments.They are widespread in tropical, subtropical and temperate regions of the worldwhere there are animal dropping collections [7, 8].

The orderAstigmata includes a variablegroup of small mites belonging to more than 70 families and nearly 5000 species. The mites of this group areeither free- living or parasitize on the incomplete phases of insects of the orders Diptera, Hymenoptera, and Coleoptera [9].

This family Acaridae includes two important species, namely*Acarussiro* and *Acarusgracilis*, with the former being the most studied species [10].

The order Prostigmata include many families. The families Cheyletoidae and Pyemotidae (Acariformes: Cheyletoidae) currently havemore than 440 species belonging to 75 genera, 78% of which are predators and some live in organic matter clusters and in soil. It is a very common group whichparasitizes on vertebrates, invertebrates, and insects. Some of them parasitizeon birds and mammals, while other species of this family causeagricultural damages and affect the health of domestic animals and humans [11, 12]. Some species of this family use insects for transmission [13].

The Order Mesostigmatais the largest order of mites as it includes about 11,500 species, representing about 20% of the recorded mites' species [14].

Macrochelidaefamily from order Mesostigmata includes many species that feed on the eggs and larvae of the first stage of the house fly, whereas they feed on small arthropods, nematodes, and jumping species of orderCollembola, as an alternative food in the absence of immature stages of flies. This family is one of the most numerous families in terms of numbers of individuals and species. It includes the predatory mites, which live in clusters of organic matter of decomposing animals and plants [15-17].

Al-Ani [18] reportedthat this species of mites is an external parasite on the eggs and larvae of house flies where it can reduce their population density by feeding on their larvae and eggs.

The aims of this study were to isolate andidentify mites in poultry droppings, and to obtainknowledge of their dominance and frequency. In addition, we aimed to evaluate the effects ofsome environmental factors on the population density of mites throughout the duration of the research.

Materials and Methods

A total of 75 samples were collected from Al-Saqlawiya poultry farm's soil in Fallujah twice a month over a period of 8 months, from November 2018 to June 2019. All samples were taken from adepth of 5-10 cm. These samples were kept in transparent nylon bags, which were closed well and then brought to the lab. These samples were individually extracted in the laboratory through a modified Tullgren funnels extractor.

A total of 552 individuals of adult mites were isolated (224 in November, 277 in December, 30 in February, and 21in April). Meanwhile, no individuals were isolated during January, May, and June.

Mites were isolated from soil samples using adissecting microscope. The isolated mites were cleared and purified by heating in 50% Lactic acid, then mounted in Hoyer's medium by transferringthe specimens on glass slides. The loadedslides were placed on ahot plate to dry the loading medium and to isolatethe final form to be examined under a compound microscope. Mites were classifiedbyaspecialist in Acarology, using the taxonomic keys [19-21].

Dominanceand Frequency

Dominance

The following equations were used to calculate percentages of dominance and frequency, which were then categorized according to the classes described below [7, 22]:

$$\mathbf{D} = \frac{\mathbf{No.\ of\ individuals}}{\mathbf{Total\ No.\ of\ mites}} \times \mathbf{100}$$

- **Dominant:**5% or more of the total number of individuals.
- **Influent:** the percentage is higher than 2% and less than 5% of the total number of individuals.
- **Resident:** 2% or less of the total number of individuals.

Frequency

$$\mathbf{F} = \frac{\mathbf{No.\ of\ positive\ samples}}{\mathbf{No.\ of\ total\ samples}} \times \mathbf{100}$$

- **Constant:** species occurs in more than (50)% of the samples.
- **Accessory:** species occurs in (25-50)% of the samples.
- **Accidental:** species occurs in less than (25)% of the sample

Results

In this study, 75 samples of poultry droppings were examined. 552 individuals of mite, belonging to 3 orders and 8 families representing 15 species, were found. Three species belonged to the order Astigmata which has no-respiratory apertures, 9 species belonged to the order Mesostigmata which has middle respiratory apertures, and 3 species belonged to the order Prostigmata which has front ventilation openings (Table-1).

Table 1-Recorded mite species in poultry droppings during the duration of the study (November 2018_ June 201**9)**

Order	Family	Genus	Species
Astigmata	Acaridae	*Acarus*	*A. gracilis*
		Acarus	*A. siro*
		Caloglyphus	*C. berlesi*
Mesostigmata	Laelapidae	*Androlaelaps*	*A. casalis*
	Sijidae	*Sejus*	*S. temperaticus*
	Parasitidae	*Parasitus*	*P. paraconsanguineus*
		Eugamasus	*E. butleri*
	Macrochelidae	*Macrocheles*	*M. medarius*
		Macrocheles	*M. glaber*
		Macrocheles	*M. muscaedomesticae*
		Macrocheles	*M. matrius*
	Ameroseiidae	*Kleemannia*	*K. plumosus*
Prostigmata	Cheyletidae	*Cheyletus*	*C. eruditus*
		Cheyletus	*C. malaccensis*
	Pyemotidae	*Pyemotes*	*P. herfsi*

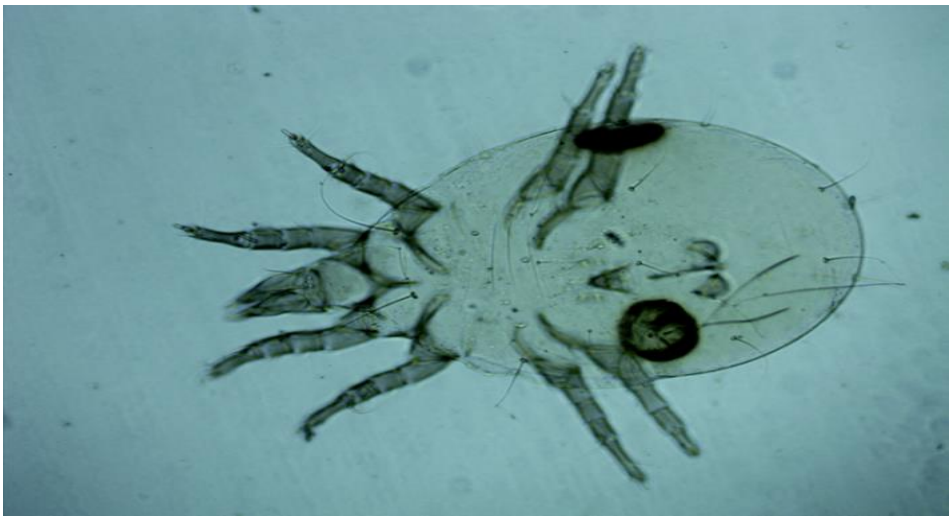

Figure 1-Light microscopic image of *Caloglyphus berlesi* (100X).

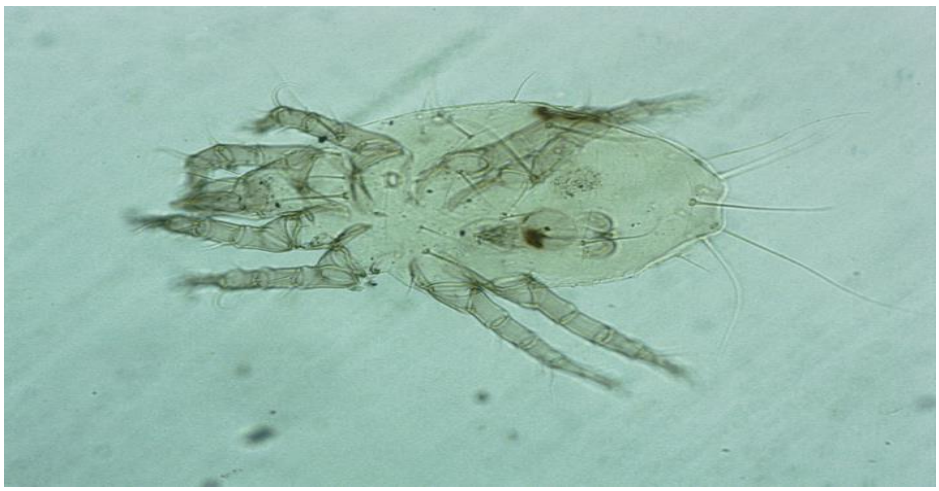

Figure 2-Light microscopic image of *Acarus gracilis* (100X).

Table 2-Dominance and frequency ofmite species recorded in poultry droppings.

Order	Family	Species	D	F
Astigmata	Acaridae	*Acarus gracilis*	15.2	6.66
		Acarus siro	1.26	5.33
		Caloglyphus berlesi	68.29	26.66
Mesostigmata	Laelapidae	*Androlaelaps casalis*	0.90	4
	Sijidae	*Sejus temperaticus*	0.36	2.66
	Parasitidae	*Parasitus paraconsanguineus*	0.90	2.66
		Eugamasus butleri	0.90	4
	Macrochelidae	*Macrocheles medarius*	1.26	4
		Macrocheles glaber	3.98	6.66
		Macrocheles muscaedomesticae	3.26	8
		Macrocheles matrius	1.63	6.66
	Ameroseiidae	*Kleemannia plumosus*	0.90	1.33
Prostigmata	Cheyletidae	*Cheyletus eruditus*	0.54	1.33
		Cheyletus malaccensis	0.36	1.33
	Pyemotidae	*Pyemotes herfsi*	0.18	1.33

Table-2 shows the dominance and frequency of the species that appeared in poultry droppings during the study. Two dominant species, *Caloglyphus berlesi* and *A. gracilis* (Figures- 1 and 2) belonged to the order Astigmata . Their dominance values were 68.29% and 15.2%, respectively.Two influential species, *M. glaber* and *M. muscaedomesticae* belonged to the order Mesostigmata (Figures-3 and 4), with dominance values of 3.98%, 3.26%. While the remainingspecies were resident. One constant species,*Caloglyphusberlesi*, belonged to the order Astigmata with a frequency of 26.66%. Moreover, one species, *Macrochelesmuscaedomesticae*, belonged to the order Mesostigmata and had a frequency of 8%. All the remainingspecies were accidental.

Figure 3-Light microscopic image of *Macrocheles glaber* (100X).

Figure 4-Light microscopic image of *Macrocheles muscaedomesticae* (100X).

Figure-5 shows the monthly average temperatures during the study months (November 2018-June 2019) registered in the Iraqi Meteorological Directoratein Fallujah. The lower average temperature,10℃, wasrecordedin November. The average temperature during December was 12.25℃, while it was 13.5℃ during January. In February and March, the temperature reached 15℃ and 18.75℃, respectively. Then, the temperature increased during April and May,with values of 28.25℃ and 33℃, respectively. The highest temperature rate,34.5℃, was recorded in June.

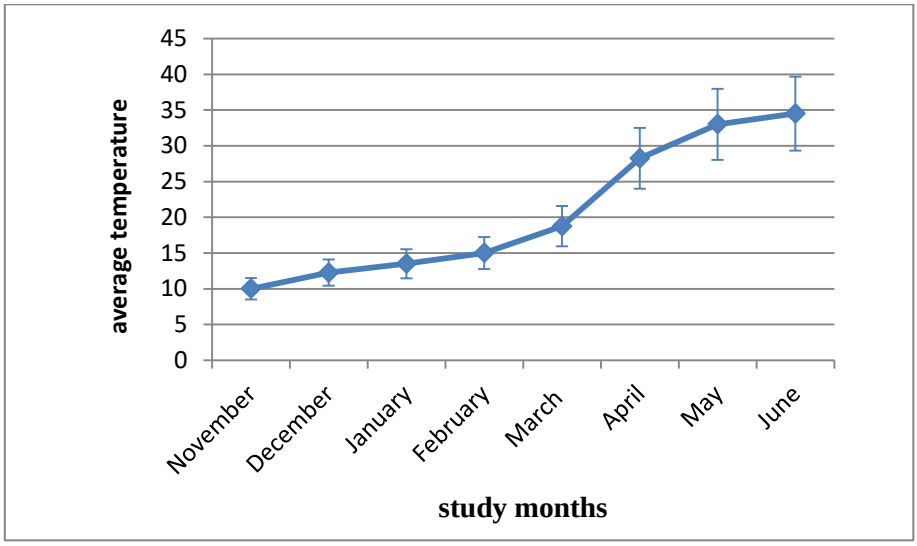

Figure 5-Average temperatures during the study months (November 2018- June 2019).

Table-3 presents the population density of mite species in poultry droppings. The highest population density was recorded during the winter months. On the other hand, the number of recorded species was very lowduring the summer months. In addition, *Caloglyphusberlesi* recorded the highest population density in December, which was 216 individuals. Meanwhile, *M. matrius*(Figure-6) showedthe lowest population density in April,which was 4 individuals. However, there were no species of mites in poultry droppings during the months of January, March, May, and June.

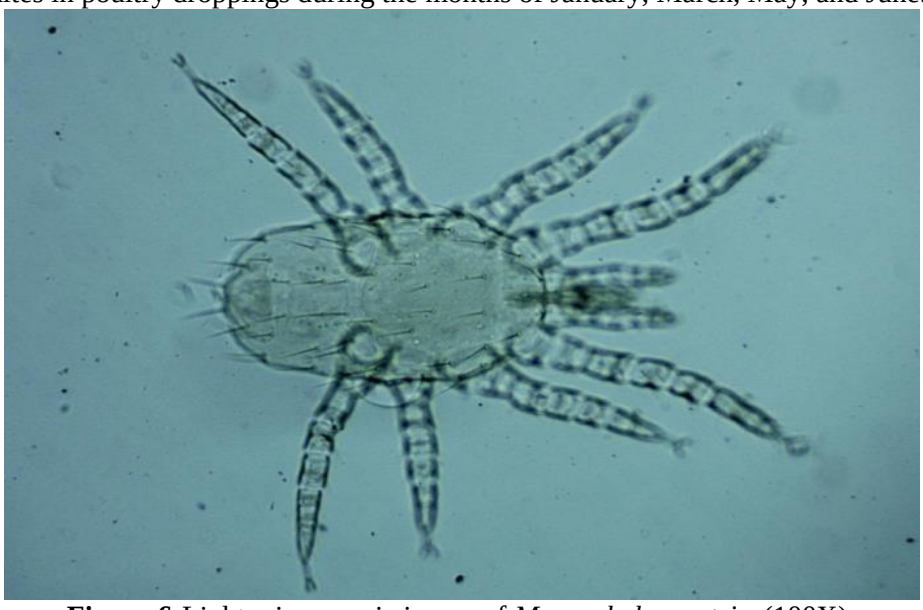

Figure 6-Light microscopic image of *Macrocheles matrius*(100X).

Table 3-Population density of mite species individuals of poultry droppings during the study months (November 2018- June 2019)

Species	Number of mite species individuals during the study months							
	November	**December**	**January**	**February**	**March**	**April**	**May**	**June**
A, gracilis	68	5	0	11	0	0	0	0
A. siro	0	2	0	1	0	4	0	0
C. berlese	154	216	0	7	0	0	0	0
A. casalis	0	0	0	5	0	0	0	0
S. temperaticus	0	2	0	0	0	0	0	0
P. paraconsanguineus	0	5	0	0	0	0	0	0
M . medarius	0	7	0	0	0	0	0	0
M . glaber	2	20	0	0	0	0	0	0
M. muscaedomesticae	0	15	0	3	0	0	0	0
M . matrius	0	5	0	0	0	4	0	0
K. plumosus	0	0	0	0	0	5	0	0
E. butleri	0	0	0	2	0	3	0	0
C. eruditus	0	0	0	0	0	3	0	0
C. malaccensis	0	0	0	0	0	2	0	0
P. herfsi	0	0	0	1	0	0	0	0
Total individuals	**224**	**277**	**0**	**30**	**0**	**21**	**0**	**0**
Number species	**3**	**9**	**0**	**7**	**0**	**6**	**0**	**0**

Discussion

Through the results, the most prevalent species of mites belonged to the order Astigmata (Table-2). The two most dominant species were *C. berlesi* and *A. gracilis* (68.29% and 15.2%), respectively. This may be due to the availability of food as most of these speciesfeed on fungi that needs adequate temperature and high humidity to grow,which is in agreement with the results obtained in a previous research [7]. Meanwhile, two abundant species *(M. glaber* and *M. muscaedomesticae*, order Mesostigmata) were found. The dominance values of them were3.98% and 3.26%, respectively (Table- 2). This may be due to the availability of food (prey) from other mite species and the suitable environmental conditions. This conclusion is in agreement with the results obtained in previous studies [8, 18].

The species of the order Prostigmatawereresident and less visible. This might be due to insufficient food sources from insects and the lack of suitable conditions of temperature and humidity, which led to their disappearance during winter and appearance during summer. In April, two species *C. eruditus* and *C. malaccensis* were isolated,which indicates that the endurance to the extreme environmental conditions of the order Prostigmata individuals is higher than that of the orders Astigmata and Mesostigmata. This is consistent with the results of other researchers [8, 13] who reported that insects are good prey for a mite species fromProstigmata.

As we can observe in Table-3, the species *C. berlese* from order Astigmata recorded the highest number of mites in poultry droppings in December (216 individuals), followed by the species *A. gracilis* in November (68 individuals). This is because some species in this order appear when the temperatures are relatively low and humidity is relativelyhigh, as it depends on fungi as a food, that need high humidity to grow.The inadequate conditions for growth during summer includehigh temperature and low relative humidity. This result is in agreement with those obtained in previous studies [7, 8].

The number of species belonging to Mesostigmata appeared as lowerthan that of the order Astigmata andhigherthan that of the order Prostigmata. The species *M. glaber* recorded 20 individuals in December, *M. muscaedomestica*e recorded 15 individuals during December,*M. Medarius* recorded 7 individuals in December, and the other species recorded a few different numbers, as shown in Table-

3. This is due to the availability of food (prey) for species of Mesostigmata as well as the occurrence of another source of food from insects larvae that appeared in mites isolated from samples. This is in agreement with the results obtained in previous researches [8, 18].

The lowest number of species (3) of order Prostigmata appeared in two poultry dropping samples only,as compared to other individuals that appeared from the mites that belong to the orders Astigmata and Mesostigmata. *C. eruditus* recorded 3 individuals in April, followed by *C. malaccensis* which recorded 2 individuals during the same month. Meanwhile, *P. herfsi* recorded only one individual during the month of February (Table-3). This is because the individuals of this order areparasitic or predatory and depend in their food on some species of mites and insects. This conclusion agreeswith the results of other researchers [8, 23].

The highest total number of individuals (only adults were collected) was recorded during December, as it reached 277 individual mites, followed by November (224 individual mites). 30 individual mites were recorded during February. The lowest total number of individuals was recorded during April (21 individuals). This is may be due to the availability of appropriate environmental conditions such as temperature, humidity, and the availability of an appropriate nutritional source for each species.Other factors can include the suitability of soil propertiesin which poultry droppings are present, including, temperature and wet weight of sample during the study period, as well as suitable PH . These results are in agreement with the results obtained in previous studies [3, 7].

Conclusions

Our results showed the population density of the mites, recorded in terms of both number of species and individuals. The Mesostigmataand Prostigmatamites' density was associated with the density of their prey ofincomplete phases of fly insectsin poultry droppings. Finally, we conclude that the high temperatures that lead to the drying of poultry droppings are one of the most important determinant factors of the mites found in that environment.

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