FACULTY OF AGRICULTURE

Minia J. of Agric. Res. & Develop.

Vol. (41), No.1, pp67-.76, 2021

FACULTY OF AGRICULTURE

IMPACT OF SOME CLIMATIC FACTORS ON THE POPULATION DENSITY OF TWO RODENTS SPECIES AND THEIR ASSOCIATED ECTOPARASITES IN ANIMAL PRODUCTION FARM AT SHOSHA DISTRACT, MINIA GOVERNORATE.

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Received: 16July (2021) Accepted: 27September (2021)

ABSTRACT

Redents and their ectoparasites populations are key components of animal production farms production in Egypt and all over the world. However, their population dynamics and the factors affecting their abundance are still not well understood. The seasonal variations during the activity periods of *Rattus rattus frugivorous* and *Rattus norvegicus*, and their associated ectoparasites with three weather factors i.e., maximum biweekly mean temperature, minimum biweekly mean temperature as well as biweekly mean relative humidity as significant drivers of the rodent and their associated ectoparasites presence were recorded. Results showed that the biweekly fluctuations of weather factors seem to be mostly a reaction wards condition in altering the activity of both the rodents and their associated ectoparasites. Both species had three periods of activity in the two years of study and four and five periods of activity of the ectoparasites on *R. rattus frugivorous* and *R. norvegicus*. The highest biweekly variation in rodent's population was observed on the date 12 March and 10th September for the two species respectively. Also, a significant positive and negative correlation between the climatic conditions and the population activity of the two rodents and their ectoparasites is dependent on the periods of the activity. The combined effect of the three weather factors on the fluctuation of population activity of the two species of rodents was ranged from 78.9 to 98.03% and from 55.31 to 99.11% for *R. rattus frugivorous* and *R. norvegicus* during the three periods of activity through the two years of study. The simultaneous effect of the three tested weather factors on the fluctuation of population activity of rodents and their ectoparasites were varied through periods of activity. The temperature and relative humidity were two key factors that influenced the seasonal fluctuation of rodents and ectoparasites.

Key words: *Rattus rattus frugivorous, Rattus norvegicus*, weather factors.

INTRODUCTION

Rodents represent over 40% of mammalian species in the world **(*Wilson and Reeder, 2005*)**. They are characterized by high fluctuating population dynamics and metabolic rates **(*Krebs*, 2013).** They can reproduce several times per year, have high growth rates, and produce a lot of offspring;

however, they act as human- and livestock-disease vectors **(*Taylor,* 1972, *Salit* et al., 1982).** Rodents cause economic losses in man food and often hinder production too, hamper health to people and livestock in villages. Rodents and their ectoparasites populations are an important component of many ecosystems around the world. Their population dynamics are important to the theoretical basis of population biology, ecology, and their control **(*Hegab et al,* 2006).** Their species can show three to six - years of population peaks ***(Krebs, 2013; Rizk* et al., 2017).** Little is known about the factors influencing the outbreak phenomena, such factors could include: weather conditions, population density, their overwintering success, food availability, and predator's prevalence **(*Radchuk et al., 2016 and Rizk et al*., 2017).** The high numbers population ("outbreaks") cause serious damage to crops, so requiring intensive and costly management efforts **(*Jacob and Tkadlec* 2010).** The most abundant and widely distributed species in Egypt's cultural landscape are *Rattus rattus frugivorous* and *Rattus norvegicus*.**(*El Roby,A.S.M. et al*. (2021)**.

MATERIALS AND METHODS

Study area:

Data for this study were collected in an animal production farms in a newly reclaimed area at Shosha district, El.Minia Governorate, Egypt during two consecutive seasons (2017 and 2018). The study area had a variety of crop types: wheat, maize, mixed vegetables, as well as different fruit trees. The animal farm had also a variety of animal species: rabbits,sheep,cows, and buffalo, and many feed store.

Trapping and environmental data

We used biweekly trapping data from January 2017 to December 2018. Rodents wire-box traps with spring door (25 X 12X 10cm) were set biweekly and distributed at distances 5-10 meters (***Corominas, 2004; Nicolas and Colyn*, 2006)** as crow legs shape. We set traps baited with favorable food of rodents. Traps were distributed at night just before dusk and they checked the following morning for three days respectively. The number of set traps was 60 traps. For each captured rodents, the species was identified and recorded. Ectoparasites were collected from four captured rodent bodies were taken randomly on each date. The captured rodent bodies were dipped in bowl filled partially with liquid soap solution (water with few drops of detergent) to kill rodents by asphyxia and to remove the ectoparasites attached to the rodent bodies, then these ectoparasites were delivered to small jar contained 75% ethyl alcohol for identification aid of the stereoscopic microscope. The ectoparasites were classified as fleas, lice and mites. Identification of parasites was done according to keys constructed by (Karg 1971, Hughes, 1961 and 1976, Krantz,1978 and Evans,1992). One rodent represented one replicate. The average numbers of the detected animal organisms of four replicates were recorded and the general mean estimated and was recorded Relative humidity % and temperature data were collected from the climatic station of an airport, Minia governorate. And the average biweekly was calculated.

Population dynamics of study:

Population dynamics of the dominant rodents species and their ectoparasites were estimated during two years 2017&2018. Aclose comparison was made between the rat curves and their ectoparasites and recorded climatic factors
(maximum biweekly mean temperature, minimum biweekly mean temperature as well as biweekly mean relative humidity), to indicate the confirmation between population activity and the climatic factors. These parts were subjected to simple correlation analysis to asses the separate of each climatic factor on population activity.

RESULTS AND DISCUSSION

The simultaneous effects of certain weather factors on the population densities of the two species of rodents:

Analysis of activity: -

A close comparison of the three figures running mean curves of the number of the two species of rodents and their ectoparasites with the corresponding curves of each of the three considered weather factors indicated that the activity of rodents and their ectoparasites confirmed to a great extent with the fluctuations of weather factors during certain periods in the considered season of study. It is obvious as shown in Fig 1 to 4 that these periods extended over three parts of the annual distribution curve of rodents. Certain parts of the annual distribution curve, represented by the number of rodents, are decidedly independent of those of weather factors. For more explanation, it could be concluded that certain parts of the annual curve are more influenced by the so-called " population effect". Therefore, these periods are independent weather factors. Such periods, in investigating the relationships between the number of rodents and certain weather factors, should be eliminated as far as possible **(*Rizk et. al*., 1978)**. The prevailing biweekly mean relative humidity (X1) biweekly maximum temperature (X2), and biweekly minimum temperature (X3) were three considered variables tested in the present analysis for evaluating their real influence on the abundance of the two species of rodents and their ectoparasites. The separate effect of each weather factor on the number of rodents and ectoparasites was primarily carried out by calculating the simple correlation. More precise effects, however, were illustrated adopting partial regression termed the " C- Multipliers " on those factors. **(*Hosny*, 1955)**.

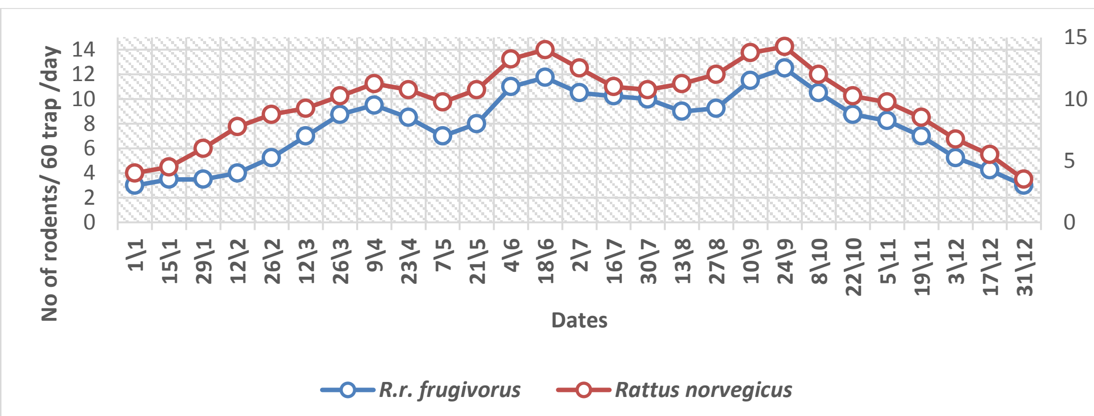

Fig (1): Population dynamic of rodents at Shosha animal production farm in samalote district during 2017.

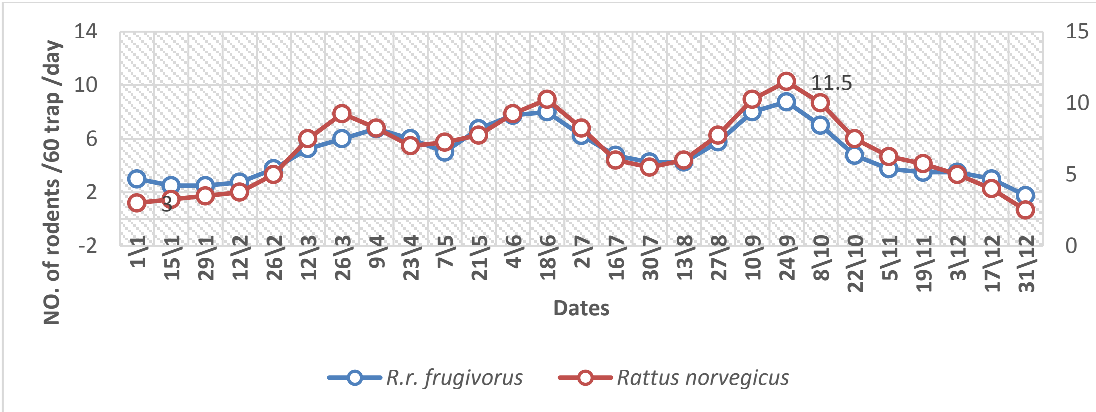

Fig (2): Population dynamic of rodents as trap index in Shosha animal production farm in Samalote district during 2018

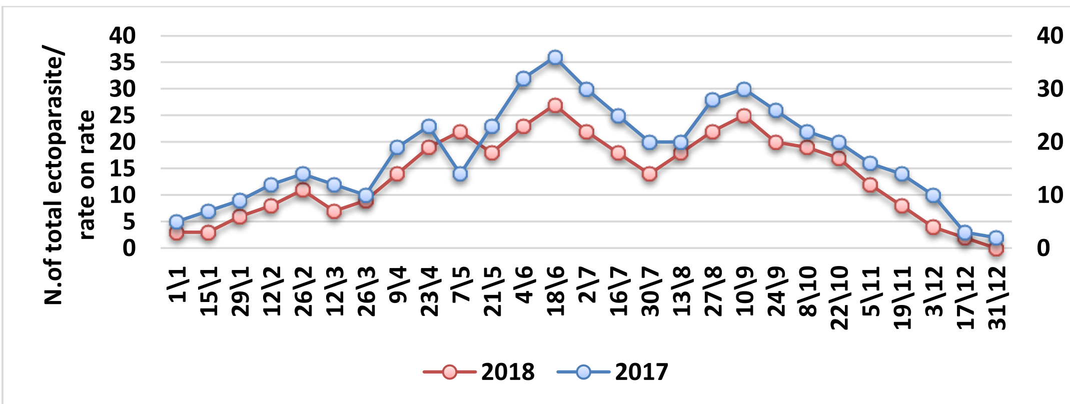

Fig (3): Population dynamic of total ecto-parasites on *R. rattus frugivorus* in Shosha animal production farm during 2017&2018

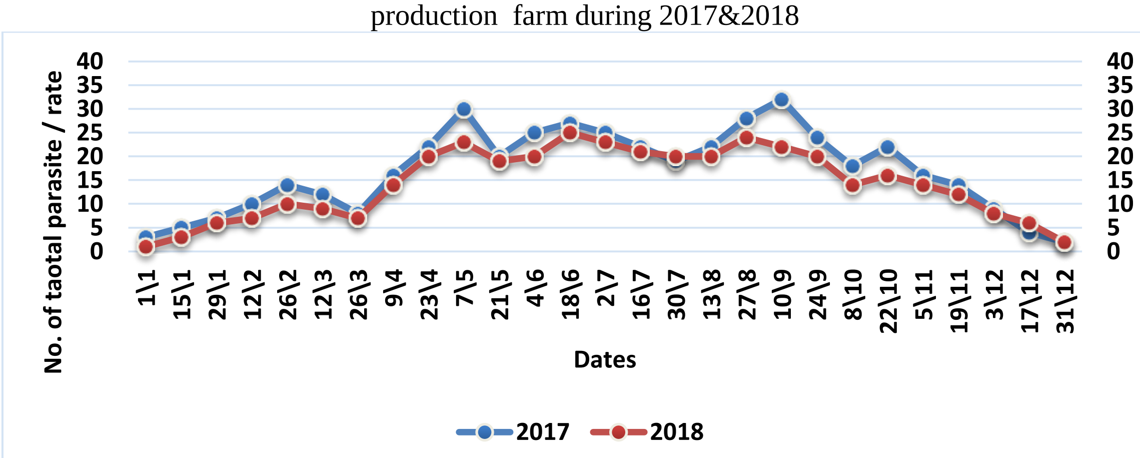

Fig (4): Population dynamic of total ecto-parasites ont *Rattus norvegicus* in Shosha animal production farm during 2017&2018

The effect of biweekly mean relative humidity% on the fluctuations of both *Rattus rattus frugivorous*, *Rattus norvegicus*, and their ectoparasites separately:-

Tables (1 – 4), showed that The calculated "r" values were negatively and significantly for the effect of this factor in 1st and nonsignificant at the two other periods of activity during 2017 and significantly negative in the 1st ,3rd and 4th periods in 2017 for *R. norvegicus* and significantly negative during the first three periods of activity during 2018. The partial regression on the biweekly mean relative humidity in each period is shown in Tables (1 and 2). The tabulated figures indicated that partial regression values were negative and significant during the majority of tested periods of activity. Therefore, it could be concluded, that a drop in of 1 % in the biweekly mean relative humidity increased the average population of rodents from one count to another from 0.17 and 0,142 rodents during. 2017 and from 0.0.17 to 0.87 for *R. rattus frugivorous*. These results support that in the periods of activity the influence of the biweekly mean relative humidity was generally, within the optimal range of activity in spring and summer. However, during the winter and autumn periods, this factor was not in the optimal range. The same trend was observed with the ectoparasites associated.

The effect of biweekly maximum temperature on the fluctuations of both *Rattus rattus frugivorous, Rattus norvegicus*, and their ectoparasites separately: -

As shown in Tables (1 to 4), the calculated "r" values were positively significant for the effect of this factor in the 1^{s}, and 3^{rd} periods for both of the rodent species at both years and it was positive or negative and insignificant during the 2^{nd} period. The partial regression on biweekly maximum temperature indicated that partial regression values were negative and insignificant in the 2^{nd} period for *R. rattus* and the 2^{nd} and 3^{rd} period 2018 for *R. norvegicus*. However, during the 1^{st} and 2^{nd} periods, the calculated values were positive and significant. Therefore, it could be concluded; however, that a drop in 1C° in the biweekly maximum temperature increased the average population of rodents from one count to another ranged from 0.011 to 1.54 rodents and was difrenat according to the period of activity and the species of rodent. The same trend was observed with ectoparasites.

The effect of biweekly minimum temperature on the fluctuations in the number of rodents and their ectoparasite: -

The tested weather factor was within the optimal range for rodent activity in the 2^{nd}, 3^{rd} periods. Statistically, the regression of any independent variable is due to a unit change in the independent factor. It was obvious that an increase of 1C° in the departures of biweekly mean minimum temperature caused an increase of +2.71 rodent and -0.31, and it ranged from positive and negative non significant effect for *Rattus rattus frugivorous, Rattus norvegicus* and total ectoparasite in the total population from count to another in the 1^{st} period, 2^{nd} , 3^{rd} and 5th periods respectively. The partial regression value was positive and highly significant only at the 4^{th} period during 2018 for *R. norvegicus* this means that an increase of 1C° in the biweekly mean minimum temperature caused significant an increase of rodents 2.71 and decrease - 0.31 rodents during the first period of activity of 2018 in the population from count to another for *R. rattus frugivorus*. The same results were observed for the total numbers of ectoparasites, their effect was not significant except the fourth period of activity of the ectopasite associated with *R. rattus* frugivorus.and only significant positive effect on the fifth period of activity 2018 for *R. norvegicus.*

The combined effect of the three weather factors on the activity periods of rodents and their ectoparasites

The combined effect of the three weather factors on the fluctuation of population activity of the two species of rodents was ranged from 78.9 to 98.03% and from 55.31 to 99.11% for *R. rattus frugivorous R. norvegicus* during the three periods of activity for the two species respectively through the two years of study. The simultaneous effect of the three tested weather factors on the fluctuation of population activity of rodents and their parasites were varied through periods of activity. The temperature and relative humidity were two key factors which influenced the seasonal fluctuation of rodents and ectoparasites.**(*Dietze, M., and Lynch, H.,* 2019).**

Table (1): Simple correlation cofficient (r) ± se between different factors of weather and the total number of *R. rattus frugivorus* with the partial regression (P), during (2017 and 2018 seasons).

year	Period	Date	Factor	Average	(r)	P	E. v
2017	1st	1\1 to 7\5	RH	67.77±15.73	-0.82 ± 0.2**	-0.088*	76.77%
			Max.	24.34±4.77	+0.85± 0.18**	+0.92ns	
			Min	8.42±2.58	+0.79 ± 0.21**	-+0.21ns	
	2nd	7\5 to 13\8	RH	42.5 ±8.93	+0.038±0.004 ns	-0.18ns	85.57%
			Max.	37.73±2.9	+0.56± 0.41ns	-0.7ns	
			Min	20.45±2.55	+0.64± 0.38ns	++1.4ns	
	3rd	13\8 to 31/12	RH	68.52±7.43	-0.57 ± 0.27ns	-+0.2**	81.85%
			Max.	28.77±6.35	+0.84± 0.18**	++0.8**	
			Min	14.06±6.53	+0.83 ± 0.18**	-0.49ns	
2018	1st	1\1 to 7\5	RH	66.31±12.21	-0.96±0.11***	-0.11***	99.11%
			Max.	25.07±3.74	+0.91±0.16**	+0.3ns	
			Min	9.28±0.08	+0.62±0.31ns	-0.31**	
	2nd	7\5 to 13\8	RH	47.96±5.9	-0.79±0.26*	-0.21*	67.30%
			Max.	36.7±1.66	-0.21±0.18ns	+0.16ns	
			Min	20.85±1.96	+0.3±0.42ns	-0.031ns	
	3rd	13\8 to 31/12	RH	67.06±0.09	-0.39±0.3ns	+0.005ns	55.31%
			Max.	28.96±6.95	+0.74±0.22**	+0.22*	
			Min	14.46±6.87	+0.56±0.27ns	+0.023ns	

Table (2): Simple correlation cofficient (r) ± se between different factors of weather and the total number of *R. norvegicus* with the partial regression (P), during (2017 and 2018 seasons).

year	Period	Date	Factor	Average	(r)	P	E. v
2017	1st	1\1 to 7\5	RH	67.77±15.7	-0.8 ± 0.2**	+0.11***	90.26%
			Max.	24.34±4.77	+0.86 ± 0.17**	+1.53*	
			Min	8.42±2.58	0.74± 0.23*	-0.72ns	
	2nd	7\5 to 30\7	RH	42.5 ±8.93	-0.48±0. 43 ns	0.28ns	96.25%
			Max.	37.73±2.9	+0.2±0. 48ns	-0.97ns	
			Min	20.45±2.55	+0.16±0.49ns	+1.69*	
	3rd	30\7 to 31/12	RH	68.52±7.43	-0.54 ± 0.28ns	-0.17***	85.72

			Max.	28.77±6.35	+0.89± 0.15***	+0.76**	
			Min	14.06±6.53	+0.88± 0.16***	-0.37ns	
2018	1st	1\1 to 7\5	RH	66.31±12.2	-0.87±0.19**	0.011***	98.003%
			Max.	25.07±3.74	+0.87±0.19**	+1.11ns	
			Min	9.28±0.08	+0.52±0.34ns	-0.73**	
	2nd	7\5 to 30\7	RH	47.96±5.9	-0.79±0.27*	-0.142**	98.86%
			Max.	36.7±1.66	-0.45±0.39ns	-0.51ns	
			Min	20.85±1.96	+0.54±0.37ns	+0.67**	
	3rd	30\7 to 31/12	RH	67.06±0.09	-0.38±0.3ns	+0.18ns	78.79%
			Max.	28.96±6.95	+0.77±0.21**	-0.85**	
			Min	14.46±6.87	+0.81±0.19**	+1.31*	

Table (3): Simple correlation (r) ± se between different factors of weather and the number of ecto-parasites *at R. rattus frugivorus* with the partial regression (P).

year	Period of activity	Date	Factor	Average	Simple correlation	Partial regression	Explained variance
2017	**1st**	**1/1 to 26\3**	**RH%**	76.14±9.18	-0.38±0.41ns	+0.16ns	**90.8%**
			Max.	21.72±2.69	+0.58±0.36ns	+2.56*	
			Min	5.86±2.18	+0.14±0.44ns	-1.93ns	
	2nd	**26\3 To 7\5**	**RH%**	48.25±6.62	+0.71±0.7ns	0.62ns	**99.1%**
			Max.	30.45±0.68	-0.71±0.7ns	-3.3ns	
			Min	14.9±1.37	-0.096±0.9ns	+3.6ns	
	3rd	**7\5 to 30\7**	**RH%**	42.58±8.96	-0.60±0.39ns	-0.87*	**95.31%**
			Max.	37.73±2.94	+0.25±0.48ns	-2.22ns	
			Min	20.45±2.55	+0.11±0.49ns	+4.16ns	
	4th	**13\8 to 31\12**	**RH%**	68.47±7.36	+0.44±0.26ns	-0.17*	**78.67%**
			Max.	28.77±6.35	+0.88±0.12ns	-1.27**	
			Min	14.4±6.17	+0.86±0.16**	-0.05ns	
2018	**1st**	**1/1 to 12\3**	**RH%**	73.11±9.88	-0.76±0.28	-0.32*	**86.03%**
			Max.	23.18±3.83	+0.84±0.24*	-0.9ns	
			Min	7.98±2.96	+0.91±0.17**	+1.11ns	
	2nd	**26\3 to 21\5**	**RH%**	49.66±6.21	-0.89±0.44ns	+0.21ns	**100%**
			Max.	30.2±3.06	+0.84±0.53ns	-1.1ns	
			Min	13.77±3.54	+0.96±0.26ns	+2.19ns	
	3rd	**21\5 to**	**RH%**	48.25±6.44	-0.64±0.38ns	-0.94*	**99.15**
			Max.	37.27±2.94	+0.98±0.09**	-4.7ns	

		30\7	**Min**	21.04±0.94	+0.85±0.25*	-1.82ns	
	4th	**30\7 to 31\12**	**RH%**	67.04±8.08	+0.61±0.26*	+0.004**	**96.07**
			Max.	28.96±6.95	+0.88±0.15**	-1.44***	
			Min.	**14.65±6.58**	**+0.95±0.1*** **	**+2.71*** **	

Table (4): Simple correlation (r) ± se between different factors of weather and total number of ecto-parasites *at* *Rattus norvegicus* with the partial regression (P), during (2017 and 2018 seasons).

year	Period of activity	Date	Factor	Average	Simple correlation	Partial regression	Explained variance
2017	1st	1/1 to 26\3	RH	76.14±9.18	+0.404±0.41ns	+0.173ns	78.4%
			Max.	21.72±2.69	+0.57±0.36ns	2.9ns+	
			Min	5.86±2.18	+0.18±0.44ns	-2.13ns	
	2nd	26\3to 21\5	RH	48.1±10.24	-0.91±0.24*	-0.82ns	95.71
			Max.	30.15±2.6	+0.89±0.25*	-0.16ns	
			Min	14.05±2.7	+0.93±0.20*	+3.1ns	
	3rd	21\5 to 30\7	RH	42.58±8.96	-0.93±0.17**	-0.44*	99.1%
			Max.	37.73±2.94	-0.20±0.40ns	-0.71ns	
			Min	20.45±2.55	-0.46±0.44ns	1.12ns	
	4th	30\7 to 8\10	RH	62.35±2.88	+0.24±0.56ns	-3.71ns	76.33
			Max.	35.46±1.83	-0.54±0.48ns	-18.5ns	
			Min	21.14±2.35	-0.32±0.54ns	+15.56ns	
	5th	8\10 to 31\12	RH	71.55±7.54	-0.26±0.43ns	+0.13*	98.55
			Max.	25.22±5.05	+0.86±0.22**	-0.89**	
			Min	10.18±4.42	+0.98±.08***	0.64*	
2018	1st	1/1 to 26\3	RH	73.11±9.88	-0.75±0.29ns	+1.02*	86.17%
			Max.	23.18±3.83	+0.83±0.24*	+3.6ns	
			Min	7.98±2.96	+0.86±0.22*	-0.53ns	
	2nd	26\3to 21\5	RH	49.66±6.21	-0.79±0.35ns	-0.53ns	97.23
			Max.	31.36±4.47	+0.58±0.47ns	-0.27ns	
			Min	14.21±2.76	+0.76±0.37ns	+3.3ns	
	3rd	21\5 to 30\7	RH	48.25±6.44	-0.13±0.49ns	+0.16ns	83.94%
			Max.	37.27±2.94	-0.82±0.25*	-2.79ns	
			Min	21.04±0.94	+0.74±0.33ns	-0.78ns	
	4th	30\7 to 8\10	RH%	60.3±2.98	+0.29±0.55ns	2.84ns	91.13
			Max.	35.86±2.12	-0.27±0.55ns	3.11ns	
			Min.	21.21±0.70	+0.40±0.52ns	3.46ns	
	5th	8\10 to 31\12	RH%	70.57±8.1	-0.13±0.44ns	-.08ns	94.26
			Max.	25.40±6.2	+0.95±0.13***	1.94**	
			Min.	10.43±5.41	+0.90±0.19**	-1.38ns	

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المخلص العربى

تأثير بعض العوامل المناخية على الوفره العدديه لنوعين من القوارض وطفيلياتها الخارجية المصاحبة لها في مزرعة الإنتاج الحيوانى فى شوشة محافظة المنيا.

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تعتبر القوارض والطفيليات الخارجية عليها هي احد المكونات الرئيسي للنظام البيئي المؤثرة في مزارع الانتاج الحيواني في مصر وجميع أنحاء العالم . ونظرا لان العوامل التي تؤثر علي تقلبات المجموع لهذه القوارض وطفيلياتها ووفرتها الموسمية لا تزال غير مفهومة فهما جيدا .لذلك قمنا بتحليل تقلبات المجموع لنوعين من القوارض والعوامل الجوية المؤثرة علي تقلبات المجموع في فترات النشاط المختلفة لكل من القوارض والطفيليات المرتبطة بكل نوع في مزرعة انتاج حيواني بمنطقة شوشا بمحافظة المنيا خلال موسمي 2017 و 2018.

وعند تحليل التقلبات الموسمية خلال فترات نشاط لكلا من الجرذ المتسلق ذو البطن البيضاء والجرذ النرويجى والطفيليات الخارجية المرتبطة بكليهما مع ثلاثة عوامل جوية وهي: متوسط الحد الأقصى لدرجة الحرارة كل أسبوعين، ومتوسط الحد الأدنى لدرجة الحرارة كل أسبوعين بالإضافة إلى متوسط الرطوبة النسبية كل أسبوعين كعوامل هامة ومؤثرة علي نشاط القوارض والطفيليات الخارجية المرتبطة بها. وأظهرت النتائج أن تقلبات عوامل الطقس كل أسبوعين لها تأثير فعال في نشاط كل من القوارض والطفيليات الخارجية المرتبطة بها. وقد تم تحديد التأثير الأولي لكل عامل جوي منفردا عن طريق الارتباط البسيط "r". ثم تحديد التأثير المتزامن لكل عامل في وجود العوامل الأخرى والتأثير المشترك للعوامل الجوية الثلاثة من خلال تحليل الانحدار المركب "C- multiplyers". وأشارت النتائج إلى أن كلا النوعين من القوارض كان لهما ثلاث فترات نشاط في موسمي الدراسة وأربع وخمس فترات نشاط للطفيليات الخارجية على *R. rattus frugivorous* و *R. norvegicus*. لوحظ من خلال دراسة التغيرات في مجموع اعداد القوارض كل اسبوعين كان اعلي تغير في أعداد القوارض في تاريخ 12 مارس و 10 سبتمبر للنوعين على التوالي. وان هناك علاقة ارتباط موجبة اوسالبة معنوية بين الظروف المناخية وتقلبات المجموع للقوارض والطفيليات الخارجية تعتمد على فترة النشاط المدروسة. تراوح التأثير المشترك للعوامل المناخية الثلاثة على تقلبات المجموع لنوعي القوارض من 78.9 إلى 98.03٪ ومن 55.31 إلى 99.11٪ لكل من *R. norvegicus* *R. rattus frugivorous* خلال عامي الدراسة. كما اختلف التأثير المتزامن لعوامل المناخ المدروسة على تقلبات نشاط المجموع في فترات النشاط المختلفة للقوارض وطفيلياتها. كانت درجة الحرارة والرطوبة النسبية من العوامل الرئيسية التي أثرت سلبا وايجابا على التقلبات الموسمية للقوارض والطفيليات الخارجية.