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INFLUENCE OF TEMPERATURE ON DEVELOPMENTAL STAGES AND LIFE TABLE PARAMETERS OF THE PREDATORY MITE *Neoseiulus neoreticulatus* Yousef AND El-Brollosy (ACARINA: PHYTOSEIIDAE).

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ABSTRACT

The influence of different degrees of temperature 15, 20, 25, 30 & 35°C and 70±5% R.H. was investigated on the developmental stages, fecundity, feeding capacity and life table parameters of the predatory mite *Neoseiulus neoreticulatus* Yousef & El-Brollosy when fed on immature stages of the spider mite *Tetranychus urticae* Koch under laboratory conditions. The obtained data revealed that the higher temperature degree the shorter period of different stages.

Female and male longevity decreased when temperature increased from 15-35°C, whereas female longevity amounted 52.6, 30.8, 18.4, 12.3 and 9.4 days at 15, 20, 25, 30 and 35°C respectively.

It could be concluded that life table parameters affected by temperature degrees, whereas, 30°C gave the highest, net reproductive rate (Ro), survival rate and rm values as 25.8, 0.90 and 0.27 respectively.

INTRODUCTION

The wide spread of phytoseiid mites attracted the attention of some authors to investigate the effect of temperature and food type on its biology efficiency, fecundity and life table parameters (Yousef *et al.* 1984); Xin *et al.* (1984); Kandeal *et al.* (1994); Kim *et al.* (1996) and Abd-Allah (2004).

The predacious mite *Neoseiulus neoreticulatus* Yousef & El-Borollosy recorded in association with phytophagous mites and various immature stages of sucking pests on cotton plants in Beni-Suef governorate during season 2004.

The present work was aim to throw light on the effect of five degrees of temperature on biological developmental stages, fecundity, feeding capacity and life table parameters of the predatory mite *N. neoreticulatus* under laboratory conditions.

MATERIALS AND METHODS

Biological studies on the predatory mite *Neoseiulus neoreticulatus* Yousef & El- Brollosy:

- Rearing Method:

The predator mite *N. neoreticulatus* culture was established by placing a copulated female together with suitable prey (*T. urticae* immatures) on a mulberry leaf disc situated upside down on moist cotton pad in petri-dishes (10 cm in daimeter) where suitable moisture was daily supplied to keep leaf discs fresh for longer time. The edges of the leaf disc were also lined with a wet cotton as barrierand the female left to deposite eggs leaves were changed by fresh ones when needed (4-6 days) and the culture were kept in room temperature. After hatching, larvae were fed on the suitable prey (*T. urticae* immatures) and kept to develop and adults to reproduce. When mite

number increased, resultant females were spread on other mulberry leave discs in Petri-dishes for maintaining the culture.

For studying the effect of different temperatures as the predatory mite, newly deposited predator eggs were transferred singly each to a mulberry leaf disc and kept under tested temperatures i.e 15°C, 25°C, 30°C and 35°C. Each hatched larva was supplied with a known number of fresh *T. urticae* immature. The number of consumed prey individuals were counted daily and replaced with fresh ones till reaching maturity. Emerged females were copulated and kept for oviposition under the previous tested temperatures.

Data were noticed for the whole life span, where observations were noted twice daily. Each tested temperature were started with not less than 30 newly hatched larvae.

Life table parameter:

During developmental periods moralities of different stages and sex of the progeny was determined. Oviposition by resultant females were recorded daily for each female.

Life table parameters were estimated using the BASIC computer program (Abu-Setta *et al..*, 1986) parameters were determined by the following formula where :

$$\sum_{0}^{max} e^{-rmx}\ lx\, mx\, dx = 1$$

L = Number of females alive
M= Total progeny at each interval for all females.
X = Actual female age
M_x = Female progeny / female
L_x= Rate of survival (survivorship)
R_o= The net reproduction rate.
T = The mean genaration time
R_m = Interinsic rate of natural increase
E^{rm} = Finite rate of increase.

RESULTS AND DISCUSSION

Both sexes of *N. neoreticulatus* pass through egg, larva, protonymph, deutonymph and adult stage.

Obtained results in table (1) showed that temperature had an obviously effect on incubation period of *N. neoreticulatus*. As temperature ranged from 15 to 35°C, this period changed from 8.6 to 2.0 days, for female and from 8.6 to 2.5 days for male.

The statistical analysis showed that temperature negatively affected larval, protonymphal and deutonymphal stages, whereas, data revealed that the higher temperature degree the shorter period of immature stages (table 1).

Thus, female life cycle averaged, in descending order, 26.1, 13.8, 8.5, 6.9 and 5.2 days at 15, 20, 25, 30 and 35°C respectively. Table (1) showed that these results confirmed with that obtained by Kim *et al.* (1996) and El-Laithy and El-Sawi (1998).

Table (1): Duration of different stages of *Neoseiulus neoreticulatus* female fed on *T. urticae* Koch immature at different temperatures.

Temp.	Incubation period	Larval stages	Proto-nymphal stages	Deuto-nymphal stages	Total Immature stages	Life cycle	Longevity	Life span
15°C	8.6±1.5	5.3±0.9	6.8±0.5	5.5±0.4	17.5±2.1	26.1±2.0	52.6±8.1	78.7±8.5
20°C	5.1±0.8	2.7±0.3	3.3±1.0	2.8±0.5	8.7±0.6	13.8±1.0	30.8±5.3	44.6±5.6
25°C	3.0±0.4	1.6±0.4	2.0±0.7	1.9±0.3	5.5±0.5	8.5±0.8	18.4±3.3	26.9±3.0
30°C	2.5±0.4	1.4±0.6	1.6±0.7	1.4±0.3	4.4±0.7	6.9±0.8	12.3±8.5	19.1±8.7
35°C	2.0±0.4	0.9±0.3	1.2±0.3	1.1±0.2	3.2±0.5	5.2±0.7	9.4±4.8	14.6±6.2
L.S.D$_{0.05}$	0.7	0.5	0.5	0.4	1.0	1.5	4.8	5.2

Female longevity decreased when temperature increased from 15-35°C, while, non significant between 30 and 35°C, female longevity lasted 52.6, 30.8, 18.4, 12.3 and 9.4 days at the above mentioned degrees of temperature (table 2).

Similar occurred with trend male adulthood as that obtained with female but having shorter periods table (3).

Table (2): Adult female longevity and fecundity of *Neoseiulus neoreticulatus* fed on *T. urticae* Koch immature at different temperatures.

Temp.	Average period (in days)				No. of eggs/female	
	Pre-Oviposition period	Oviposition Period	Post-Oviposition period	Longevity	Total average	Daily life
15°C	6.2±1.4	40.7±8.0	5.7±1.0	52.6±8.1	10.4±3.2	0.26
20°C	2.9±0.5	25.6±5.4	2.3±0.5	30.8±5.3	18.5±6.0	0.72
25°C	2.0±0.3	14.6±3.6	1.8±0.4	18.4±4.3	28.4±8.5	1.94
30°C	1.3±0.4	10.0±7.5	1.0±0.5	12.3±8.5	41.6±9.1	4.16
35°C	0.8±0.2	7.8±3.9	0.8±0.3	9.4±4.8	29.0±7.2	3.71
L.S.D$_{0.05}$	0.5	2.4	0.3	4.8	6.4	

Table (3): Duration of different stages of *Neoseiulus neoreticulatus* male fed on *T. urticae* immature at different temperatures.

Temp.	Incubation period	Larval stages	Proto-nymphal stages	Deuto-nymphal Stages	Total Immature stages	Life cycle	Longevity	Life span
15°C	8.5±1.0	5.2±0.3	6.5±0.8	5.1±0.9	16.8±0.3	25.3±1.2	44.3±7.4	69.6±7.0
20°C	5.0±0.5	2.3±0.4	2.6±0.2	2.2±0.6	7.1±0.7	12.1±1.0	26.1±4.8	38.2±4.0
25°C	2.8±0.4	1.4±0.2	1.9±0.3	1.4±0.2	4.6±0.5	7.4±1.6	14.0±2.2	21.4±2.4
30°C	2.4±0.4	1.1±0.2	1.4±0.6	1.2±0.4	3.7±0.4	6.1±0.6	9.0±2.0	15.1±2.1
35°C	2.0±0.6	0.9±0.2	1.2±0.4	0.9±0.2	3.0±0.3	5.0±0.7	7.0±2.6	12.0±1.0
L.S.D$_{0.05}$	0.6	0.4	0.4	0.3	0.6	0.9	4.0	3.7

Female oviposition period and fecundity were affected by temperature degrees, whereas the oviposition period averaged between 40.7 and 7.8 days at 15 and 35°C and deposited 10.4 and 29.0 eggs with a daily rate of 0.26 and 3.71 eggs respectivly.

Feeding capacity, data presented in tables (4 & 5) revealed that temperature significantly effected on *N. neoreticulatus* consumption of immature stages of *T. urticae* as the most suitable preys.

Table (4): Food consumption of *N. neoreticulatus* female during its life span fed on *T. urticae* immature at different temperatures.

Stages	No. of devoured prey immature										L.S.D at 0.05
	15°C		20°C		25°C		30°C		35°C		
	Total	Daily rate	Total	Daily rate	Total	Daily rate	Total	Daily rate	Total	Daily rate	
Larvae	--	--	--	--	--	--	--	--	--	--	--
Protonymph	5.0±1.2	0.7	5.9±1.4	1.8	8.2±1.7	4.1	11.9±1.9	7.4	8.0±1.3	6.7	1.3
Deutonymph	3.8±0.6	0.7	5.6±1.3	2.0	7.9±2.1	4.2	10.4±2.5	7 4	7.5±2.1	6.8	1.2
Total immature	8.8±1.8	0.5	11.5±1.7	1.3	16.1±3.7	2.9	22.3±3.5	5.1	15.5±3.0	4.8	2.1
Pre-oviposition	4.0±1.3	0.6	5.2±1.2	1.8	5.7±1.6	2.9	9.0±1.7	6.9	6.0±1.8	7.5	2.3
Oviposition	50.4±5.0	1.2	69.3±10.1	2.7	120.0±14.5	8.2	167.0±30.0	16.7	106.0±13.0	13.5	18.0
Post-oviposition	3.9±0.7	0.7	4.0±1.0	2.3	6.0±1.0	3.3	8.0±2.8	8.0	5.0±1.8	6.2	1.5
Longevity	58.3±7.8	1.1	78.5±5.4	2.5	131.7±14.2	7.1	184.0±38.0	15.0	117.0±14.3	12.4	18.2
Life span	67.1±7.1	0.9	90.0±10.4	2.0	147.8±15.5	5.5	206.3±37.5	10.8	132.5±13.8	9.0	18.7

Table (5): Food consumption of *N. neoreticulatus* male during its life span fed on *T. urticae* immature at different temperatures.

Stages	No. of devoured prey immature										L.S.D at 0.05
	15°C		20°C		25°C		30°C		35°C		
	Total	Daily rate	Total	Daily rate	Total	Daily rate	Total	Daily rate	Total	Daily rate	
Larvae	--	--	--	--	--	--	--	--	--	--	--
Protonymph	3.2±1.0	0.5	3.7±1.1	1.4	4.2±1.2	2.2	8.0±1.5	5.7	5.0±0.9	4.1	1.4
Deutonymph	2.0±0.6	0.4	3.0±1.0	1.4	4.0±1.0	2.9	6.7±1.3	5.6	4.0±1.0	4.4	1.0
Total immature	5.2±1.3	0.3	6.7±1.3	0.9	8.0±1.5	1.7	14.7±2.0	4.0	9.0±1.8	3.0	1.6
Longevity	33.5±5.5	0.8	41.4±5.0	1.6	74.1±8.5	5.3	85.0±10.3	9.4	50.0±7.2	7.1	11.6
Life span	38.7±5.1	0.6	48.1±6.1	1.3	82.3±10.6	3.8	99.7±13.2	6.6	59.0±10.1	4.9	12.1

During oviposition period, female was at its highest efficiency as it consumed 50.4, 69.3, 120.0, 167.0 and 106.0 individuals, with a daily rate of 1.2, 2.7, 8.2, 16.7 and 13.5 prey at the previous tested degrrs of temperatures respectively.(Table 4). These results coincided with that obtained by Easterbrook *et al.*.(2001).

Male followed the same trend as that of female, but it consumed in smaller numbers table (5). Thus, 30°C was the suitable degree of temperature, where the female laid the highest number of eggs and consumed the large number of spider mites.

Life table parameters:-

Obtained data in table (6) and Figs (1-5) showed that the net-reproduction rate (Ro) differed according to temperature as this values increased with increasing of temperature till reaching 30°C then began to decrease at 35°C. The highest (Ro) value 25.8 was obtained when the individual reared on 30°C, while the lowest value of (Ro) 3.93 was obtained on the lowest degree (15°C). Mean generation time (T) were varied much between the temperature degrees, this values averaged 49.5, 26.14, 15.44, 12.06 and 8.9 days; the intrinsic rate of natural increase (R_m) was 0.027, 0.10, 0.17, 0.27 and 0.21 individuals/female/day; a finite rate of natural increase (e^{rm}.) was 1.02, 1.08, 1.18, 1.30 and 1.30; the sex ratio (females/ total) was 0.57, 0.61, 0.64, 0.69 and 0.71; the generation time (G) was 32.3, 16.7, 10.4, 8.2 and 6.0 days at 15, 20, 25, 30 and temperature °C, respectively, when *N. neoreticulatus* fed on immature of *T. urticae* (Table, 6). The survival rate differed according to 35°C. Thus, this averaged 0.663, 0.70, 0.767, 0.90 and 0.80 when the mite species reared on the same previously mentioned temperature respectively.

Thus, it could be concluded that according to different life table parameters, temperature degree 30°C gave the highest, net reproductive rate (Ro); survival rate and rm values as 25.8; 0.40 and 0.27, respectively for the predator *N. neoreticulatus*. The obtained data curves of survival rate (Lx) and expected female progeny/female/day (Mx) are illustrated at Figs. (1-5). These results coincided with that obtained by Kim *et al.*. (1996); El-Laithy & El-Sawi (1998) and Abd-Allah (2004).

Table (6): Effect of temperature on life table parameters of *N. neoreticulatus* when fed on *T. urticae* immature.

Life Table Parameters	Temperatures				
	15°C	20°C	25°C	30°C	35°C
The net reproduction (R_o)	3.93	7.89	13.94	25.8	16.30
The mean generation time (T)	49.5	26.14	15.44	12.06	8.9
The intrinsic rate of natural increase (R_m)	0.027	0.10	0.17	0.27	0.21
The finite rate of increase (e^{rm})	1.02	1.08	1.18	1.30	1.30
The sex ratio (females/total)	0.57	0.61	0.64	0.69	0.71
The generation time (G)	32.3	16.7	10.4	8.2	6.0
Survival rate (Lx)	0.663	0.70	0.767	0.90	0.80

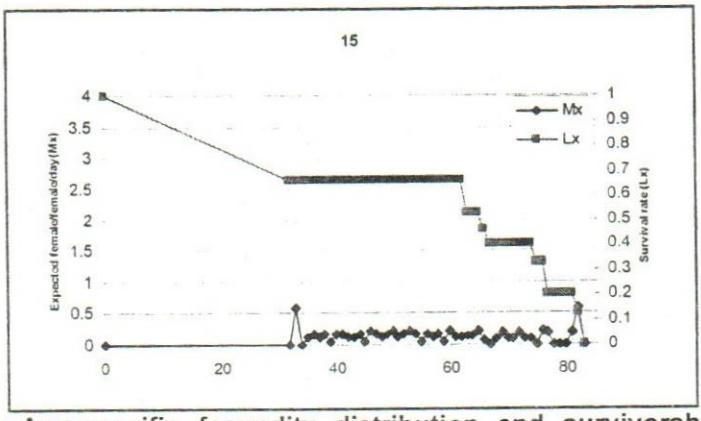

Fig. (1): Age-specific fecundity distribution and survivorship of *N. neoreticulatus* at 15°C.

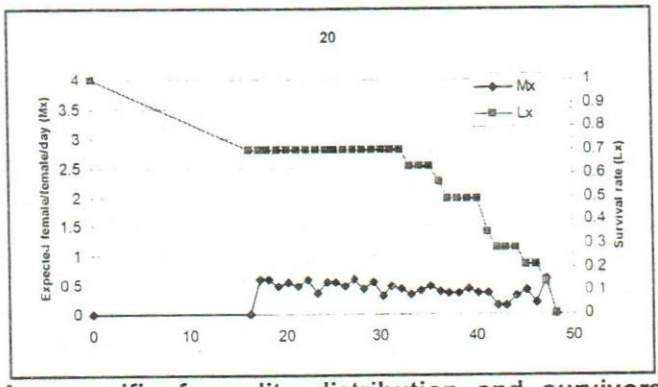

Fig. (2): Age-specific fecundity distribution and survivorship of *N. neoreticulatus* at 20°C.

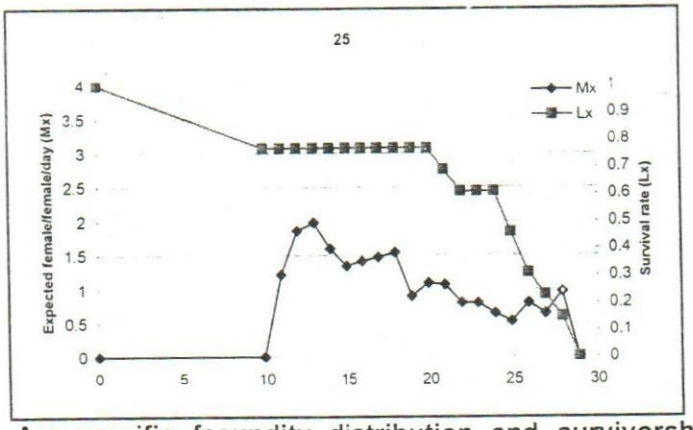

Fig. (3): Age-specific fecundity distribution and survivorship of *N. neoreticulatus* at 25°C.

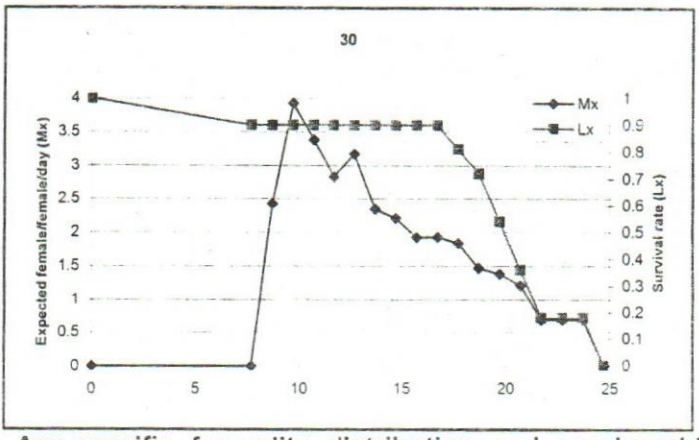

Fig. (4): Age-specific fecundity distribution and survivorship of *N. neoreticulatus* at 30°C.

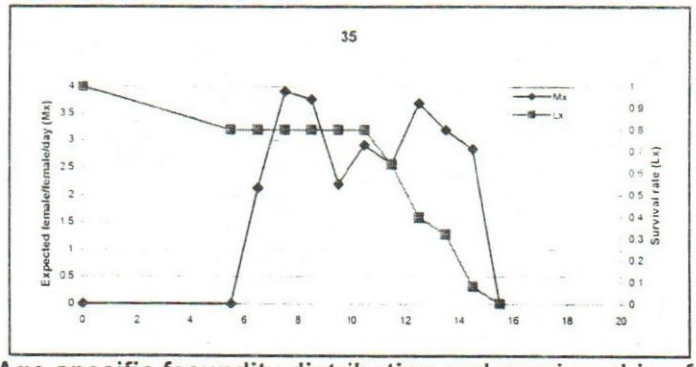

Fig. (5): Age-specific fecundity distribution and survivorship of *N. neoreticulatus* at 35°C.

REFERENCES

Abd-Allah, A.S.S. (2004): Biological studies and mass rearing of predacious mite. M.Sc. Thesis Fac., Agric., Al-Azhar univ. Cairo, 64 pp.

Abou-Setta, M.M.; Sorrell, R.W. and Childers, C.C. (1986): Life 48 a BASIC computer program to calculate life table parameters for an insect or mite species. Fla: Ent., 69 : 690-697.

Easterbrook, M.A.; Fitzaerald, D. and Solomon, M.G. (2001): Biological control of strawberry tarsonemid mite *Phystonemus pallidus* and two-spotted spider mite *Tetranychus urticae* on strawberry in the U.K. using species of *Neoseiulus californicus* (Acari: Phytoseiidae). Exp. Appl. Acarol. 25 : 25-36.

El-Laithy, A.Y.M. and El-Sawi, S.A. (1998): Biology and life table parameter of the predatory mite *Neoseiulus californius* fed on different diet. Z.Pflkrankh, Pflschutz, 105: 532-537.

Kandal, M.M.; El-Zohairy, M.M.; Amir, M.I. and Ibrahim, N.A. (1994): Biological study on the predatory mite Amblyseius swirskii Athias hennoit on two insect preys. Egypt. J. Appl. Sci. 9 (5): 581-592.

Kim, D.L.; Lee, S.C. and Kin, S.S. (1996): Biological characteristics of *Amblyseus womersleyi* Schicha (Acarina: Phytoseiidae) as a predator of *Tetranychus kanzawai* Kishida (Acarina: tetranychidae) Korean, J. Appl. Ent., 35 : 38-44.

Yousef, A.A.; Metwally, A.M.; Abou-El-Naga and Taha, H.A. (1984): Effect of different prey on the development and fecundity of the predator mite *Amblyseius cydnodactylon* Shehata & Zaher (Acarina: Phytoseiidae). Agric. Res. Rev. 62 (1): 329-336.

Xin, J.L.; Liang, L.R. and Ke, L.S. (1984): Biology and utilization of *Amblyseius pseudolongispinosus* (Acarina: Phytosediidae) in china pp. 693-698. In: D.A. Griffiths and C.E. Bowman (eds.) Acarology VI. Ellis Horwood, Chichester, U.K.

تأثير درجات الحرارة على تطور وجداول الحياة للحلم المفترس نيوسيلس نيوريتكيولتس التابع لعائلة فيتوسيدى

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تم تربية هذا ا لنوع على خمس درجات حرارة ١٥، ٢٠، ٢٥، ٣٠، ٣٥ و رطوبة نسبة ٧٠±٥% و تغذيته على الأطوار الغير كاملة لحلم العنكبوت الأحمر العادى (النوع الأخضر) لمعرفة تأثير درجات الحرارة على تطور وخصوبة الحيوان والكفاءة الأفتراسية وكذلك معدل الزيادة الموروث للأنثى (rm) ومعدل تكرارها لنفسها (Ro) وكانت النتائج كالأتى :

- فى حالة ا لتربية على درجة الحرارة ١٥°م كان متوسط فترة دورة الحياة للأنثى ، وفترة حياة الطور البالغ لها ومتوسط وضع البيض ٢٦,١، ٥٢,٦ يوما و ١٠,٤ بيضة على الترتيب، وفى حالة التربية على درجة حرارة ٣٥ °م كان متوسطات فترة دورة حياة الأنثى وفترة حياة الطور البالغ لها ومتوسط وضع البيض ٥,٢ ، ٩,٤ يوما و ٢٩ بيضة على الترتيب بينما أوضحت الدراسة أن ٣٠°م هى أنسب درجة لتربية هذا النوع عند إكثاره لإستخدامه فى المكافحة البيولوجية حيث أعطت متوسط فترة دورة حياة الأنثى و فترة حياة الطور البالغ لها ومتوسط وضع البيض ٦,٩ ، ١٢,٣ يوما و٤١,٦ بيضة على ا لترتيب.
- بلغ متوسط ما تفترسه الأنثى خلال ا لطور الكامل على درجات الحرارة ١٥، ٢٠ ، ٢٥، ٣٠ ، ٣٥°م هى ٥٨,٣ ، ٦٨,٥ ، ١٣١,٧ ، ١٨٤ ، ١١٧ فردا من العنكبوت الأحمر العادى على الترتيب.
- مقاييس جداول الحياة تبرهن على أن درجة ٣٠°م هى أنسب درجة حرارة حيث أعطت أعلى معدل للزيادة الموروثة (rm) ٠,٢٧ على درجة ٣٠°م بينما كانت الـ (rm) ٠,١٧ و ٠,٢١ على درجتى ٢٥ و ٣٥°م على الترتيب. أعطت التربية على درجة حرارة ٣٠°م أعلى معدل لتكرار الأنثى لنفسها (Ro) ٢٥,٨ على درجة حرارة ٣٠°م بينما كانت الـ (Ro) ١٣,٩ و ١٦,٣ على درجتى ٢٥ و ٣٥°م على الترتيب.