

STUDY ON SUBTERRANEAN TERMITE SUSCEPTIBILITY AFFECTED BY CONSTANT AND VARIABLE TEMPERATURES UNDER LABORATORY CONDITIONS

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Abstract

The work has been conducted to study staying possibility and maintenance of Egyptian subterranean termite *Anacanthotermes ochraceus* and *Ametermes desertorum*, under laboratory conditions for research purposes under constant and variable temperatures (thermo-rhythm), in addition to study the termite susceptibility variable under the tested temperatures degrees. Data obtained revealed that, the constant temperature 25C° was the most favorable for termite survival and food consumption, followed by the temperature 30C°, but, when using of variable temperatures (thermo-rhythm), data obtained showed that, the temperature 25-30C° were the most favorable relatively for termite activities (termite life and food consumption). Under conditions, the constant temperature 25C° and the variable temperature 25-30C°, survival and food consumption recorded highly rates and the examined termites were lived more than 6th week. In addition to, the survival rates for all treatments were decreased gradually from 1st week to 6th week and vice versa, in case consumption rates. in comparison between the two tested subterranean termites, data showed that, the termite *A. ochraceus*, was the highly endurance, more than, *A. desertorum*, for life activities under the examined conditions. Throughout the data the using of thermo-rhythm around 25-30C° are the favorable condition for termite when the staying and maintenance of termite are desired.

INTRODUCTION

The Egyptian subterranean termites *Psammotermes hypostoma* (Desn.), *Anacanthotermes ochraceus* (Borm.) and *Ametermes desertorum* (Desn.) belong to families (Rhinotermitidae, Hodotermitidae and Termitidae respectively), are live in conditioned tunnels underground and able to adapted in different soil types. However the termites are very susceptible to the variable conditions and for obtaining on accurate results of laboratory researches, the termite must be live under optimal conditions. The temperature is very important and determining factor on survival and food consumption of termite. Many attempts were made to study the effect of temperature on the termite surviving, such as, Pence (1956), Sen-Sarma (1964), Mishar & Singh (1978), Morsy & Khalil (1982), and El-Bassiouny (2001), who studied the effect of soil temperature on the termite activity in the field.

The present work was conducted to study the effect of constant and variable temperature (thermo-rhythm) on survival and food consumption of subterranean termite *A. ochraceus* and *A. desertorum* under laboratory conditions, in addition to studying of the two subterranean termite susceptibility under the tested temperatures degrees.

MATERIALS AND METHODS

Termite collection for all castes of the Harvester termite *A. ochraceus* were collected by hand from a house in Sangha village, Kafr Sakr, El-Sharquia Governorate, while *A. desertorum* castes were collected from palm trees farm located in Mut village, at New valley Governorate, by using El-Sebay modified trap (El-Sebay 1991), which used in termite catching. The caught termites were separated from the trap by small brush and maintained good for one week in plastic case contained soil and moistened carton corrugated card-board for screening and using healthy termites. The healthy workers were used directly in the treatments.

The living condition and materials of termites included sterilized Petri-dishes (9.5cm in diameter ×1.5cm in height), filled with 20gm sterilized sand by electric oven at 105C° for 24 hours to eliminate the microorganisms, spores and vegetative stages and a weighed piece of corrugated card-board was dried in electric oven at 105C° for 24 hours to weight fixing and then, the card-board was moisten with distilled water and placed into the sand. 25 healthy workers of termites were liberated to each treatment. Each treatment was replicated four times and placed in incubator at the tested temperature.

The tested thermo-rhythm choosing were selected according to Morsy and Khalil (1982), they used the same examined temperatures on subterranean termite *P. hypostoma*. Six and eight degrees of temperature were chosen in the present study for each constant and variable temperatures respectively, and heating-cooling incubators were used at 10, 15, 20, 25, 30 and 35C° for constant temperatures which were chosen in the normal rang of termite tolerance, while the variable regime are represented 10-15, 10-20, 15-20, 15-25, 20-25, 20-30, 25-30 and 25-35C°. which were changed every 12 hours for every tested temperature by changing of incubator temperature degree on the lower regime degree in the night and upper regime degree in the daytime. Tested termites were observed daily at 12 hours and the data were taken weekly for constant and variable temperatures. The data of surviving termites were recorded until they were dead, while the data of food consumption rate (weight loss in used card-board), were recorded after drying of card-board and reweighed.

The effect of constant and variable temperatures on survival and food consumption of tested subterranean termite were subjected to analysis of variance ANOVA and the means were compared by L.S.D. test at 0.05 level, using SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

1. Effect of constant and variable temperatures on the harvester termite *A. ochraceus*

a. The effect of constant temperatures

Data in table (1), illustrated in fig. (1), showed that, the action of constant temperatures on survival and food consumption of harvester termite *A. ochraceus*, calculated (zero) for the two tested factors at 10 C° but at 15C° constant temperatures calculated (3 and 0.58gm) in 1st week and then data obtained (zero) in the 2nd week for two tested factors. At 20C°, data resulted (13.50 and 0.97gm) in the first week, reached gradually to (0.75 and 1.37gm) in the 4th week for termite survival and food consumption respectively. At 25C°, data resulted (25 and 1.3gm) in the 1st week, to reach (21.25 and 1.90gm) in the 4th week of the two tested factors, and termite lived continued passing the 6th week, and considered the optimum constant temperature for termite survival and food consumption. The constant temperature 30C°, come in the 2nd rank, resulted (23.50 and 0.97gm) in the 1st week, to reach (5 and 2.20gm) in the 5th week, and termite lived continued passing the 6th week. At 35C°, data resulted (18.25 and 0.67gm) in the 1st week, to reach (5.75 and 1.20gm) in the 3rd week for tested factors respectively.

b. The effect of variable temperatures

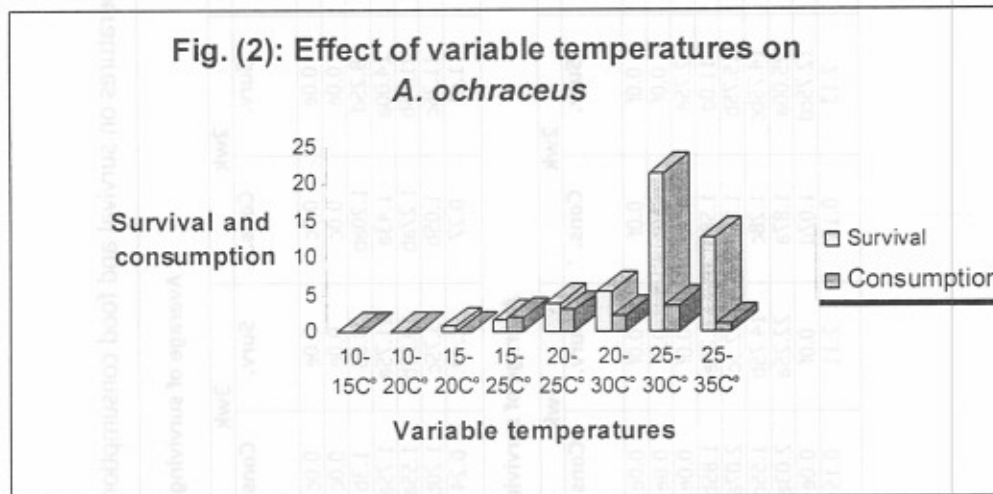
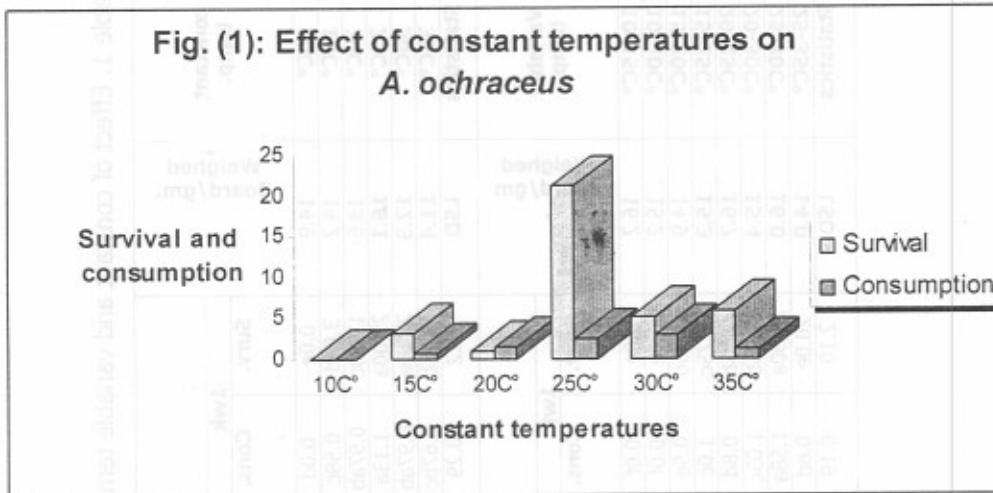
In table (1), and fig. (2), data clarified that, the efficacy of variable temperatures on survival and food consumption of harvester termite *A. ochraceus*, and data recorded (zero) at 10-15 and 10-20C° variable temperatures, in 1st week. At 15-20C°, data recorded (10.75 and 0.5gm) and (2.75 and 0.7gm) in the 1st and 2nd week for two tested factors respectively, while at 15-25C°, data recorded (17.75 and 1.0gm) in the 1st week, to reach (1.75 and 1.92gm) in the 4th week. At 20-25C°, data calculated (22.25 and 0.8gm) in the 1st week and reached gradually to (3.75 and 2.73gm) in 5th week. The effect of thermo-rhythm 20-30C°, data gave (20.25 and 1.5gm) to reach (5.50 and 2.0gm) in the 5th week for survival and food consumption

respectively. The optimum variable temperatures for the two tested factors were 25-30C°, resulted (25 and 1.58gm) in the 1st week, to reach (21.25 and 2.65gm) in the 4th week. At the rhythm 25-35C°, data resulted (20 and 0.8gm) in the 1st week, and reached gradually to (12.75 and 1.07gm) in the 2nd week, for termite survival and food consumption respectively. Under the thermo-rhythm 20 and 30C°, limits, around 15-85% at the lower and higher respectively, the tested workers were lived continues more than 6 weeks.

Becker (1970) mentioned that, the optimum temperature for termite life may be different according to the optimum temperature for feeding activity, and the suitable temperature for most termite species was 26C°.

Table 1. Effect of constant and variable temperatures on survival and food consumption of harvester termite *A. ochraceus*.

constant temp.	Weighed Board/gm.	Average of surviving and food consumption/gm											
		1wk		2wk		3wk		4wk		5wk		6wk	
		Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.
10C°	14.9	0.0e	0.0d	0.0e	0.0c	0.0e	0.0c	0.0c	0.0c	0.0c	0.0b	0.0c	0.0b
15C°	14.2	3.00d	0.58c	0.0e	0.0c	0.0e	0.0c	0.0c	0.0c	0.0c	0.0b	0.0c	0.0b
20C°	13.6	13.50c	0.97ab	8.25d	1.20ab	3.0d	1.3b	0.75c	1.37b	0.0c	0.0b	0.0c	0.0b
25C°	16.1	25.00a	1.13a	24.00a	1.43a	21.75a	1.75a	21.25a	1.90a	21.25a	2.30a	21.25a	2.80a
30C°	12.3	23.50a	0.97ab	21.75b	1.27ab	19.25b	1.55a	9.75b	1.75a	5.00a	2.20a	5.00b	2.75a
35C°	11.4	18.25b	0.67bc	11.25c	1.05b	5.75c	1.20b	0.0c	0.0c	0.0c	0.0b	0.0c	0.0b
Statistics	LSD	2.12	0.29	1.41	0.27	1.49	0.24	1.12	0.24	1.15	0.25	1.14	0.27
Variable temp.	Weighed Board/gm	Average of surviving and food consumption											
		1wk		2wk		3wk		4wk		5wk		6wk	
		Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.
10-15C°	16.2	0.0e	0.0f	0.0f	0.0f	0.0f	0.0e	0.0d	0.0c	0.0d	0.0d	0.0d	0.0d
10-20C°	15.2	0.0e	0.0f	0.0f	0.0f	0.0f	0.0e	0.0d	0.0c	0.0d	0.0d	0.0d	0.0d
15-20C°	14.9	10.75d	0.5e	2.75e	0.7e	0.0f	0.0e	0.0d	0.0c	0.0d	0.0d	0.0d	0.0d
15-25C°	15.3	17.75c	1.0c	11.0d	1.58b	6.75e	1.85b	1.75d	1.92b	0.0d	0.0d	0.0d	0.0d
20-25C°	16.7	22.25b	0.8d	15.75b	1.80a	12.5c	2.07a	6.75c	2.53a	3.75c	2.73b	3.75c	2.85b
20-30C°	15.4	20.25b	1.05c	14.75bc	1.28c	14.75b	1.55c	10.75b	1.77b	5.50b	2.00c	5.50b	2.23c
25-30C°	16.0	25.00a	1.58a	25.00a	1.87a	22.25a	2.03a	21.25a	2.65a	21.25a	3.00a	21.50a	3.58a
25-35C°	14.0	20.0e	0.8d	12.75cd	1.07d	0.0f	0.0e	0.0d	0.0c	0.0d	0.0d	0.0d	0.0d
Statistics	LSD	2.10	0.19	2.13	0.15	2.11	0.15	2.04	0.17	1.21	0.23	1.21	0.28



Morsy and Khalil (1982), studied, the effect of constant and variable temperature on survival and food consumption of sand termite *P. hypostoma* Desneux, under laboratory conditions and reported that, the living period of the tested workers was very low when they were maintained under the low or high constant temperature, and the most favorable constant temperature for surviving was around 30C°, whereas it was around 25C°, for food consumption and the thermo-rhythm of variable temperature with 20 and 30C°, limits under which 25% of sand termite *P. hypostoma* workers lived more than 6 weeks was the best for survival, while under the rhythm of 17 and 30C°, workers consumed the largest amount of food.

Statistical analysis in Table (1) show that, the LSD show highly significant differences between the constant and variable temperature degrees on survival and food consumption of termite *A. ochraceus*, and the rank on data, clarified that the optimum degrees were 25-30C°, for survival and food consumption.

2. Effect of constant and variable temperatures on the sand termite *A. desertorum*

a. The effect of constant temperatures

Data in table (2), illustrated in fig. (3), clarified that, the action of constant temperatures 10 and 15C° on termite *A. desertorum*, calculated (zero). It was (2.5 and 0.2gm) at 20C° in the 1st week for two tested factors, while at 25C° constant temperature calculated (22 and 1.05gm) in 1st week and to reach (1.0 and 1.14gm) in the 4th week and then, data recorded (zero), for two tested factors, it considered the best constant temperature for termite life and consumption, followed by constant temperature 30C°, which resulted (14.5 and 0.5gm) in the 1st week, and reached gradually to (7.25 and 0.68gm) in the 2nd week. At 35C°, data resulted (zero) for two tested factors.

Data are agreement with that obtained by Becker (1967), who found that, the tropical species die at 18-20C°.

Mishra and Singh (1978), mentioned that, the minimum survival period of subterranean termites *Koptotermes heimi* and *Nasutitermes dunenses* was obtained at 35C°.

b. The effect of variable temperatures

Data in table (2), and fig. (4), showed, the variable temperatures 10-15, 10-20 and 15-20C°, recorded (zero) for survival and food consumption of the tested termite. At 15-25C°, data recorded (11.25 and 1.0gm) and (0.50 and 0.9gm) in the 1st and 3rd week for two tested factors respectively, also at 20-25C°, data recorded (18 and 1.03gm) in the 1st week, to reach (12 and 1.50gm) in the 3rd week. At 20-30C°, data resulted (18.75 and 1.30gm) reached gradually to (4.75 and 1.47gm) in the 1st and 4th

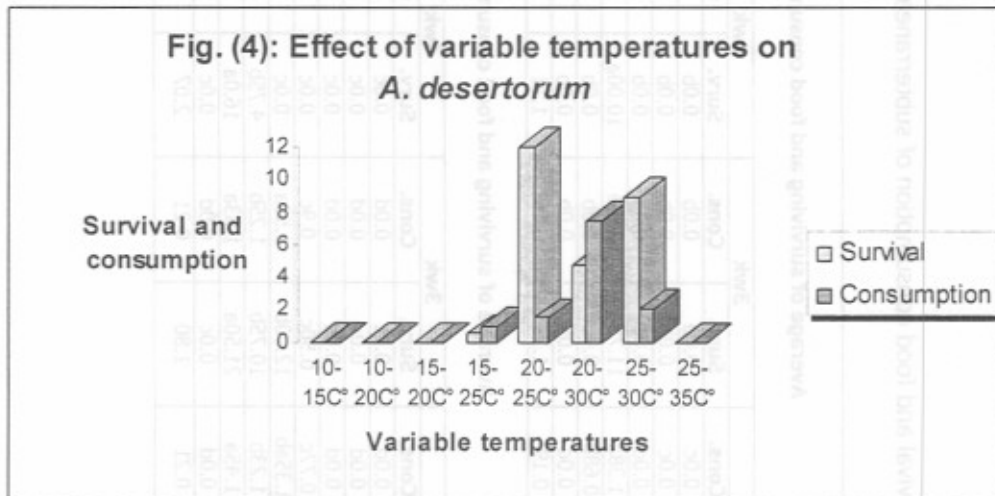
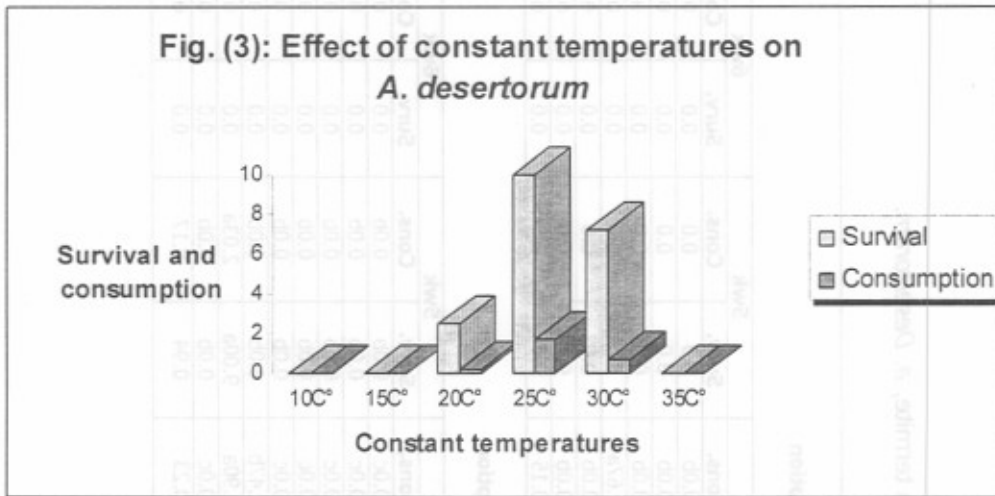
week respectively. The optimum of variable temperatures degree was 25-30C°, whereas the data gave (23.75 and 0.2gm) in the 1st week, and reached gradually to (9 and 2.03gm) in the 5th week for survival and food consumption respectively. At the rhythm 25-35C°, data resulted (zero). Under the thermo-rhythm 15 and 30C°, limits, around 2-36% of the tested workers not lived more than 3 and 5 weeks at the lower and higher respectively.

Statistical analysis in Table (2) showed that, the LSD results were highly significant differences between the constant and variable temperatures degrees on the survival and food consumption of termite *A. desertorum*, and the optimum degrees were 25-30C°, for tested activities.

In general, throughout the previous data in tables (1 and 2), we can come to conclusion that, the survival rates were decreased gradually from 1st week to 6th week and vice versa, in case consumption rates. Also, the constant temperature 25C° was the most favorable for termite survival and food consumption, also the using of thermo-rhythm around 20-30C° was the best for termite activities (termite life and consumption), more than the constant temperature, so, we can recommend by using of thermo-rhythm when the termite maintenance is desired. In addition to that, data showed, the harvester termite *A. ochraceus* had higher endurance, when reared under tested temperatures than the termite, *A. desertorum* which was had susceptible and lower endurance and gave negligible results when live under tested temperatures.

Table 2. Effect of constant and variable temperatures on survival and food consumption of subterranean termite, *a. Desertorum*.

constant temp.	Weighed Board/g m.	Average of surviving and food consumption											
		1wk		2wk		3wk		4wk		5wk		6wk	
		Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.
10C°	11.7	0.0c	0.0c	0.0c	0.0c	0.0b	0.0b	0.0b	0.0b	0.0	0.0	0.0	0.0
15C°	13.9	0.0c	0.0c	0.0c	0.0c	0.0b	0.0b	0.0b	0.0b	0.0	0.0	0.0	0.0
20C°	14.0	2.50c	0.2c	0.0c	0.0c	0.0b	0.0b	0.0b	0.0b	0.0	0.0	0.0	0.0
25C°	14.9	22.00a	1.05a	13.5a	1.38a	11.75a	1.43a	10.00a	1.67a	0.0	0.0	0.0	0.0
30C°	15.0	14.5b	0.5b	7.25b	0.68b	0.0b	0.0b	0.0b	0.0b	0.0	0.0	0.0	0.0
35C°	13.7	0.0c	0.0c	0.0c	0.0c	0.0b	0.0b	0.0b	0.0b	0.0	0.0	0.0	0.0
Statistics	LSD	2.67	0.19	1.29	0.19	1.25	0.16	1.11	0.15	0.0	0.0	0.0	0.0
Variable temp.	Weighed Board/g m.	Average of surviving and food consumption											
		1wk		2wk		3wk		4wk		5wk		6wk	
		Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.	Surv.	Cons.
10-15C°	12.3	0.0d	0.0d	0.0d	0.0d	0.0c	0.0d	0.0c	0.0c	0.0b	0.0b	0.0	0.0
10-20C°	10.1	0.0d	0.0d	0.0d	0.0d	0.0c	0.0d	0.0c	0.0c	0.0b	0.0b	0.0	0.0
15-20C°	16.2	0.0d	0.0d	0.0d	0.0d	0.0c	0.0d	0.0c	0.0c	0.0b	0.0b	0.0	0.0
15-25C°	13.9	11.25c	1.00b	5.00b	0.77c	0.50c	0.9c	0.0c	0.0c	0.0b	0.0b	0.0	0.0
20-25C°	16.1	18.00b	1.03b	12.00b	1.35ab	12.00b	1.50a	0.0c	0.0c	0.0b	0.0b	0.0	0.0
20-30C°	13.0	18.75b	1.30a	13.00b	1.23b	10.75b	1.25b	4.75b	1.47b	0.0b	0.0b	0.0	0.0
25-30C°	15.3	23.75a	0.2d	22.25a	1.45a	21.50a	1.63a	16.0a	1.90a	9.00a	2.03a	0.0	0.0
25-35C°	11.6	0.0d	0.0d	0.0d	0.0d	0.0c	0.0d	0.0c	0.0c	0.0b	0.0b	0.0	0.0
Statistics	LSD	2.07	0.21	2.12	0.21	1.80	0.21	2.07	0.23	0.94	0.17	0.0	0.0



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دراسة على حساسية النمل الأبيض تحت أرضى متأثرة بدرجات الحرارة الثابتة والمتغيرة تحت الظروف المعملية

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أجريت هذه الدراسة بغرض إختبار مدى تحمل أفراد النمل الأبيض تحت أرضى للإعاشة أطول فترة ممكنة تحت الظروف المعملية المختبرة وهي درجات الحرارة الثابتة والمتغيرة مع الأخذ فى الإعتبار دراسة حساسية أنواع النمل الأبيض التخت أرضى " أناكانثوترمس أوكريشيس" و "أميترمس ديزرتوروم" تحت ظل هذه الظروف المختبرة . وقد أثبتت النتائج أن درجة الحرارة الثابتة 25°C كانت المثلى لحياة النمل الأبيض والإستهلاك الغذائى ، أما درجة الحرارة الثابتة 30°C كانت فى المرتبة الثانية ، ولكن عند إستخدام درجات الحرارة المتغيرة أو الرجيم الحرارى كانت درجات الحرارة $25-30^{\circ}\text{C}$ أنسبها للحياة والإستهلاك الغذائى نسبيا عن درجة الحرارة الثابتة 25°C . وتحت ظروف إختبار درجة الحرارة الثابتة 25°C والمتغيرة $25-30^{\circ}\text{C}$ سجلت أعلى نسب ومعدلات الحياة والإستهلاك الغذائى حيث ظلت أعلى نسبة من الحشرات المختبرة على قيد الحياة بعد الأسبوع السادس . بالإضافة إلى أن معدلات الحياة لنوعى النمل الأبيض المختبر فى كل المعاملات كانت تقل تدريجيا من الأسبوع الأول إلى الأسبوع السادس والعكس فى حالة كمية الإستهلاك . أيضا أثبتت النتائج أن نوع النمل الأبيض التخت أرضى "أناكانثوترمس أوكريشيس" كان الأكثر تحملا والأقل حساسية عن النوع "أميترمس ديزرتوروم" الذى كان أكثر حساسية وأقل تحملا لنشاطات الحياة والظروف المختبرة . ومن خلال النتائج ينصح بإستخدام الرجيم الحرارى $25-30^{\circ}\text{C}$ عند الرغبة فى الحفاظ على أفراد النمل الأبيض التخت أرضى أطول فترة ممكنة تحت الظروف المعملية .