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INFLUENCE OF DIFFERENT TEMPERATURES ON THE BIOLOGICAL ASPECTS OF *Eutetranychus africanus* (Tucker) (ACARI:TETRANYCHIDAE:PROSTIGMATA)

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ABSTRACT

The effect of three temperature degrees (20, 25 and 30ºC) and 65±5%RH. on the biological aspects of *Eutetranychus africanus* (Tucker) were investigated. Threshold of development (t) and accumulated heats (k) for total immature duration development of *E. africanus* (Tucker) were calculated to be 15.7 ºC and 48.8 degree-days (DD`s, female). Development of egg stage required 61.6 & 65.6 dd`s above 13.4 ºC while generation period demanded 162.540dd`s , above 13.02 ºC and this value 155.9 dd`s above 8.05 ºC for Longevity. The accumulated thermal heat units (T.U.) or effective degree-days estimated through the mite activity time. The aim of this part of investigation is to establish the velocity constants (i.e the relationship between temperature and speed of development).

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is considered one of the most important leguminous vegetable crops in Egypt. It is cultivated for exportation and also for local consumption.

In Egypt Common bean is infested with different pests which cause considerable damage in both quantity and quality of the pods. Among these pests, the tetranychid mite species were considered the most important especially during the summer plantation El-Kawass, (2000) and El-Moghazy (2002).

Integrated pest management programs, demonstrates a total system approach to the suppression of pest population, which depend on the importance of the predicting the seasonal abundance of insects, which has led to the formulation of many mathematical, models that, described the developmental rates as a function of temperature. Sevacherian, 1977.

Therefore, the aim of the current study was to estimate the influence of constant temperature degrees on the biological aspects of *E. africanus* and thermal units (degree-days).

MATERIALS AND METHODS

This investigation was carried out in laboratory at Vegetable Research Pests Dep. Plant Protection Research Institute Dokki,Giza . The stock culture of *E. africanus* (Tucker) was reared on the common bean, *Phaseolus vulgaris* (Fam : Leguminosae) were carried out in the laboratory under three different temperatures [20 – 25 – 30 °C and 65 ± 5% R.H.]. Pure cultures of mite individuals were maintained in the laboratory, on the upper leaf surface of common bean. A number of mated females were transferred to discs one inch in diameter of leaves of host vegetable plants. The discs were placed on

moistened cotton wool in Petri – dishes, 9 cm in diameter. Eggs laid within 24 hrs. by such females and then observed until hatching. Fifty newly hatched larvae were placed singly on fresh leaves placed upside down in similar Petri dishes. Observation was made twice daily to obtain the duration of the different developmental stages throughout the life cycle and also the number of eggs laid per female

Statistical analysis:

Thermal units required for complete development of each stage was determined according to the equation of thermal summation Blunk,1923.

$$K = y(T-t0)$$

Where: y = Developmental duration of a given developmental stage.

T =Temperature in degree centigrade.

t_0 = Temperature threshold of development, in degree centigrade.

K = Thermal units (degree –days).

The developmental threshold value that has been estimated after constant temperature experiment carried out before. Whereas the zero development (t0) was 13.02 ºC for *E. africanus* generation .Hereinafter, the following formula was used for computing the heat units (DD) according to Richmond *et al* .,(1983):

H = HJ

H=Number of accumulated heat units to emergence.

HJ=(Max.+Min.)/3-C,if max.>C&min.>C.

=(max.-C)2/2(max.-min.).if max >C&min.<C

= 0 if max. <C&min.<C

C=Threshold temperature.

RESULTS AND DISCUSSION

Data obtained in Tables (1,2&3) showed that the incubation period of *E. africanus* at 30°C was 3.6±0. 11 days; being insignificantly shorter than those at 20 and 25 °C (5.1±0.26and 8.6±0.2) respectively (<*P*0.05).

The duration of larval stage (active +quiescent) periods (A+Q) was also affected with the different degrees of constant temperature. Data in

Tables (1&2) showed that, the duration of the larval stage was 4.9±3, 2.3±0.2and 1.6±0.1 at 20, 25, 30°C respectively, being insignificantly different from each other (*P*<0.05) (Table 1). From the aforementioned results, it can be concluded that *E. africanus* took longer developmental period at 20°C than the other two tested temperatures. In three-tested temperature, however, the duration of the developmental stages of *E. africanus* depends on temperature; whereas, the duration of each developmental stage decreased as well as increasing temperature.

1-2

Table (3): Effect of different temperatures on the oviposition period and fecundity of *Eutetranychus africanus* (Tucker) when fed on leaves of common bean, *Phaseolus vulgaris* L. at 65 ± 5% R.H.

Temperature ºC	Oviposition period (in days)	Number of deposited eggs	
		Total average	Daily mean
20	7.8 ± 1.91	22.82 ± 4.64	2.92 ± 1.42
25	4.88 ± 0.58	12.45 ± 1.15	2.55 ± 0.98
30	3.66 ± 0.55	31.55 ± 4.0	8.78 ± 2.2
L. S.D at 0.05 at 0.01	2.364 3.708		

Developmental rates and heat summations of *E. africanus* under different constant temperatures:

- Egg stage

As mentioned before, the incubation period of *E. africanus* was markedly affected by temperature variations. The rate of embryo development was positively dependent on temperature; where it increased as increasing of tested temperatures. In this case, the percentage of egg hatchability was 71.5, 79.9, and 51.2% at 20, 25, 30°C (Table 1) The estimated threshold of egg development (t_0) was (13.42°C) (Table 3). On the other hand, the average of thermal units or thermal summation was (56.19, 57.90 and 82.90 DD's), respectively, at 20, 25 and 30°C, with an average (65.66 DD's) (Table 4).

Table (4): Rate of development, threshold of development (t_0) and thermal units (DD's) of eggs of *E. africanus* at constant temperatures

Temperatures	Incubation period of eggs (days)	Rate of development %	Threshold of development (to)	Thermal units (DD)	Hatchability %
20◦C	8.54±0.20	11.712	13.42	56.19	71.5
25◦C	5.00±0.27	20.00		57.90	79.9
30◦C	3.39±0.22	29.499		82.90	51.2
Average	-	-		65.66	-

The total immature stages

Total immature stage of *E. africanus* passed through (A = Active stage, Q = Quiescent stage, larvae Protonymph and Deutonymph). Total immature duration was shortened with the increase of temperature (Table 1). Hence, the developmental rate of total immature stages increased as the temperature increased from 20 to 30^{o}C.

Table (5): **Total immature development, threshold of development (t_0) and thermal units (DD's) of larvae of *E. africanus* at constant temperature**

Temperature	Mean of immature duration± S.E. (days)	Rate of development (%)	t_0 (^{o}C)	Thermal units (DD's)
20◦C	10.76±0.022	9.2	15.74	45.838
25◦C	5.93±0.106	16.86		54.912
30◦C	3.21±0.248	31.15		45.775
Average				48.842

The threshold of total immature development (t_0) was estimated as (15.74^{o}C) and the thermal units were (45.838, 54.912 and 45.775DD's, respectively, at 20, 25 and 30°C (Table 5) with an average of 48.842DD's.

As other developmental stages, the duration of the generation development decreased with temperature increase; while the rate of development was retarded at lower temperature.

For *E. africanus*, the estimated threshold of generation development (t_0) was 13.02°C. The thermal units were (161.796., 164.006 and 161.819 DD's) at 20, 25 and 30°C; with an average of 162.54DD's (Table 6).

Table (6): Whole generation development, threshold of development (t_0) and thermal units (DD's) of *Eutetranychus africanus* (Tucker) at constant temperatures.

Temperature (^{o}C)	Mean duration period ±S.E. (days)	Rate of development (%)	t_0 (^{o}C)	Thermal units (DD's)
20	23.18±0.022	4.314	13.02	161.796
25	13.69±0.375	7.304		164.006
30	9.53±0.20	10.493		161.819
Average				162.540

Longevity:

As show in Table (7) each developmental stage of *E. africanus*, was affected by different degrees of temperature, where by, the duration of Longevity decreased with increasing temperatures from 20 to 30°C. The development rates on the other hand increased with increasing of tested temperatures (Table 7). The estimated threshold of development differed in the three localities, being 8.056°C. The thermal units for the Longevity as a whole also varied as cording to temperatures, being 160.41, 146.90and 160 at 20, 25 and 30°C with an average 155.91 DDs (Table 7).

Table (7): **Longevity development, threshold of development (t_0) and thermal units (DD's) of *E. africanus* at different constant temperatures**

Temperature	Longevity (days) (Mean±SE)	Rate of development (%)	Zero of development (^{o}C)	DD's
20◦C	13.43±0.07	7.45	8.056	160.41
25◦C	8.67±0.60	11.53		146.90
30◦C	7.31±0.35	13.68		160.41
Average				155.91

In the present study, an explanation for variation in the number of annual generations was given here in for the first time on the basis of available data and calculated degree-days required for mite development. The expected number of annual generation could be predicted by determining the date ate which 162.54 dd**'s** have been accumulated at the beginning of spring. Sevacherian (1977); Johnson *et al*.(1979) , Tangigoshi *et al*. (1979) and Goyal**,** *et al*. (1985).(developed similar degree-day systems for predicting the need for and timing of insecticide application for different insect species.

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تـــــاثير درجـــــات الحـــــرارة الثابتـــــةعلى الخطـــــوات البيولوجيـــــة *Eutetranychus africanus* (Tucker) والوحـدات الحـرارية

حورية على عبد الوهاب، سالم عبد السلام هادي و نجلاء فتحى رياض
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أجريت هذه الدراسة فى معمل قسم بحوث آفات الخضر بمعهد بحوث وقاية النباتات بالدقى . نهد ف من البحث الى دراسة تأثير ثلاث درجات حرارة وهى ٢٠، ٢٥،٣٠° م على الخطوات البيولوجية المختلفة للحلم *Eutetranychus africanus* (Tucker) (بيضة-يرقة-حورية-الطور الكامل) وقد استخدمت مجموع درجات الحرا رة الفعالةThermal summation لتحديد العلاقة بين درجات الحرارة و معدل النمو. تعين معدل النمو لكل طور من أطوار الاكاروس. حساب صفر النمو البيولوجى لكل الاطوار وايضا الجيل حيث بلغ ١٣,٤، ١٥,٧٤، ٨,٠٥ولكل من البيضة ومجموع الاطوار الغير كاملة و Longevity غلى التوالى. وجد أن صفر النمو البيولوجىللجيل للحلم *Eutetranychus africanus*(Tucker) وهى ١٣,٠٢° م يحتاج الى١٦٢.٥٤ وحدة حرارية. للتنبؤ بأجيال الحلم وتحديد ميعاد مكافحة هذا النوع من الآكاروسات.

قام بتحكيم البحث

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Table (1): Effect of different temperatures on the life cycle of *Eutetranychus africanus* (Tucker) when reared on leaves of common bean, *Phaseolus vulgaris* L. at 65 ± 5% R.H.

Temperature ºC	Average period of different developmental stages (in days)								
	Incubation period	Immature stages						Total immature stages	Life cycle
		Larva		Protonymph		Deutonymph			
		A	Q	A	Q	A	Q		
20	8.64 ± 0.169	2.78 ± 0.214	2.09 ± 0.07	2.07 ± 0.71	1.5 ± 0.138	1.85 ± 0.142	1.46 ± 0.133	11.69 ± 0.051	20.41 ± 0.83
25	5.07 ± 0.26	1.28 ± 0.125	0.96 ± 0.035	1.25 ± 0.114	0.96 ± 0.09	1.03 ± 0.09	0.85 ± 0.62	6.33 ± 0.19	11.40 ± 0.44
30	3.6 ± 0.11	1.04 ± 0.041	0.54 ± 0.028	0.62 ± 0.062	0.58 ± 0.038	0.95 ± 0.84	0.79 ± 0.54	4.5 ± 0.12	8.1 ± 0.22
L. S.D at 0.05 at 0.01	0.430 0.992							0.358 0.573	0.453 0.751

A = Active stage **Q = Quiescent stage**

Table (2): Effect of different temperatures on the longevity and life span of *Eutetranychus africanus* (Tucker) when reared on leaves of common bean, *Phaseolus vulgaris* L. at 65 ± 5% R.H.

Temperature ºC	Duration of different stages (in days)				
	Female				
	Pre-oviposition	Generation	Post-oviposition	Longevity	Life span
20	2.785 ± 0.39	23.18 ± 0.022	2.66 ± 0.44	13.43 ± 0.07	33.89 ± 0.022
25	2.29 ± 0.31	13.69 ± 0.375	1.5 ± 0.2	8.67 ± 0.6	20.07 ± 0.56
30	1.1 ± 0.12	9.53 ± 0.20	1.3 ± 0.23	7.31 ± 0.35	15.95 ± 0.29
L. S.D at 0.05 at 0.01		0.342 0.537		0.6366 0.9985	0.539 0.845