EFFECT 0F CONSTANT TEMPERATURE DEGREES ON CERTAIN BIOLOGICAL CHARACTERSTICS OF THE COCCINELLID PREDATOR *Rodolia cardinalis* (MULSANT) (COLEOPTERA: COCCINELLIDAE)

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ABSTRACT

Laboratory experiments were carried out in the Insectary of Economic Entomology Department Faculty, of Agriculture, Mansoura University, from the beginning of October 2011 tell the end of September 2012 under three constant temperature degrees (15±1, 25±1 and 30±1 C^o) to study the influence of three constant temperature degrees on biological characteristics for the coccinellid predator *Rodolia cardinalis* (Mulsant) when reared on the third nymphal instars of *Icerya purchasi* Mask. The obtained results revealed that, the average of the total consumption per larva was 55.96 ± 1.3 individuals, the duration period of the larval stage averaged 30.1±0.56 days. The percentages of the mortality were 20.5, 13.9, 6.9 and 5.6 % during the four larval instars respectively when this predator reared on *I. purchasi* under constant temperature of 15±1 C^o and 70±5 %. The predator female fed on a total average of 389.28±5.7 individuals, during the longevity period of 66.07±3.7 days. The number of deposited eggs per predator female was averaged 156±3.9 eggs. The predator male consumed a total average of 210.75±3.42 individuals. Meanwhile the data showed that, the average of the total consumption per larva was 107.53±6.2 individuals, when this predator reared on *I. purchasi* nymphs under constant temperature of 25±1 C^o and 70±5 %, the duration period of the larval stage averaged 14.37±1.6 days. The percentages of the mortality were 13.4, 9.1, 4.5 and 3.7 % % during the four larval instars respectively. The predator female fed on a total average of 348.82 ± 8.56 individuals, during the longevity period of 42.5±2.1days. The number of deposited eggs per predator female was averaged 455.79±10.17 eggs. The predator male consumed a total average of 201.74 ± 5.96 individuals. The obtained results revealed that, the average of the total consumption per larva was 87.16±4.6 individuals, the duration period of the larval stage averaged 9.24±1.95 days. The percentages of the mortality were 14.2, 10.4, 5.7 and 4.5 % during the four larval instars respectively when this predator reared on *I. purchasi* under constant temperature of 30±1 C^o and 70±5 %. The predator female fed on a total average of 248.30±7.96 individuals, during the longevity period of 32.15±1.92 days. The number of deposited eggs per predator female was averaged 310.75±8.56 eggs. The predator male consumed a total average of 176.35±5.46 individuals. Statistical analysis showed significant differences between the duration periods as well as the average of total consumption per larvae for the larval stage under the three constant temperature degrees. Meanwhile the statistical analysis cleared significant differences between the longevity period for female and male as well as the average of total consumption and the number of deposited eggs per female and the three constant temperature degrees. In conclusion the optimum temperature for mass rearing of this predator was 25±1 C^o because the number of deposited eggs per female the feeding capacity was the highest in comparison with the other temperature degrees.

Keywords: *Rodolia cardinalis* (Mulsant); *Icerya purchasi* Mask; constant temperature; Biology.

INTRODUCTION

Coccinellid predator is potentially important predatory insects found throughout the world on many economic crops. Certain species may have a significant role in biological control of aphid species, whiteflies and other soft bodied insects. *R. cardinalis* (Coleoptera: Coccinellidae) is an important Coccinellid predator feeding on mealybug species (Hamed and Saad, 1989; Lehane 1998; Ibrahim 2005; Ghanim *et al.* 2006 and Awadalla 2010). The effect of temperature degrees and mealybug species as preys on the developmental time, fecundity and other biological aspects were studied by several investigators in different part of the world (Khalaf 1987; Ragab 1995; Cuaston *et al.* 2004; Grafton *et al.* 2005; Ghanim *et al.* 2006; Awadalla 2010 and Abdel-Salam *et al.* 2013). In Egypt little information is available on the influence of different constant temperature degrees on the biological characteristics and life table parameters of the most important predators feeding on mealybug species. However, scanty attention has been paid to the developmental time and feeding capacity and fecundity of the female to measure these parameters for mass rearing and release. Therefore the objective of this study was aimed to study the influence of three constant temperature degrees on biological characteristics for the coccinellid predator *R. cardinalis*.

MATERIALS AND METHODS

Laboratory experiments were carried out in the Insectary of Economic Entomology Department Faculty, of Agriculture, Mansoura University, from the beginning of October 2011 tell the end September 2012 under three constant temperature degrees (15±1, 25±1 and 30±1). To obtain a culture from *Rodolia cardinalis* (Mulsant) a large number of this predator in the pupal stage were collected from ficus, *Ficus nitida* Thunb., guava trees, *Psidium guajava* L. and citrus trees which were found to be a heavily infested with *Icerya purchasi* Mask and transferred to Laboratory until emergence of the adults. Newly deposited eggs of this predator was divided into three group; each group consisted of 50 eggs each group of the eggs was kept at one of the following constant temperature degrees 15±1 , 25±1 and 30±1 as well as 70±5 % R. H.

A: Larval experiments

To avoid cannibalism , newly first larval instar of the predator from each group were individually in Petri dishes (10 cm diameters) and divided to three groups consisted of 20 larvae was use as a replicate and fed on *I. purchasi* nymphs . Apiece of filter paper was placed on the bottom of each Petri dish to provide a walking surface for the predator larvae. A known surplus numbers of the third nymph instar of I. *purchasi* species were offered and the devoured individuals were replaced daily for *R. cardinalis*. A small leaves from ficus or guava replaced daily as a food for the third nymphal instar of this mealybug species. Attached prey individuals were counted and recorded daily throughout the period of the larval instars.

B.: Adult experiments

After emergence from the pupae the predator adults were sexed and then introduced singly into a Petri dish. Know numbers of *I. purchasi* nymphs were offered daily on a ficus or guava leaflet to predator adults. Counting and removing the un- devoured nymphs in Petri dish were practiced before introducing the new nymph individuals. After five or six days of emergence copulation took place and the two sexes were immediately separated and kept singly in the dishes. Daily numbers of laid eggs per predator female during its ovipositional period was counted. In addition the total number of eggs laid per predator female was estimated. The daily consumption throughout adult was calculated.

C: Data analysis

Data for the developmental time and average of consumption per larval stage longevity, fecundity and consumption rate of the *R. cardinalis* adult when reared on *I. purchasi* nymphs were subject for one way analysis of variance (Anova) and the means were separated using Dancan's Multiple Rang Test (Cohrot Software 2004)

RESULTS AND DISCUSSION

I: *Rodolia cardinalis* reared on *I. purchasi* nymphs under constant temperature of 15±1 C^o and 70±5 R.H.

A: Larval stage

Data represented in Table (1) showed the duration period, food consumption and mortality percentages of the larval stage when reared on the third nymphal instar of *I. purchasi* and constant temperature of 15±1 C^o and 70±5 relative humidity. It can be seen from this table that, the duration period of the larval stage averaged 30.1±0.56 days. The average of the total consumption during the four larval instars was 8.56 ± 0.4, 8.78±0.43, 16.86±0.52 and 21.76±0.8 individual respectively. Meanwhile, the results revealed that, the average of the total consumption per larva was 55.96±1.3 individuals. The percentages of feeding capacity for each of the four larval instars of this predator were 15.3, 15.69, 30.13 and 38.88 % respectively. Therefore, it is obvious that, the third and fourth larval instar of this predator represent together 69.01 % or backbone in the predation activity. The percentages of the mortality were 20.5, 13.9, 6.9 and 5.6 % during the four larval instars respectively.

Awadalla (2010) indicated that the total developmental times of the immature stages for *R. cardinalis* were 62.30, 41.10, 26.85, 18.85 and 12.7 days with significant differences when reared on *I. purchasi* at 16, 20, 24, 28 and 32 C^o respectively. Abdel-Salam *et al.* (2013) recorded that the average of developmental time of the larval stage lasted 29.65±0.95 days when reared *I. purchasi* nymphs and reared under 16 C^o and 60±5% R. H.

Table (1): Duration period, predaceous efficiency and percentage of mortality of *R. cardinalis* reared on *I. purchasi* nymphs under constant temperature of 15±1 C^o and 70±5% relative humidity.

Larval stage	Duration in days	Daily average consumption	Average of total consumption	% of feeding capacity	% of Mortality
1 st instar	8.8±0.17	0.97	8.56±0.4	15.3	20.5
2 nd instar	6.9±0.26	1.27	8.78±.43	15.69	13.9
3 rd instar	5.8±0.32	2.9	16.86±0.52	30.13	6.9
4 th instar	8.6±0.39	2.53	21.76±0.8	38.88	5.6
Total	30.1±0.56	1.86	55.96±1.3	100	

B: Adult stage
1: Predator female

The predator female fed on a total average of 389.28±5.7 individuals, with a daily rate of 5.89 individuals during the longevity period of 66.07±3.7 days as seen in Table (2). The average of the pre-oviposition period was 10.46±0.75 days. The predator female consumed during this period 76.96 individuals with a daily rate of 7.35 individuals. The predator female consumed during the ovipasition period on an average of 256.47±3.76 individuals, this period lasted an average of 38.75±1.86 days with a daily rate of 6.62 individual's. The number of deposited eggs per predator female averaged 156±3.9 eggs with a daily rate 4.03 eggs per day. During the post-oviposition period, the predator female consumed 55.85±2.15 individuals this period lasted an average of 16.86±0.96 days with a daily rate of 3.31 individuals.

2: Predator male

During its longevity, was lasted for an average of 45.96±2.4 day's Table (2). The predator male consumed a total average of 210.75±3.42 individuals with daily rate of 4.58 individuals.

Table (2): Longevity, food consumption and fecundity of *R. cardinalis* adult reared on the third nymphal instars of *I. purchasi* under constant temperature of 15±1 C^o and 70±5% relative humidity.

Adult stage	Period in days	Daily average consumption	Average of total consumption	No. of eggs	
				Daily	Total
A : Female					
Pre-oviposition	10.46±0.75	7.35	76.96±1.96		
Oviposition	38.75±1.86	6.62	256.47±3.76	4.03	156±3.9
Post-oviposition	16.86±0.96	3.31	55.85±2.15		
Longevity	66.07±3.7	5.89	389.28±5.7		
B : Male Longevity	45.96±2.4	4.58	210.75±3.42		

II: *Rodolia cardinalis* reared on *I. purchasi* nymphs under constant temperature of 25±1 C^o and 70±5 R.H.

A: Larval stage

Data represented in Table (3) revealed that the duration period, food consumption and mortality percentages on the third nymphal instar of *I. purchasi* and constant temperature of 25±1 C^o. It can be seen from this table that, the duration period of the larval stage averaged 14.37±1.6 days. The average of the total consumption during the four larval instars were 13.12±0.90, 15.72±1.2, 20.89±2.53 and 57.80±3.21 individual, respectively. Meanwhile, the results revealed that, the average of the total consumption per larva was 107.53±6.2 individuals. The percentages of feeding capacity for each of the four larval instars of this predator were 12.2, 14.62, 19.43 and 53.75 % respectively. Therefore, it is obvious that, the third and fourth larval instar of this predator represent together 73.18 % or backbone in the predation activity. The percentages of the mortality were 13.4, 9.1, 4.5 and 3.7 % during the four larval instars respectively.

Table (3): Duration period, predaceous efficiency and percentage of mortality of *R. cardinalis* reared on *I. purchasi* nymphs under constant temperature of 25±1 C^o and 70±5% relative humidity.

Larval stage	Duration in days	Daily average consumption	Average of total consumption	% of feeding capacity	% of Mortality
1 st	3.82±0.36	3.43	13.12±0.90	12.20	13.4
2 nd	2.91±0.17	5.40	15.72±1.20	14.62	9.1
3 rd	2.53±0.12	8.26	20.89±2.53	19.43	4.5
4 th	5.11±0.85	11.31	57.80±3.21	53.75	3.7
Total	14.37±1.6	7.48	107.53±6.2	100	

Ibrahim (2005) added that the temperature threshold for egg stage, first, second, third and four larval instars and pupal stage were 10.67, 9.23, 9.60, 9.84, 11 and 10.74 C^o respectively.

B: Adult stage

1: Predator female

The predator female fed on a total average of 348.82±8.56 individuals, with a daily rate of 8.21 individuals during the longevity period of 42.5±2.1 days as seen in Table (4). The average of the pre-oviposition period was 5.42±0.32 days. The predator female consumed during this period 49.78±1.3 individuals with a daily rate of 9.18 individuals. The predator female consumed during the ovipasition period on an average of 263.75± 6.4 individuals, this period lasted an average of 30.85±1.36 days with a daily rate of 8.55 individual's. The number of deposited eggs per predator female averaged 455.79±10.17 eggs with a daily rate 14.77 eggs. During the post-oviposition period, the predator female consumed 35.29±1.1 individuals this period lasted an average of 6.23±0. 5 days with a daily rate of 5.66 individuals.

2: Predator male

During its longevity, which was lasted for an average of 28.57±1.94 day's table (4). The predator male consumed a total average of 201.74±5.96 individuals with daily rate of 7.06 individuals.

Table (4): Longevity, food consumption and fecundity of *R. cardinalis* adult reared on the third nymphal instars of *I. purchasi* under constant temperature of 25±1 C^o and 70±5% relative humidity.

Adult stage	Period in days	Daily average consumption	Average of total consumption	No. of eggs	
				Daily	Total
A : Female					
Pre-oviposition	5.42±0.32	9.18	49.78±1.30	14.77	455.79±10.17
Oviposition	30.85±1.36	8.55	263.75±6.4		
Post-oviposition	6.23±0.5	5.66	35.29±1.1		
Longevity	42.5±2.1	8.21	348.82±8.56		
B : Male					
Longevity	28.57±1.94	7.06	201.74±5.96		

Matsuka and Watanabe (1981) indicated that adult females of vedalia beetles which fed on adults of Icerya scales in Petri dish at 25 C^o produce an average of 365 eggs during their life spain of 29.4 days. Awadalla (2010) mentioned that the fecundity rate were significantly higher at 28 **C^o** than that at 24, 32, 20 and 16 **C^o** when fed on the third nymphal instar of *I. purchasi*, *I. aegyptiaca* and *I. seychellarum*

III: *Rodolia cardinalis* reared on *I. purchasi* nymphs under constant temperature of 30 C^o.

A: Larval stage

Data represented in Table (5) indicated the duration period, food consumption and mortality percentages of the larval stage of *R. cardinalis* under constant temperature of 30±1 C^o and 70±5% relative humidity. It can be seen from this table that, the duration period of the larval stage averaged 9.24±1.95 days. The average of the total consumption during the four larval instars was 10.78±1.2, 13.54±1.53, 17.26±1.82 and 45.58±2.1 individuals respectively. Meanwhile, the results revealed that, the average of the total consumption per larvae was 87.16±4.6 individuals. The percentages of feeding capacity for each of the four larval instars of this predator were 12.37, 15.53, 19.8 and 52.3 % respectively. Therefore, it is obvious that, the third and fourth instar larvae of this predator represent together 72.1 % or backbone in the predation activity. The percentages of the mortality were 14.2, 10.4, 5.7 and 4.5 % during the four larval instars respectively.

Table (5): Duration period, predaceous efficiency and percentage of mortality of *R. cardinalis* reared on *I. purchasi* nymphs under constant temperature of 30C° and 70 ± 5% relative humidity.

Larval stage	Duration in days	Daily average consumption	Average of total consumption	% of feeding capacity	% of Mortality
1 st	2.87±0.26	3.76	10.78±1.2	12.37	14.2
2 nd	1.70±0.19	7.96	13.54±1.53	15.53	10.40
3 rd	1.52±0.15	11.36	17.26±1.82	19.8	5.70
4 th	3.15±1.7	14.47	45.58±2.1	52.30	4.50
Total	9.24±1.95	9.43	87.16±4.6	100	

Awadalla (2010) indicated that the duration period for the larval stage of *R. cadinalis* was lasted 5.9±0.33 days where reared on *I. purchasi* nymphs under constant temperature of 32 C° and 60±5 % R. H.

B: Adult stage

1: Predator female

The predator female fed on a total average of 248.3 ± 7.96 individuals, with a daily rate of 7.72 individuals during the longevity period of 32.15±1.92 days as seen in table (6). The average of the pre-oviposition period was 4.2±0.5 days. The predator female consumed during this period 33.78±2.6 individuals with a daily rate of 8.04. The predator female consumed during the ovipasition period on an average of 185.56±4.78 individuals, this period lasted an average of 22.19±1.37 days with a daily rate of 8.36 individuals. The number of deposited eggs per predator female averaged 310.75±8.56 eggs with a daily rate 14.0 eggs per daily. During the post-oviposition period, the predator female consumed 28.96±5.36 individuals this period lasted an average of 5.76±0.65 days with a daily rate of 5.02 individuals.

2: Predator male

During its longevity, which was lasted for an average of 23.92±1.42 days the predator male consumed a total average of 176.35±5.46 individuals with daily rate of 7.37 individuals Table (6).

Table (6): Longevity, food consumption and fecundity of *R. cardinalis* adult reared on the third instars of *I. purchasi* under constant temperature of 30 C° and 70 ± 5% relative humidity.

Adult stage	Period in days	Daily average consumption	Average of total consumption	No. of eggs	
				Daily	Total
A : Female					
Pre-oviposition	4.20±0.5	8.04	33.78±2.6		
Oviposition	22.19±1.37	8.36	185.56±4.78	14.0	310.75±8.56
Post-oviposition	5.76±0.65	5.02	28.96±5.36		
Longevity	32.15±1.92	7.72	248.30±7.96		
B : Male					
Longevity	23.92±1.42	7.37	176.35±5.46		

Hamed and Chemsedine (2001) noticed that the fecundity of females at different temperatures ranged between 107 eggs at 15 C^o and 601.86 eggs at 30 C^o. The pre-oviposition period ranged between 23.75 days at 15 C^o and 3.47 at 35 C^o. Abdel-Salam (2013) found that the fecundity of *R. cardinalis* females was 336.6±25.43 eggs per female when reared *I. aegyptiaca* nymphs under constant temperature of 28 and 70±5 R.H.

The obtained result in Table (7) cleared that the duration period and average of total consumption per larva of *R. cardinalis* when fed on *I. purchasi* nymphs under different constant temperature of 15, 25 and 30 C^o lasted 30.1±0.56; 14.37±1.6 and 9.24±1.95 respectively. Also the average of the total consumption per larva was 55.96±1.3, 107.53±6.2 and 87.16±4.6 individual respectively. Statistical analysis showed significant differences between the duration period as well as the average of total consumption per larvae for the larval stage under the three constant temperature degrees.

Table (7) Influence of three constant temperature degrees on duration period of the larval stage and predaceous efficiency of *R. cardinalis* reared on third nymphal instar of *I. purchasi*

Biol. aspects Temp. degree	Duration in days	Average of total consumption
15 C^o	30.1 ± 0.56a	55.96 ± 1.3c
25 C^o	14.37 ± 1.6b	107.53 ± 6.2a
30 C^o	9.24 ± 1.95c	87.16 ± 4.6b

Mean followed by the same letters in a column for each period are not significantly differences at 0.05level of probability (Dancan's Multiple Range Test).

Data illustrated in Table (8) revealed that the longevity; average of total consumption and fecundity per female under the three constant temperature. As a conclusion the average of longevity for female were reached 66.07±3.7, 42.5±2.1 and 32.15±1.92 days and for the male 45.96±2.4, 28.57±1.98 and 23.92±1.42 under the three constant temperature degrees respectively. Meanwhile the average total consumption per female was 389.28±8.35, 348.82±8.1 and 284.3±7.96 individuals while that was 210±3.42, 201.74±5.96 and 176.35±3.46 individuals per the male of this predator and the three constant temperatures respectively. The number of deposited eggs per female was 156±3.9, 455.79±10.17 and 310.75±8.56 under the three constant temperature statistical analysis showed significant differences between the longevity period for female and male as well as the average of total consumption and the number of deposited eggs per female and the three constant temperature degrees. In conclusion the optimum temperature for mass rearing of this predator was 25 C^o because the number of deposited eggs per female the feeding capacity was the highest in comparison with the other temperature degrees.

Table (8) Influence of three constant temperature degrees on the longevity; predator efficiency and fecundity of *R. cardinalis* adults reared on the third nymphal instar of *I. purchasi*.

Biol.aspects Temp. degree	Longevity		Average of total consumption		Fecundity
	Female	Male	Female	Male	Female
15 C°	66.07± 3.7a	45.96± 2.4a	389.28± 8.35a	210± 3.42a	156± 3.9c
25 C°	42.5± 2.1b	28.57± 1.98b	348.82± 8.1b	201.74± 5.96a	455.79± 10.17a
30 C°	32.15± 1.92c	23.92± 1.42bc	284.3± 7.96c	176.35± 3.46b	310.75± 8.56b

Mean followed by the same letters in a column for each period are not significantly differences at 0.05level of probability (Dancan's Multiple Range Test).

The obtained results are in agreement with those by Ibrahim (2005); Grafton *et al.* (2005); Awadalla (2013) and Abdel-Salam *et al.* (2013).

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تـأثير درجـات الحرارة الثابتـة علـى بعض الخصـائص البيولوجيـة لمفترس الفيداليا (Mulsant) *Rodolia cardinalis* رتبة غمدية الأجنحة فصيلة أبو العيد.

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أجريت تجارب معملية فى معمل تربية الحشرات بقسم الحشرات الإقتصادية كلية الزراعة جامعة المنصورة فى الفترة من بداية اكتوبر 2011 و حتى نهاية سبتمبر 2012 تحت ثلاث درجـات حرارة ثابتـة هـى 15 م⁰ , 25 م⁰ و 30 م⁰ لدراسـة تأثيرهـا علـى بعض الخصـائص البيولوجية لمفترس الفيداليا عندما تمت تغذيته على حوريات العمر الثالث للبق الدقيقى الإسترالى. و لقد أوضحت النتـائج المتحصـل عليها أن متوسط الأعـداد التـى تغذت عليهـا اليرقـة الواحدة هـى 55.96±1.3 فردا عند تربيتها على درجة حرارة ثابتة 15 م⁰ خلال فترة تطورها و التى بلغت 30.1±0.56 يوما و كانت النسبة المئوية للموت خلال فترة الأعمار اليرقية الأربعـة كـالآتى 20.5 , 13.9 , 6.9 , 5.6 % على التوالى. و أن أنثى المفترس تغذت بمتوسط 389.28±5.7 فردا من العمر الحورى الثالث للبق الدقيقى الإسترالى خلال فترة حياتها و التى بلغت 66.07±3.7 يومـا و أن جملة ما وضعتة الأنثى من البيض بلغ 156±3.9 بيضة و أن الذكر تغذى طول فترة حياته على 210.75±3.42 حورية و كذلك أظهرت النتائج أن متوسط ما تغذت عليه اليرقة الواحدة كان 107.53±6.2 حورية عمر ثالث من البق الدقيقى الإسترالى عند تربية هذا المفترس علـى درجـة حرارة ثابتـة 25 م⁰ و رطوبـة نسبية 70 % خـلال فترة العمر اليرقـى للمفترس و التـى بلغت 14.37±1.6 يومـا و أن نسبة الموت للأعمـار اليرقية الأربعـة كانت 13.4 , 9.1 , 4.5 , 3.7 %, لقد تغذت أنثى هذا المفترس على 348.82±8.56 حورية عمر ثالث للبق الدقيقى الإسترالى خـلال فتـرة حياتهـا و التـى بلغت 42.5±2.1 يومـا و أن متوسـط مـا وضعتـه الأنثـى هـى 455.79±10.17 بيضة و أن متوسط مـا تغذى عليه ذكر هذا المفترس هو 201.74±5.96 حورية كما أظهرت النتائج أنه عند تربية هذا المفترس على 30 م⁰ كان متوسط ما تغذت عليه اليرقة 87.16±4.6 حورية عمر ثالث خلال فترة حياة هذه اليرقة و التى بلغت 9.24 يوما و أن نسبة الموت كانت 14.2 , 10.4 , 5.7 , 4.5 % للأعمار اليرقية الأربعة على التوالى و جملة ما تغذت عليه أنثى المفترس كانت 248.3±7.96 حورية خـلال فترة حياتها و التـى بلغت 32.15±1.92

يوما و أن متوسط ما وضعتة الأنثى من البيض 310.75±8.56 بيضة و لقد تغذى الذكر خلال فترة حياته على 176.35±5.46 حورية.

ولقد أكد التحليل الإحصائى وجود فروق معنوية بين فترات نمو اليرقات و متوسط الإستهلاك الكلى لكل يرقة عند التربية على درجات الحرارة الثابتة الثلاثة كذلك أظهر التحليل الإحصائى وجود فروق معنوية بين فترة حياة الأطوار الكاملة و كذلك متوسط الإستهلاك الكلى لها و أيضا متوسط كمية البيض التى وضعتها الإنثى عند كل درجة حرارة ثابتة و لقد أوضحت الدراسة أن درجة الحرارة المثلى لتربية خنفساء الفيداليا على البق الدقيقى 25 ±1م لأن الأنثى وضعت عندها أعلى كمية من البيض و كانت الكفاءة الإفتراسية عالية للأطوار اليرقية و الحشرات الكاملة بالمقارنة بدرجات الحرارة الأخرى.

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