

STUDIES ON THE EFFECT OF CONSTANT TEMPERATURE DEGREES AND SOME MEALYBUG SPECIES AS PREYS ON THE BIOLOGICAL ASPECTS OF *Nephus includens* (KIRSCH) (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 February 2012 till the end of March 2013 under three constant temperature degrees (20 ± 1 , 25 ± 1 and $30\pm 1^{\circ}\text{C}$) to study the influence of three constant temperature degrees on certain biological characteristics of the coccinellid predator *Nephus includens* (Kirsch) when reared on the third nymphal instars of *Planococcus citri* Risso, *Icerya seychellarum* (Westwood) and *Maconellicoccus hirsutus* (Green). The data cleared that with increasing the temperature degrees the duration periods of the immature stages decreased, with significant differences. The obtained results revealed that the average of total consumption per larva was the highest at $25\pm 1^{\circ}\text{C}$ and when this predator fed on the mealybug species *P. citri* during its larval stage. The results revealed that, the longevity of the predator adult stage decrease with increasing the temperature degrees, also it can be noticed that, the highest consumption rate per female at $30\pm 1^{\circ}\text{C}$ comparing with the other temperature degrees. The number of deposited eggs per female was the highest 185.74 ± 1.92 eggs when this predator female reared on *P. citri* at $25\pm 1^{\circ}\text{C}$. As a conclusion the best mealybug species for the mass rearing this predator on *P. citri* at $25\pm 1^{\circ}\text{C}$ comparing with the other tested mealybug species and the other temperature degrees.

Keywords: *Nephus includens* (Kirsch) *Planococcus citri* Risso ; *Icerya seychellarum* (Westwood); and *Maconellicoccus hirsutus* (Green) Constant temperature degrees, Biological aspects.

INTRODUCTION

Several mealybug species are pests of citrus, fruit trees, ornamental plants and grapevine in Egypt. The cottony-cushion scale, *Icerya purchasi* Maskell, the Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglas), the seychellarum mealybug, *Icerya seychellarum* (Westwood); *Planococcus citri* Risso and *Maconellicoccus hirsutus* (Green); are important pests in many locations of the world especially in tropical and subtropical countries. Their high harmfulness is mainly due to the absence of effective entomophagous insects which could reduce their numbers (Hamed and Saad 1989; Abd-Rabou 2001; Esfandiari and Mossadegh 2007 and Abdel-Salam *et al.* 2010). *Nephus includens* (Coleoptera: Coccinellidae) is an important indigenous predator of mealybugs (Homoptera: Pseudococcidae) Kontodimas *et al.* (2007). Several studies drew attention to the importance of this coccinellid

species as a predator. This coccinellid predator could make a good candidate for rearing and release in pest hot spot infestations in open fields because it has a good searching activity and high consumption rate (Izhevsky and Orlinsky 1998; Kontodimas *et al.* 2004a; Kontodimas *et al.* 2004b; Omakar and James 2004; Kontodimas *et al.* 2007 Awadalla, Hagar 2010; Abdel-Salam *et al.* 2013 and Awadalla, Hagar 2013). In Egypt, few information is available on the influence of different temperature degrees and prey types 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, consumption rate, longevity, fecundity of this predator to measure these parameters for mass rearing and release. Therefore, the objective of this investigation was aimed to study the influence of different constant temperature degrees and mealybug species as preys on the biological characteristics of this coccinellid predator *N. includens* under laboratory conditions.

MATERIALS AND METHODS

Laboratory experiments were carried out in the Insectary of Economic Entomology Department Faculty, of Agriculture, Mansoura University, from the beginning of February 2012 till the end of March 2013 under three constant temperature degrees (20 ± 1 , 25 ± 1 and $30\pm 1^\circ\text{C}$). To obtain a culture from *Nephus includens* (Kirsch) 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 *Planococcus citri* Risso, *Icerya seychellarum* (Westwood) and *Maconellicoccus hirsutus* (Green) and transferred to Laboratory until emergence of the adults. Newly deposited eggs of this predator was divided into three group; each group consisted of 70 eggs each group of the eggs was kept at one of the following constant temperature degrees 20 ± 1 , 25 ± 1 and $30\pm 1^\circ\text{C}$ as well as $70\pm 5\%$ 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 *P. citri*, *I. seychellarum* and *M. hirsutus* nymphs each group of the larvae was kept at one of the following constant temperature degrees (20 ± 1 ; 25 ± 1 ; $30\pm 1^\circ\text{C}$). A piece 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 *P. citri*, *I. seychellarum* and *M. hirsutus* species were offered and the devoured individuals were replaced daily for *N. includens*. A small leaflet from ficus or guava replaced daily as a food for the third nymphal instar of these mealybug species. Attacked 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. Known numbers of *P. citri*, *I. seychellarum* and *M. hirsutus* nymphs were offered daily on a ficus or guava leaflet to predator adults. Counting and removing the undevooured nymphs in

Petri dish were practiced before introducing the new nymph individuals. After five or six days from 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 *N. includens* adult when reared on *P. citri*, *I. seychellarum* and *M. hirsutus* nymphs were subject for one way analysis of variance (Anova) and the means were separated using Duncan's Multiple Rang Test (Cohrot Software 2004).

RESULTS AND DISCUSSION

I: The biological aspects of the predator *N. includens*

1.1. Rearing on the three mealybug species under 20±1°C

A: Immature stages

The obtained results in Table (1) showed that the duration period of the larval stage of the predator *N. includens* when reared at 20±1°C and fed on the third nymphal instar of *P. citri*; *I. seychellarum* and *M. hirsutus* lasted 14.96±0.64; 17.89±0.72 and 19.04±0.85 days respectively. The average of the total consumption during the larval stage when reared on *P. citri*; *I. seychellarum* and *M. hirsutus* as preys reached 105.71±1.96; 119.67±2.1 and 91.56±1.3 individuals respectively. The duration period of the pupal stage was lasted 11.52±0.5; 11.96±0.57 and 12.1±0.73 days when this predator was fed on the three tested preys. The total development time of the immature stages was 36.01±1.96; 39.46±2.15 and 40.99±2.72 days when this predator reared on the three mealybug species, with significant differences.

Table (1): uration periods; average total consumption of the immature stages of the coccinellid *N. includens* when reared on some mealybug species at 20±1°C and 70±5% R.H.

Immature stage Preys species	Eggs incubation	Larval stage		Pupal stage	Egg- Adult
		Duration in days	Average of total consumption		
<i>P. citri</i>	9.53± 0.4a	14.96± 0.64c	105.71 ±1.96b	11.52± 0.5a	36.01± 1.96ab
<i>I. seychellarum</i>	9.64± 0.46a	17.89± 0.72b	119.67± 2.1a	11.96± 0.57a	39.46± 2.15a

<i>M. hirsutus</i>	9.85± 0.53a	19.04± 0.85a	91.56± 1.3c	12.1± 0.73a	40.99± 2.72a
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Mean followed by the same letters in a column for each period are not significantly differences at 0.05level of probability (Duncan's Multiple Range Test).

B: Adult stage

Data represented in Table (2) cleared that the female longevity when the predator fed on *P. citri*; *I. seychellarum* and *M. hirsutus* lasted 84.76±1.96 ; 87.35±2.17 and 80.27±1.85 days respectively, while that was lasted for the adult male 64.78±2.1; 72.65±2.46 and 61.42±1.95 days respectively. The obtained results showed that the total consumption for the predator female during its longevity period were 420.82±5.1; 345.87±4.26 and 244.62±3.9 individuals when the predator fed on *P. citri*; *I. seychellarum* and *M. hirsutus* respectively. The average of the total consumption for the predator adult male was 240.86±2.84; 215.73±2.15 and 160.21±1.78 individuals when this predator reared on the three mealybug species. The number of deposited eggs per predator female was averaged 102.52±1.51; 77.73±1.16 and 49.27±1.1 eggs, when this predator reared on the three obviously mealybug species with significant differences.

Table (2): Longevity; average total consumption and Fecundity of the coccinellid *N. includens* when reared on certain mealybug species under constant temperature at 20±1°C and 70±5% R.H..

Preys species	Female			Male	
	Longevity	Average of total consumption	Fecundity	Longevity	Average of total consumption
<i>P. citri</i>	84.76± 1.96ab	420.82± 5.1a	102.52± 1.51a	64.78± 2.1b	240.86± 2.84a
<i>I. seychellarum</i>	87.35± 2.17a	345.87± 4.26b	77.43± 1.16b	72.65± 2.46a	215.73± 2.15b
<i>M. hirsutus</i>	80.27± 1.85c	244.62± 3.9c	49.27± 1.1c	61.42± 1.95b	160.21± 1.78c

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

1.2. Rearing on the three mealybug species at 25±1 °C

A: Immature stages

The obtained results in Table (3) showed that the duration period of the larval stage of the predator *N. includens* when reared at 25±1°C and fed on the third nymphal instar of *P. citri*; *I. seychellarum* and *M. hirsutus* lasted 12.13±0.57; 15.1±0.84 and 16.75±1.1 days respectively. The average of the total consumption during the larval stage reared on *P. citri*; *I. seychellarum* and *M. hirsutus* as preys reached 125.71±2.54; 140.6±2.96 and 110.47±1.79 individuals respectively. The duration period of the pupal stage was lasted 9.75±0.45; 10.26±0.52 and 10.73±0.54 days when this predator was fed on the three tested preys. The total developmental time of the immature stages was 28.63±1.27; 32.27±1.74 and 34.43±1.93 days when fed on the three mealybug species, with significant differences.

Table (3): Duration periods; average total consumption of the immature stages of the coccinellid *N. includens* when reared on some mealybug species at 25±1°C and 70±5% R.H..

Immature stage Preys species	Eggs incubation	Larval stage		Pupal stage	Egg-Adult
		Duration in days	Average of total consumption		
<i>P. citri</i>	6.75±0.24a	12.13±0.57c	125.71±2.54b	9.75±0.45a	28.63±1.27c
<i>I. seychellarum</i>	6.91±0.3a	15.1±0.84ab	140.6±2.96a	10.26±0.52a	32.27±1.74ab
<i>M. hirsutus</i>	6.95±0.33a	16.75±1.1a	110.47±1.79c	10.73±0.54a	34.43±1.93a

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

B: Adult stage

Data represented in Table (4) cleared that the female longevity when the predator fed on *P. citri*; *I. seychellarum* and *M. hirsutus* lasted 73.46±1.81 ; 75.62±1.95 and 71.51±1.56 days respectively, while that was lasted for the adult male 59.62±1.51; 61.51±1.97 and 56.42±1.32 days respectively. The obtained results showed that the total consumption for the predator female during its longevity period were 564.73±6.84; 407.21±6.15 and 280.62±3.7 individuals when the predator reared on *P. citri*; *I. seychellarum* and *M. hirsutus* respectively. The average of total consumption for the predator adult male was 378.5±3.15; 305.96±2.84 and 188.46±1.56 individuals when this predator reared on the three mealybug species. The number of deposited eggs per predator female was averaged 185.74±1.92; 109.46±1.54 and 71.35±1.1 eggs, when this predator reared on the three obviously mealybug species.

Table (4): Longevity; average total consumption and Fecundity of the coccinellid *N. includens* when reared on certain mealybug species under constant temperature at 25±1°C and 70±5% R.H..

Adults Preys species	Female			Male	
	Longevity	Average of total consumption	Fecundity	Longevity	Average of total consumption
<i>P. citri</i>	73.46± 1.81b	564.73± 6.84a	185.74± 1.92a	59.62± 1.51b	378.5± 3.15a
<i>I. seychellarum</i>	75.62± 1.95a	407.21± 6.15b	109.46± 1.54b	61.51± 1.97a	305.96± 2.84b
<i>M. hirsutus</i>	71.51± 1.56b	280.62± 3.7c	71.35± 1.1c	56.42± 1.32b	188.46± 1.56c

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

1.3. Rearing on three mealybug species at 30±1°C

A: Immature stages

The obtained results in Table (5) showed that the duration period of the larval stage of the predator coccinellid *N. includens* when reared at 30±1°C and fed on the third nymphal instar of *P. citri*; *I. seychellarum* and *M. hirsutus* lasted 10.76±0.46 ; 11.95±0.51 and 12.7±0.69 days respectively. The average of the total consumption during the larval stage when this predator reared on the three obviously mealybug species as preys reached

107.6±2.57; 121.89±3.1 and 102.87±2.71 individuals respectively. The duration period of the pupal stage was lasted 8.54±0.36; 8.86±0.42 and 9.24±0.56 days. The total development time of the immature stages was 24.25±1.3; 25.53±1.46 and 26.74±1.57 days on the three mealybug species, with significant differences.

Table (5): Duration periods; average total consumption of the immature stages of the coccinellid *N. includens* when reared on some mealybug species at 30±1°C and 70±5% R.H..

Immature stage Preys species	Eggs incubation	Larval stage		Pupal stage	Egg-Adult
		Duration in days	Average of total consumption		
<i>P. citri</i>	4.65± 0.17a	10.76± 0.46ab	107.6± 2.57ab	8.54± 0.36a	24.25± 1.3ab
<i>I. seychellarum</i>	4.72± 0.19a	11.95± 0.51a	121.89± 3.1a	8.86± 0.42a	25.53± 1.46a
<i>M. hirsutus</i>	4.8± 0.2a	12.7± 0.69a	102.87± 2.71b	9.24± 0.56a	26.74± 1.57a

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

B: Adult stage

Data represented in Table (6) cleared that the female longevity when the predator fed on *P. citri*; *I. seychellarum* and *M. hirsutus* lasted 64.85±1.46 ; 66.41±1.84 and 65.17±2.1 days respectively, while that was lasted for the adult male 51.24±1.15; 55.71±1.18 and 53.8±1.62 days respectively. The obtained results showed that the total consumption for the predator female during its longevity period were 486.38±5.67; 398.46±3.48 and 260.68±3.1 individuals respectively. The average of total consumption for the predator adult male was 307.38±2.85; 278.55±2.15 and 172.16±1.67 individuals when this predator reared on the three mealybug species. The number of deposited eggs per predator female was averaged 115.84±1.76; 82.6±1.5 and

50.67±0.91 eggs, when this predator reared on the three obviously mealybug species.

Table (6): Longevity; average total consumption and Fecundity of the coccinellid *N. includens* when reared on certain mealybug species under constant temperature at 30±1°C and 70±5% R.H..

Adults Preys species	Female			Male	
	Longevity	Average of total consumption	Fecundity	Longevity	Average of total consumption
<i>P. citri</i>	64.85± 1.46a	486.38± 5.67a	115.84± 1.76a	51.24± 1.15ab	307.38± 2.85a
<i>I. seychellarum</i>	66.41± 1.84a	398.46± 3.48b	82.6± 1.5b	55.71± 1.18a	278.55± 2.15b
<i>M. hirsutus</i>	65.17± 2.1a	260.68± 3.1c	50.67± 0.91c	53.8± 1.62a	172.16± 1.67c

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

II: Influence of constant temperature degrees and mealybug species as preys on some biological aspects of *N. includens*

Data represented in Table (7) cleared that the larval stage of the predator *N. includens* when reared on the three mealybug species under constant temperature of 20±1°C lasted an average of 14.96±0.64; 17.89±0.72 and 19.04±0.85 days respectively. The average of the total consumption for larval stage when this predator fed on the obviously mealybug species reached 105.71±1.96; 119.67±2.1 and 91.56±1.3 individuals respectively, with highly significant differences. Meanwhile, results showed that, the duration period of the larval stage of *N. includens* was lasted 12.13±0.57; 15.1±0.84 and 16.75±1.1 days when reared on *P. citri*, *I. seychellarum* and *M. hirsutus* at 25±1°C respectively. Average of total consumption during the larval stage when this predator fed on the three tested mealybug species were 125.71±2.54; 140.6±2.96 and 110.47±1.79 individuals respectively. The obtained results showed that the larval stage lasted 10.76±0.46; 11.95±0.51 and 12.7±0.69 days when this predator fed on the three tested mealybug species at 30±1°C. The average of the total consumption per larva was

107.6±2.57; 121.89±3.1 and 102.82±2.71 individuals respectively, with highly significant differences. The data cleared that with increasing the temperature degrees the duration periods of the immature stages decreased with significant differences. The obtained results revealed that the average of total consumption per larva was the highest at 25±1°C and when fed the mealybug species on *P. citri* during its larval stage.

Table (7) Influence of constant temperature degrees and some mealybug species on some biological aspects of the predator *N. includens* immature stages.

Temp. degrees	Mealybug species	Immature stages				Egg-Adult
		eggs	Larval stages		Pupal stage	
			Average duration	Average consumption		
20 °C	<i>P. citri</i>	9.53± 0.4	14.96± 0.64	105.71 ±1.96	11.52± 0.5	36.01± 1.96
	<i>I. seychellarum</i>	9.64± 0.46	17.89± 0.72	119.67± 2.1	11.96± 0.57	39.46± 2.15
	<i>M. hirsutus</i>	9.85± 0.53	19.04± 0.85	91.56± 1.3	12.1± 0.73	40.99± 2.72
25 °C	<i>P. citri</i>	6.75± 0.24	12.13± 0.57	125.71± 2.54	9.75± 0.45	28.63± 1.27
	<i>I. seychellarum</i>	6.91± 0.3	15.1± 0.84	140.6± 2.96	10.26± 0.52	32.27± 1.74
	<i>M. hirsutus</i>	6.95± 0.33	16.75± 1.1	110.47± 1.79	10.73± 0.54	34.43± 1.93
30 °C	<i>P. citri</i>	4.65± 0.17	10.76± 0.46	107.6± 2.57	8.54± 0.36	24.25± 1.3
	<i>I. seychellarum</i>	4.72± 0.19	11.95± 0.51	121.89± 3.1	8.86± 0.42	25.53± 1.46
	<i>M. hirsutus</i>	4.8± 0.2	12.7± 0.69	102.87± 2.71	9.24± 0.56	26.74± 1.57

Canhilal *et al.* (2001) mentioned that the developmental times of eggs, 1st, 2nd, 3rd, 4th, larval instar, pupa and total (egg-adult) of *N. includens* when reared on *P. citri* were 7.3, 3.3, 2.3, 2.6, 3.6, 12.3 and 31.4 days at 25°C, while at 30°C, they were 5.4, 3.0, 2.0, 2.2, 3.1, 8.9 and 24.6 days. Meanwhile, Kontodimas *et al.* (2004a) reared *N. includens* on *P. citri* on *Citrus aurantium* leaves and found that the durations of eggs, 1st, 2nd, 3rd, 4th larval instar, pre-pupa and pupa were 7.84±1.05, 2.7±0.58, 2.0±0.25, 2.22±0.25, 3.96±0.43, 1.56±0.42, and 7.98±0.59 days at 25°C, while at 30°C, they were 5.16±0.49, 2.08±0.24, 1.54±0.35, 1.88±0.36, 3.42±0.45, 1.34±0.35, and 5.10±0.5 days. Abdel-Salam *et al.* (2010) found that, the total

developmental time of *N. includens* immature stages was 26.3, 25.9 and 28.2 days when this predator reared on *I. purchasi*; *I. aegyptiaca* and *I. seychellarum* respectively at 28 °C, with significant differences.

Table (8) Influence of constant temperature degrees and some mealybug species on some biological aspects of the predator *N. includens* adult stages.

Temp. degrees	Mealybug species	Adult stages				
		Female			Male	
		Longevity	Average of consumption	Fecundity	Longevity	Average of consumption
20 °C	<i>P. citri</i>	84.76± 1.96	420.82± 5.1	102.52± 1.51	64.78± 2.1	240.86± 2.84
	<i>I. seychellarum</i>	87.35± 2.17	345.87± 4.26	77.43± 1.16	72.65± 2.46	215.73± 2.15
	<i>M. hirsutus</i>	80.27± 1.85	244.62± 3.9	49.27± 1.1	61.42± 1.95	160.21± 1.78
25 °C	<i>P. citri</i>	73.46± 1.81	564.73± 6.84	185.74± 1.92	59.62± 1.51	378.5± 3.15
	<i>I. seychellarum</i>	75.62± 1.95	407.21± 6.15	109.46± 1.54	61.51± 1.97	305.96± 2.84
	<i>M. hirsutus</i>	71.51± 1.56	280.62± 3.7	71.35± 1.1	56.42± 1.32	188.46± 1.56
30 °C	<i>P. citri</i>	64.85± 1.46	486.38± 5.67	115.84± 1.76	51.24± 1.15	307.38± 2.85
	<i>I. seychellarum</i>	66.41± 1.84	398.46± 3.48	82.6± 1.5	55.71± 1.18	278.55± 2.15
	<i>M. hirsutus</i>	65.17± 2.1	260.68± 3.1	50.67± 0.91	53.8± 1.62	172.16± 1.67

The obtained results in Table (8) revealed that, the longevity for female when reared on the three mealy bug species under constant temperature of 20±1°C lasted an average of 84.76±1.96; 87.35±2.17 and 80.27±1.85 days respectively, while the longevity period for the male reached 64.78±2.1; 72.65±2.46 and 61.42±1.95 days respectively. The average of the total consumption per female was reached 420.82±5.1; 345.87±4.26 and 244.62±3.9 individuals at 20±1°C respectively with highly significant differences. Also for adult male reached 240.86±2.84; 215.73±2.15 and 160.21±1.78 individuals respectively with highly significant differences. The number of deposited eggs per female was 102.52±1.51; 77.43±1.16 and 49.27±1.1 eggs when the predator female fed on the three tested mealybug species respectively with highly significant temperature.

The longevity for female when reared on the three mealy bug species under constant temperature of 25±1°C lasted an average of 73.46±1.81; 75.62±1.95 and 71.51±1.56 days respectively, while the longevity period for the male reached 59.62±1.51; 61.51±1.97 and 56.42±1.32 days

respectively. The average of the total consumption per female was reached 564.73 ± 6.84 ; 407.21 ± 6.15 and 280.62 ± 3.7 individuals at $25 \pm 1^\circ\text{C}$ respectively with highly significant differences. Also the adult was male reached 378.5 ± 3.15 ; 305.96 ± 2.84 and 188.46 ± 1.56 individuals respectively with highly significant differences. The number of deposited eggs per female was 185.74 ± 1.92 ; 109.46 ± 1.54 and 71.35 ± 1.1 eggs when the predator female fed on the three tested mealy bug species respectively.

The longevity for female when reared on the three mealy bug species under constant temperature of $30 \pm 1^\circ\text{C}$ lasted an average of 64.85 ± 1.46 ; 66.41 ± 1.84 and 65.17 ± 2.1 days respectively, while the longevity period for the male reached 51.24 ± 1.15 ; 55.71 ± 1.18 and 53.8 ± 1.62 days respectively. The average of the total consumption per female was reached 486.38 ± 5.67 ; 398.46 ± 3.48 and 260.68 ± 3.1 individuals at $30 \pm 1^\circ\text{C}$ respectively with highly significant differences. Also the adult male was reached 307.38 ± 2.85 ; 278.55 ± 2.15 and 172.16 ± 1.67 individuals respectively with highly significant differences. The number of deposited eggs per female was 115.84 ± 1.76 ; 82.6 ± 1.5 and 50.67 ± 0.91 eggs when the predator female fed on the three tested mealybug species respectively. The obtained results in Table (8) revealed that, the longevity of the predator adult stage decreased with increasing the temperature degrees, also it can be noticed that, the highest consumption rate per female at $30 \pm 1^\circ\text{C}$ comparing with the other temperature degrees. The number of deposited eggs per female was the highest 185.74 ± 1.92 eggs when this predator female reared on *P. citri* at $25 \pm 1^\circ\text{C}$. As a conclusion the best mealybug species for the mass rearing of this predator was *P. citri* at $25 \pm 1^\circ\text{C}$ comparing with the other mealybug species and the other temperature degrees.

Canhilal *et al.* (2001) mentioned that the mean longevity of pre-oviposition, oviposition, post-oviposition, total longevity periods of *N. includens* when fed on *P. citri* were 5.7, 45.8, 21.7, and 70.0 days at 25°C while at 30°C they were 4.6, 41.2, 21.1, and 69.0 days. The mean longevity of males was 78.0, and 77.0 days at 25 and 30°C , respectively. The mean number of eggs/female and mean number of eggs/female/days were 133.5, and 2.4 eggs at 25°C , while at 30°C , they were 123.0 and 2.1 eggs. Kontodimas *et al.* (2004a) reared *N. includens* on *P. citri* on *Citrus aurantium* leaves and found that the duration of pre-oviposition period (adult-egg), total immature (egg-adult) and biological cycle (egg-egg) were 5.62 ± 0.46 , 28.26 ± 1.66 and 33.88 ± 1.49 days at 25°C , while at 30°C they were 4.62 ± 0.36 , 20.52 ± 1.11 and 25.14 ± 1.3 days. Moreover Kontodimas *et al.* (2007) reported that the average longevity of *N. includens* at 25, 30, and 32.5°C were 69.5, 61.1 and 49.6 days, respectively and the average fecundity was 126.8; 108.5 and 87.4 eggs per female at the same temperature degrees. Abdel-Salam *et al.* (2010) found that the predator *N. includens* when reared on *I. seychellarum* under constant temperature of 28°C the total longevity and fecundity per female 60.17 ± 5.20 days and 50.67 ± 4.79 eggs respectively.

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دراسات على تأثير درجات الحرارة الثابتة و بعض أنواع البق الدقيقى كفرائس على بعض الخصائص البيولوجية لمفترس *Nephus includens* (Krisch) 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 فبراير 2012 و حتى نهاية مارس 2013 تحت ثلاث درجات حرارة ثابتة هى 20 م⁰ , 25 م⁰ و 30 م⁰ لدراسة تأثيرها على بعض الخصائص البيولوجية لمفترس *Nephus includens* عندما تمت تغذيته على حوريات العمر الثالث لثلاثة أنواع من البق الدقيقى و هى *Planococcus citri* Risso و *Icerya seychellarum* (Westwood) و *Maconellicoccus hirsutus* Green و أوضحت النتائج أنه عند الارتفاع التدريجى لدرجات الحرارة فإن مدة الأطوار الغير كاملة للمفترس تكون قصيرة بمعنوية واضحة. كما أظهرت النتائج المتحصل عليها أن متوسط ما استهلكته اليرقة الواحدة كان أعلى عند درجة حرارة 25 م⁰ عندما تغذت هذه اليرقات على نوع بق الموالح الدقيقى *P. citri* خلال فترة أعمارها اليرقية و كذلك أكدت النتائج أن فترة حياة الأطوار الكاملة نقصت بارتفاع أو زيادة درجات الحرارة تدريجيا و كان أعلى استهلاك لها عند درجة حرارة 30 م⁰ بالمقارنة بدرجات الحرارة الأخرى و لقد وضعت اناث هذا المفترس أعلى كمية من البيض حيث وصلت إلى 1.92±185.74 بيضة للانثى الواحدة عند تربية هذه الاناث على درجة حرارة 25 م⁰ و تنصح الدراسة أن أفضل نوع من البق الدقيقى للتربية المكثفة لمفترس أبو العيد *N. includens* هو بق الموالح الدقيقى *P. citri* على درجة حرارة 25 م⁰ بالمقارنة بأنواع البق الدقيقى المختبرة و درجات الحرارة الأخرى.

قام بتحكيم البحث

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