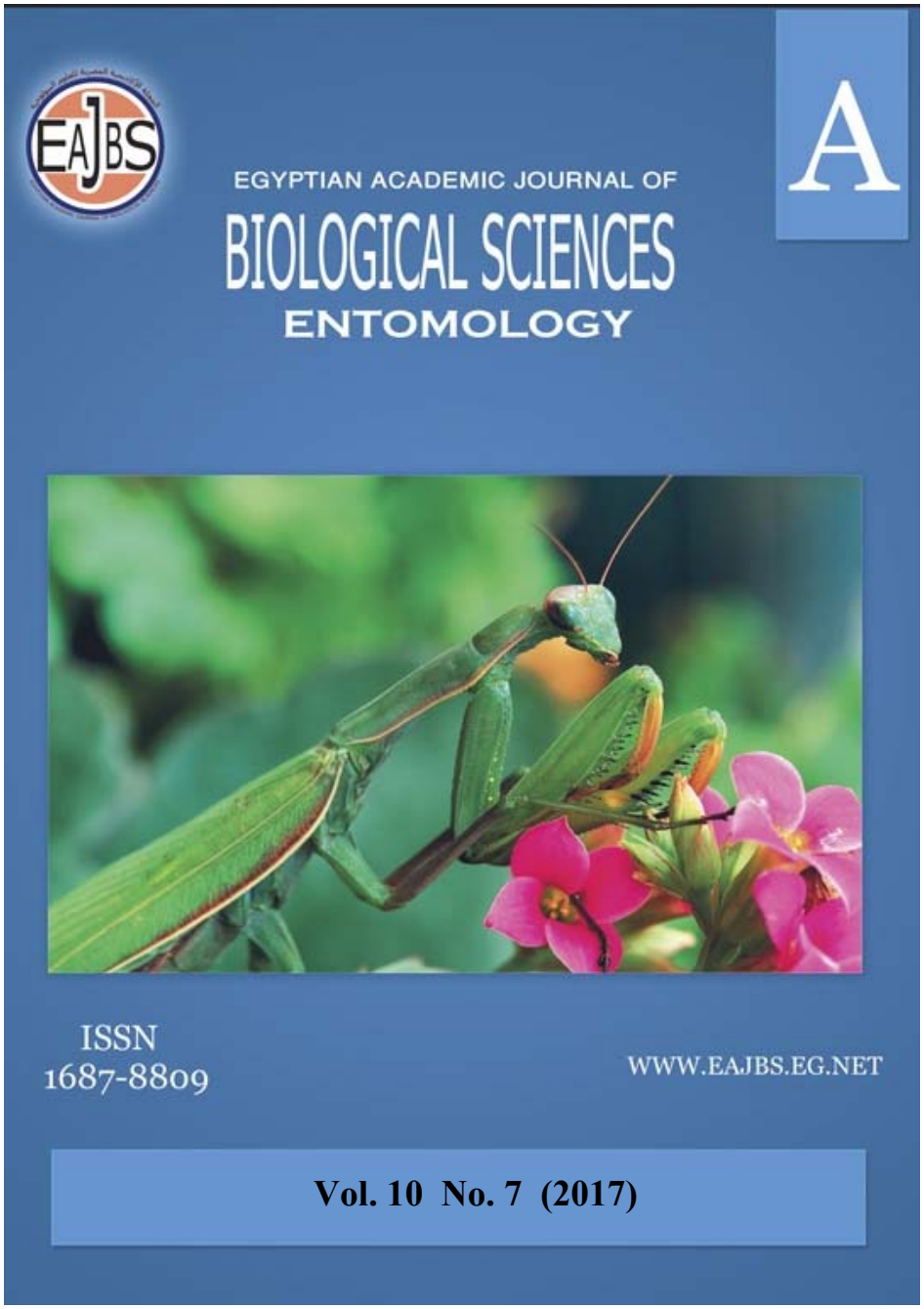

Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences, Department of Entomology, Faculty of Sciences Ain Shams University.

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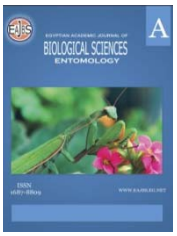
www.eajbs.eg.net

Egypt. Acad. J. Biolog. Sci., 10(7): 31–40 (2017)

Egyptian Academic Journal of Biological Sciences
A. Entomology

ISSN 1687- 8809
www.eajbs.eg.net



Relationship Between Developmental Stages of Predator *nephus includens* (kisch) (coleoptera: coccinellidae) Reared on Certain Mealy Bug Species and the Required Thermal Units.

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ARTICLE INFO
Article History
Received: 9/10/2017
Accepted:10/11/2017

Keywords:
Nephus includens, Planococcus citri, *Icerya seychellarum, Maconellicoccus hirsutus*, biology, heat unit.

BSTRACT

The present work was conducted to study the relationship between the developmental stages of the predator *Nephus includens* (Kisch) (Coleoptera: Coccinellidae) and the required thermal units at three constant temperatures, (20, 25 and 30ºC) on certain mealy bug species (*Planococcus citri* Risso, *Icerya seychellarum* (Westwood) and *Maconellicoccus hirsutus* (Green).

The results indicated that, the duration of the predator was longer at 20ºC. As temperature increased from 20-30ºC the longevity decreased, the lower thermal threshold for the development of *N. includens* 10.9, 10.6 and 11.1ºC for eggs , 6.4, 2.1 and 0.7ºC for larvae, 8.4, 5.6 and 11.9ºC for pupa while it were 0.1, 3.2 and 1.9ºC for the total duration from (egg to adult). The heat units requirement for the development of eggs were 90.1, 92.4 and 91.5 DD's , for larvae were 387.7, 328.1 and 382.5 DD's, for the pupa 325.8, 308.1 and 390.1 DD's while it were 713.8, 674.2 and 765.3 DD's for the development period of *P. citri, I. seychellarum* and *M. hirtsutus* respectively. The lower thermal threshold for longevity (female and male) of *N. includens* were 12.8 & 18.4, 10.9 and 13.2& 22.8 & 48.7, meanwhile, the heat units requirement for longevity of (female and male) were 2779.8 & 2513.7, 2709.9 and 2380.7 & 2432.4 & 4206.2 on the same mealy bug species, respectively. The average of total consumption per larva was the highest at 25 ± 1ºC and when this predator fed on the mealy bug species *P. citri* during its larval stage.

The results revealed that, the longevity of the predator adult stage decreased with increasing the temperature degrees. The highest consumption rate per female was at 30 ± 1ºC comparing with the other temperature degrees. The number of deposited eggs per female was the highest (185.74 ± 1.92 eggs) when female reared on *P. citri* at 25 ± 1ºC. Obtained results provide essential information for predicting the field population of the predator *N. includens*, releasing time on certain mealy bug species for controlling these pests and it's recommended to be an item of Integrated Pest Management Programs in Egyptian field designed to control certain mealy bug species.

INTRODUCION

Several mealy bug species are pests of citrus, fruit trees, ornamental plants and grapevine in Egypt. The cottony - cushion scale, Icerya purchasi Maskell, the Egyptian fluted mealy bug, *Icerya aegyptiaca* (Douglas), the seychellarum mealy bug, *Icerya seychellarum* (Westwood); *Planococcus citri* Risso and *Maconellicoccus hirsutus* (Green) ;(Hemiptera: Pseudococcidae) are important pests in many parts of the world especially in the tropical and subtropical regions. Their high harm 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* (Coleopetra: Coccinellidae) is an important indigenous predator of mealy bugs Kontodimas et al. (2007). 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.* 2004 a and b Kontodimas *et al.* 2004b; Omakar and James 2004; Kontodimas *et al.* 2007; Awadalla, Hagar(2010and2013) and Abdel-Salam *et al.* 2013). In Egypt, few informations are available on the influence of different temperatures degrees and prey types on the biological characteristics and life table parameters of the most important predators feeding on mealy bug species. However, scanty attention has been paid to the developmental time, consumption rate, longevity and fecundity of this predator to measure these parameters for mass rearing and release. Therefore, the objective of this investigation aimed to study the influence of different constant temperature degrees and mealy bug species as preys on the biological characteristics of this coccinellid predator (*N. includens*) under laboratory conditions(Mohamed *et al.*,2013).

MATERIALS AND METHODS

The present study was carried out in Plant Protection Research Institute, Sharkia Branch to evaluate the effect of temperature on the development of the predator *Nephus. includens* when reared on the third nymphal instars of *Planococcus citri, Icerya seychellarum* and *Maconellicoccus hirsutus*. The experiment was performed at three constant temperatures, (20 $\pm$ 1, 25 $\pm$ 1 and 30 $\pm$ 1ºC)a laboratory culture of mealy bug species were used.

Life cycle of *N. includens* on certain mealy bug species:

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 were used 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 $\pm$ 1; 25 $\pm$ 1 and 30 $\pm$ 1ºC). 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 mealy bug 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 dishs. Know 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 undevoured 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.

Statistical analysis:

The effect of temperatures (20 $\pm$ 1 , 25 $\pm$ 1 and 30 $\pm$ 1ºC) on developmental time of *N. includens* determined by analysis of variance (ANOVA). The relationship between temperature and mean developmental rate of each stage and generation under tested temperature was determined using liner regression. For each temperature, Development Rate (DR) was calculated as reciprocals of Development Time (DT) of individual *N. includens* stages (DR=1/DT). The relations between Developmental Rate (DR) and Temperature (T) was determined using linear regression equation:

$$DR = a + bT$$

where a, b are parameters of the linear regression.

The lower Developmental Threshold (LDT), i.e., the temperatures when development ceases was determined:

$$LDT=-a/b$$

On the other hand, Degree Days (DD's) for completion development of each stage was calculated according to Arnold (1959):

$$DD's = DT (T-to)$$

Where, TD is development time of a given stage, T is temperature in degree centigrade and to is the lower developmental threshold.

RESULTS AND DISCUSSION

On *Planococcus citri*: Temperature dependence of the predator *N. includens* development reared on *P. citri* .

Egg stage:

The incubation period of *N. includens* was 9.5 days at 20ºC, with increasing temperature, the developmental time of the egg stage decreased to 6.75 days at 25ºC and 4.63 days at 30ºC.

Larval stage:

At 20ºC, the development of larvae took 14.88 days and decreased to 12.13 days at 25ºC and 10.75 days at 30ºC.

The lower developmental threshold of *N. includens* larva was 6.40ºC and the thermal constant for their development was 387.7 DD's (Table 1).

Pupal stage:

At 20ºC, the development of pupa lasted 11.50 days, 9.75 days at 25ºC and 8.50 days at 30ºC respectively.

The lower developmental threshold of the predator *N. includens* pupa when reared on *P. citri* was 8.4ºC and the thermal constant for their development was 325.8 DD's Table (1).

Total development periods:

The data revealed that the total development period of *N. includens* was significantly shortest (23.88 days) at 30ºC and significantly longest (35.88 days) at 20ºC, when reared on *P. citri*.

Canhilal *et al.* (2001) mentioned that the developmental times of eggs, 1st , 2nd , 3rd , 4th , larval instars, 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 25ºC ,while at 30ºC, they were 5.4, 3.0, 2.0, 2.2, 3.1, 8.9 and 24.6 days.

According to the regression line equation the lower developmental threshold of *N. includens* was 0.1ºC and the thermal constant for their development was 713.8 DD's. Kontodimas *et al.,* (2004a) mentioned that the developmental zero (lower temperature threshold) was estimated to be 10.9 and 9.4 degrees C., and the thermal constant was 490.5 and 614.3 DD for *N. includens* and *N. bisignatus* respectively.

Longevity:

The average life span of adult female and male of *N. includens* decreased as the temperature increased from 84.63 and 64.38 days at 20ºC to 64.88 and 51.25 days at 30ºC, respectively.

According to the regression line equation, the lower developmental threshold of *N. includens* life span (female and male) 12.8 and 18.4ºC, the thermal constant for their development were 2779.8 and 2513.7 DD's respectively. 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 25ºC while at 30ºC 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 30ºC respectively. On the other hand, Kontodimas *et al.,* (2007) showed that the average longevity of females *N. bisignatus* were 99.5, 84.7, 69.5, 61.1, 49.6 and 30.1 days at temperatures (15, 20, 25 30, 32.5 and 35ºC).

Table (1). Effect of different temperature on *Nephus includens* when reared on *Planococcus citri*.

Variable	Temp. (ºC)	Eggs Incubation	Larval stage	Pupal stage	Egg-adults	Longevity	
						Female	Male
Duration DT	20	9.500a	14.875a	11.500a	35.875a	84.625a	64.375a
	25	6.750b	12.125b	9.750b	28.625b	73.500b	59.625b
	30	4.625b	10.750c	8.500b	23.875c	64.875c	51.250c
LSD 0.05		1.2065	1.1458	1.4452	1.0373	1.4452	1.0673
Rate DR	20	0.105	0.067	0.087	0.028	0.012	0.016
	25	0.148	0.082	0.103	0.035	0.014	0.017
	30	0.216	0.093	0.118	0.042	0.015	0.020
Regression values	Intercept a	0.121	0.016	0.026	0.002	0.005	0.007
	Slope b	0.011	0.003	0.003	0.001	0.001	0.001
	t_0(ºC)	10.9	6.4	8.4	0.1	12.8	18.4
	K (Degree days) DD	90.1	387.7	325.8	713.8	2779.8	2513.7
	R^2	0.983	0.989	1.000	1.000	1.000	0.955

DT: Developmental time in days
DR: Developmental rate
DD: Degree days
LDT: Lower developmental threshold
a: Intercept
b: Slope

On *Icerya seychellarum*: Temperature dependence of *N. includens* development reared on *I. seychellarum* is summarized in Table (2).

Egg stage:

The incubation period of *N. includens* was 9.63 days at 20ºC, with increasing temperature, the developmental time of the egg stage decreased to 6.57 days at 25ºC and to 4.71 days at 30ºC. The study revealed that the incubation period of *N. includens* were differ significantly between the values at 20 , 25 and 30ºC respectively.

Table (2) shows the rate of development of the different life history stages in relation to temperature expressed by the linear regression equation. According to the regression line equation the lower developmental threshold of *N. includens* eggs was 10.6ºC and the thermal constant for their development was 92.4 DD's.

Larvae stage:

At 20ºC , the development of larvae took 17.88 days and decreased to 15 days at 30ºC and to 11.57 days at 20ºC. The average duration of larval stage was highly significant differences between the values at 20, 25 and 30ºC respectively. The previously mentioned results are similar to Canhilal *et al.* (2001)

In the present study, the lower developmental threshold of *N. includens* larvae was 2.1ºC and the thermal constant for their development was 328.1 DD's (Table 2).

Pupal stage:

At 20ºC, the development of pupa lasted 11.88 days, 10.29 days at 25ºC and 8.57 days at 30ºC, respectively. The average durations of pupal stage of *N. includens* was highly significant differences.

The lower developmental threshold of *N. includens* pupa when reared on *I. seychellarun* was 5.6 and the thermal constant for their development was 308.1 DD's (Table 2).

Total development periods:

The data revealed that, the total developmental period of *N. includens* was significantly shortest (24.86 days) at 30ºC and significantly longest (39.38 days) at 20ºC, when reared on *I. seychellarum*.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 28ºC, with significant differences.

Longevity:

The average life span of adult female and male of *N. includens* decreased as the temperature increased from 87.5 and 72.25 days at 20ºC to 66.14 and 55.43 days at 30ºC, respectively. The average longevity of adult female and male of *N. includens* was highly significant differences according to the regression line equation the lower developmental threshold of *N. includens* life span (female and male)were 10.9 and 13.2ºC and the thermal constant for their development were 2709.9 and 2380.7 DD's respectively.Abdel-Salam *et al.* (2010) mentioned that the predator *N. includens* when reared on *I. seychellarum* under constant temperature of 28ºC the total longevity and fecundity per female 60.17 $\pm$ 5.20 days and 50.67 $\pm$ 4.79 eggs respectively.

Table (2). Effect of different temperature on *Nephus includens* when reared on *Icery Seychellarum*

Variable	Temp. (ºC)	Eggs Incubation	Larval stage	Pupal stage	Egg-adults	Longevity	
						Female	Male
Duration DT	20	9.625a	17.875a	11.875a	39.375a	87.500a	72.250a
	25	6.571b	15.000b	10.286b	31.857b	75.714b	61.714b
	30	4.714c	11.571c	8.571c	24.857c	66.143c	55.429c
LSD 0.05		0.9071	0.12579	0.9071	1.1800	1.3072	1.3312
Rate DR	20	0.104	0.056	0.084	0.025	0.011	0.014
	25	0.152	0.067	0.097	0.031	0.013	0.016
	30	0.212	0.086	0.117	0.040	0.015	0.018
Regression values	Intercept a	0.114	0.007	0.018	0.005	0.004	0.006
	Slope b	0.011	0.003	0.003	0.001	0.001	0.001
	t_0(ºC)	10.6	2.1	5.6	3.2	10.9	13.2
	K (Degree days) DD	92.4	328.1	308.1	674.2	2709.9	2380.7
	R^2	0.996	0.972	0.987	0.988	1.000	0.995

On *Maconellicoccus hirsutus*: Temperature dependence of *N. includens* development reared on *M. hirsutus* is summarized in Table (3).

Egg stage:

The incubation period of *N. includens* was 9.88 days at 20ºC with increasing temperature, the developmental time of the egg stage decreased to 7.0 days at 25ºC and 4.75 days at 30ºC. The study revealed that the incubation period of *N. includens* differ significantly between the values at 20 and 30ºC, respectively with highly significant differences.Table (3) show the rate of development of the different life history stages in relation to temperature expressed by the linear regression equation. According to the regression line equation the lower developmental threshold of *N. includens* eggs was 11.1ºC and the thermal constant for their development was 91.5 DD's (Table 3).

Larval stage:

At 20ºC the development of larvae took 19.13 days with increasing temperature, the developmental times of the larval stage decreased to 16.75 days at 25ºC and 12.75 days at 30ºC. The study revealed that ,the larvae period of *N. includens* with highly significant differences.

According to the regression line equation, the lower developmental threshold of *N. includens* was 0.7ºC and the thermal constant for their development was 382.5 DD's (Table 3).

Pupal stage:

At 20ºC the development of pupa was 12.13 days. Also, with increasing temperature, the developmental times of the pupa stage decreased to 10.75 days at 25ºC and 9.25 days at 30ºC. The data indicated that average the durations of pupal stage of *N. includens* was significant differences.

In the present study, the lower developmental threshold of *N. includens* pupa when reared on *M. hirsutus* was 11.9ºC and the thermal constant for pupal developmental was 390.1 DD's (Table 3).Akshay *et al.* (2015) mentioned that the average incubation period of *Cryptolaemus montrouzieri* (Mulsant) when reared on *M. hirsutus* was 3.67 $\pm$ 0.33 and the duration of 1^{st} , 2^{nd} , 3^{rd} and 4^{th} larval instars were 4.33 $\pm$ 0.33 , 6.0 $\pm$ 0.58 , 5.0 $\pm$ 0.08 and 5.67 $\pm$ 0.33 days respectively.

Pre-pupal and pupal period completed in 2-3 days (2.67 $\pm$ 0.33 days) and 8 days (8.0 $\pm$ 0.33) respectively.

Total developmental periods:

The mean duration of *N. includens* (from egg to adult) were 41.13 days at 20ºC, 34.5 days at 25ºC and 26.75 days at 30ºC.The lower developmental thresholds of *N. includens* duration was 1.9ºC and the mean thermal constant was 765.3 DD's (Table 3).

Longevity:

The mean longevity of adult female and male of *N. includens* decreased as the temperature increased from 80.38 and 61.63 days at 20ºC to 65.13 and 53.75 days at 30ºC, respectively with highly significant differences.Akshay *et al.* (2015) showed that the average longevity of adult male and female *C. montrouzieri* was recorded 65 – 70 days and 72 – 78 days with the mean of 68.67 ± 1.45 and 75.33 ± 2.03 respectively.

In this present study, the lower development threshold of *N. includens* longevity (female and male) were 22.8 and 48.7ºC and the thermal constant for their development were 3432.4 and 4206.2 DD's, respectively (Table 3).

Table (3). Effect of different temperature on *Nephus includens* when reared on *Maconellicoccus hirsutus*

Variable	Temp. (ºC)	Eggs Incubation	Larval stage	Pupal stage	Egg-adults	Longevity	
						Female	Male
Duration DT	20	9.875a	19.125a	12.125a	41.125a	80.375a	61.625a
	25	7.000b	16.750b	10.750b	34.500b	71.500b	56.375b
	30	4.750c	12.750c	9.250c	26.750c	65.125c	53.750c
LSD 0.05		1.1251	1.7063	1.1529	1.3072	0.9071	1.5711
Rate DR	20	0.101	0.052	0.082	0.024	0.012	0.016
	25	0.143	0.060	0.093	0.029	0.014	0.018
	30	0.211	0.078	0.108	0.037	0.015	0.019
Regression values	Intercept a	0.122	0.002	0.030	0.002	0.007	0.012
	Slope b	0.011	0.003	0.003	0.001	0.001	0.001
	t_0(ºC)	11.1	0.7	11.9	1.9	22.8	48.7
	K (Degree days) DD	91.5	382.5	390.1	765.3	3432.4	4206.2
	R^2	0.981	0.941	0.990	0.974	0.999	0.976

Table (4), showed that influence of constant temperature degrees and some mealy bug species on average consumption of the predator *N. includens* larval and adult stage.

The average of the total consumption for larval stage when this predator fed on the three mealy bug species under constant temperature of 20 ± 1ºC reached 105.71 ± 1.96 ; 119.67 ± 2.1 and 91.56 ± 1.3 individuals respectively, with highly significant differences.

Results showed that, the average of the total consumption during the larval stage when fed on the three tested mealy bug species were 125.71 ± 2.54; 140.6 ± 2.96 and 110.47 ± 1.20 individuals respectively at (25 ± 1ºC). The obtained results showed that the average of the total consumption per larva at 30 ± 1ºC was 107.6 ± 2.57 ; 121.89 ± 3.1 and 102.87 ± 2.71 individuals respectively. The obtained results revealed that the average of total consumption per larva was the highest at 25 ± 1ºC and when fed the mealy bug species on *P. citri* during its larval stage.

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 ± 1ºC with highly significant differences.

For adult male reached 240.86 ± 2.84; 215.73 ± 2.15 and 160.21 ± 1.78 individuals respectively. 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 mealy bug species, respectively with highly significant temperature.

Akshay *et al.* (2015) showed that 1st , 2nd , 3rd and 4th larval instars of *C. montrouzieri* consumed an average of 26.68 ± 1.68; 50.33 ± 0.89 ; 63.67 ± 5.04 and 83.0 ± 2.29 (*M. hirsutus*) respectively. Male and female of *C. montrouzieri* consumed 245.0 ± 2.51 and 273.33 ± 3.33 *M. hirsutus* respectively.

The average of the total consumption per female at 25 ± 1ºC was reached 564.73 ± 6.84; 407.21 ± 6.15 and 280.62 ± 3.7 individuals when fed on the three mealy bug species respectively, with highly significant differences. Also the adult 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 ± 1.10 eggs when the predator female fed on the three tested mealy bug species, respectively with highly significant differences.

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 ± 1ºC., 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 mealy bug species respectively. The obtained results in Table (4) revealed that, the highest consumption rate per female at 30 ± 1ºC 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 ± 1ºC. As a conclusion the best mealy bug species for the mass rearing of this predator was *P. citri* at 25 ± 1ºC comparing with the other mealy bug species and the other temperature degrees.

Table (4). Influence of constant temperature degrees and some mealy bug species on average consumption of the predator *N. Includens* larval and adults stage

Stages	**Average of consumption**											
	20 ± 1				**25± 1**				**30 ± 1**			
		Adult stage				**Adult stage**				**Adult stage**		
Mealy bug species	**Larval stage**	**Male**	**Female**	**Fecundity**	**Larval stage**	**Male**	**Female**	**Fecundity**	**Larval stage**	**Male**	**Female**	**Fecundity**
P. citri	105.7 ± 1.96b	240.86 ± 2.84a	420.82 ± 5.1a	102.52 ± 1.51a	125.71 ± 2.54b	378.5 ± 3.15a	564.73 ± 6.84a	185.74 ± 1.92a	107.6 ± 2.57b	307.38 ± 2.85a	486.38 ± 5.67a	115.84 ± 1.76a
I. seychellarum	119.67 ± 2.1a	215.33 ± 2.15b	345.87 ± 4.26b	774.43 ± 1.16b	140.6 ± 2.46a	305.96 ± 2.84b	407.21 ± 6.15b	109.46 ± 1.54b	121.89 ± 3.1a	278.55 ± 2.15b	398.46 ± 3.48b	82.6 ± 1.5b
M. hirsutus	91.56 ± 1.3c	160.21 ± 1.78c	244.62 ± 3.9c	49.27 ± 1.1c	110.47 ± 1.20c	188.4 ± 1.56c	280.62 ± 3.7c	71.33 ± 1.10c	102.87 ± 2.71b	172.16 ± 1.67c	260.68 ± 3.1c	50.67 ± 0.91c
LSD 0.05	2.7902	8.4385	12.8087	6.4536	6.2846	8.2603	5.9960	6.2796	5.0755	2.9554	4.5285	3.2609

Canhilal *et al.* (2001) mentioned that the mean number of eggs /female and the mean number of eggs / female / day 133.5 and 2.4 eggs at 25ºC while at 30ºC

they were 123.0 and 2.1 eggs when *N. includens* fed on *P. citri*. On the other hand **Kontodimas *et al.* (2007)** showed that the average total fecundities of *N. includens* at temperatures 15, 20, 25, 30, 32.5 and 35 ºC were 49.2, 97.8, 162.8, 108.5, 87.4 and 31.1 eggs / female .

Moreover, Kontodimas *et al.* (2007) reported that the average longevity of *N. includens* at 25, 30 and 32.5ºC 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.

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ARABIC SUMMARY

العلاقة بين تطور الاطوار المختلفة للمفترس *Nephus includens* المربى على بعض أنواع البق الدقيقى والوحدات الحرارية المتجمعة

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أجريت التجارب لدراسة العلاقة بين العلاقة بين تطور الاطوار المختلفة للمفترس *Nephus includens* المربى على بعض أنواع البق الدقيقى والوحدات الحرارية المتجمعة على ثلاث درجات حرارة ثابتة (٢٠و ٢٥ و٣٠ م°).

أوضحت النتائج أن دورة حياة المفترس أطول عند درجة حرارة ٢٠ م° ، وبزيادة درجة الحرارة من ٢٠-٣٠ م° تقل طول فترة حياة الحشرة الكاملة للمفترس *Nephus includens* ، وكانت درجة حرارة صفر النمو لمراحل تطور المفترس المختلفة هى : ١٠.٩ و١٠.٦و ١١.٩ لطور البيضة ، ٦.٤ و ٢.١و ٧,. م° لطور اليرقة و ٨.٤ و٥.٦ و١١.٩ لطور العذراء بينما كانت ١,. و٣.٢ و١.٩ م° لدورة الحياة الكلية من (البيضة – الحشرة الكاملة).

وأظهرت النتائج أن الوحدات الحرارية اللازمة لمدة طور البيضة هى : ٩٠.١ و٩٢.٤ و٩١.٥ DD's ، وكانت ٣٧.٧ و٣٢٨.١ و ٣٩٠.١ DD's لطور العذراء بينما كانت ٧١٣.٨ و٦٧٤.٢ وDD's ٧٦٥.٣ لمدة دورة الحياة الكلية من (البيضة – الحشرة الكاملة) على الثلاث أنواع من البق الدقيقى

Planococcus citri Risso, *Icerya seychellarum* (Westwood) and *Maconellicoccus hirsutus* (Green).

بينت النتائج أن درجة حرارة صفر النمو لفترة حياة الحشرة الكاملة للمفترس الأنثى هى : ١٢.٨ و ١٨.٤ و١٠.٩ بينما كانت للذكور ١٣٠٢ و ٢٢.٨ و ٤٨.٧ ، بينما كانت الوحدات الحرارية اللازمة لطول حياة الحشرة الكاملة للأنثى هى : ٢٧٧٩.٨ و ٢٥١٣.٧ و٢٧٠٩.٩ بينما كانت للذكور ٢٣٨٠.٧ و ٢٤٣٢.٤ و ٤٢٠٦.٢ على نفس أنواع البق الدقيقى المذكورة . كما أظهرت النتائج المتحصل عليها أن متوسط ما استهلكتة اليرقة الواحدة كان أعلى عند درجة حرارة ٢٥ م° 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 بإرتفاع أو زيادة درجات الحرارة تدريجيا و كان أعلى استهلاك لها عند درجة حرارة ٣٠ م٠ بالمقارنة بدرجات الحرارة الأخرى. و لقد وضعت اناث هذا المفترس أعلى كمية من البيض حيث وصلت إلى ١٨٥.٧٤±١.٩٢ بيضة للانثى الواحدة عند تربية هذه الاناث على درجة حرارة ٢٥ م° و تنصح الدراسة أن أفضل نوع من الق الدقيقى للتربية المكثفة لمفترس أبو العيد *N. includens* هو بق الموالح الدقيقى *P. citri* على درجة حرارة ٢٥ م° بالمقارنة بأنواع البق الدقيقى المختبرة و درجات الحرارة الأخرى. و تتضح من النتائج المتحصل عليها فى امكانية التنبؤ بتعداد المفترس أبو العيد *N. includens* و كذلك وقت اطلاق الطفيل واستخدامه فى برامج المكافحة المتكاملة بالحقول المصرية وذلك لمكافحة أنواع البق الدقيقى المذكورة.