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BIOLOGICAL ATTRIBUTES AND LIFE TABLE PARAMETERS OF *Nephus includens* (Kirsch) (Coleoptera: Coccinellidae) AS A NATURAL ENEMY OF MARGARODID MEALYBUGS IN EGYPT.

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ABSTRACT

Developmental time and rate of immature stages, growth index, survival percentage, longevity, fecundity, and life table parameters of *Nephus includens* (Kirsch) were investigated when reared on the three mealybug species namely, *Icerya purchasi, Icerya aegyptiaca*, and *Icerya seychellarum* at 28^{o}C.

There was no significant variation in the incubation periods for *N. includens* when the predator was reared on the three tested preys. ANOVA showed that there were no significant differences in 1st, 2nd, 3rd, and 4th instars larvae when the predator was reared on the three tested preys. The total developmental time of immature stages was 26.3, 25.9, and 28.2 days on the three tested preys, with significant differences. Growth index of *N. includens* was 2.8517, 2.9069, and 2.4823 on the three tested preys, respectively. Developmental rates of the total immature stages were 0.0380, 0.0388, and 0.0355 on the three tested preys, with no significant difference. Results indicated that the survival percentages of immature stages when reared on *I. purchasi* and *I. aegyptiaca* were higher than on *I. seychellarum*.

There were no significant differences in pre-oviposition, oviposition, inter-oviposition, and total longevity periods among the three tested preys. Male longevity was 61.33, 63.83, and 53.17 days with no significant difference among the three tested preys. Fecundity of females was 94.17, 122.17, and 50.67 with significant differences among the three tested preys.

The mean generation time (T) was 41.66, 43.94, and 48.22 days, respectively when reared on the three tested preys. The population of this predator could be doubled every 76.30, 8.80, and 127.60 days on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* at 28^{o}C. The values of gross reproductive rate (GRR) were 69.82, 57.52, and 31.86. R_o was 44.03, 31.94 and 13.73 when reared on the three tested preys. The intrinsic rate of increase (r_m) was 0.0091, 0.0788, and 0.0054 when reared on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* at 28^{o}C. The finite rate of increase (λ) was 1.0951, 1.0820, and 1.0558 on the three tested preys. The survivorship (Lx) for female age intervals was 64.0, 68.0, and 58.0 on the three tested preys, respectively.

Keywords: *Nephus includens*, biological attributes, life table, *Icerya purchasi*, *Icerya aegyptiaca*, *Icerya seychellarum*

INTRODUCTION

Several mealybug species are pests of citrus, fruit trees, ornamental plants and vine in Egypt. The cottony-cushion scale, *Icerya purchasi* Maskell, the egyptian fluted mealybug, *Icerya aegyptiaca* (Douglas), and the seychellarum mealybug, *Icerya seychllarum* (Westwood) 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; Matar and Mangoud, 2007).

Coccinellids are potentially important predatory insect group found throughout the world on many economic crops. Some species may have a significant role in biological control of aphid species, whiteflies, and other soft-bodied insects. *Nephus includens* (Kirsch) (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 mass rearing and release in pest hot spot infestations in open fields because it has a good search activity and a high consumption rate (Izhevsky and Orlinsky, 1998; Kontodimas *et al*., 2004 and 2007). In order to use this predator in biological control programs, it is necessary to understand its biological and life table attributes prior to mass production and release. There are rare data on the biological characteristics and life table parameters of *N. includens* in Egypt.

Life table parameters are often used by biological control workers when choosing the most effective biocontrol agents. In the absence of other criteria, the species with the greatest natural increase (r_m) is usually selected (Birch, 1948; Hulting *et al.*, 1990.; Roy *et al.*, 2003; Lanzoni *et al.,* 2004). Knowledge of biological parameters is essential for assessing the potential rate of increase for a population. Life table parameters are essential to know the general biology of an insect and provide a valuable picture for the fecundity and growth potential of *N. includens* under prevailing environmental conditions. Population growth rate is a basic ecological characteristic. It is usually expressed as the intrinsic rate of natural increase (r_m) which is regarded as the best available single description of the population growth of a species under given conditions (Southwood and Henderson, 2000). The intrinsic rate of natural increase (r_m) can be used for predator's selection. Moreover, r_m is suitable for evaluation of the mass rearing quality of biological control agents. It can be determined by its developmental time and reproduction rate. It has been used to compare a species under different environmental conditions and as an index of population rate response to selected preys (Birch, 1948; Hulting *et al.*, 1990.; Roy *et al.*, 2003; Lanzoni *et al.,* 2004).

However, scanty attention has been paid to the developmental time and rate, growth index, longevity, fecundity and life table parameters of this predator to measure these parameters for mass rearing and release. Therefore, the objective of this study was to assess some biological properties of *N. includens* on three mealybug species to serve as a basis for the use of this predatory coccinelid in a biological control program. Developmental time and mortality of different immature stages, longevity and fecundity were determined. Life tables were constructed using these data.

MATERIALS AND METHODS

I. Rearing of immature stages:

Adults of *Nephus includens* (Kirsch) were collected from ficus, *Ficus nitida* Thunb. and guava trees (*Psidium guava* L.) at the Experimental Research Station, Faculty of Agriculture, Mansoura University and reared on the first nymphal instar of *Icerya aegyptiaca*. The eggs of *N. includes* were collected daily, and monitored until hatching. To avoid cannibalism, hatched larvae were reared individually in petri dishes (9 cm in diameter) in the incubator at 28±0.5^{o}C. The relative humidity was 60.0±5.0% and the photoperiod was 14:10 (L: D). A piece of filter paper was placed on the bottom of each dish to provide a walking surface for the larvae. Twenty larvae from the predator were reared on the three mealybug species namely, *Icerya purchasi*, *Icerya aegyptiaca*, and *Icerya seychellarum*. Each larva was considered a replicate. The developmental time and rate (1/developmental time) (Omakar and James, 2004) of immature stages, survival from eggs to adult eclosion, and sex ratio were recorded. The ability of the larvae to moult and metamorphose on the tested preys was determined as (a) percentage of individuals transforming into adults, and (b) average period required o. The ratio of (a) to (b) then represented the insect's "growth index" (Saxena, 1969).

II. Rearing of adult stage:

After eclosion, 10 males and 10 females of the predator were also fed on the three tested mealybug species until development was completed. The longevity of females was divided to three periods according to Phoofolo and Obrycki (1995) and Lanzoni *et al.* (2004). The pre-oviposition period was measured as the number of days from female eclosion to initiation of egg laying, while inter-oviposition one as the number of days between two successive ovipositions, and finally the oviposition period was the number of days during which oviposition occurred. The fecundity of female, fecundity rate (number of progeny produced per female per day) and the longevity of males were recorded.

Life table parameters were calculated using a BASIC computer program (Abou-Setta *et al.,* 1986) for females reared on the three tested aphid species. This computer program is based on Birch's method (1948) for the calculation of an animal's life table. Constructing a life table, using rates of age-specific (Lx), and fecundity (Mx) for each age interval (x) was assessed. The following population growth parameters were determined: the mean generation time (*T*), gross reproductive rate (GRR) (=ΣMx), the net reproductive increase (R_o), the intrinsic rate of increase (r_m), and the finite rate of increase (λ). The doubling time (*DT*) was calculated according to Mackauer's method (Mackauer, 1983). The life tables were prepared from data recorded daily on developmental time (egg to first egg laid), sex ratio, the number of deposited eggs, the fraction of eggs reaching maturity, and the survival of females. Interval of one day was chosen as the age classes for constructing the life table.

III. Data analysis:

Data of developmental times of immature stages, pre-oviposition, inter-oviposition, and oviposition periods, total longevity of females, fecundity, fecundity rate, and the male longevity of *N. includens* reared on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* were subjected for one way analysis of variance (ANOVA), and the means were separated using Duncan's Multiple Range Test (CoHort Software, 2004).

RESULTS AND DISCUSSION

Developmental times of immature stages

ANOVA indicated that there was no significant variation in the incubation periods for *N. includens* when the predator was reared on any of the three tested preys (*I. purchasi*, *I. aegyptiaca*, and *I. seychellarum*) (Table 1). Table (1) showed that developmental time of the four larval instars when reared *N. includens* on *I. purchasi* were 3.25, 2.05, 2.5, and 3.3 days, respectively. There were no significant differences in 1^{st}, 2^{nd}, 3^{rd}, and 4^{th} instar larvae when the predator reared on the three tested preys. On *I. aegyptiaca* as a prey, data in Table (1) showed that developmental times of the four larval instars were 3.15, 2.0, 2.4, and 3.3 days, respectively. While, developmental times of the four larval instars when reared *N. includens* on *I. seychellarum* were 3.8, 2.5, 3.1, and 3.6 days, respectively. The developmental time of larval stage was 11.1, 10.85, and 13.0 days with a significant difference among the three tested preys. The pupal stage averaged 9.3, 9.2, and 9.45 days when the predator reared on the three tested preys (*I. purchasi*, *I. aegyptiaca*, and *I. seychellarum*) with no significant differences. The total developmental time of immature stages was 26.3, 25.9, and 28.2 days on the three tested preys, with significant differences.

Canhilal *et al.* (2001) mentioned that the developmental times of eggs, 1^{st}, 2^{nd}, 3^{rd}, 4^{th} larval instars, pupa and total (egg-adult) of *N. includens* when reared on *Planococcus citri* Risso were 7.3, 3.3, 2.3, 2.6, 3.6, 12.3, and 31.4 days at 25 ºC, while at 30 ºC, they were 5.4, 3.0, 2.0, 2.2, 3.1, 8.9, and 24.6 days. Meanwhile, Kontodimas *et al.* (2004) reared *N. includens* on *P. citri* on *Citrus aurantium* leaves and found that the durations of eggs, 1^{st}, 2^{nd}, 3^{rd}, 4^{th} larval instars, pre-pupa, and pupa were 7.84±1.05, 2.70± 0.58, 2.00± 0.25, 2.22± 0.25, 3.96± 0.43, 1.56± 0.42, and 7.98± 0.59 days at 25 ºC, while at 30 ºC, 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±0.50 days. Atlihan and Chi (2008) evaluated the development, survival, and fecundity of demography of *Scymnus subvillosus* (Coleoptera: Coccinellidae) reared on *Hyalopterus pruni* (Homoptera: Aphididae) were studied at 20, 25, 30, and 35°C, 60±5% RH, and a photoperiod of 16:8 (L: D) h under laboratory conditions. They found that the total developmental time from egg hatching to adult eclosion ranged from 22.6 days at 20°C to 10.6 days at 35°C. The developmental rates of the egg stage, the larval stage, and total pre-adult stage at different temperatures increased linearly with increasing temperature.

Table (1). Developmental time[a] (mean±SEM) in days of immature stages of *N. includens* reared on three mealybug species at 28°C.

Prey Species	Egg	Larval instar					Pupal stage	(Egg-Adult)
		1st	2nd	3rd	4th	Total		
I. purchasi	5.75 ± 0.20 a	3.25 ± 0.23 a	2.05 ± 0.15 a	2.5 ± 0.26 a	3.3 ± 0.25 a	11.1 ± 0.43 b	9.3 ± 0.40 a	26.3 ± 0.52 b
I. aegyptiaca	5.8 ± 0.20 a	3.15 ± 0.24 a	2.0 ± 0.17 a	2.4 ± 0.26 a	3.3 ± 0.21 a	10.85 ± 0.33 b	9.2 ± 0.33 a	25.9 ± 0.48 b
I. seychellarum	5.8 ± 0.20 a	3.8 ± 0.22 a	2.5 ± 0.25 a	3.1 ± 0.23 a	3.6 ± 0.21 a	13.0 ± 0.48 a	9.45 ± 0.34 a	28.2 ± 0.58 a

[a]Means followed by the same letter in a column among the three prey species are not significantly different at the 5% level of probability (Duncan's Multiple Range Test).

Growth index (GI) and developmental rate (DR)

Growth index of *N. includens* was 2.8517, 2.9069, and 2.4823 on the three tested preys, respectively (Table 2).

Developmental rates of *N. includens* eggs were 0.1724, 0.1724, and 0.1724, respectively when reared on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* (Table 2). There were no significant differences in developmental rates among 1st, 2nd, 3rd, and 4th instar larvae when the predator reared on the three tested preys. Developmental rate of the four larval instars when rearing *N. includens* on *I. purchasi* were 0.3030, 0.4762, 0.4000, and 0.3030 respectively. On *I. aegyptiaca* as a prey, data in Table (1) showed that developmental rates of the four larval instars were 0.3125, 0.5000, 0.4167, and 0.3030, respectively. While, the developmental rates of the four larval instars when reared *N. includens* on *I. seychellarum* were 0.2632, 0.4000, 0.3226, and 0.2778, respectively. The developmental time of larval stage was 0.0901, 0.0917, and 0.0769 with no significant difference among the three tested preys. DR of the pupal stage was 0.1075, 0.1087, and 0.1053 when the predator reared on the three tested preys (*I. purchasi*, *I. aegyptiaca*, and *I. seychellarum*, respectively) with no significant differences. DR of the total immature stages was 0.0380, 0.0388, and 0.0355 on the three tested preys, with no significant difference.

Table (2). Growth index and developmental rate[a] of *N. includens* reared on three mealybug species at 28°C.

Prey Species			*I. purchasi*	*I. aegyptiaca*	*I. seychellarum*
Growth index			2.8517 a	2.9069 a	2.4823 a
Developmental Rate	Egg		0.1724 a	0.1724 a	0.1724 a
	Larval stage	1st	0.3030 a	0.3125 a	0.2632 a
		2nd	0.4762 a	0.5000 a	0.4000 a
		3rd	0.4000 a	0.4167 a	0.3226 a
		4th	0.3030 a	0.3030 a	0.2778 a
		Total	0.0901 a	0.0917 a	0.0769 a
	Pupal stage		0.1075 a	0.1087 a	0.1053 a
	(Egg-Adult)		0.0380 a	0.0388 a	0.0355 a

[a]Means followed by the same letter in a row among the three prey species are not significantly different at the 5% level of probability (Duncan's Multiple Range Test).

Survival percentage:

Hatching percentage of *N. includens* was 81.0 when reared on the three tested preys (Table 3). Survival percentages of larval instars, pupal stage, and total immature stages of the predator were 82.7, 97.0, 98.5, 100.0, 79.0, 100.0, and 64.0% when reared on *I. purchasi* (Table 3). Meanwhile, they were 85.2, 98.6, 100.0, 100.0, 84.0, 100.0, and 68% on *I. aegyptiaca*, 77.8, 93.7, 96.6, 98.2, 69.1, 96.4, and 54.0% on *I. seychellarum*. Generally, data in Table (3) indicated that the survival percentages of immature stages when reared on *I. purchasi* and *I. aegyptiaca* were higher than *I. seychellarum*.

Canhilal *et al.* (2001) reported that the survival rates of eggs, 1st, 2nd, 3rd, 4th larval instars, pupa and total from egg to adult of *N. includens* on *P. citri* were 76.0, 83.3, 100.0, 100.0, 100.0, 100.0, and 63.3% at 25 ºC, while at 30 ºC, they were 82.0, 80.0, 100.0, 100.0, 100.0, 100.0, 65.7%. Kontodimas *et al.* (2004) reared *N. includens* on *P. citri* on sour orange, *Citrus aurantium* leaves and noted that the survival rates of *N. includens* larval stage at 25 and 30ºC were 68.0 and 68.3%, respectively.

Table (3). Survival percentages of immature stages of *N. includens* reared on three three mealybug species at 28°C.

Prey species	Hatching %	Survival %						
		Larval instar					Pupal stage	(Egg - Adult)
		1st	2nd	3rd	4th	Total		
I. purchasi	81.0	82.7	97.0	98.5	100	79.0	100.0	64.0
I. aegyptiaca	81.0	85.2	98.6	100.0	100.0	84.0	100.0	68.0
I. seychellarum	81.0	77.8	93.7	96.6	98.2	69.1	96.4	54.0

Longevity and fecundity of adult stage:

Longevity and fecundity of *N. includens* when reared on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* at 28°C are given in Table (4). There were no significant differences in pre-oviposition, oviposition, inter-oviposition, and total longevity periods among the three tested preys (Table 4). On *I. purchasi* as a prey, pre-oviposition, oviposition, inter-oviposition, and total longevity periods lasted 5.0, 41.83, 21.67, and 68.5 days, respectively. While these periods were 4.83, 42.5, 22.17, and 69.5 on *I. aegyptiaca*, and 6.0, 34.5, 19.67, and 60.17 days on *I. seychellarum*, respectively. Male longevity was 61.33, 63.83, and 53.17 days with no significant difference among the three tested preys.

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 ºC, 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 30 ºC, respectively. The mean number of eggs/female and mean number of eggs/female/day were 133.5, and 2.4 eggs at 25ºC, while at 30 ºC, they were 123.0, and 2.1 eggs. Kontodimas *et al.* (2004) 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 ºC, while at 30 ºC, they were 4.62± 0.36,

20.52±1.11, and 25.14± 1.30 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.

Concerning the fecundity of females, the average number of eggs per female was 94.17, 122.17, and 50.67 with significant differences among the three tested preys (Table 4). In addition, results in Table (4) showed that fecundity rate was 2.40, 2.93, and 1.57 on the three tested preys.

Kontodimas *et al*. (2007) reported that the average fecundity of *N. includens* at 25, 30, and 32.5°C were 162.8, 108.5, and 87.4 eggs/female when fed on *P. citri*.

Simple linear regression between female age (independent variable X) and fecundity rate (dependent variable Y) of *N. includens* females when reared on *I. purchasi* yielded R^2=0.6159 (Fig. 1). The regression equation was derived: Female fecundity rate (Y) =2.0117-0.0361 female age (X). This equation indicated that there was a negative relationship between female age and female fecundity rate (Fig. 1). Considering rearing *N. includens* on *I. aegyptiaca*, the value of R^2 was 0.5851 and the regression equation was Y= 2.7235-0.0521X. This equation indicated that there was a negative relationship between female age and fecundity rate which means that the fecundity rate gradually decreased as the age of female increased (Fig. 1). Simple linear regression between female age (independent variable X) and fecundity rate (dependent variable Y) of *N. includens* females when reared on *I. seychellarum* yielded R^2=0.335. The regression equation was derived: Female fecundity rate (Y) = 0.9272-0.0108X. This equation indicated that there was a relationship between female age and female fecundity rate (Fig. 1).

Table (4). Longevity[a] (mean±SEM) in days and fecundity of *N. includens* when reared on three mealybug species at 28°C.

Prey species	*I. purchasi*	*I. aegyptiaca*	*I. seychellarum*
Pre-oviposition	5.0 ± 0.52 a	4.83 ± 0.48 a	6.0 ±0.45 a
Oviposition	41.83 ± 3.84 a	42.5 ± 3.06 a	34.5 ± 3.58 a
Inter- oviposition	21.67 ± 2.36 a	22.17 ± 2.30 a	19.67 ± 1.50 a
Longevity:			
Female	68.5 ± 4.79 a	69.5 ± 2.99 a	60.17 ± 5.20 a
Male	61.33 ± 4.48 a	63.83 ± 4.43 a	53.17 ± 6.10 a
Fecundity	94.17 ± 9.70 a	122.17 ± 9.73 a	50.67 ± 4.79 b
Fecundity Rate	2.4 ± 0.45 a	2.93 ± 0.28 a	1.57 ± 0.22 a

[a]Means followed by the same letter in a row among the three prey species are not significantly different at the 5% level of probability (Duncan's Multiple Range Test).

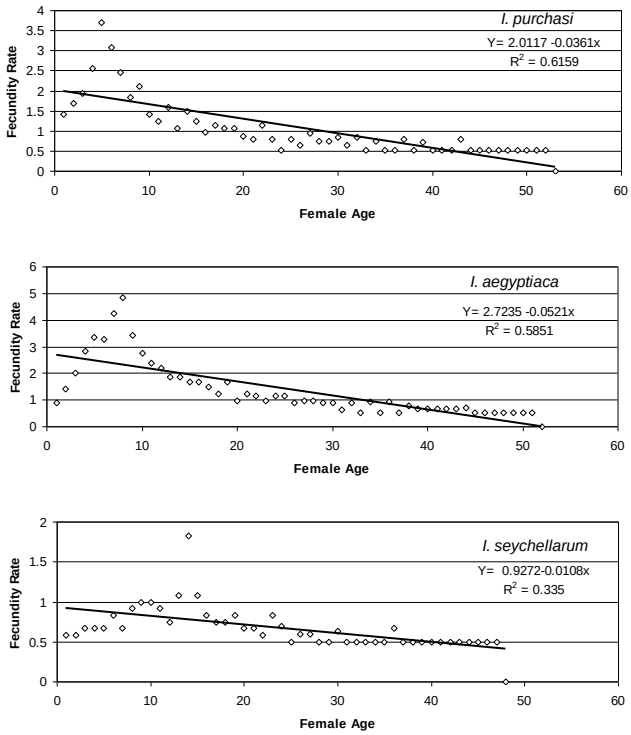

Figure (1). Simple linear regression between female age (X) and fecundity rate (Y) of of *N. includens* when reared on three mealybug species at 28°C.

Life table parameters

Data presented in Table (5) illustrate the life table parameters of *N. includens* females when reared on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* at 28°C.

The mean generation time (T) was 41.66, 43.94, and 48.22 days, respectively when reared on the three tested preys. The population of this predator could be doubled every 76.30, 8.80, and 127.60 days on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* at 28°C. The value of gross reproductive rate (GRR) was 69.82, 57.52, and 31.86. GRR refers to the sum of the average number of females produced per living female per day. This value is greater than the simple mean estimate of total fecundity per female per generation. The net reproduction rate (R_o), representing the total female births was 44.03. This meant that the population of this predator would be able to multiply 44.03 times when fed on *I. purchasi* at the end of each generation. R_o was 31.94 and13.73 on *I. aegyptiaca* and *I. seychellarum*. The value of the intrinsic rate of increase (r_m) was 0.0091, 0.0788, and 0.0054 when the predator was reared on *I. purchasi*, *I. aegyptiaca*, and *I. seychellarum* at 28°C.

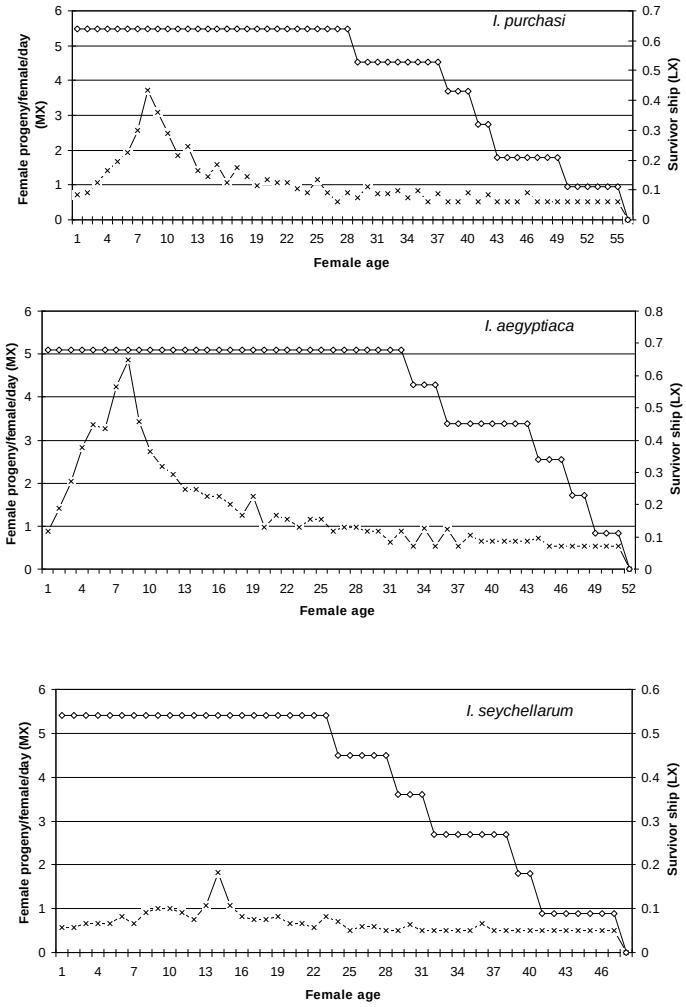

Figure (2). Age-specific fecundity (Mx) and survivorship (Lx) of *N. includens* females when reared on three mealybug species at 28°C.

The finite rate of increase (*λ*) was 1.0951, 1.0820, and 1.0558 on the three tested preys that the population had the capacity to multiply 1.0951, 1.0820, and 1.0558 times per female per day. From data illustrated in Figure (2), it could be noted that the survivorship (L*x*) for female age intervals was 64.0, 68.0, and 58.0 on the three tested preys which means that most of eggs had developed to maturity, and death happened gradually after an extended ovipositional period. Maximum oviposition rate per female per day (M*x*) was 3.71 on 8th day, 4.86 on 8th day, and 1.08 on 14th day at the three tested preys (*I. purchasi*, *I. aegyptiaca*, and *I. seychellarum*, respectively) (Fig. 2).

The net reproductive rate (R_o), intrinsic rate of increase (r_m) and mean generation time (T) of *N. includens* when reared on *P. citri* were 54.4, 0.067, and 59.6 days at 25 ºC, while at 30ºC, they were 38.0, 0.081, and 44.9 days (Canhilal *et al.*, 2001). Kontodimas *et al*. (2007) mentioned that the net reproductive rates (R_o) of *N. includens* at 25, 30, and 32.5°C were 162.8, 108.5, and 87.4 eggs/female when fed on *P. citri* were 60.7, 32.6, and 20.7 females/female, and the intrinsic rates of increase (r_m) 0.083, 0.086, and 0.077 females/female/day, respectively. While, Atlihan and Chi (2008) noted that the intrinsic rate of increase of *Scymnus subvillosus* (Goeze) when reared on *Hyalopterus pruni* (Geoffory) was 0.0845, 0.1138, 0.1395, and 0.0668 day at 20, 25, 30, and 35°C, respectively. The net reproductive rate was highest at 25°C (R_o=78.7), and lowest at 35°C (R_o=4.7). The mean generation time was shortest at 35°C ($T_=$ 23.9 days). The life table data can be used for the projection of population growth and designing mass rearing programs.

Table (5). Life table parameters of *N. includens* females when reared on three mealybug species at 28°C.

Prey species	Life table parameters					
	Mean generation time (T) (in days)	Doubling time (DT) (in days)	Gross reproductive rate (GRR)	Net reproductive rate (R_o)	Intrinsic rate of increase (r_m)	Finite rate of increase (λ)
I. aegyptiaca	41.66	76.296	69.82	44.03	0.0091	1.0951
I. purchasi	43.94	8.796	57.52	31.94	0.0788	1.0820
I.seychellarum	48.22	127.60	31.86	13.73	0.0054	1.0558

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الصفات البيولوجية و مقاييس جداول الحيـــاة للمفترس *Nephus includens* (Kirsch) كعدو طبيعى للبق الدقيقى فى مصر

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تمت دراسة كل من فترة النمو ومعدل نمو الأطوارغير الكاملة وفهرس النمو ونسبة البقاء وطول العمر والخصوبة وجداول الحياة للمفترس *Nephus includens* (Kirsch) وذلك بالتربية على ثلاثة أنواع من البق الدقيقى هى: البق الدقيقى الأسترالى والبق الدقيقى المصرى وبق السيشلارم على درجة حرارة 28 °م.

أوضحت النتائج عدم وجود إختلافات معنوية فى فترات حضانة البيض عند تربية المفترس على الفرائس الثلاثة المختبرة. وأوضح التحليل الإحصائى أنه لا توجد فروق معنوية بين الأعمار اليرقية الأولى والثانية والثالثة والرابعة عند تربية المفترس على الفرائس الثلاثة المختبرة.

أظهرت النتائج أيضاً أن فترة نمو الأطوار غير الكاملة كانت 26.3، 25.9، 28.2 يوماً على الفرائس الثلاثة المختبرة بفروق معنوية. وقد كان فهرس النمو للمفترس 2.8517، 2.9069، 2.4823 على الفرائس الثلاثة المختبرة على التوالى. وقد وجد أن معدل النمو للأطوار غير الكاملة 0.0380، 0.0388، 0.0355 على الفرائس الثلاثة المختبرة بدون فروق معنوية . وقد أوضحت النتائج أن معدل البقاء للأطوارغير الكاملة عندما تم تربيتها على البق الدقيقي الأسترالى والبق الدقيقي المصرى كانت أعلى من بق السيشلارم.

أشارت نتائج هذه الدراسة أنه لا توجد أى فروق معنوية فى فترة ما قبل وضع البيض وفترة وضع البيض وفترة مابين وضع البيض Inter-oviposition period وكذلك فترة الحياة الكلية للفرائس الثلاثة المختبرة. و كانت فترة حياة الذكور 61.33، 63.83، 53.17 يوماً بدون أى إختلافات معنوية على الفرائس الثلاثة المختبرة .وكانت نسبة وضع البيض اليومى للإناث هو 94.17، 122.17، 50.67 بفروق معنوية بين الفرائس الثلاثة المختبرة .

أظهرت النتائج أيضاً أن قيم جداول الحياة المحسوبة لفترة الجيل (T) كانت 41.66، 43.94، 48.22 يوماً عندما ربيت على الفرائس المختبرة . أما الزمن اللازم للتضاعف (DT) كان 76.30، 8.80، 127.60 يوماً على البق الدقيقي الأسترالى واليق الدقيقي المصرى وبق السيشلارم على درجة حرارة 28 °م. أما قيم معدل التكاثر (GRR) كانت 69.82، 57.52، 31.86. أما معامل التضاعف (R_O) فكان 44.03، 31.94، 13.73 عندما ربيت على الفرائس الثلاثة المختبرة. وكان معدل الزيادة الطبيعى (r_m) 0.0091، 0.0788، 0.0054 عندما ربيت على اليق الدقيقي الأسترالى واليق الدقيقي المصرى وبق السيشلارم على درجة حرارة 28 °م. وكان معدل الزيادة النهائى (λ) 1.0951، 1.0820، 1.0558 على الفرائس الثلاثة المختبرة. وكانت قيم معدل الحياة (LX) لأعمار الإناث 64، 68، 58 على الفرائس الثلاثة المختبرة.

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