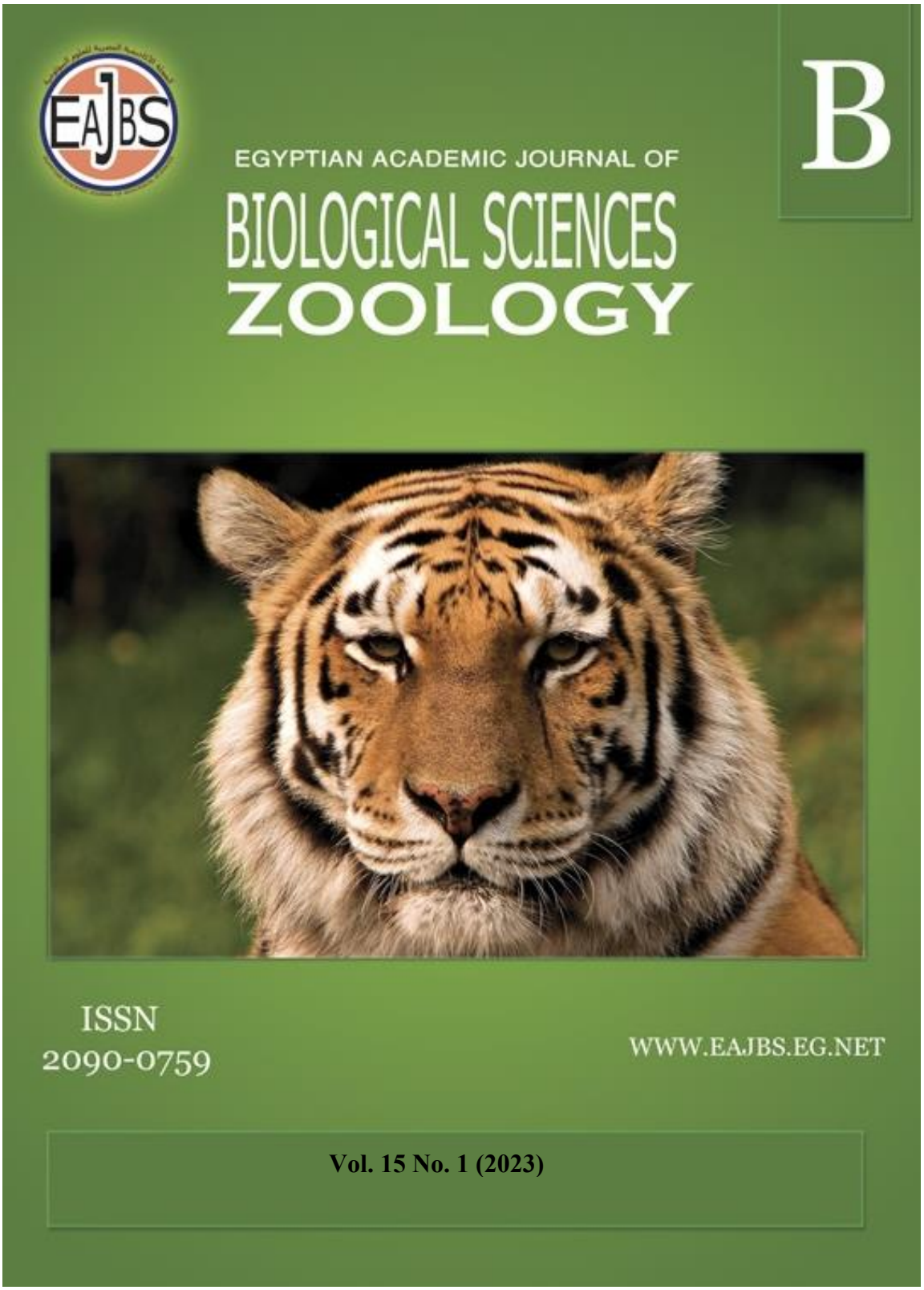

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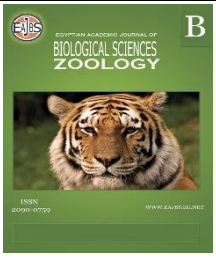

Biological Aspects and Life Table Parameters of the Predatory Mite, *Cydnoseius negevi* (Swirski& Amitai) Reared on Different Diets

Ola M. Roshdy *; Fatma M. Saleh and Walaa A. Tawfik
Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.
E-mail*: Dr.olaroshdy@gmail.com

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ABSTRACT

Cydnoseius negevi (Swirski & Amitai), (Family Phytosidae), is a predaceous mite of different mites and insect pests. This study finds different food choices for its mass rearing to enable its use as a biological control agent. The predatory mite *C. negevi* can feed and complete its life span successfully on these foods. *A. kuehniella* eggs prolonged the life cycle of *C. negevi*. while the shortest life span period was observed when males and females fed on eggs of *T. urtica*. *C. negevi* females' fecundity was the highest when it fed on pollen. Food sources also affected all life tables where spider mite eggs and pollen grains were the most favorable foods increasing Ro, rm, erm and GRR values. Insect eggs increase T and Dt times of the tested mite *C. negevi*. Therefore, *C. negevi* lasted its life span successfully on date palm pollen and eggs of *A. kuehniella* and *T. urticae*.

INTRODUCTION

Controlling phytophagous mites and insects in profitable crops using biological means is a crucial strategy (Greco et al., 2005; Khodayari et al., 2013). Throughout various locations of Egypt, there are several phytoseiid mite species that frequently coexist with insect and mite populations and are impacted by food sources (Fouly 1982 and Zaher, 1986).

In the Middle East, *Cydnoseius negevi* (Swirski & Amitai) is pervasive and common (Abou-Awad et al. 1998; Palevsky and Ueckermann 2009 and Hountondji et al. 2010). *Tetranychus urticae* is one of the most dangerous phytophagous mites among pests endangering crop output (20-45% of the yield was lost depending on the season), since growth, chlorophyll content, fruit size, and quality are all impacted by severe mite infection (Rhodes et al., 2006; Premalatha et al., 2018). *T. urticae* reproduces rapidly and has a brief life cycle that can last just seven days at temperatures as high as 32°C. Strawberries are severely impacted by *T. urticae* (Rhodes et al., 2006). A population that is resistant to chemical pesticides becomes dominant due to the long-term, intense usage of acaricides, which is reflected in plant yield (Fraulo and Liburd, 2007).

Anagasta (*Ephestia*) *kuehniella* (Keller), a Lepidoptera: Pyralidae insect found primarily in nations with temperate climates, attacked stored grain goods, notably flour,

A. Kuehniella used to raise parasitic and predatory species' eggs and larvae (Hamasaki and Matsui, 2006 and Paust et al., 2008).

Consequently, the goal of the current study was to assess how *Cydnoseius negevi's* biological characteristics and life table parameters responded to feeding on three distinct types of food (date palm pollen, eggs of *Anagasta kuehniella* and the phytophagous mite *Tetranychus urticae*). To permit its employment as a biological control agent, as an alternate type of nourishment to its bulk rearing.

MATERIALS AND METHODS

All biological studies on the predatory mite *Cydnoseius negevi* (Swirski &Amitai) were conducted in the laboratory of Plant Protection Research Institute (Mansoura branch).

1. *Cydnoseius negevi* Culture*:*

Cydnoseius negevi, were collected from eggplant leaves (*Solanum melongena* L. Solanaceae) in Aga, Dakahlia governorate. Leaf samples were transorted to the Plant Protection Research Institute laboratory (Mansoura branch) for examination by using stereomicroscopic binoculars. A pure culture of *C. negevi* was reared on mulberry leaves feeding on *Tetranychus urticae* immature stages under controlled condition at 25±1 °C and 70±5% RH.

2. Date Palm Pollen Source:

Phoenix dactylifera L. Pollen grains were collected from a date palm orchard in Belkas, Dakahlia governorate. The collected pollen grains were dried at 37°C for 48 hrs and then kept in a refrigerator at 4°C (Al-Shammery, 2011).

3. Culture of *Anagasta kuehniella* (Keller) (Lepidoptera:Pyralidae):

The Mediterranean flour moth, *A. kuehniella* was cultured in plastic cylinders with one hundred grams of a standard diet (43.5 percent wheat flour, 43.5 percent maize meal, 3.0 percent yeast, and 10 percent glycerin). By nature, adults should not feed during their adult longevity (Norris and Richards, 1934).

Two pairs of moths were inserted into a cylinder containing two paper towels (25 x 25 cm) which were placed in each cylinder. Twenty pairs of *A. kuehniella* moths laid their eggs in a plastic jar (10 × 16 × 20 cm) lined with two porous plastic sheets. The fresh eggs of *A. kuehniella* were replaced daily in each arena.

4. *Tetranychus urticae* Culture:

The two-spotted spider mite individuals were collected from strawberry-infested leaves from Belkas, Dakahlia governorate, and reared in post-prepared mulberry leaf discs in Petri-dishes at 25±2 °C and 70±5 % R.H.

5. Experimental Technique:

Newly deposited eggs of *C. negevi* were transferred singly to mulberry leaf discs (2.5cm) each. Three groups of 30 eggs each were separated, where the newly hatched larvae were provided with date palm pollen or one of the experimental prey separately.
A male mite and female are kept together for their longevity. Treatments were reared at controlled conditions of 25°C and 70% RH.

6. Effect of Food Sources on Life Tables of *Cydnoseius negevi*:

Life table parameters, intrinsic rate of natural increase rm, the net reproductive rate (Ro), the mean generation time (T) in days of *C. negevi* were examined using Birch (1948) and Laing (1968) methods and Abou-Setta *et al.* (1986).

Basic Computer Program. Furthermore, the doubling time (Dt) was calculated using the methods of Laughlin (1965), May (1976), and Carey (1993). Lx was calculated using the hatchability and survival rate. The Mx values were calculated using the proportion of females (No.♀/total ♀+♂).

7. Analysis of Biological Data:

All biological aspects of *C. negevi* were investigated using one-way ANOVA and Duncan Multiple Range Test (Costat Software Program 1990).

RESULTS AND DISCUSSION

1. Developmental Periods:

When *C. negevi* females were fed on *T. urtica* eggs, the egg duration was recorded 1.5 days. Although when *C. negevi* females were fed on *A. kuehniella* eggs, the incubation period was recorded 2.17 days. The total duration of immature stages (Larva and 1st nymph and 2nd nymph) was significantly longer when *C.* negevi was fed on *A. kuehniella* eggs with 11 days, while the shortest one was noticed when *C. negevi* was fed on *T. urticae* with only 8 days, Table (1).

Table 1: Biological aspects (per day) of *Cydnoseius negevi* males when reared on different food types at 25±1°C, 70±5 % R.H.

Biological aspect	*Anagasta kuehniella*	*Tetranychus urtica*	Date palm pollen	L.S.D. at 5%
Incubation period	2.17±0.29^{a}	1.50±0.5^{b}	1.67±0.58^{b}	0.4
Larva	1.83±0.29^{a}	1.33±0.29^{b}	1.33±0.58^{b}	0.3
Protonymph	3.50±0.50^{a}	2.67±0.76^{b}	3.50 ±0.50^{a}	0.7
Deutonymph	*5.67*±0.76^{a}	4.00±0.50^{b}	3.67±0.76^{c}	1.3
Total nymphal stage	9.17±1.15^{a}	6.67±1.15^{c}	7.17±1.15^{b}	1.8
Life cycle	11.00±0.87^{a}	8.00±1.32^{c}	9.33±1.61^{b}	2.2
Longevity	22.33±4.62^{b}	24.50±0.50^{a}	18.17±1.52^{c}	3.1
Life span	33.33±5.11^{a}	32.50±1.73^{a}	27.50±2.18^{b}	4.8

At the same time, Table (2) showed that the shortest incubation period was recorded when *C. negevi* males fed on date palm pollen (1.83 days), although the longest incubation period was recorded when *C. negevi* males fed on *A. kuehniella* eggs (2.83 days). And the total life cycle for *C. negevi* males was shortened when fed on date palm pollen (6.83 days) and longed when *C. negevi* males fed on *A. kuehniella* eggs (10.5 days).

Table 2: Biological aspects (per day) of *Cydnoseius negevi* females when reared on different food types at 25±1°C, 70±5% R.H.

Biological aspect	*Anagasta kuehniella*	*Tetranychus urtica*	Date palm pollen	L.S.D. at 5%
Incubation period	2.83±0.29^{a}	2.00±0.50^{b}	1.83±0.29^{b}	0.2
Larva	1.83±0.29^{b}	2.17±0.76^{a}	1.50±0.50^{b}	0.3
Protonymph	5.33±0.58^{a}	3.33±0.58^{b}	3.17±0.29^{b}	1.6
Deutonymph	5.17±0.29^{a}	4.50±0.87^{b}	3.67±0.58^{c}	1.2
Total nymphal stage	10.50±O.50^{a}	7.83±0.76^{b}	6.83±0.76^{c}	0.9
Life cycle	12.33±0.29^{a}	10.00±1.32^{b}	8.33±0.29^{c}	1.7

2. Longevity and Fecundity:

The type of food significantly affected longevity and fecundity**.** Therefore, the pre-oviposition, oviposition and post-oviposition periods were totally affected by food type, where female fecundity gives the highest reproduction rate (31.67 eggs) when fed on date palm pollen. Although, the lowest reproduction rate was (9.67 eggs) when *Cydnoseius negevi* females fed on *A. kuehniella* egg mites, (Table 3).

Table 3: Mean Longevity and fecundity of *Cydnoseius negevi* female reared on different prey types.at 25±1°C, 70± 5% R.H.

Biological aspect	*Anagasta kuehniella*	*Tetranychus urtica*	Date palm pollen	L.S.D. at 5%
Pre-oviposition	5.17±0.29^{a}	4.67±0.76^{b}	4.17±1.26^{b}	0.5
Oviposition	14.83±0.76^{b}	15.50±1.32^{a}	14.67±1.26^{b}	0.4
Post-oviposition	4.83±0.76^{c}	5.83±0.76^{b}	8.17±0.76^{a}	3.2
Longevity	24.83±0.29^{c}	26.00±1.32^{b}	27.00±3.28^{a}	2.2
Life span	37.17±0.29^{a}	36.00±2.00^{b}	35.33±3.01^{c}	1.3
Fecundity	9.67±0.58^{c}	27.67±1.53^{b}	31.67±1.53^{a}	15.9
Daily rate	0.65±0.06^{c}	1.79±0.08^{b}	2.16±0.09^{a}	1.1

3. Life Table Parameters:

Data in Table (4) showed that food source significantly affected Ro values, which recorded (17.23, 16.75 and 8.26) females | female when *C. negevi* was provided with *T. urtica*, date palm pollen and *A. kuehinella*, respectively.

And the intrinsic rate of natural increase (rm) was recorded (0.156, 0.127 and 0.075) when *C. negevi* was provided with *T. urtica*, date palm pollen and *A. kuehinella*, respectively.

And for the Finite rate of increase (e^{rm}) ƛ the values were (1.169, 1.135 and 1.078) when *C. negevi* was provided with *T. urtica*, date palm pollen and *A. kuehinella*, respectively.

These results proved that spider mites and date palm pollen were the most preferable food source, while different insect eggs were not as much.

Table (4): Life table parameters of *Cydnoseius negevi* when reared on different food types at 25±1°C, 70± 5% R.H.

Parameters	*Anagasta kuehniella*	*Tetranychus urtica*	Date palm pollen
Net reproduction rate (Ro)^{b}	8.26	17.23	16.75
Mean generation time (T)^{a}	28.14	18.21	22.16
Intrinsic rate of increase (r m^{c})	0.075	0.156	0.127
Finite rate of increase (e^{rm}) ƛ	1.078	1.169	1.135
Generation doubling (days)(DT)	9.242	4.44	5.458
Gross reproduction (GRR)	8.9	21.29	17.66

These observations agree with those obtained by (Nomikou *et al.*, 2001; Momen and El-Sawi, 2008; Fouly *et al.*, 2011; El-Shammery, 2018; Fouly *et al.*, 2021).

In conclusion, previous studies proved the ability of predaceous phytoseiid mites, *C. negevi* to live and survive on different food types (Tanigoshi and Griffiths, 1982; Messelink *et al.*, 2005; Winner *et al.*, 2008 Al-Shammery, 2011, Fouly *et al.* 2011 and Fouly *et al.*2021). Generally, this study presents alternative diets for mass rearing of *C. negevi* that could be used in case of the absence of *T. urticae*,

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