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Influence of Alternative Food Sources on Different Biological Aspects of *Cydnoseius negevi* (Acari: Phytoseiidae)

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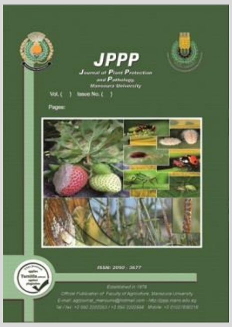

ABSTRACT

The predatory mite *Cydnoseius negevi* (Swirski & Amitai), (Family Phytosidae), is a predaceous mite of different mite and insect pests, such as two-spotted spider mite and castor whitefly. This work aimed to study the role of *C. negevi* in controlling the four arthropod pests, *Spodoptera littoralis* (Boisduval), *Trialeurodes ricini* (Misra), and *Anagasta* (*Ephestia) kuehniella* (Keller) as well as spider mite *Tetranychus urtica* (Koch) compared with date palm pollen as food options under controlled conditions. The predatory mite *C. negevi* can feed and complete its life span successfully on these foods. *Trialeurodes ricini* and *A. kuehniella* eggs prolonged the life cycle of *C. negevi*. Likewise, the shortest period observed when male and female fed on eggs of *T. urtica*. Egg production of the tested mite was the highest when it fed on pollen, while oviposition was lower when the predatory mite fed on *T. ricini*. Food sources also affected all life tables where spider mite eggs and pollen grains were the most favorable foods increased R_o, r_m, e^{rm} and GRR values. Insect eggs prolonged T and D_t times of the tested mite *C. negevi*. Therefore, *C. negevi* could be reared successfully on date palm pollen and eggs of *S. littoralis*, *T. ricini*, *A. kuehniella* and *T. urticae*.

***Keywords**: Cydnoseius negevi*, biology, life tables, insect and mite preys and date palm pollen.

INTRODUCTION

Mites in family Phytoseiidae are effective biocontrol agents throughout the world (Helle and Sabelis, 1985; Mc Murtry *et al.* 2013). Many species successfully introduced to eliminate mite and insect pests especially spider mites, whiteflies and thrips. (Mc Murtry *et al.* 2013). Many of phytoseiid mite species usually found in association with both insect and mite populations in different regions throughout Egypt and they influenced by food sources (Fouly 1982 and Zaher, 1986).

Cydnoseius negevi (Swirski & Amitai), is a widespread and common in the Middle East (Abou-Awad *et al.* 1998; Palevsky and Ueckermann 2009 and Hountondji *et al.* 2010). No much data is available about its developmental times and reproduction on various preys and alternative food (Momen 1997; Momen *et al.* 2009; Negm *et al.* 2014; Hussein *et al.* 2016). The possibility of mass rearing a phytoseiid predator on alternative diets such as pollen grains could help rearing the predators as biocontrol agents (Castagnoli and Simoni 1999). Pollens may serve as a good nutrition for phytoseiid mites (Cook *et al.* 2003; Riahi *et al.* 2016, 2017 and Al-Shammery, 2018).

Therefore, pollens may help in the survival of many generalists. (Hanna *et al.* 2005).

The cotton leaf worm, *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) is a critical pest. Its larvae can defoliate numerous economical important crops including 112 plants belonging to 44 families (Moussa *et al*., 1960; Hatem *et al*., 2009 and EPPO, 2008). It distributes in Southern Spain, Middle East, and Northern and Central Africa (Carter, 1984; Gomez and Arroyo, 1994) and it is a key pest of cotton and other crops in Egypt (Hosny *et al.*, 1986, Russell *et al.* 1993).

Spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) attacks many crops especially vegetables and fruits. The two-spotted spider mite considered to be the most destructive species reported from 150 economic host plants (Rott and Ponsonby, 2000; Zhang, 2003 and Wilkerson *et al*., 2005).

The castor whitefly, *Trialeurodes ricini* (Misra), (Hemiptera: Aleyrodidae) mainly infests castor bean, *Ricinus communis* L. and other plants (Bink-Moenen, 1983; Shishehbor and Brennan 1995).

The Mediterranean flour moth, *Anagasta (Ephestia) kuehniella* (Keller) (Lepidoptera: Pyralidae) infests stored grain products, especially flour. This insect was found especially in countries with temperate climates. Eggs and larvae of *A. kuehniella* are used to rear parasitoid and predaceous species (Hamasaki and Matsui 2006 and Paust *et al.* 2008).

The present study aims to determine the impact of four alternative food sources (date palm pollen and eggs of *S. littoralis*, *T. ricini* and *A. kuehniella*) compared to spider mite *T. urticae* on the biology and life tables of the predatory mite *C. negevi* under constant temperatures and relative humidity.

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MATERIALS AND DISCCUSION

Cultures of Cydnoseius negevi

Samples of *C. negevi* (Swirski & Amitai), were collected from eggplant leaves (*Solanum melongena* L. Solanaceae) growing in a plastic greenhouse at Mansoura University, during February and March 2019. Leaf samples were collected in paper pages and transferred to the laboratory of the Plant Protection, Faculty of Agriculture, Damietta University for direct examination using stereomicroscopic binocular. A pure culture of *C. negevi* was maintained on *T. urticae* in an incubator at 27±1 °C and 70±5% RH. Predatory mite individuals were kept on small hibiscus leaf discs, *Hibiscus rosa chinenses* L. The wet cotton wool maintained the leaf freshness by water when needed.

Date palm pollen source

Pollen grains, *Phoenix dactylifera* L. were collected from Damietta governorate during March and April, 2019. The pollen grains were dried, shaken on a paper, and then collected in glass vials and kept in a refrigerator at 4ºC (Al-Shammery 2011).

Culture of Spodoptera littoralis eggs

Cotton leaf worm culture originated from the plant protection laboratory, Faculty of Agriculture, Al-Azhar University. Larvae were provided with castor leaves and rearing technique of Adham *et al.*, (2009) was followed. Deposited egg batches were used in rearing the predatory mites as needed.

Culture of Trialeurodes ricini

The castor whitefly, *T. ricini* eggs were collected from wild castor leaves three times a week and kept in a fridge. Fresh eggs were counted and introduced to the predatory mite where fresh eggs were replaced daily.

Culture of Anagasta (Ephestia) kuehniella

A laboratory colony of the Mediterranean flour moth, *A. kuehniella* was maintained according to Norris and Richards (1934).

Culture of spider mite Tetranychus urticae

Fresh eggs of the two-spotted spider mite, *T. urticae* were gathered from eggplant leaves grown at the greenhouse of the Faculty of Agriculture, Damietta University. The fresh eggs were replaced daily.

Laboratory Technique

Newly deposited eggs of *C. negevi* were gathered every day for a week, transferred singly to hibiscus leaf discs (2.5cm) each. Six groups of 50 eggs each were separated, where the newly hatched larvae were provided with a surplus amount of date palm pollen or one of the experimental prey for their prolonged existence.

Mite individuals have been inspected daily where the incubation period, number of immature stages reached adulthood and sex ratio were recorded. A male mite was introduced to each of the new emerged female for copulation and both kept together for their longevity. Eggs in each replicate were charted daily. Treatments were managed at constant conditions of 27°C and 70% RH.

Analysis of Biological Data

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

Effect of food sources on life tables of Cydnoseius negevi

Life table parameters, intrinsic rate of natural increase r_m, lx the age-specific survival rate, Mx the oviposition rate at age x, the net reproductive rate (R_o), the mean generation time (T) in days of *C. negevi* were examined according to Birch (1948) and Laing (1968) and then by using the Basic Computer Program of Abou-Setta *et al.* (1986). Moreover, the doubling time (D_t) was determined according to Laughlin (1965); May (1976) and Carey (1993). The hatchability and survival rate were used for estimating Lx. The proportion of females (No.♀/total ♀+♂) was used for calculating the Mx values.

RESULTS AND DISCUSSION

The obtained results revealed that male and female larva of *C. negevi* molted one time to reach the nymph stage, whereas nymphs molted two times to reach the adult stage, called Protonymph and deutonymph.

Effects of Different Nourishments on C. negevi Development

Table (1) showed that there were no significant differences found between the incubation periods of *C. negevi*. The shortest incubation period was noted when *C. negevi* was fed on *T. urtica* eggs with 1.5 days. While the longest incubation period were recorded when *C. negevi* fed on *A. kuehniella* eggs with 2.7days. Total duration of immature stages (Larva and 1st nymph and 2nd nymph) was significantly longer when *C. negevi* was fed on *T. ricini* and *A. kuehniella* eggs with 11.5 and 11.4 days respectively, while the shortest one was noted when *C. negevi* was fed on *T. urticae* with only 6.35 days.

Table 1. Duration of incubation period, immature stages (days) of *Cydnoseius negevi* female provided with five kinds of food and kept at constant conditions.

Developmental stages	Date palm Pollen	*Spodoptera littoralis*	*Tetranychus urticae*	*Trialeurodes ricini*	*Anagasta (Ephestia) kuehniella*	L.S.D.	F	P (≤0.05)
Incubation period	1.9±0.3 ab	2.1±0.7 ab	1.5±0.65 b	2.3±0.62 ab	2.7±0.89 a	0.6	3.8	0.003 **
Larva	0.8±0.2 c	1.0±0.3 bc	0.9±0.23 c	1.2±0.32 bc	1.7±0.44 a	0.3	8.5	0.000 ***
Protonymph	3.6±1.0 c	3.0±1.1 c	2.9±0.73 c	5.7±0.67 b	5.0±0.93 b	1.1	36.3	0.000 ***
Deutonymph	3.4±0.5 bc	3.7±1.3 abc	2.6±0.50 c	4.7±0.98 ab	4.5±1.00 ab	1.6	4.6	0.001 **
Total	7.78±1.2 a	7.67±1.7 b	6.35±1.0 c	11.5±1.6 a	11.4±1.9 a	1.18	35.8	0.000 ***
Life cycle	9.8±1.4 b	9.7±1.6 b	8.0±1.14 c	13.9±1.18 a	13.9±1.80 a	1.3	36.3	0.000 ***
Generation	12.7±1.2 b	13.0±1.7 b	11.5±1.16 b	20.1±1.63 a	19.5±1.8 a	1.5	69.6	0.000 ***

Means followed by similar letters in each row are not significantly different

Therefore, it can be noticed that female life cycle prolonged when *C. negevi* was fed on *T. ricini* and *A. kuehniella* eggs with 13.9and 13.9 days respectively, while the shortest life cycle was recorded on *T. urticae* with 8.0 days. That means spider mites shortened the development of the predatory mite. These findings are in harmony with Fouly *et al.* (2011) who reared *T. swirskii* on eggs of the whitefly *B. tabaci.*

The female generation period of *C. negevi* significantly affected by the tested alternative food sources. Total generation period of *C. negevi* was significantly longer when *C. negevi* was fed on *T. ricini and A. kuehniella* eggs with 20.1 and 19.5 days respectively, while the shortest one was recorded when it fed on *T. urtica* eggs with 11.5 days, (Table 1).

The same trend obtained with *C. negevi* males, where the shortest incubation period was noted when *C. negevi* was fed on *T. urticae* with 1.6 days, while the longest period was on *T. ricini* and *A. kuehniella* eggs with 2.0 days (Table2).

Table 2. Duration of incubation period, immature stages and adult stage (days) of *Cydnoseius negevi* male fed on five kinds of food and kept at constant conditions.

Developmental stages	Date palm Pollen	*spodoptera littoralis*	*Tetranychus urticae*	*Trialeurodes ricini*	*Anagasta (Ephestia) kuehniella*	L.S.D.	F	P (≤0.05)
Incubation period	2.0±0.18 [a]	2.3±1.0[a]	1.6±0.5[a]	2.0±0.9 [a]	2.0±0.8 [a]	0.81	0.82	0.547 ns
Larva	0.8±0.35 [C]	0.9±0.2[bc]	0.9±0.2[bc]	1.2±0.4 [abc]	1.7±0.5[a]	0.5	4.30	0.0022 **
Protonymph	3.0±0.41 [c]	2.8±1.0[c]	3.7±0.8[c]	5.6±0.9[b]	3.1±0.8[bc]	1.7	26.72	0.000 ***
Deutonymph	3.5±0.60 [b]	3.1±0.8[b]	2.7±0.8[b]	4.33±1.0[ab]	5.2±1.1 [ab]	2.0	3.80	0.0054 **
Total	7.2±1.1 [b]	6.75±1.3[b]	7.3±0.8[b]	11.4±1.9[a]	11.7±1.6[a]	1.5	27.60	0.000 ***
life cycle	9.2 ±0.93 [a]	9.3±1.3[b]	8.9±1.0[b]	13.4±1.7[a]	13.7±1.3[a]	1.4	29.60	0.000 ***
Longivity	19.1±0.60[a]	15.8±2.8[a]	22.4±1.3[a]	21.4±6.7[a]	20.0±1.9[a]	5.9	1.82	0.1559 ns
Life span	28.3±0.60[a]	25.1±2.1[d]	31.2±1.3[bc]	37.4±0.9[a]	33.7±2.4[ab]	4.9	8.94	0.000 ***

Means followed by similar letters in each row are not significantly different

From the aforementioned results it was observed that total duration of immature stages (larval and nymphal periods) was significantly longer when *C. negevi* was fed on *T. ricini* and *A. kuehniella* eggs with 11.4and 11.7 days respectively, while the shortest period was noted when the tested predatory mite fed on *S. littoralis* with 6.75 days. The longest male life cycle occurred when mites fed on *A. kuehniella* (13.7 days), while the shortest was on eggs of *T. urticae* (8.9 days) (Table 2). Therefore, it can be concluded that males and females of *C. negevi* were variably able to feed and successfully survive feeding on spider mites as well as other tested alternative food sources such as date palm pollen and eggs of *S. littoralis*, *T. ricini* and *A. Kuehniella* (Tables 1 & 2). Similarly, El-Sawi and Momen (2005) and Momen and El-Sawi (2008) and Al-Shammery (2018) showed that phytoseiid mites *E. scutalis, N. cucumeris* and *N. barkeri* completed successfully their development feeding on *A. kuehniella, S. littoralis,* and *S. cerealella* eggs. Inconsistent, *N. (Amblyseius) californicus* (McGregor) didn't accept *Corcyra cephalonica* eggs as food source and, therefore, could not complete its development (Romeih *et al*., 2004). The present observations agree with those of Fouly *et al*. (2013) who found that whitefly eggs caused life cycle of *E. scutalis* longer than mobile stages of spider mite *T. urticae*, while plant pollen gave the shortest life cycle. Similar results also obtained by Escudero and Ferragut (2004) who found that development was longer when *N. californicus* and *Phytoseiulus persimilis* A.–H. supplied with a diet of *Tetranychus evansi* Baker than *T. urticae*, *T. turkestani* Ugarov and Nikolski, as well as *T. ludeni* Zacher.

Concerning longevity of *C. negevi* Male, the current findings proved that food source affected its life time but didn't show significant differences. Male longevity was longer on *T. urtica* eggs (22.4 days). The shortest life of males were noticed when *C. negevi* was offered eggs of cotton leaf worm (15.8 days) (Table 2). Females lived also a shorter time (20.2 days) feeding on eggs of *S. littoralis*, but they lived for a longer period (24 days) when they subjected to date palm pollen or *T. ricini* eggs (Table 3).

Pre-oviposition period of *C. negevi* females started laying eggs after 2.9, 3.3, 3.4, 6.2 and 5.6 days when reared on date palm pollen and eggs of *S. littoralis, T. urtica, T. ricini, A. kuehniella*, respectively. (Table 3). Oviposition showed a longer time when *C. negevi* females fed on *T. urtica* eggs with 14.3 days than on other prey species, while the shortest ovipositional period was 10.9 days when females of *C. negevi* fed on *S. littoralis*. (Table 3). The longest post-oviposition period (7.5 days) achieved with a diet consisting of date palm pollen, while it was shorter (3.9 days) on *A. kuehniella* eggs (Table 3). These findings agree with those of Al-Shammery (2018) who reported that *N. barkeri* and *N. cucumeris* males and females lived for a longer time when both predators were supplied with *S. cerealella* eggs. The same effect was shown in pre-oviposition, oviposition and post-oviposition periods. From the obtained results presented in (Tables 2 and 3), it can be concluded that male and female life span significantly affected by the type of food. The longest life span of male and female of *C. negevi* (37.4 and 38.1 days) was noted with *T. ricini* eggs, while it was only 25.1 and 29.9 days with *S. littoralis*. Several authors also studied the capability of generalist phytoseiid mites, such as *C. negevi*, and they mentioned that they are able to survive and reproduce on several food as well as plant pollen (Tanigoshi *et al*., 1993; Messelink *et al.*, 2005; Winner *et al.*, 2008; Al-Shammery, 2011 and Fouly *et al.* 2011).

Table 3. Mean duration time (days) of *Cydnoseius negevi* female provided with five different nourishments and kept at constant conditions.

Biological aspects	Date palm Pollen	*spodoptera littoralis*	*Tetranychus urticae*	*Trialeurodes ricini,*	*Anagasta (Ephestia) kuehniella*	L.S.D.	F	P (≤0.05)
Pre-oviposition period	2.9±0.5[b]	3.3±0.6[b]	3.4±0.52[b]	6.2±0.78[a]	5.6±0.79[a]	0.7	42.9	0.000 ***
Oviposition. Period	13.8±1.8[a]	10.9±0.8[c]	14.3±1.63[a]	12.3±1.54[b]	13.7±0.76[a]	1.2	13.4	0.000 ***
Post-oviposition period	7.5±1.2[a]	5.9±1.9[b]	6.2±1.01[b]	5.8±0.83[b]	3.9±0.73[c]	1.0	15.7	0.000 ***
Longivity	24.2±1.4[a]	20.2±2.1[b]	24±2.06[a]	24.2±1.47[a]	23.2±1.1[a]	1.5	13.0	0.000 ***
Life span	34.0±1.9[b]	29.9±2.4[d]	32.0±1.73[c]	38.1±1.28[a]	37.1±1.78[a]	1.8	35.3	0.000 ***

Means followed by similar letters in each row are not significantly different

Results in (Table 4) showed that the total number of deposited eggs of *C. negevi* female significantly affected by different food sources, where quantity of eggs laid by mite female was highest when it fed on date palm pollen (30.0 eggs/female). That means each female can lay daily average of 2.3 eggs. Eggs of *T. ricini* caused only 10.8 eggs/female with a daily rate of 0.9 eggs and considered the lowest. Similarly, Al-Shammery (2018) mentioned that *N. cucumeris* and *N. barkeri* were at their highest fecundity rate, when both subjected to a diet of *A. kuehniella* eggs. Their lowest egg deposition obtained when they fed on *S. cerealella* eggs. Inconsistent, *N. cucumeris* showed a higher fecundity rate on *S. cerealella* eggs. Moreover, *E. scutalis* was at its highest fecundity when it fed on eggs of both noctuid insects *S. littoralis* and *S. exigua*, while it was significantly lower on *A. ipsilon* eggs (Momen and El-Sawi, 2008). Similarly, Zhang *et al*. (2018) reported that *Amblyseius orientalis* (Ehara) fed on the whitefly *B. tabaci* eggs had the shortest oviposition duration and longevity, while its lowest fecundity compared to eggs of the carmine spider mite *Tetranychus cinnabarinus* (Boisduval). Similar results obtained by Messelink *et al*. (2005), Winner *et al.* (2008) and Seiedy *et al*. (2016)

Table 4. Duration of oviposition period (days), total and daily rate of deposited eggs of *Cydnoseius negavi* fed on five different diets and kept at constant conditions.

Fecundity	Prey mite species							
	Date palm Pollen	***Spodoptera littoralis***	***Tetranychus urticae***	***Trialeurodes ricini,***	***Anagasta (Ephestia) kuehniella***	**LSD**	**F**	**P**
Oviposition. Period	13.8±1.8^{a}	10.9±0.8^{c}	14.3±1.63^{a}	12.3±1.54^{b}	13.7±0.76^{a}	1.2	13.4	0.000 ***
Total deposited egg	30.0±3.1^{a}	11.5±2.0^{c}	27.0±1.58^{b}	10.8±0.92^{c}	11.2±2.24^{c}	2.1	198.2	0.000 ***
Daily rate of egg	2.3±0.4^{a}	1.1±0.2^{c}	2.0±0.59^{b}	0.9±0.06^{cd}	0.8±0.14^{d}	0.2	97.1	0.000 ***

Means followed by similar letters in each row are not significantly different

Impact of different food sources on life tables of Cydnoseius negevi

Survival percentages of *C. negevi* was at its highest level when the predatory fed on date palm pollen and *S. littoralis* eggs by an average of 96%. Feeding on eggs of *A. kuehniella* gave 95% of predatory survival, while it was only 91% when *C. negevi* females provided with eggs of both spider mite *T. urticae* and *T. ricini*, respectively as shown in Table (5) and Figure (1). It was noticed that Lx value of *C. negevi* declined during the egg-laying period. Food source didn't affect sex ratio where a diet of *T. urticae* caused a female proportion of 0.76 and decreased to 0.67, 0.65, 0.61 and 0.54 when *C. negevi* fed on *T. urticae, A. kuehniella, S. littoralis, T. ricini* and date palm pollen, respectively (Table 5). These values directly affected the reproductive potentiality as represented in life table parameters. Data also showed that a diet of eggs of *A. kuehniella* caused a longer mean generation time T (27.53 days), while *T. urticae* shortened it (19.23 days). These values averaged 26.32 and then decreased to 21.79 and 21.13 days when the predatory mite fed on *T. ricini*, *S. littoralis* and date palm pollen, respectively (Table 5). Therefore, a nourishment consists of *T. urticae*, pollen as well as *S. littoralis* eggs were favorable foods for rearing *C. negevi*, where they shortened its development. The same trend was observed with the time in which *C. negevi* could multiply its population D_t where the same previous diets gave an average of 2.05, 3.48, 2.31, 4.05 and 4.68, respectively. Momen and El-Sawi (2008) who found similar results and mentioned that feeding on eggs of *S. littoralis* and *S. exigua* (Hübner) had a good impact on the predatory mite *Euseius scutalis,* where both diets shortened its generation and doubling time. Contradictory, Al-Shammery (2018) found that *Sitotroga cerealella* (Oliv.) eggs, as a food, caused a longer generation (T) period of the phytoseiid mite *N. cucumeris* (23.45 days), while eggs of *A. kuehniella* shortened it to 17.42 days.

With regard to the net reproductive rate R_o, which represents the sum number of females born in two generations (No. multiplication | generation), data in Table (5) clearly showed that food source significantly affected R_o values. A diet of either spider mite or date palm pollen raised this value to 16.90 and 16.27 females | female and then declined to 7.63, 6.60 and 5.43 females|female when *C. negevi* provided with *A. kuehinella*, *s. littoralis* and *T. ricini*, respectively. These results proved that spider mites and pollen grains were the most preferable food source, while different insect eggs were not as much. Momen and El-Sawi (2008) found that R_o value of *E. scutalis* fed on *S. cerealella* eggs reached its lowest rate where it was only 6.87 and 8.09 females/female, while it highly increased feeding on eggs of *S. littoralis* and *S. exigua* and significantly decreased when fed on *A. ipsilon* eggs. The same authors added that R_o values were still lower than R_o when *E. scutalis* was provided with a nourishment of *T. urticae* or pollen grains. El-Shammery (2018) found that a diet of either *A. kuehniella* or *S. littoralis* was suitable food source for rearing *N. cucumeris* and *N. barkeri* because both preys caused higher rates of R_o.

Concerning the intrinsic rate of natural increase (r_m), which is to predict the mite population growth (Birch (1948), data indicated that it averaged 0.064, 0.074 and 0.086 females female | day when *C. negevi* provided with eggs of each *T. ricini, A. kuehinella* and *S. littoralis*, respectively (Table 5). Correspondent values highly increased to 0.132 and 0.147 females | female | day when *C. negevi* fed on pollen and *T. urticae*, respectively (Table 5 and Figure 2). Number of new daughters that can added every day to mite population (multiplication times | day), is the finite rate of increase e^{rm} (λ). Data in Table 5 showed a similar trend as mentioned above. Rate of e^{rm} reached its highest level 1.158 and 1.141 when *C. negevi* fed on spider mite and pollen grains, respectively (Table 5). El-Shammery (2018) also found that e^{rm} was 1.100 and 1.134 for *N. cucumeris* and *N. barkeri* when they offered a diet of *A. kuehniella* eggs, and then reached its lowest rate when both mites were subjected with eggs of *S. cerealella*. Similarly, Fouly *et al.* (2011) found that e^{rm} of *Typhlodromips swirskii* A.-H. reached its lowest rate when fed on eggs of the whitefly *B. tabaci.* Spider mite and date palm pollen also positively enhanced the gross reproduction GRR where they caused an average of 20.60 and 16.95, respectively. These values considerably decreased to 8.04, 7.82 and 7.03 when *C. negevi* fed on eggs of *A. kuehinella*, *S. littoralis* and *T. ricini* as shown in Table (5) and Figure (2), respectively. These observations agree with those obtained by Nomikou *et al.* (2001).

In general, previous studies proved the ability of predaceous phytoseiid mites such as *C. negevi* to consume and survive feeding on different nourishments (Tanigoshi and Griffiths, 1982; Messelink *et al.*, 2005; Winner *et al.*, 2008 Al-Shammery, 2011 and Fouly *et al.* 2011). Accordingly, the present protocol showed that *C. negevi*, which considered a good eliminator to some phytophagous mites and insects and it fortunately reared successfully under laboratory conditions on alternative food sources.

Table 5. Life table parameters of *Cydnoseius negavi* fed on five different kinds of food sources and incubated at 27 °C and 70% RH

Life table parameters	Prey mite species				
	Date palm Pollen	*Tetranychus urticae*	*Spodoptera littoralis*	*Trialeurodes ricini,*	*Anagasta (Ephestia) kuehniella*
No. mites	28	32	30	27	29
Survival %	96	94	96	91	95
Female proportion	0.54	0.76	0.65	0.61	0.67
Mean generation time (T)	21.13	19.23	21.79	26.3	27.52
Doubling time (D_t)	2.31	2.05	3.48	4.68	4.05
Net reproductive rate (R_o)	16.26	16.90	6.60	5.43	7.6
Intrinsic rate of increase (r_m)	0.132	0.146	0.086	0.064	0.074
Finite rate of increase (e^{rm}) λ	1.142	1.158	1.090	1.066	1.076
Gross reproduction (GRR)	16.95	20.60	7.82	7.03	8.04

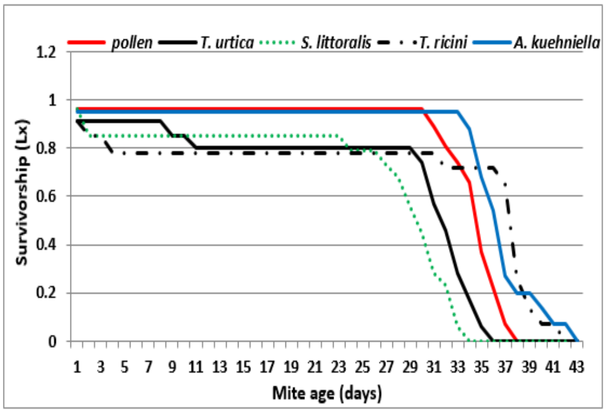

Figure 1. Age specific survivorship (Lx) of *Cydnoseius negevi* fed on different foods

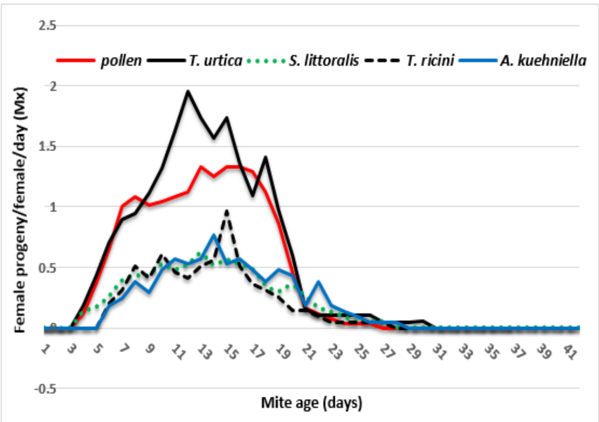

Figure 2. Age specific Fecundity (female progeny/female) of *Cydnoseius negevi* fed on different foods

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تأثير مصادر الغذاء البديلة على النواحي البيولوجيه المختلفه للمفترس الأكاروسي *Cydnoseius Negevi* (Acari: Phytoseiidae)

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يعد الأكاروس المفترس *Cydnoseius Negevi* (Swirski & Amitai)، من عائلة Phytosiidae، هو أحد أهم عناصر المكافحة البيولوجية الأكثر شيوعًا ضد الآفات الأكاروسية والحشرية المختلفة، مثل الحلم العنكبوتي ذو البقعتين وذبابة الخروع البيضاء وغيرها. ولتقييم الدور المحتمل للأكاروس *C. negevi* في مكافحة أربعة أنواع مختلفة من الآفات الأكاروسية والحشرية، تمت دراسة النواحي البيولوجية المختلفة ومعايير جدول الحياة لهذا الأكاروس المفترس وذلك عند تغذيته على حبوب لقاح نخيل التمر وكذلك بيض الحلم العنكبوتي ذو البقعتين ودودة ورق القطن الكبرى وذبابة الخروع البيضاء وفراشة دقيق البحر المتوسط، كمصادر غذائية في ظل ظروف ثابتة (27 ± 1 درجة مئوية و70 ± 5٪ رطوبة نسبية). أظهرت النتائج أن الأكاروس المفترس *C. Negevi* قادر على التغذية وإكمال تطوره على أنواع الغذاء المذكورة أعلاه. كما لوحظ تأثر نمو المفترس بنوع الغذاء، حيث كانت مدة دورة الحياة أطول بدرجة معنوية عندما تغذى *C. Negevi* على بيض ذبابة الخروع البيضاء وفراشة دقيق البحر المتوسط (13.4، 13.7 يومًا للذكور 13.9 يومًا للإناث على الترتيب) من الأنواع الأخرى من الغذاء. وبالمثل فقد لوحظ أن الحد الأدنى من الوقت للذكور والإناث الذين تغذوا على بيض العنكبوت ذو البقعتين (8.9 أيام للذكور 11.5 يومًا للإناث على الترتيب). وكانت خصوبة الأكاروس هي الأعلى على حبوب لقاح النخيل (30 بيضة / أنثى بمعدل يومي 2.3 بيضة / أنثى / يوم) ، كما كانت أقل خصوبة عندما تم إمداد الأكاروس المفترس *C. Negevi* ببيض ذبابة الخروع البيضاء 10.0 بيضة / أنثى بمعدل 0.9 بيضة / أنثى / يوم). وأثرت مصادر الغذاء بدرجات متفاوتة على جميع معايير جدول حياة الأكاروس المفترس *C. Negevi* حيث أدت التغذية على بيض العنكبوت الأحمر وحبوب لقاح النخيل على أعلى معدلات التزايد النوعي ودرجة الخصوبة ومعدل تضاعف الأجيال المتوقعة عند توافر نفس الظروف - وعليه فأنه يمكن استنتاج أنه يمكن الحفاظ على الأكاروس الفايتوسيدى بنجاح على الغذاء البديل، حبوب لقاح النخيل وبيض دودة ورق القطن الكبرى، الحلم العنكبوتي ذو البقعتين، ذبابة الخروع البيضاء وفراشة دقيق البحر المتوسط، في التجارب المعملية عندما تكون أنواع الفرائس الطبيعية قليلة التواجد.