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Suitability of two eriophyoid mites as prey to *Neoseiulus barkeri* (Acari: Phytoseiidae)

Shimaa F. Fahim* | **Amira A. Abdel-Khalek** | **Faten M. Momen**

Pests and Plant Protection Department, National Research Centre (NRC), El-Buhouth Street, Dokki, Cairo, Egypt; E-mails: shimaa_fahiim@yahoo.com, amira_afifi777@hotmail.com, fatmomen@gmail.com

*** Correspondence**

shimaa_fahiim@yahoo.com

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ABSTRACT

Neoseiulus barkeri (Hughes) is a common predatory mite in the Middle East region. In the present study, the development and biological parameters of *N. barkeri* when preyed on *Rhyncaphytoptus ficifoliae* Keifer or *Aceria ficus* (Cotte) mite pests were investigated. The predatory mite successfully developed on *R. ficifoliae* and *A. ficus*. The pre-adult duration of *N. barkeri* individuals fed on *A. ficus* (9.24 days) was shorter than that of those reared on *R. ficifoliae* (10.35 days). Conversely, the egg production of *N. barkeri* females reared on *R. ficifoliae* (35.53 eggs/♀) was lower compared to those fed on *A. ficus* (44.12 eggs/♀). *Neoseiulus barkeri* individuals reared on *R. ficifoliae* showed considerable lower values of intrinsic (r) and finite rates of increase (λ) ($r = 0.141$ day^{-1}, $\lambda = 1.151$ day^{-1}) compared to those preyed on *A. ficus* ($r = 0.165$ day^{-1}, $\lambda = 1.179$ day^{-1}). Our results suggest that *N. barkeri* could be considered as a potential biocontrol agent for controlling these pests.

KEYWORDS

Aceria ficus, biological control, life table, mite pests, population growth parameters, predatory mites, *Rhyncaphytoptus ficifoliae*

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INTRODUCTION

Neoseiulus barkeri (Hughes) (Acari: Phytoseiidae) is a common predatory mite in the Middle East region (Jafari *et al.* 2010); it is a type-III generalist phytoseiid (McMurtry *et al.* 2013) that feeds on many small pests infesting trees, vegetables, and stored fruits (e.g., thrips, spider mites, and plant nematodes) (Khaliq *et al.* 2018; Yang *et al.* 2020; Fahim and Momen 2022a). This phytoseiid is an efficient commercial predatory mite (van Lenteren *et al.* 2018) that is extensively utilized as a bio-control agent in several countries (Mcmurtry *et al.* 2013; Gomez-Martinez *et al.* 2017; Yu *et al.* 2024). It is commercialized in different regions for the management of the tarsonemid mite *Polyphagotarsonemus latus* (Banks) (Fan and Petitt 1994), *Thrips tabaci* L. (Thysanoptera: Thripidae) (van Lenteren *et al.* 2018), and the tenuipalpid mite *Raoiella indica* Hirst (Filgueiras *et al.* 2020a, b, c).

Mites belonging to the superfamily Eriophyoidea are small phytophagous mites that can cause considerable loss in crop productivity (Lindquist *et al.* 1996). Species of Eriophyoidea have been documented to be the second main Acari pest after tetranychid mite pests (van Leeuwen *et al.* 2010). Eriophyid and diptilomiopid mites occur on shrubs, herbaceous plants, and trees, causing serious damage to leaves, fruits, and buds (Zaher 1986).

In Egypt, fig (*Ficus carica* L.) is an important economic fruit (Abou El-Saad and Salem 2011). This fruit has great nutritional value as it is rich in vitamins and minerals in addition to containing essential amino acids and carbohydrates (Desoky *et al.* 2021). Many pests attack fig orchards (Halawa 2017) and cause crop loss (El-Halawany *et al.* 1986; Ali 2006). The fig bud mite, *Aceria ficus* (Cotte) (Eriophyidae), is found in and around the buds on developing foliage. It is the key mite pest that attacks fig leaves (Abo-Taka *et al.* 2014). This mite is very damaging since, in addition to feeding on fig tree (Abou-Awad *et al.* 2000b), it is a vector of fig mosaic virus disease too (Caglayan *et al.* 2012). The fig leaf mite *Rhyncaphytoptus ficifoliae* Keifer (Diptilomiopidae) is a free-living mite living on the surface of the plant. It is an important phytophagous pest that affects fig trees (Louni *et al.* 2014). In Egypt, eriophyoid mite pests are causing damage to fig trees, and infestation rates have increased to considerable levels in the past few years (Desoky *et al.* 2021).

Chemical pesticides are usually used in Egypt for the management of phytophagous mites on fruit trees. However, mite infestation remains high in fig orchards despite pesticide treatments (Bahiraei *et al.* 2019). In fact, the widespread utilization of chemical pesticides can cause resistance besides their harmful influence on non-target organisms (Bergeron and Schmidt-Jeffris 2020), humans, and the environment (Momen *et al.* 2014). Hence, it is crucial to use other effective tactics to manage fig mite pests. In several cases, the biological control procedures are environmentally and economically viable alternatives to chemical treatments (van Lenteren and Bueno 2003). Actually, the hymenopterans offered the first principal set of bio-control agents followed by the predatory mite species (van Lenteren 2012). In the ecosystem, predatory mites can play a substantial role in reducing eriophyid mite populations (Abou-Awad *et al.* 2011). Indeed, studies offering information on the life table features of predator species when reared on mite prey are significant for predicting their success in prey control programs (McMurtry *et al.* 2013; Fahim and Momen 2022a). From the literature review, some phytoseiids could complete their growth and reproduce on eriophyoid mite species (Abou-Awad *et al.* 2010; Louni *et al.* 2014; Halawa 2017; Fahim and Abdel-Khalek 2022; Fahim and Momen 2022b). Although *N. barkeri* was found to exist in high populations in the soil of fig orchards (Desoky *et al.* 2021), no study has investigated the demographic parameters of this predator when preying on *R. ficifoliae* and *A. ficus* that infest fig trees. Therefore, to fill this knowledge gap, our study aimed to assess the developmental and life table parameters of *N. barkeri* when fed on *R. ficifoliae* and *A. ficus* as a key step in determining the appropriateness of *N. barkeri* as a biocontrol agent for these fig mite pests. However, *R. ficifoliae* is a leaf-surface feeding mite, whereas *A. ficus* primarily attacks developing buds, which may influence predator efficiency.

MATERIAL AND METHODS

Predatory mite

The predatory mite *N. barkeri* was initially collected from debris under fig trees in orchards at Qalyubia Governorate, Egypt. Colonies of *N. barkeri* were kept separately on *R. ficifoliae* and *A. ficus* in the laboratory. The rearing units were made from clean fig leaf discs on wet cotton layers placed in the middle of Petri dishes. Wet cotton strips were placed around the edges of the discs to prevent mite escape. Water was supplied frequently to keep the cotton wet. When the leaf substrate began to deteriorate (e.g., color change or wilting), it was replaced with a fresh one. All rearing units were kept in an incubator at 26 ± 1 °C, 70 ± 5% RH, and 16L: 8D photoperiod.

Prey mites

In our study, *R. ficifoliae* and *A. ficus* were provided as food sources for *N. barkeri*. It is difficult to maintain eriophyoid colonies in the laboratory, and there has been difficulty in transporting the various stages of the eriophyoids tested (Abou-Awad *et al.* 2000a). Therefore, small pieces of developing foliage or leaves infested with *A. ficus* or *R. ficifoliae*, respectively, were carefully examined and introduced directly to the leaf unit to feed *N. barkeri*. These pieces were changed daily with fresh ones to ensure that there is sufficient prey. Both *R. ficifoliae* and *A. ficus* were collected from infested fig trees in orchards at Qalyubia Governorate, Egypt.

Individuals from the predatory mite and the two tested prey were mounted separately on slides for examination under a stereomicroscope and were identified at the Acarology laboratory, Pests and Plant Protection Department, National Research Centre (NRC). The two tested prey were confirmed by Abou-Awad, B.A., Pests and Plant Protection Department, NRC. The predatory mite was confirmed by the third author, Momen, F.M., following the most recent keys to Egyptian phytoseiid species by Abo-Shnaf and de Moraes (2014).

Experiments

Based on preliminary consumption observations, each individual of *N. barkeri* was supplied daily with excess numbers of moving stages of the prey (more than that consumed daily; 50–70 active stages of *R. ficifoliae* or 100–120 active stages of *A. ficus*). A small piece of leaf or developing foliage heavily infested with *R. ficifoliae* or *A. ficus* was inspected under a stereomicroscope and introduced directly to each experimental unit designated for *R. ficifoliae* or *A. ficus*, respectively, to feed *N. barkeri*. For each prey, mated females of *N. barkeri* were transported to new leaf units and left to deposit eggs for 12 h, then the females were removed. Thirty-five newly laid eggs (0–12 h) were transported separately to the experimental units and checked daily to determine the duration of immature stages of *N. barkeri* on each prey. After maturity, each female of this predator (for each prey) was paired with a male. The mated predatory females were checked daily to estimate their fecundity, longevity, and reproductive periods. Because multiple mating is needed for *N. barkeri* (Bonde 1989; Momen 1993), a predatory male was added weekly to every experimental unit. When the leaf discs began to deteriorate (e.g., color change or wilting), they were carefully replaced with fresh ones, so as not to affect predation rates or survival. All experimental predatory individuals were inspected every day until their death.

Statistical analysis

The present data on *N. barkeri* were analyzed according to the age-stage, two-sex life table method (Chi *et al.* 2022) using the TWOSEX-MSChart (Chi 2023). All tested parameters such as, age-stage-specific fecundity (f_{xj}) (where x = age and j = stage), age-stage-specific survival rate (s_{xj}), age-specific survival rate (l_x), age-specific fecundity (m_x), age-stage specific life expectancy (e_{xj}), and age-stage specific reproductive value (v_{xj}) along with population growth parameters [finite rate of increase (λ), intrinsic rate of increase (r), gross reproductive rate (GRR), net reproductive rate (R_0), and mean generation time (T)] were estimated using TWOSEX-MSChart program (Chi 2023). The means and standard errors of developmental stages durations, adult pre-oviposition period (APOP), total pre-oviposition period (TPOP), oviposition days, fecundity, and lifespan as well as the population parameters (r, λ, R_0, T, and GRR) were estimated by the bootstrap method with 100,000 re-sampling using the TWOSEX-MSChart program (Chi 2023); while means were compared by the paired bootstrap test based on the confidence interval of difference ($P < 0.05$) (Huang and Chi 2013; Wei *et al.* 2020).

RESULTS

Development, lifespan, and fecundity

The obtained data exhibited that *N. barkeri* can reproduce and grow on *R. ficifoliae* or *A. ficus*. *Neoseiulus barkeri* individuals fed on *A. ficus* (9.24 days) reached adulthood statistically faster than those fed on *R. ficifoliae* (10.35 days) (Table 1). The eriophyoid prey considerably influenced the TPOP and APOP of *N. barkeri* (all *P*'s < 0.05). A marked reduction in oviposition days was observed in *N. barkeri* females preyed on *R. ficifoliae* (23.82 days) compared to those fed on *A. ficus* (27.94 days) ($P < 0.05$). The longevity of this predator was considerably longer for individuals reared on *A. ficus* (37.76 days) than for those preyed on *R. ficifoliae* (35.29 days; $P < 0.05$). The oviposition of *N. barkeri* females reared on *R. ficifoliae* (35.53 eggs/♀) was lower than that of those reared on *A. ficus* (44.12 eggs/♀; $P < 0.05$) (Table 1).

The age-stage, two-sex life table

The age-stage specific survival rate (s_{xj}) of *N. barkeri* (the possibility that a newly oviposited egg of this predator will survive to age x and stage j) is displayed for each prey tested in Figure 1. Because of the variations in growth rates of *N. barkeri* individuals, an overlap amongst different *N. barkeri* stages have been detected. The highest possibility that a newly deposited egg of *N. barkeri* survived to adulthood was 0.63 in the case of females and 0.37 in the case of males for the two species of eriophyoids.

Table 1. Developmental durations, lifespan, and fecundity of *Neoseiulus barkeri* reared on *Aceria ficus* and *Rhyncaphytoptus ficifoliae*.

Parameters	Eriophyoid mites	
	A. ficus	***R. ficifoliae***
Egg (days)	3.47 ± 0.12a	3.53 ± 0.12a
Larva (days)	1.35 ± 0.12a	1.47 ± 0.12a
Protonymph (days)	2.00 ± 0.00b	2.65 ± 0.13a
Deutonymph (days)	2.41 ± 0.13a	2.71 ± 0.11a
Pre-adult (days)	9.24 ± 0.10b	10.35 ± 0.20a
APOP (days)	2.53 ± 0.12b	3.53 ± 0.12a
TPOP (days)	11.76 ± 0.13b	13.88 ± 0.26a
Oviposition days (days)	27.94 ± 0.34a	23.82 ± 0.41b
Adult female (days)	37.76 ± 0.33a	35.29 ± 0.29b
Fecundity (eggs/female)	44.12 ± 0.28a	35.53 ± 0.32b
Lifespan (days)	47.00 ± 0.33a	45.65 ± 0.40b

Means in each row followed by similar letters are insignificantly different ($P < 0.05$; Paired bootstrap test with 100,000 re-sampling).

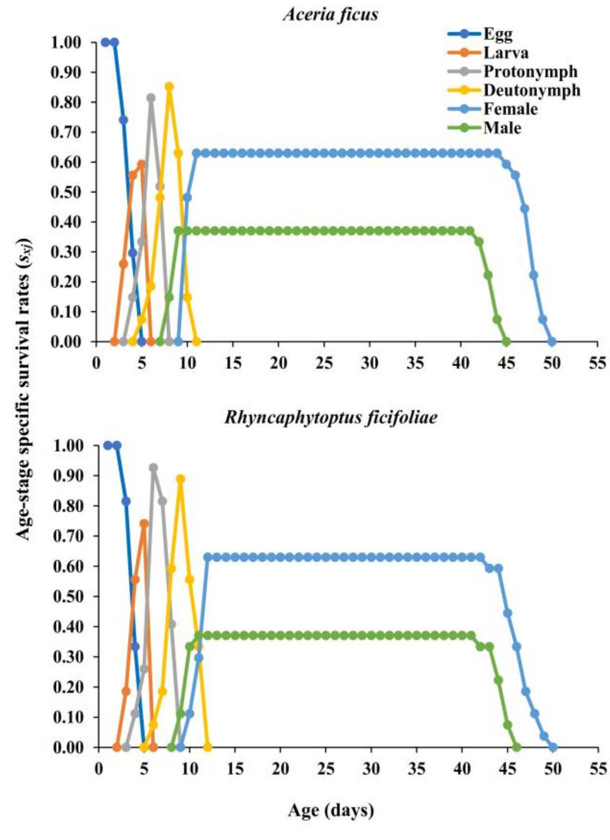

Figure 1. Age-stage specific survival rates (s_{xj}) of *Neoseiulus barkeri* fed on *Aceria ficus* and *Rhyncaphytoptus ficifoliae*.

The age-specific fecundity (m_x), age-specific survivorship (l_x), and age-stage-specific fecundity (f_{xj}) of *N. barkeri* when reared on *R. ficifoliae* and *A. ficus* are exhibited in Figure 2. The f_{xj} of *N. barkeri* presented the number of eggs deposited by individuals of this predator of age x and stage j/day. Currently, the maximum values of f_{xj} of *N. barkeri* were 2.41 eggs/day for *A. ficus* and 2.12 eggs/day for *R. ficifoliae*.

Age-stage specific reproductive value (v_{xj}) of *N. barkeri* when reared on *R. ficifoliae* and *A. ficus* is presented in Figure 3. The v_{xj} of *N. barkeri* represents the contribution of *N. barkeri* individuals of age x and stage j to the future offspring. The v_{xj} peaks of *N. barkeri* were 12.74 for *A. ficus* and 12.15 for *R. ficifoliae*.

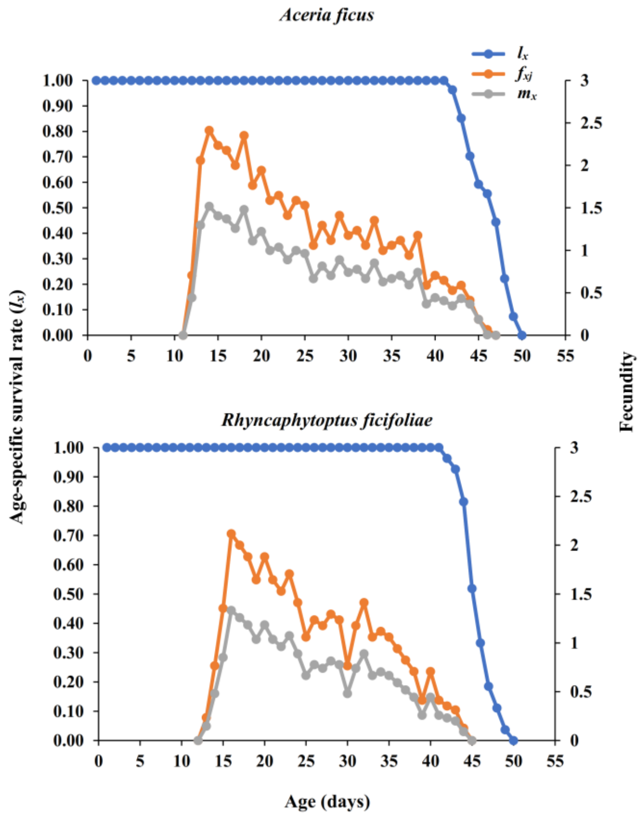

Figure 2. Age-specific fecundity (m_x), Age-specific survival rate (l_x), age-stage specific fecundity (f_{xj}) of *Neoseiulus barkeri* fed on *Aceria ficus* and *Rhyncaphytoptus ficifoliae*.

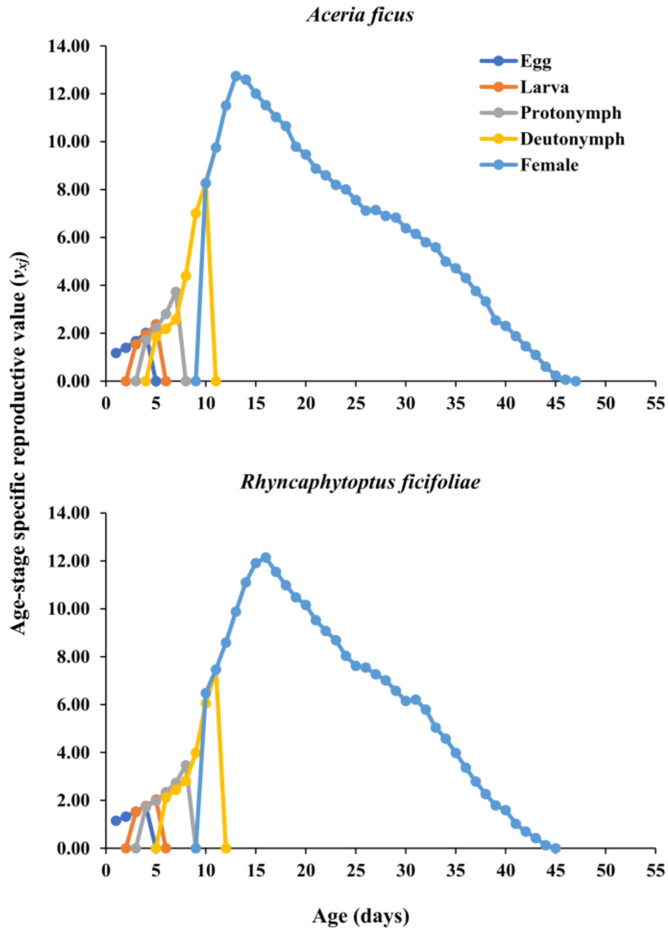

Figure 3. Age-stage specific reproductive value (v_{xj}) of *Neoseiulus barkeri* fed on *Aceria ficus* and *Rhyncaphytoptus ficifoliae*.

Age-stage specific life expectancy (e_{xj}) of *N. barkeri* when reared on *R. ficifoliae* and *A. ficus* is given in Figure 4. The e_{xj} of *N. barkeri* showed the predictable period that an individual of *N. barkeri* of age x and stage j will survive. The 38.00 and 36.65 days were the peaks of e_{xj} of *N. barkeri* female for *A. ficus* and *R. ficifoliae*, respectively. Moreover, the uppermost e_{xj} values of *N. barkeri* males were 35.70 days for *A. ficus* and 35.60 days for *R. ficifoliae*.

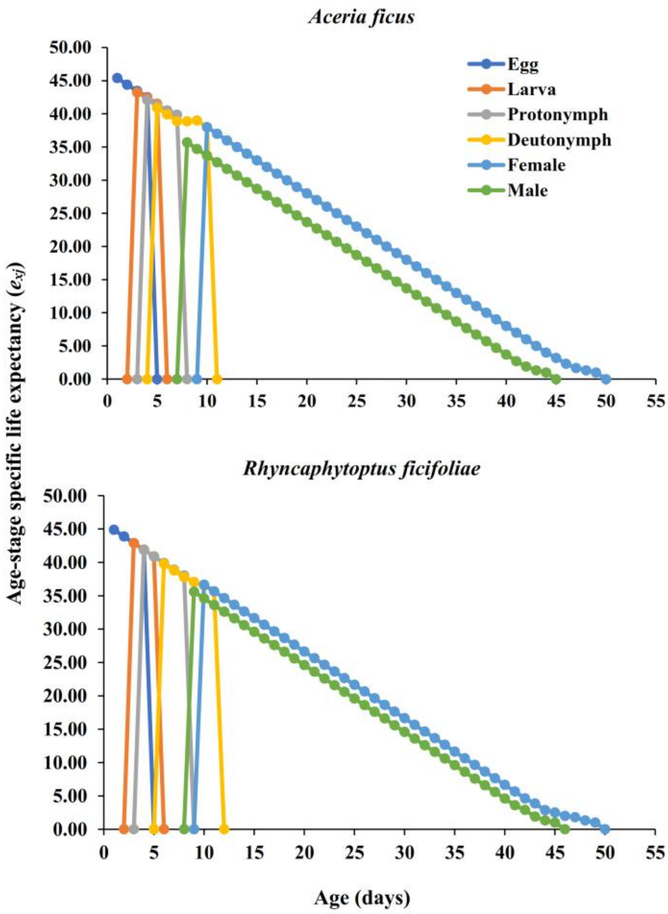

Figure 4. Age-stage specific life expectancy (e_{xj}) of *Neoseiulus barkeri* fed on *Aceria ficus* and *Rhyncaphytoptus ficifoliae*.

Life table parameters

Individuals of *N. barkeri* reared on *R. ficifoliae* showed clearly lower intrinsic (r) (0.141 day^{-1}) and finite rates of increases (λ) (1.151 day^{-1}) than those reared on *A. ficus* (r = 0.165 day^{-1}, λ = 1.179 day^{-1}). Furthermore, it was observed that the mean generation time (T) was markedly shorter when *N. barkeri* was fed on *A. ficus* (20.143 days) compared to that on *R. ficifoliae* (22.096 days). Nevertheless, non-significant variations in gross (*GRR*) and net reproductive rates (R_0) were seen between *N. barkeri* reared on *R. ficifoliae* and *A. ficus* (Table 2).

Table 2. Life table parameters (Mean ± SE) of *Neoseiulus barkeri* reared on *Aceria ficus* and *Rhyncaphytoptus ficifoliae*.

Life table parameters	Eriophyoid mites	
	A. ficus	***R. ficifoliae***
Intrinsic rate of increase (*r*)	0.165 ± 0.008a	0.141 ± 0.007b
Finite rate of increase (*λ*)	1.179 ± 0.009a	1.151 ± 0.008b
Net reproductive rate (R_0)	27.778 ± 3.753a	22.370 ± 2.976a
Mean generation time (*T*)	20.143 ± 0.198b	22.096 ± 0.319a
Gross reproductive rate (*GRR*)	28.070 ± 3.693a	22.411 ± 2.974a

Means in each row followed by similar letters are insignificantly different (P < 0.05; Paired bootstrap test with 100,000 re-sampling).

DISCUSSION

The biological control strategy involves the utilization of natural biocontrol agents versus the target pests in order to keep their density under the level of causing economic loss to plants (van Driesche and Heinz 2004). Phytoseiid mites are important predators due to their use in biological control of several arthropod pests that infest various plants (Mandape and Shukla 2017; Hajiqanbar and Farazmand 2021). Both tested prey species, *R. ficifoliae* and *A. ficus*, commonly attack fig orchards in Egypt (Halawa 2017). Research into indigenous phytoseiids (such as, *N. barkeri*) that have been adapted to the native environment of fig orchards and can prey on fig mite pests may yield favorable outcomes in the biological control strategies for these pests. Herein, *N. barkeri* was successfully developed and reproduced when reared on *R. ficifoliae* and *A. ficus*. In the same way, *Amblyseius swirskii* Athias-Henriot, *A. largoensis* (Muma), and *Phytoseius finitimus* (Ribaga),(all Acari: Phytoseiidae) were preyed and developed on these fig mite pests (Abou-Awad *et al.* 2000a; Abou-Awad *et al.* 2018; Fahim and Abdel-Khalek 2022).

In our study, the duration of the pre-adult stage in *N. barkeri* was shorter than that observed for this predator feeding on *Colomerus vitis* (Pagenstecher), *Tetranychus urticae* Koch, and *Brevipalpus lewisi* McGregor (at 25 °C) (Al-Azzazy 2021). The pre-adult development of *N. barkeri* when reared on thrips (Bonde 1989), *Aceria dioscoridis* (Soliman & Abou-Awad) (Momen 1995), *Aceria guerreronis* Keifer (Negloh *et al.* 2008), *Eotetranychus kankitus* Ehara, *Panonychus citri* (McGregor) (Li *et al.* 2017), and *Oligonychus mangiferus* (Rhaman & Sapra) (Fahim and Momen 2022a) was faster than that observed in the current study.

Fecundity of *N. barkeri* feeding on the tested eriophyoids was higher than that reported for this predator when other prey, e.g., *Aleuroglyphus ovatus* (Troupeau) (at 32 °C) (Xia *et al.* 2012), *Oligonychus afrasiaticus* (McGregor) (at 35 °C) (Negm *et al.* 2014), *E. kankitus*, *T. urticae*, *P. citri* (Li *et al.* 2017), and *B. lewisi* (at 25 °C) (Al-Azzazy 2021) were offered. Similar fecundity was observed when *N. barkeri* was fed either *A. ficus* (44.12 eggs/♀; current study) or *A. dioscoridis* (44.21 eggs/♀ at 25 °C) (Momen 1995). The total oviposition of *N. barkeri* females reared on *Thrips tabaci* Lindeman (47.1 eggs/♀ at 25 °C) (Bonde 1989) was higher than our findings.

In comparison with the current results, shorter pre-adult duration and lower fecundity were seen for other phytoseiid species, *Phytoseius plumifer* (Canestrini & Fanzago) feeding on *R. ficifoliae* (Louni *et al.* 2014). Currently, the fecundity of *N. barkeri* was higher than that of *A. swirskii* (Abou-Awad *et al.* 2000a) and *A. largoensis* (Fahim and Abdel-Khalek 2022) feeding on both of the tested eriophyoids. Herein, the pre-adult period and fecundity of *N. barkeri* when feeding on *A. ficus* were shorter and higher, respectively, than those of *Neoseiulus californicus* (McGregor) versus the same prey (Halawa 2017). After *R. ficifoliae* was presented as food, the fecundity of *N. californicus* (Halawa 2017) was lower than that observed for *N. barkeri* in our results. In fact, *N. barkeri* is an important biological control agent and is superior to many other predators due to its high reproductive potential, short growth period, low natural death rate, and strong dispersal capacity (Bonde 1989).

The parameters r and R_0 are principal growth parameters that show the developmental and reproduction potential of the population of mite (Fahim and Abdel-Khalek 2022). Our study clearly showed that the tested fig mite pests are appropriate prey for *N. barkeri*, and caused higher values of r, λ, and R_0 than those achieved by a diet of *E. kankitus* ($r = 0.116$ day^{-1}, $\lambda = 1.12$ day^{-1}, $R_0 = 5.7$ offspring), *P. citri* ($r = 0.077$ day^{-1}, $\lambda = 1.08$ day^{-1}, $R_0 = 5.6$ offspring), *T. urticae* ($r = 0.099$ day^{-1}, $\lambda = 1.10$ day^{-1}, $R_0 = 10.7$ offspring) (Li *et al.* 2017), and *B. lewisi* ($r = 0.095$ day^{-1}, $\lambda = 1.020$ day^{-1}, $R_0 = 10.70$ offspring) (at 25 °C) (Al-Azzazy 2021). These tested slow-moving preys (*A. ficus* and *R. ficifoliae*) are easy to consume and are present in large numbers, enabling the predator (*N. barkeri*) to obtain the necessary amount of food for its growth and reproduction in a better way compared to some other prey. However, higher values of r, λ were attained when *N. barkeri* was reared on thrips ($r = 0.22$ day^{-1}, $\lambda = 1.25$ day^{-1}) (Bonde 1989), and *O. mangiferus* ($r = 0.234$ day^{-1}, $\lambda = 1.264$ day^{-1}) (Fahim and Momen 2022a).

When *R. ficifoliae* was utilized as a food source, lower values of r, λ, and R_0 were documented for *A. swirskii* ($r = 0.122$ day^{-1}, $\lambda = 1.13$ day^{-1}, $R_0 = 15.62$ offspring) (Abou-Awad *et al.* 2000a) compared with our results. In this study, *N. barkeri* reared on *R. ficifoliae* presented lower r, λ, and higher R_0 values compared to other phytoseiid mites reared on this mite prey (e.g., *P. plumifer* (Louni *et al.* 2014) and *A. largoensis* (Fahim and Abdel-Khalek 2022). Comparing the present results for *A. ficus*, Abou-Awad *et al.* (2000a) observed lower values of *r*, *λ*, and R_0 for *A. swirskii* feeding on the same eriophyoid. Actually, higher *r* and *λ* values were recorded for *A. largoensis* (Fahim and Abdel-Khalek 2022) when reared on *A. ficus*.

Our findings showed that *A. ficus* may be more favorable than *R. ficifoliae* as a prey for *N. barkeri* population development. This may be explained by the easier consumption of *A. ficus* (a slender and spindle-shaped mite) compared to *R. ficifoliae* (a fusiform and curved body mite). The present findings reinforce other studies that have suggested that *A. ficus* is a suitable prey for other phytoseiid mites such as *A. swirskii* (Abou-Awad *et al.* 2000a), *C. negevi* (Abou-Awad *et al.* 1998), *P. finitimus* (Abou-Awad *et al.* 2018), and *A. largoensis* (Fahim and Abdel-Khalek 2022). The above-discussed results indicated that *N. barkeri* may be a beneficial predatory mite in the control strategies of the tested eriophyoid mites.

CONCLUSION

Our study can help to understand the efficiency and applicability of *N. barkeri* as a biocontrol agent for the tested eriophyoid pests. This study demonstrated that *N. barkeri* can grow and reproduce on the tested eriophyoids. These results indicate that *N. barkeri* could serve as a potential biocontrol agent against *A. ficus* and *R. ficifoliae* and could be used in biological control systems against these fig pests in order to decrease chemical control procedures.

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Availability of data and materials: Data are available upon request from the authors.

Ethics approval and consent to participate: This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

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Competing interests: The authors declare no conflict of interest.

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REFERENCES

Abo-Shnaf, R.I.A. & de Moraes, G.J. (2014) Phytoseiid mites (Acari: Phytoseiidae) from Egypt, with new records, descriptions of new species, and a key species. *Zootaxa*, 3865(1): 1–71.

Abo-Taka, S.M., Heikal, H.M. & Zakaria, S. (2014) mites inhabit fig trees at menoufia governorate with control of phytophagous mites. *Acarines*, 8: 45–48.

Abou El-Saad, A.K. & Salem, A.A. (2011) Survey of phytophagous mites on fig trees and their associated predators at Assiut governorate. *Minia Journal of Agricultural Research and Development*, 13: 13–18.

Abou-Awad, B.A., Abdel-khalek, A.A. & Afia, S.I. (2018) Life tables, functional and numerical responses of predatory mite *Phytoseius finitimus* (Ribaga) (Acari: Phytoseiidae) to different densities of two eriophyoid mites *Aceria ficus* and *Rhyncaphytoptus ficifoliae*, infesting fig orchards. *Bioscience Research*, 15: 3888–3899.

Abou-Awad, B.A., El-Sawaf, B.M. & Abdel-Khalek, A.A. (2000a) Impact of two eriophyoid fig mites, *Aceria ficus* and *Rhyncaphytoptus ficifoliae*, as prey on postembryonic development and oviposition rate of the predacious mite *Amblyseius swirskii*. *Acarologia*, 41: 367–371.

Abou-Awad, B.A., El-Sawaf, B.M., Reda, A.S. & Abdel-Khalek, A.A. (2000b) Environmental management and biological aspects of the two eriophyoid fig mites *Aceria ficus* (Cotte) and *Rhyncaphytoptus ficifoliae* Keifer in Egypt. *Journal of Pest Science*, 73: 5–12.

Abou-Awad, B.A., El-Sherif, A.A., Hassan, M.F. & Abou-Elela, M.M. (1998) Laboratory studies on development, longevity, fecundity and predation of *Cydnoseius negevi* (Swirski & Amitai) (Acari: Phytoseiidae) with two mite species as prey. *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz*, 105: 429–433.

Abou-Awad, B.A., Metwally, A. & Al-Azzazy, M.M. (2011) Environmental management and biological aspects of two eriophyid mango mites in Egypt: *Aceria mangiferae* and *Metaculus mangiferae*. *Acarologia*, 51: 481–497.

Abou-Awad, B.A., Metwally, A.M. & Al-Azzazy, M.M. (2010) *Typhlodromips swirskii* (Acari: Phytoseiidae) a predator of eriophyid and tetranychid mango mites in Egypt. *Acta Phytopathologica et Entomologica Hungarica*, 45: 135–148.

Al-Azzazy, M.M. (2021) Biological performance of the predatory mite *Neoseiulus barkeri* Hughes (Phytoseiidae): a candidate for controlling of three mite species infesting grape trees. *Vitis*, 60: 11–20.

Ali, M.M. (2006) *Studies on some mite species infesting deciduous fruits in Upper Egypt*. Ph.D. Thesis, Faculty of Agriculture, Assiut University, Egypt, 155 pp.

Bahiraei, F., Jafari, S., Lotfollahi, P. & Shakarami, J. (2019) Temperature dependent development and temperature thresholds of *Rhyncaphytoptus ficifoliae* Keifer (Diptilomiopidae). *Journal of Asia-Pacific Entomology*, 23: 186–195.

Bergeron, P.E. & Schmidt-Jeffris, R.A. (2020) Not all predators are equal: miticide non-target effects and differential selectivity. *Pest Management Science*, 76: 2170–2179.

Bonde, J. (1989) Biological studies including population growth parameters of the predatory mite *Amblyseius barkeri* at 25 °C in the laboratory. *Entomophaga*, 34: 275–287.

Caglayan, K., Elci, E., Serce, C.U., Kaya, K., Gazel, M. & Medina, V. (2012) Detection of fig mosaic virus in viruliferous eriophyid mite *Aceria ficus*. *Journal of Plant Pathology*, 94: 629–634.

Chi, H. (2023) TWO SEX-MSChart: A computer program for the age-stage, Two-sex life table analysis.

Chi, H., Kara, H., Ozgokce, M.S., Atlihan, R., Guncan, A. & Risvanli, M.R. (2022) Innovative application of set theory, Cartesian product, and multinomial theorem in demographic research. *Entomologia Generalis*, 42: 863–874.

Desoky, A.S., Mohamed, A.A., Fouad, H.A. & Amin, N.A. (2021) Occurrence of phytophagous and predacious mites in two fig cultivars with population dynamics of the most abundant species in relation to weather factors and plant phenology at Sohag governorate, Egypt. *Acarines*, 15: 33–44.

El-Halawany, M.E., Kandeel, M.A.H. & Rakha, M.A. (1986) Mites inhabiting deciduous fruit trees. *Agricultural Research Review*, 64: 115–22.

Fahim, S.F. & Abdel-Khalek, A.A. (2022) Development and reproduction of *Amblyseius largoensis* (Acari: Phytoseiidae) feeding on two eriophyoid mites. *Persian Journal of Acarology*, 11: 483–496.

Fahim, S.F. & Momen, F.M. (2022a) Biology and life table parameters of some phytoseiid mites fed on *Oligonychus mangiferus* (Acari: Tetranychidae). *Persian Journal of Acarology*, 11: 263–274.

Fahim, S.F. & Momen, F.M. (2022b) Suitability of three eriophyid mites as prey for the predatory mite, *Typhlodromus athiasae* (Acari: Phytoseiidae). *Persian Journal of Acarology*, 11: 295–307.

Fan, Y. & Petitt, F.L. (1994) Biological control of broad mite, *Polyphagotarsonemus Latus* (banks), by *Neoseiulus Barkeri* Hughes on pepper. *Biological Control*, 4: 390–395.

Filgueiras, R.M.C., Mendes, J.A., da Silva, F.W.B., Sousa, N.E.P. & Melo, J.W.S (2020a) Prey stage preference and functional and numerical responses of *Neoseiulus barkeri* Hughes (Acari: Phytoseiidae) to eggs of *Raoiella Indica* Hirst (Acari: Tenuipalpidae). *Systematic and Applied Acarology*, 25: 1147–1157.

Filgueiras, R.M.C., Mendes, J.A., Sousa, N.E.P., Monteiro N.V. & Melo, J.W.S. (2020b) *Neoseiulus barkeri* Hughes (Acari: Phytoseiidae) as a potential control agent for *Raoiella indica* Hirst (Acari: Tenuipalpidae). *Systematic and Applied Acarology*, 25: 593–606.

Filgueiras, R.M.C., Silva, B.W., Sousa, N.E.P., Mendes, J.A. & Melo, J.W.S. (2020c) Can the prey species *Raoiella indica* Hirst (Acari: Tenuipalpidae) support the development and reproduction of *Neoseiulus barkeri* Hughes (Acari: Phytoseiidae). *Systematic and Applied Acarology*, 25: 1485–1494.

Gomez-Martinez, M.A., Jaques, J.A., Ibáñez-Gual, M.V. & Pina, T. (2017) When the ground cover brings guests: is *Anaphothrips obscurus*, a friend or a foe for the biological control of *Tetranychus urticae*, in clementines? *Journal of Pest Science*, 91: 613–623.

Hajiqanbar, H. & Farazmand, A. (2021) Biological control by mites in Iran. *In:* Karimi, J. & Madadi, H. (Eds.), *Biological control of insect and mite pests in Iran - A review from fundamental and applied aspects*. Progress in biological control. Vol. 18. Springer, Cham., pp. 89–141.

Halawa, A.M. (2017) Possibility of utilizing the predatory mite, *Neoseiulus californicus* (McGregor) (Acari: Phytoseiidae) for controlling two eriophyoid fig mites, *Aceria ficus* (Cotte) and *Rhyncaphytoptus ficifoliae* Keifer (Acari: Eriophyidae). *Menoufia Journal of Plant Protection*, 2: 223–230.

Huang, Y.B. & Chi, H. (2013) Life tables of *Bactrocera cucurbitae* (Diptera: Tephritidae): with an invalidation of the jackknife technique. *Journal of Applied Entomology*, 137: 327–339.

Jafari, S., Fathipour, Y., Faraji, F. & Bagheri, M. (2010) Demographic response to constant temperatures in *Neoseiulus barkeri* (Phytoseiidae) fed on *Tetranychus urticae* (Tetranychidae). *Systematic and Applied Acarology*, 15: 83–99.

Khaliq, A., Afzal, M., Raza, A.M., Kamran, M., Khan, A.A., Aqeel, M.A., Ullah, M.I., Khan, B.S. & Kanwal, H. (2018) Suitability of *Thrips tabaci* L. (Thysonaptera: Thripidae) as prey for the phytoseiid mite *Neoseiulus barkeri* Hughes (Acari: Phytoseiidae). *African Entomology*, 26(1): 131–135.

Li, Y.Y., Zhang, G.H., Tian, C.B., Liu, M.X., Liu, Y.Q., Liu, H. & Wang, J.J. (2017) Does long-term feeding on alternative prey affect the biological performance of *Neoseiulus barkeri* (Acari: Phytoseiidae) on the target spider mites? *Journal of Economic Entomology*, 110: 915–923.

Lindquist, E.E., Sabelis, M.W. & Bruin, J. (1996) *Eriophyoid mites: their biology, natural enemies and control. World Crop Pests, 6*. Elsevier's Science Publ., Amsterdam, The Netherlands, 790 pp.

Louni, M., Jafari, S. & Shakarami, J. (2014) Life table parameters of *Phytoseius plumifer* (Phytoseiidae) fed on *Rhyncaphytoptus ficifoliae* (Diptilomiopidae) under laboratory conditions. *Systematic and Applied Acarology*, 19: 275–282.

Mandape, S.S. & Shukla, A. (2017) Diversity of phytoseiid mites (Acari: Mesostigmata: Phytoseiidae) in the agro-ecosystems of South Gujarat, India. *Journal of Entomology and Zoology Studies*, 5: 755–765.

McMurtry, J.A., de Moraes, G.J. & Sourassou, N.F. (2013) Revision of the lifestyles of phytoseiid mites (Acari: Phytoseiidae) and implications for biological control strategies. *Systematic and Applied Acarology*, 18: 297–320.

Momen, F.M. (1993) Effects of single and multiple copulation on fecundity, longevity and sex ratio of the predacious mite *Amblyseius barkeri* (Hugh.) (Acari, Phytoseiidae). *Anzeiger für Schäd lingskunde Pflanzenschutz Umweltschutz*, 66: 148–150.

Momen, F.M. (1995) Feeding, development and reproduction of *Amblyseius barkeri* (Acarina: Phytoseiidae) on various kinds of food substance. *Acarologia*, 36: 101–105.

Momen, F.M., Abdel Rahman, H.A., Samour, E.A., Aly, S.M. & Fahim, S.F. (2014) Acaricidal activity of *Melissa officinalis* oil and its formulation on *Tetranychus urticae* and the predatory mite *Neoseiulus californicus* (Acari: Tetranychidae and Phytoseiidae). *Acta Phytopathologica et Entomologica Hungarica*, 49: 95–115.

Negloh, K., Hanna, R. & Schausberger, P. (2008) Comparative demography and diet breadth of Brazilian and African populations of the predatory mite *Neoseiulus baraki*, a candidate for biological control of coconut mite. *Biological Control*, 46: 523–531.

Negm, M.W., Fahad, J.A. & Yousif, N.A. (2014) Biology, predation, and life table of *Cydnoseius negevi* and *Neoseiulus barkeri* (Acari: Phytoseiidae) on the old world date mite, *Oligonychus afrasiaticus* (Acari: Tetranychidae). *Journal of Insect Science*, 14: 1–6.

van Driesche, R.G. & Heinz, K.M. (2004) An overview of biological control in protected culture. *In*: Heinz, K.M., van Driesche, R.G. & Parrella, M.P. (Eds.), *Biocontrol in Protected Culture*. Ball Publishing, Batavia, pp. 1–24.

van Leeuwen, T., Witters, J., Nauen, R., Duso, C. & Tirry, L. (2010) The control of eriophyoid mites: state of the art and future challenges. *Experimental and Applied Acarology*, 51: 205–224.

van Lenteren, J.C. (2012) The state of commercial augmentative biological control: Plenty of natural enemies, but a frustrating lack of uptake. *BioControl*, 57: 1–20.

van Lenteren, J.C. & Bueno, V.H. (2003) Augmentative biological control of arthropods in Latin America. *Biocontrol*, 48: 123–139.

van Lenteren, J.C., Bolckmans, K., Köhl, J., Ravensberg, W.J. & Urbaneja, A. (2018) Biological control using invertebrates and microorganisms: plenty of new opportunities. *Biocontrol*, 63: 39–59.

Wei, M.F., Chi, H., Guo, Y.F., Li, X.W., Zhao, L.L. & Ma, R.Y. (2020) Demography of *Cacopsylla chinensis* (Hemiptera: Psyllidae) reared on four cultivars of *Pyrus bretschneideri* and *P. communis* (Rosales: Rosaceae) pears with estimations of confidence intervals of specific life table statistics. *Journal of Economic Entomology*, 113: 2343–2353.

Xia, B., Zou, Z., Li, P.X. & Lin, P. (2012) Effect of temperature on development and reproduction of *Neoseiulus barkeri* (Acari: Phytoseiidae) fed on *Aleuroglyphus ovatus*. *Experimental and Applied Acarology*, 56: 33–41.

Yang, S.H., Zhou, W.Q., Wang, D.W., Xu, C.L. & Xie, H. (2020) Evaluation of (Acari: Phytoseiidae) for the control of plant parasitic nematodes, (Tylenchida: Pratylenchidae) and (Tylenchida: Heteroderidae). *Biocontrol Science* and *Technology*, 30: 201–211.

Yu, S.-J., Wang, L., Ding, L.-L., Pan, Q., Li, S.–C., Liu, L., Cong, L. & Ran, C. (2024) A down regulated cytochrome P450 in *Neoseiulus barkeri* Hughes (Acari: Phytoseiidae) can dechlorinate and hydroxylate chlorpyrifos without producing chlorpyrifos-oxon. *Journal of Hazardous Materials*, 476: 135163.

Zaher, M.A. (1986) *Survey and ecological studies on phytophagous, predaceous and soil mites in Egypt*. I phytophagous mites of Nile Valley, PL, 480 Program, USA, 567 pp.

مناسب بودن دو هرنای اریوفیوئید به عنوان طعمه برای *Neoseiulus barkeri* (Acari: Phytoseiidae)

شیماء اف. فهیم* | امیرۀ عبدالخالق | فاتن ام. مؤمن

بخش آفات و گیاهپزشکی، مرکز پژوهش‌های ملی، خیابان البحوث، دوکی، قاهره، مصر؛ رایانامه‌ها: shimaa_fahiim@yahoo.com، amira_afifi777@hotmail.com، fatmomen@gmail.com

** نویسندۀ مسئول*
shimaa_fahiim@yahoo.com

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۱۰ بهمن ۱۴۰۴

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دبیر تخصصی
آ. فرازمند

چکیده

گونۀ *Neoseiulus barkeri* (Hughes) هرنای شکارگر رایج در منطقۀ خاورمیانه است. در مطالعه حاضر، پراسنجه‌های رشد و زیستی *N. barkeri* با تغذیه از هرناهای *Rhyncaphytoptus ficifoliae* Keifer یا *Aceria ficus* (Cotte) بررسی شد. کنۀ شکارگر با موفقیت روی *R. ficifoliae* و *A. ficus* رشد کرد. دورۀ پیش از بلوغ افراد *N. barkeri* تغذیه شده با *A. ficus* (۹/۲۴ روز) کوتاه‌تر از افراد پرورش یافته روی *R. ficifoliae* (۱۰/۳۵ روز) بود. برعکس، تولید تخم ماده‌های *N. barkeri* پرورش یافته روی *R. ficifoliae* (۳۵/۵۳ تخم به ازای هر ماده) در مقایسه با افراد تغذیه شده با *A. ficus* (۴۴/۱۲ تخم به ازای هر ماده) کمتر بود. افراد *Neoseiulus barkeri* پرورش یافته روی *R. ficifoliae* مقادیر بسیار کمتری از میزان ذاتی (*r*) و میزان متناهی افزایش(λ) (r = ۰/۱۴۱ بر روز ، λ = ۱/۱۵۱ بر روز) را در مقایسه با افراد شکار شدۀ *A. ficus* (r = ۰/۱۶۵ بر روز ، λ = ۱/۱۷۹ بر روز) نشان دادند. نتایج این پژوهش نشان می‌دهد که *N. barkeri* می‌تواند به عنوان عامل مهار زیستی بالقوه برای کنترل این آفات در نظر گرفته شود.

واژگان کلیدی: *Aceria ficus*، مهار زیستی، جدول زندگی، هرناهای آفت، پراسنجه‌های رشد جمعیت، هرناهای شکارگر، *Rhyncaphytoptus ficifoliae*

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