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RELATIONSHIPS BETWEEN FOOD SUBSTANCES, DEVELOPMENTAL SUCCESS AND REPRODUCTION IN TYPHLODROMUS TRANSVAALENSIS (ACARI: PHYTOSEIIDAE)

by Faten MOMEN* and Hoda HUSSEIN*

Summary: The predacious mite, _Typhlodromus transvaalensis_ (Nesbitt) completed its life cycle when fed on the eriophyid mites _Eriophyes dioscoridis_ Soliman and Abou-Awad and _Eriophyes olive_ Zaher & Abou-Awad, eggs of the scale insect _Parlatoria zizyphus_ (Lucas) and pollen of _Ricinus communis_ (L.) in experimental conditions. The percentage of individuals attaining maturity was less than 20% when nymphs of the tetranychid mite, _Tetranychus urticae_ Koch, were provided. The development was faster and reproduction was higher when _T. transvaalensis_ fed on eriophyid mites. _T. urticae_ was an unsuitable feeding and reproduction substrate. The daily reproduction was as low as 0.4 and 0.8 eggs/female/day when females were maintained on pollen grains of _R. communis_ and eggs of _P. zizyphus_. The adult female daily consumed 126, 97 and 6 individuals of _E. olivi, E. dioscoridis_ and _T. urticae_, respectively.

Résumé: Le développement complet de l’acarien prédateur _Typhlodromus transvaalensis_ (Nesbitt) est assuré en laboratoire avec comme nourriture _Eriophyes dioscoridis_ Soliman & Abou-Awad et _E. olive_ Zaher & Abou-Awad, les œufs de l’insecte _Parlatoria zizyphus_ (Lucas) et le pollen de _Ricinus communis_ (L.). Le pourcentage de réussite de l’œuf à la maturité est inférieur à 20% s’il est élevé avec des nymphes de _Tetranychus urticae_ Koch. La vitesse de développement est plus rapide et le taux de reproduction plus élevé sur des _eriophyides_. _T. urticae_ ne peut être ni une nourriture convenable, ni en mesure d’assurer la reproduction. Le taux journalier de reproduction est de 0,4 et 0,8 œufs par femelle et par jour quand les femelles sont nourries avec les grains de pollen de _R. communis_ et _P. zizyphus_. Les femelles adultes consomment respectivement 126, 97 et 6 individus de _E. olivi, E. dioscoridis_ et _T. urticae_.

Predatory mites of the family Phytoseiidae are important biological control agents of tetranychid and eriophyid mites in a number of Egyptian cropping systems (ABOU-EL ELLA, 1998). Some Phytoseiidae are “generalized” predators, i.e. they consume a wide range of food such as mites, scale crawlers, pollen and honeydew (SWIRSKI & DORZIA, 1968; McMurtry et al., 1970; Kamburov, 1971). A few of the Phytoseiidae are “specialized” predators feeding only on tetranychid mites (CHANT, 1966; Flaherty, 1967). For some species of phytoseiids, eriophyid mites may be a more favourable food than tetranychids (CHANT, 1959; Burrell & McCormick, 1964; El-Benhawy, 1974; Abou-Awad & El-Benhawy, 1986; Momen & El-Sawary, 1993; Abou-El Ella, 1998).

In Egypt, some species of natural enemies have been reported associated with eriophyid mites. Among these are the phytoseiids _Amblyseius olivi_ Zaher & Abou-Awad (Abou-Awad & El Benhawy, 1986).  

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Typhlodromus balanites El-Badry (El-Bagoury & Momen, 1989), Amblyseius swirskii A. H. (Momen & El-Saw, 1993). The biology of Typhlodromus transvaalensis (Nesbitt) has not been previously studied, except for the report by Momen & El-Borolossy (1999). The purpose of this study was to investigate under laboratory conditions the relationships between food substances, developmental success and reproduction in T. transvaalensis, to develop an efficient mass rearing technique and to evaluate the potential of this predator to control phytophagous mites.

**MATERIALS AND METHODS**

Adult females of T. transvaalensis used in this study were collected from heavily infested eggplant leaves at Faywom province, Egypt, in 1997. Feeding experiments were conducted in the laboratory at 27 ± 2°C and 70-75% R.H. Arenas (3 x 3 cm) of excised raspberry leaves, placed on saturated cotton in plastic Petri dishes, were used to confine the predator.

**Effect of diet on development and survival.**

Single eggs were placed on individual arenas, and the newly hatched larvae were supplied with the food resource to be evaluated. Replacements of the prey were carried out daily. Arenas were examined daily and predator development and survival were recorded.

**Effect of diet on oviposition and consumption.**

Newly-emerged mated females were confined individually on test arenas, along with the food to be tested. A few strands of cotton wool were provided as an ovipositor site on each arena. Oviposition and survival were recorded daily. Phytoseiid eggs and dead prey were removed daily in order to estimate prey consumption. Whenever a leaf substrate began to deteriorate, it was replaced with a fresh leaf.

**Diets**

Five diets were evaluated for their effect on development, survival and oviposition in T. transvaalensis:

1. Tetranychus urticae Koch was presented to female predators as nymphs. The two-spotted spider mite was obtained from infested potato leaves held under the same conditions as the predators.
2. Tests using eriophyid mites as prey were conducted on naturally infested arenas cut from leaves of respective host plants. Eriophyes dioscoridis Soliman & Abou-Awad was obtained from infested galls of the plant Pluchea dioscoridis (L.) or Eriophyes olivi Zaher & Abou-Awad and presented to predators on arenas cut from naturally heavily infested olive leaves.
3. Eggs of the scale insect Parlatoria zizyphus (Lucas), collected from commercial citrus orchards.
4. Pollen grains of Ricinus communis (L.); freshly collected pollen was made available to predators by providing each arena with 2 anthers, which were replaced at 48-h intervals.

**RESULTS**

**Affect of diet on development and survival**

Individuals of T. transvaalensis successfully developed from larva to adult when fed on the eriophyid mites, E. dioscoridis and E. olivi, pollen grains of R. communis and eggs of P. zizyphus. About 19% of the individuals of T. transvaalensis completed development on nymphs of T. urticae as food and the time required to reach maturity was longer than for individuals developing on eggs of P. zizyphus (Table 1). Also, the total developmental period was shorter on eriophyid and pollen diets, compared to that on T. urticae.

Feeding was observed during larval stage, with an average consumption of 5.1 and 3.1 eriophyids per day (Table 2).

**Affect of diet on oviposition and consumption**

Mating was essential to induce oviposition and frequent mating was important to complete reproduction. The preoviposition period was shorter on E. olivi and pollen grains than on E. dioscoridis and eggs of P. zizyphus (Table 1). Oviposition period was longer on E. olivi and E. dioscoridis compared to P. zizyphus and pollen diets (significant at 5% level).
have a higher degree of dependence upon eriophyid
were the preferred site for oviposition.

pollen diets. Strips of cotton wool on the leaf surface
an inadequate food for
deleted per female and day, averaged 45.23, 46.67,
the maturing females laid eggs.

scale insect or pollen diet. The total number of eggs
significantly higher on eriophyids than on eggs of

el and pollen grains (Table 3). A lower and less
consumption rate increased through the developmental
stages. The maximum rate was recorded during
the adult stage, the females consuming a daily average
of 126 and 97 individuals of E. olivi and E. dioscoridis, 15 eggs of scale insects or 6 tetranychid nymphs (Table 2).

The rate of reproduction of T. transvaalensis was
significantly higher on eriophyids than on eggs of
scale insect or pollen diet. The total number of eggs
deposited per female and day, averaged 45.23, 46.67, 1.54, 7.46 when fed on E. olivi, E. dioscoridis, P. zizyphus and pollen grains (Table 3). A lower and less
consistent rate of reproduction (less than 1 egg/female/day) occurred with eggs of scale insect and
pollen diets. Strips of cotton wool on the leaf surface were the preferred site for oviposition. T. urticae was an inadequate food for T. transvaalensis, as none of the maturing females laid eggs.

**Table 1**: Comparative duration (X ± SE in days) of female stage of T. transvaalensis at 27°C on test food substrates. Different letters in a horizontal row denote significant difference (F-test, P ≤ 0.05)

<table>
<thead>
<tr>
<th>Stages of T. transvaalensis</th>
<th>E. olivi</th>
<th>E. dioscoridis</th>
<th>P. zizyphus (eggs)</th>
<th>T. urticae (nymphs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larvae</td>
<td>5.1 ± 0.2 a</td>
<td>0.1 ± 0.5 b</td>
<td>7.9 ± 0.6</td>
<td>5.1 ± 0.3</td>
</tr>
<tr>
<td>Protonymph</td>
<td>82.9 ± 2.4 a</td>
<td>45.8 ± 2.1 b</td>
<td>14.8 ± 0.7</td>
<td>6.8 ± 0.9</td>
</tr>
<tr>
<td>Deutonymph</td>
<td>98.7 ± 6.6 a</td>
<td>26.2 ± 1.9 b</td>
<td>15.7 ± 0.7</td>
<td>6.9 ± 0.3</td>
</tr>
<tr>
<td>Adult female</td>
<td>126.8 ± 4.0 a</td>
<td>97.7 ± 2.6 b</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2**: Consumption rate per day of T. transvaalensis on test food substrates at 27°C. Different letters in a horizontal row denote significant difference (F-test, P ≤ 0.05).

consumption rate increased through the developmental
stages. The maximum rate was recorded during
the adult stage, the females consuming a daily average
of 126 and 97 individuals of E. olivi and E. dioscoridis, 15 eggs of scale insects or 6 tetranychid nymphs (Table 2).

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pollen diets. Strips of cotton wool on the leaf surface were the preferred site for oviposition. T. urticae was an inadequate food for T. transvaalensis, as none of the maturing females laid eggs.

**DISCUSSION**

This study indicates that T. transvaalensis seems to
have a higher degree of dependence upon eriophyid
mites than tetranychid mites do. Larvae moulting to
protonymph with feeding. MOMEN & EL-BOROLOSSY
(1999) reported that larvae of T. transvaalensis succeeeded in feeding on nymphs of Eutetranychus orientalis (Klein). Some species have been reported to feed in the larval stage (LEE & DAVIS, 1968; TAKAFUJI & CHANT, 1976; MOMEN, 1995). Mating usually takes place immediately after the final moult (AMANO & CHANT, 1978; HOY & SMILANICK, 1979). Soon after mating, the rate of predation of a predator increased drastically. Adult females of T. transvaalensis consumed a higher number of eriophyids than did predatory nymphs. These results agree with those recorded by SABELIS (1985), who noted that egg production requires much food, not merely because of the number of eggs produced, but also due to the amount of food invested per egg.

The rate of reproduction was highly significant on eriophyid species. A high reproduction rate also was recorded on eriophyid mites as prey for Euseius scu­talis A. H., A. olivi and A. swirskii A. H. (REDA & EL-BAGOURY, 1986; ABOU-AWAD & EL-BENHAWY, 1986; MOMEN & EL-SAWAY, 1993).

T. transvaalensis completed development with a
lower reproductive rate when pollen grains were provided as a single source compared to eriophyid mites. This report differs from results with other species showing superiority of pollen as food (El-Bady & El-Benawy, 1968; Kenedi et al., 1979; Abou-Setta & Childers, 1987). Phytoseiid mites vary in their ability to efficiently convert pollen food into resources for egg production (Afifi et al., 1988).

\textit{T. transvaalensis}, like other phytoseiid mites, feeds and develops well on scale insects (McMurtry & Johnson, 1965; Kamurow, 1971). The oviposition rate of females feeding on eggs of \textit{P. zizyphus} was low. Most previous studies have reported that scale insect provided sufficient food for low to medium oviposition rate for phytoseiid mites (Swirski & Dorzia, 1968; Swirski et al., 1967, 1969; Kinsley & Swift, 1971).

A number of authors (Flaherty & Huffaker, 1970; Hoyt, 1969) have stated that presence of alternative food should help phytoseiids to survive periods of prey scarcity and thus prevent severe declines in the phytoseiid population during shortages of primary foods.

\textit{T. urticae} was unsuitable for \textit{T. transvaalensis} feeding and reproduction. The unsuitability of \textit{T. urticae} as prey can be attributed to \textit{T. urticae} physiologically unsuitable for \textit{T. transvaalensis}. Momen & El-Bororessy (1999) reported that \textit{T. transvaalensis} had a long adult period without reproduction activity when fed \textit{E. orientalis}. They suggested that females may require nutrients other than \textit{E. orientalis} to develop their ovarioles or eggs. It should be mentioned that \textit{T. transvaalensis} is quite unable to move between strands of \textit{T. urticae}. Also, females and nymphs of the predator were observed to feed on their own eggs and nymphs in the absence of food. Our results, however, do not agree entirely with some previous reports showing superiority of spider mites as food (Chant, 1959; McMurtry et al., 1970; McMurtry, 1977).

Further field studies are needed to identify and determine how alternate prey, associated plants and non-prey foods impact the seasonal phenology and population dynamics of \textit{T. transvaalensis} on vegetable fields.

### Table 3: Fecundity of \textit{T. transvaalensis} on test food substrates, at 27° C.

<table>
<thead>
<tr>
<th>Type of food</th>
<th>Total eggs oviposited</th>
<th>Average no. eggs oviposited per day during oviposition period</th>
</tr>
</thead>
<tbody>
<tr>
<td>\textit{E. olivi}</td>
<td>45.2 ± 0.1 a</td>
<td>1.8 ± 0.1 a</td>
</tr>
<tr>
<td>\textit{E. dioscoridis}</td>
<td>46.7 ± 1.5 a</td>
<td>1.3 ± 0.1 b</td>
</tr>
<tr>
<td>\textit{P. zizyphus}</td>
<td>1.5 ± 0.2 b</td>
<td>0.9 ± 0.1 c</td>
</tr>
<tr>
<td>\textit{T. urticae}</td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>Pollen (R. communis)</td>
<td>7.5 ± 0.5 c</td>
<td>0.5 ± 0.0 d</td>
</tr>
</tbody>
</table>

Different letters in vertical column denote significant difference (F-test: \(p \leq 0.05\)).

### REFERENCES


Momen (F. M.) & El-Borolossy (M.), 1999. — Suitability of the citrus brown mite *Eutetranychus orientalis* (Acari, Tetranychidae) as prey for nine species of phytoseiid mites. — Acarologia, 40: 000-000.


