BIOLOGICAL ASPECTS AND FEEDING BEHAVIOUR OF THE PREDACIOUS SOIL MITE *NENTERIA HYPOTRICHUS* (UROPODINA: UROPODIDAE)

BY E. M. EL-BANHAWY*, M. A. EL-BOROLOSSY*, B. M. EL-SAWAF** and S. I. AFIA*

NENTERIA HYPOTRICHUS
LIFE-CYCLE
REPRODUCTION
DIET

SUMMARY: The uropodid mite *Nenteria hypotrichus* was common in plots of a citrus orchard receiving farmyard manure. Larvae survived on a wide range of diets, such as fungus, organic manure, collembola, acarid mites and nematodes, but individuals successfully developed to adult stage only on acarid mites and nematodes. None of these exclusive diets was sufficient to induce female reproduction. On a combination of 1 part organic matter:100 acarids:1000 nematodes, females lived longer and reproduced, indicating the necessity of a multi-food diet for a normal life-cycle and reproduction.

NENTERIA HYPOTRICHUS
CYCLE DE VIE
REPRODUCTION
RÉGIME ALIMENTAIRE

RÉSUMÉ : L'uropodide *Nenteria hypotrichus* se rencontre communément dans les vergers de citronniers recevant comme engrais du fumier de la ferme. Les larves survivent sur des régimes alimentaires très variés, comme les champignons, les matières organiques, les collemboles, les acaridides et les nématodes, mais les individus ne se développeront avec succès jusqu'au stade adulte qu'en présence d'acaridides et de nématodes. Aucun régime alimentaire pris séparément ne conduit à la reproduction chez la femelle. Avec une combinaison d'une part de matières organiques pour 100 acaridides et 1.000 nématodes, les femelles vivent plus longtemps et se reproduisent, montrant la nécessité d'un régime pluri-alimentaire pour un cycle de vie normal et une reproduction.

During the course of study on soil predacious mites in a citrus orchard, the uropodid mite *Nenteria hypotrichus* El-Borolossy & El-Banhawy was recorded in great numbers, particularly in plots receiving organic manure and in association with citrus nematodes.

The uropodid mites, in general, are common in soils rich in organic manure and seem to be feeding on a wide range of diets, including decayed organic materials, fungi, acarid mites, house-fly eggs or larvae, collembola and free living nematodes (BHATTACHARYYA, 1962; AHMED, 1984; KARG, 1986; ZAHER, 1986). Aspects of reproduction also are diverse, with some species being larviparous (PHILLIPSEN & COPPEL, 1978) and others laying few to many eggs (AHMED, 1984; ZAHER, 1986).

The present work focuses on the development, female longevity, reproduction and feeding behaviour of the common uropodid mite, *N. hypotrichus*, as a contribution to the basic information essential for the use of uropodids as biological control agents of citrus nematodes.

* National Research Centre, Pests and Plant Protection Department, Dokki, Cairo, Egypt.
** Ain Shams University, Faculty of Science, Department of Entomology, Cairo, Egypt.

Acarologia, t. XXXVIII, fasc. 4, 1997.

MATERIALS AND METHODS

Individuals of the uropodid mite *N. hypotrichus* were extracted from soil of a citrus orchard located in Al-Azizia Village (Sharkia Governorate), using Tullgren funnels, and mass reared in the laboratory in cells. Each cell was made of plastic (3cm diameter × 2cm high), lined with plaster of paris and active charcoal (9:1) and covered with a plastic lid with several minute holes for ventilation. The plaster floor was kept moderately moist by adding droplets of distilled water to the surface. Individuals of *N. hypotrichus* were maintained on a diet consisting of organic manure, nematodes (mainly *Tylenchulus semipenetrans* Cobb.), and immatures of the acarid mite *Rhizoglyphus robini* Claparède (1:1000:100). Replacement of the diet combination was carried out every week.

To study the feeding behaviour of *N. hypotrichus*, newly hatched larvae were transferred singly to the experimental cells and each supplied with single diets. These included sterile organic manure, the acarid mite *R. robini*, collembola, the citrus parasitic nematode *T. semipenetrans* in aqueous suspension (JENKINS, 1964), and mycelia of the fungi *Aspergillus niger*, *Trichoderma* sp., *Penicillium* sp. and *Fusarium oxysporium* (agar-potato dextrose media). Observations on the development and percentage of individuals reaching maturity were recorded daily. Newly mated females were isolated in the cells and supplied with either organic manure, immatures of *R. robini*, nematodes, or a combination of the three diets (1 part organic manure to 100 acarids and 1000 nematodes). Observations on reproduction and survival, and replacement of diets were carried out once a week. Experiments were conducted in a dark incubator at 30–32°C and 90% R.H.

RESULTS

The percentage of *N. hypotrichus* that successfully developed to the adult stage on a diet consisting of either acarids or nematodes was 72% and 44%, respectively (Table 1). On other diets, such as fungal mycelia, collembola or organic manure, individuals survived only into the larval stage and persisted as larvae for various periods (3–21 days). Individuals fed on *R. robini* required 6.21 and 21.8 days to reach the deutonymphal and adult stages, respectively. The majority of protonymphs confined with acarids took 6 days to reach the deutonymphal stage (range 4–13 days), and individuals with nematodes took 15 days (range 9–27 days) (Table 1). In the case of deutonymphs, individuals on both diets developed to the adult stage on an irregular schedule.

Isolation of newly-emerged females in cells sup-

	Diet							
	R. robini	*T. semipenetrans*	Organic manure	Collembola	*Aspergillus*	*Trichoderma*	*Penicillium*	*Fusarium*
Larva:								
No. observed	25	25	25	25	25	25	25	25
Avg ± S.D.	4.36 ± 2.4	9.16 ± 3.9	9.10 ± 3.7	9.40 ± 4.3	13.00 ± 5.3	9.50 ± 4.5	7.40 ± 3.0	11.20 ± 4.9
Range	2–12	4–20	4–16	3–17	7–21	3–16	4–12	5–20
Protonymph								
No. observed	19	20	2					
Avg. m; S.D.	6.21 ± 2.7	15.00 ± 8.2	3.50 ± 2.1					
Range	4–13	9–27						
Deutonymph								
No. observed	18	12						
Avg. ± S.D.	21.28 ± 11.9	21.42 ± 12.7						
Range	4–36	8–42						
Total:								
No. observed	18	11						
Avg. ± S.D.	18	11						
Avg ∓ S.D.	34.00 ± 11.2	46.91 ± 14.0						
Range	13–50	31–80						
% reaching maturity	72	44						

TABLE 1: Duration (in days) of immature stages of *N. hypotrichus* and % reaching maturity on different diets at 30–32°C.

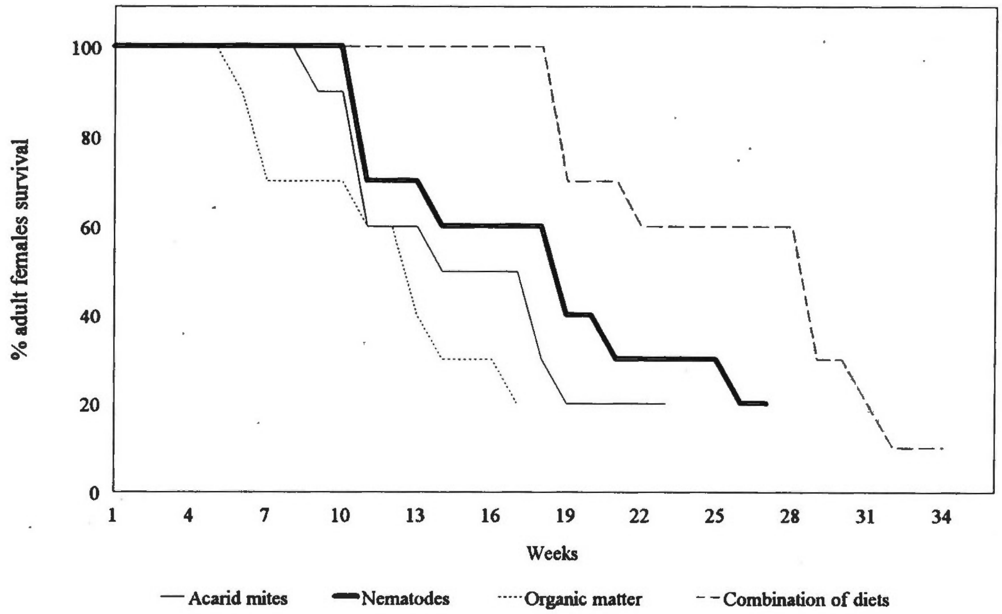

FIG. 1: Survival of adult females of *N. hypotrichus* on organic manure, *R. robini* and *T. semipenetrans*, and on a combination of the three diets.

plied with single diets or a combination of diets survived for various periods (13–21 weeks). None of the females supplied with a single diet oviposited, while those with a combination of diets laid an average of 8.5 eggs. Compared to other uropodid species, females lived longer, particularly when they were offered a multinutritional regime. For example, on a combination of diets (1 part organic manure:100 *R. robini*: 1000 nematodes), females lived for an average period of 21 weeks, whereas on organic manure they lived for about 13 weeks (Table 2).

The female survival potential was greatly affected by the type of food. For example, on organic manure, 50% of females survived up to 10 weeks, on acarids up to 11 weeks, and on nematodes up to 18 weeks, while on a combination of diets they survived up to 28 weeks and some individuals (30%) persisted to 34 weeks (Fig. 1).

Diet	No. observations	Longevity (weeks)	No. eggs/female
Organic manure	10	12.40 ± 4.58	–
R. robini	10	15.70 ± 5.19	–
T. semipenetrans	10	18.80 ± 6.92	–
Combined diet	15	20.93 ± 8.30	8.50 ± 1.97

TABLE 2: Longevity (in weeks) of adult females of *N. hypotrichus* on different diets at 30–32°C.

DISCUSSION

Nenteria hypotrichus was collected in great numbers from plots receiving organic manure application and it is believed that uropodids, in general, are indicators of the richness of organic manure in soil. The feeding behaviour and biological aspects of these mites vary greatly among species and according to the type of food. Studies have indicated that they feed on decaying organic matter (KARG, 1986), nematodes (BHATTACHARYYA, 1962), acarid mites, housefly larvae (AFIFI, 1980) and fungi (AHMED, 1984). In the present work, several diets, such as organic manure, fungal mycelia and collembola, were not sufficient for the development of *N. hypotrichus* beyond the larval stage. Other diets, such as the citrus nematode *T. semipenetrans* and the acarid mite *R. robini*, supported a limited development, since only a percentage of individuals reached maturity and then only after long, irregular periods (Fig. 1). Likewise, gravid females did not oviposit on any of the single diets tested, although they lived for quite long periods. Gravid females oviposited and survived longest on a diet consisting of a combination of organic manure, acarids and nematodes, indicating the necessity of a multinutritional regime for *N. hypotrichus* in order to attain a normal life-span.

Compared to other groups of predacious mites, female longevity of *N. hypotrichus* is rather long. For example, females of *Fuscuropoda* sp. reared on larvae of *Musca domestica* lasted 20 weeks, *Chiropturopoda* sp. on the fungus *F. oxysporium* 15 weeks (Afifi, 1980); *Urodiaspis* sp. 1 on acarid mites 14 weeks; and *Urodiaspis* sp. 2 on a fungal diet 10 weeks (Ahmed, 1984). In the present work, gravid females survived for average periods of 13, 16, 19 and 20 weeks on organic manure, acarid mites, nematodes and a combination of the three diets, respectively.

Within Uropodina, the reproduction rate of females varies greatly according to species and diet. Afifi (1980) found that *Chiropturopoda* sp. fed on larvae of *Musca domestica* oviposited 86 eggs/female, and only 13 eggs/ female on mycelia of *P. viridus*. Ahmed (1984) found that *Urodiaspis* sp. 1 fed on acarid mites oviposited 13 eggs/female, and *Urodiaspis* sp. 2 fed on fungal mycelia produced 7 eggs/female. In the present work, egg production of *N. hypotrichus* was found to be similar to that of *Urodiaspis* sp. 1 and *Urodiaspis* sp. 2 with reproduction/female on a combination of all three diets totalling about 9 eggs.

As a conclusion, in conserved soil, rich in organic content, a common predator like *N. hypotrichus*, together with other more specialized natural enemies like *Gamasiphis tylophagous* El-Borolossy & El-Banhawy (unpublished data), would achieve the desired natural control of soil pests like citrus nematodes.

REFERENCES

Afifi (A. M.), 1980. — Occurrence of mites in different organic manures. — Ph.D. Thesis, Fac. Agric., Cairo Univ., 202 pp.

Ahmed (M. A.), 1984. — Biology of some soil fauna on some soil microorganisms. — M.Sc. Thesis, Fac. Agric., Zagazig Univ., 106 pp.

Bhattacharyya (S. K.), 1962. — Laboratory studies on the feeding habits and life cycles of soil inhabiting mites. — Pedobiologia, **1** (5): 291-298.

Jenkins (W. R.), 1964. — A rapid centrifugal flotation technique for separating nematodes from soil. — Plant Disease Reporter, **48**: 692.

Karg (W.), 1986. — Vorkommen und Ernährung der Milben cohors Uropodina (Schildkrötenmilben) sowie ihre Eignung als Indikatoren in Agro-ökosystemen. — Pedobiologia, **29**: 285-295.

Phillipsen (W. J.) & Coppel (N. C.), 1978. — *Uroobevella formosana* sp. n. associated with *Formosan subterranean* Termite, *Coptotermes formosanus shiraki* (Acarina: Uropodidae-Isoptera: Rhinotermitidae). — J. Kansas Entom. Soc., 5(1): 22-27.

Zaher (M. A.), 1986. — Survey and ecological studies on phytophagous, predacious and soil mites in Egypt. II A: Predacious and non phytophagous mites (Nile Valley and Delta). — Fac. Agric., Cairo Univ., 567 pp.