STUDIES ON THE TROPHIC PREFERENCES OF CERTAIN UROPODINA MITES (ACARINA: ANACTINOTRICHIDA, UROPODINA) FOR SOME TAXA OF IMPERFECT FUNGI

Ioana Cristina CONSTANTINESCU[1] and Cristina CRISTESCU[2]
[1]Natural History Museum of Argeş District, Str. Armand Călinescu 44; e-mail: cristinactinescu@yahoo.com
[2]University of Piteşti, Department of Biology, Str. Târgul din Vale 1;
e-mail: cristescu_cri@yahoo.com

Abstract. This paper presented the results of a laboratory experiment that tries to establish the food preferences and life cycle for six species of mites of the cohort Uropodina (*Trachytes aegrota, Trachytes tesquorum, Urodiaspis tecta, Uropoda pulcherrima, Cilliba sellnicki* and *Trichouropoda ovalis*). The mites were fed with four species of pathogen fungi, obtained in vitro: *Phomopsis incarcerata* on *Rosa*, *Phomopsis juglandina* on *Juglans regia*, *Fusarium roseum* on *Zea mays* and *Penicillium italicum* on *Citrus limon*. The results obtained bring information about the life cycle of the species *Trichouropoda ovalis*, and could be the starting point in the elaboration of some methods for the biological control of fungi imperfecti with the help of these mites.

Keywords: Uropodina, food preferences, fungivorous species, feeding behavior, life cycle, pathogen fungi.

Rezumat. Studii privind preferinţele trofice ale unor specii de acarieni Uropodine (Acarina: Anactinotrichida, Uropodina) faţă de unii taxoni de fungi imperfecti. Lucrarea de faţă este rezultatul unui experiment de laborator care a încearcat să stabilească preferinţele de hrană şi ciclul de viaţă pentru şase specii de acarieni din cohorta Uropodina (*Trachytes aegrota, Trachytes tesquorum, Urodiaspis tecta, Uropoda pulcherrima, Cilliba sellnicki* and *Trichouropoda ovalis*). Acarienii au fost hrăniţi cu patru specii de fungi patogeni, obţinuţi in vitro: *Phomopsis incarcerata* pe *Rosa*, *Phomopsis juglandina* pe *Juglans regia*, *Fusarium roseum* pe *Zea mays* şi *Penicillium italicum* pe *Citrus limon*. Rezultatele obţinute aduc informaţii despre ciclul de viaţă al speciei *Trichouropoda ovalis* şi pot constitui puncte de plecare în elaborarea unor metode de combatere biologică a fungilor imperfecti cu ajutorul acestor acarieni.

Cuvinte cheie: Uropodina, prefrinţe de hrană, specii fungivore, comportament de hrănire, ciclu de viaţă.

Introduction

Uropodina are mite species that can be found in nature in various environments, preferably the ones rich in organic substances (the forest leaf litter, the trunks of decomposing trees, animal scat, anthills, bird nests, etc.) (Athias-Binche, 1977). In the soils of deciduous forests with rich leaf litter, this invertebrate group can reach high densities, and, consequently, can influence the processes of decomposing organic matter and soil humidity. Although the direct contribution of the soil fauna to the process of mineralization of organic matter is not a major one, the soil fauna has an essential indirect contribution in the decomposing processes, acting as a catalyst and preparing the way for the real decomposers, bacteria and fungus (Petersen & Luxton, 1982).

It is known that many of the soil invertebrates are not strictly specialized in using a certain type of food, and omnivorous feeding is widely spread. It is hard to research in the field the wide range of the food edaphic chains because of the small size of the animals that make it impossible to directly observe the method of feeding and the type of food used. In-lab testing of the food preferences for Uropodina species can, to a certain degree, offer useful information that can show what their role is in the food chain, although the image is far from complete.

The in-lab tests of different types of food showed that Uropodina prefer a much diversified diet. Some species are zoophagous (predaceous) and some are fungivorous (fungal feeders), necrophagous or even omnivorous.

Huțu (1978) has done a complex lab experiment in which she tested nine species of Uropodina with thirteen foods of various origin (fungi, yeasts, bacteria, detritus, nematodes, collembolans, and ciliated protozoa*)* and concluded that the species *Cilliba sellnicki* is nematophagous and the species *Trichouropoda ovalis* and *Trichouropoda obscurasimilis* are fungivorous, eating mycelia of *Spheronema* and having a very strict diet.

The researcher stressed the need to continue the research on the trophic of these mites, as this would better clarify their role in nature which, according to the researcher, is more complex then what we know now.

The present experiment looked at the food preferences for six species of Uropodina (*Trachytes aegrota*, *Trachytes tesquorum*, *Urodiaspis tecta*, *Uropoda pulcherrima, Cilliba sellnicki and Trichouropoda ovalis*) that were fed four species of fungi: *Phomopsis incarcerata*, a pathogen species on *Rosa* sp., *Phomopsis juglandina* on *Juglans regia*, *Fusarium roseum* taken from *Zea mays* and *Penicillium italicum* on *Citrus limon.* The purpose of the observation was to establish the trophic range for the mites involved in the present study, as opposed to the fungi used in the previous study, and to obtain data on the length of the development cycle for these species. The obtained results can be starting points for developing some methods to biologically eradicate this pathogen species of fungi.

Material and Methods

The six Uropodina species came from the mixed beech and hornbeam forest litter from the village Budeasa Mică, belonging to the High Plain of Piteşti (Romania) in the middle basin of the Arges River.

The forest litter was divided using Tulgren-Balogh apparatus. The collection tubes had a small quantity of water and they were daily checked and animals were collected. The growing cells were made from plastic cups with a diameter of 5.5 centimetres that had a Shereef mix for the hygroscopic substratum (Shereef, 1972, in Huțu, 1978). The mix was made of nine parts shredded wood ashes and one part gypsum, a layer of cotton and a layer of filter paper. The growing cells were kept at room temperature in relatively constant humidity.

The fungi were obtained in vitro on standard growing cultures. Round pieces of agar with fungus on them were taken from the Petri dishes with a sterilized glass tube with a diameter of 5 millimeters. The pieces of agar with fungus were placed on the filter paper in the growing cells.

The growing cells were observed daily at the binocular magnifier, and note were continuously taken about the behavior of the animals involved in the experiment, the morphological modifications that appeared during molting, and the medium life span for each developmental stage.

The experiment lasted for five months between November 2005 and April 2006.

Results and Discussion

The experiment involved 710 mite individuals in various developmental stages (protonymphs, deuthonymphs, adults of both sexes) that were placed in 47 growing cells with various types of food, as it is shown in the following table (Table 1):

Table 1. The number of experiments performed (with Roman numerals) and the number of individuals from each species (with Arab numerals) used in the experiment.

Species/Fungus type	*Fusarium roseum*	*Penicillium italicum*	*Phomopsis incarcerata*	*Phomopsis juglandina*
Trachytes aegrota	IV (63)	IV (56)	V (63)	-
Trachytes tesquorum	IV (62)	IV (75)	VI (90)	-
Urodiaspis tecta	II (31)	I (15)	III (54)	-
Uropoda pulcherrima	II (31)	II (44)	III (34)	-
Cilliba sellnicki	II (33)	II (26)	II (18)	-
Trichouropoda ovalis	-	-	I* (6)	I* (6)

*The six *Trichouropoda ovalis* individuals were fed alternatively with the two pathogen species (*Phomopsis incarcerata* and *Phomopsis juglandina*).

The individuals belonging to the *Uropoda pulcherrima* did not feed themselves with any of the fungi used in the experiment. In the first two months of the experiment adults and deuthonymphs were occasionally observed feeding themselves with agar from the *Fusarium* and *Phomopsis* varieties, as it was proved by the excavations left in its mass. The agar in which *Penicillium* was growing was not consumed by animals at all because of the release of patulin, a mycotoxin often seen in *Penicillium* species.

It was interesting to see that the individuals belonging to this species were observed displaying a tendency to aggregate in certain areas of the growing cell in all the experiments. The aggregation was even more obvious in a growing cell containing a few hundred individuals belonging to the six species used in the experiment. The individuals belonging to the other species did not mix in the aggregation areas of the *Uropoda pulcherrima* individuals.

The species *Cilliba sellnicki* does not seem to be a fungus-eating species because it did not eat at all the mycelia from the three fungi species tested. Instead of that, the adults were observed feeding on the agar growing on the *Fusarium roseum* fungus during the first half of the experiment, and after that they became less active. Huţu (1978) reached the conclusion that the species is nematophagous. She was able to observe in the lab how the deutonymphs shed their skin, how they turned into adults, and how the larva appeared.

Only one *Trachytes aegrota* larva was obtained after 30 days from the beginning of the experiment, and that was in a growing cell containing the fungus *Phomopsis incarcerata*; the larva died after 20 days. The adults were observed feeding on the mycelia especially at the basis of the spore of fructification, where drills in the mass of spore mycelia could be observed. According to the observations, in the cells containing *Fusarium roseum* no mycelia were eaten, as only agar was consumed, and the animals refused *Penicillium italicum* (and the agar on which this develops). Our data confirm Huţu's findings (1978) who noticed that the species feeds on *Sphaeronema* mycelia but it does not reproduce, which means that the food does not correspond to the regular trophic diet for this species. We believe that this species is possibly fungivorous, but it probably eats other types of fungi than the ones it was fed in the lab.

For the species *Trachytes tesquorum* five larvae were obtained after an average of 55 days since the beginning of the experiment in both the growing cells with *Phomopsis incarcerata* (2 larvae) and with *Fusarium roseum* (5 larvae), but they survived for only two or three weeks. The individuals were observed feeding on *Phomopsis incarcerata*, especially on the spore of fructification and at the basis. Because of the rich branching of *Fusarium roseum* mycelia, a lot of mites were blocked in the mycelia mass and the animals were prevented from feeding. Our conclusion is that, just like in the case of *Trachytes aegrota*, the species is probably fungivorous, but the food offered is not part of its regular diet.

The *Urodiaspis tecta* species was observed feeding on mycelia and spore of fructification of *Phomopsis incarcerata*, and also young, not very branched mycelia of *Fusarium roseum* growing at the margin of the fungus mass, probably to avoid blocking. In the first attempt to feed 6 larvae were obtained, and 3 others during the second attempt, all about 65 days from the beginning of the experiment. Some eggs were also observed and a few larvae hatched after an average of 30 days. None of the larvae survived more that 30 days. An adult was observed feeding on an agar on which *Fusarium roseum* was growing. The chelicerae of the animal were perpendicularly stretched and dipped into the agar mass, then pulled out, and the food in the chelicerae was taken to the mouth and placed inside with the help of the pedipalps. The pedipalps are actually cleaning the food off the chelicerae. We are including this species among the ones that are possibly fungivorous.

Trichouropoda ovalis is the only species that is surely fungivorous as Huțu (1978) has also shown when she proved in an experiment that it feeds on *Sphaeronema* mycelia. In our experiment, the six individuals belonging to this species (two females and four males) were fed with *Phomopsis incarcerata*, and when the fungus temporarily ran out, the individuals were fed with *Phomopsis juglandina*. Both fungus species were fit for the physiological needs of this species. In the case of this species of mites, we were able to obtain a complete life cycle in the lab. The two females laid four eggs about 60 days from the beginning of the experiment, and larvae hatched from them in 25 days. The protonyphs appeared after 18 days, and after about 35 days, these turned into deutonymphs. After 47 days, they became adults. In conclusion, the average length of the development cycle for *Trichouropoda ovalis* in the lab is 129 days.

Throughout this experiment we have recorded some aspects connected to the feeding behavior of this species. The animal feels around with its pedipalps until it finds an area with favorable food, then it grabs the mycelia with the pedipalps and directs it towards the mouth opening, where it cuts it up with its chelicerae, that are quickly pulled out from the camerostome. We could observe a movement meant to clean food from the pedipalps and the chelicerae with the help of the first pair of rubbing legs.

During the feeding, the larva supports itself on the second and third pairs of legs, and the first pair stays stretched forward. The pedipalps and chelicerae perform quick movements, as the pedipalps continuously feels the food, and the two chelicerae are quickly stretched out of the camerostome, tearing the food apart. At this time, the body of the animal bends forward. Now and then one of the legs from pair one is inserted in between the pedipalps and chelicerae, and is rubbed to clean them off. The pedipalps act not only as feelers, but also grab and hold on to the food.

The animals feed themselves heavily not only with the mycelia covering the surface of the fructification spore, but also with the spore themselves, probably because the walls are rich in organic compounds, such as lipids.

Conclusions

According to the experiment results, we have concluded the following:

1. The species that proved not to have a fungus-based diet were *Uropoda pulcherrima* and *Cilliba sellnicki*, because no *pre-adults* were obtained in the experiments.

2. The species that are possibly fungivorous proved to be *Trachytes aegrota*, *Trachytes tesquorum* and *Urodiaspis tecta*. Eggs and larva were obtained from these species in the experiments with *Phomopsis* and *Fusarium*, but these have not survived.

3. The only fungus-eating species that provided a complete development cycle (egg, larva, protonymph, deutonymph, and adult) was *Trichouropoda ovalis* that fed on both *Phomopsis incarcerata* and *Phomopsis juglandina.*

4. The results obtained can be starting points towards developing a method to use mite species to biologically eradicate certain mycotic pathogens.

References

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