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OBSERVATIONS ON THE FEEDING HABITS OF ORIBATID MITES FROM THE SOILS OF KERALA (ACARINA: CRYPTOSTIGMATA) - PANPHYTOPHAGES

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Employing suitable staining procedures analyses of the gut contents of ten species of oribatid mites collected from field were made and it was found that they fed on decaying parts of higher plants as well as microflora and were therefore assigned to the category of panphytophages. Eight species were reared in the laboratory and were offered about 20 different types of food. Some of these latter species showed feeding reactions which did not agree with the conclusions drawn from gut content analyses of individuals collected from the field. This was thought to be partly due to starvation leading to the acceptance of unnatural diets. None of the species was found to accept animal matter dead or alive as food. Generally nymphal and adult stages of the same species showed similar preference to food though there were exceptions with regard to some food items. No two species reared in the laboratory were found to have exactly the same food preference. The species considered here were thus found to occupy more or less different 'food niches'. The study also indicated that species like *Archegozetes longisetosus* could play a significant role in the breakdown of leaf litter.

INTRODUCTION

The food habits of oribatid mites, mostly of the temperate region, have been studied by a number of workers (LUXTON, 1972). In general such studies have provided information on the ability of the mites to utilise different types of food substances and thus led to their categorization into three broad feeding groups by SCHUSTER (1956). Recently LUXTON (1972) added three more categories to those of SCHUSTER (1956) and coined the term panphytophage for mites which fed on decaying parts of higher plants as well as microflora. The present study has been planned as part of a general ecological work. The taxa dealt with here have not been the subject of study by any previous worker. Since observations on the same species sometimes showed regional differences in the food habits as in the case of *Xenillus* sp. (BERTHET, 1964; LUXTON, 1972) study of the food habits of at least the more common forms becomes obligatory in the proper understanding of the aspects of ecology of these mites like their energy source, distribution, interrelationship of the species and their role in the decomposition of organic matter.

MATERIALS AND METHODS

Ten species of mites obtained from soil and litter were separated specieswise and transferred to plastic boxes 6 cm in diameter and 4 cm in height containing plaster of paris-charcoal mixture in the ratio 4 : 1. Feeding habits were studied by observing the gut contents of individuals collected from the field and by observing the feeding reactions towards food substances provided in the laboratory. Gut contents of 15 individuals of each species were dissected out in a small quantity of glycerine, fixed in 80% ethyl alcohol, centrifuged and stained in a saturated solution of phloroglucinol in 18% HCl to stain vascular elements or 0.2% fast green in 95% alcohol to stain cellulose cell wall of the epidermal and parenchyma cells or 0.5% orange G in 95% alcohol to stain fungal hyphae and spores as given in CONN (1961). Identification of the plant

materials was done following SASS (1959) and FOSTER (1960).

A variety of substances listed in Table 2 were provided in the cultures as food and the reactions of the mites noted. Each feeding test was continued for 5–10 days. The rate of production of faecal pellets was considered as an index of feeding represented in a nominal scale. Absence of animals on the food materials and consequently lack of production of faecal pellets was considered as a definite instance of rejection.

RESULTS AND DISCUSSION

Table 1 gives the results of the analyses of the gut contents of ten species of mites collected from the field. The presence of parts of vascular bundles with secondary thickening in the faeces was considered as indicative of wood feeding while that of leaf epidermal cells and parenchymatous elements as evidence of leaf feeding. The fungus feeding was naturally indicated by the presence of hyphae and spores which could be clearly distinguished in the faeces. Out of the ten species mentioned above the feeding habits of eight species of mites could be studied in the laboratory and the results are given in Table 2.

LUXTON (1972) noted that a number of earlier workers had rather mistakenly assigned several oribatid species to inappropriate feeding categories. The food habits of a species ought to be studied both under laboratory and field conditions before it is assigned to any particular feeding category. The data collected in the present work following these two lines of approach permitted to assign the ten species studied to the panphytophage group. *E. pallida pacifica* and *Galumna flabellifera orientalis* presented some difficulty as they rejected all the seven species of fungi offered to them in the laboratory. This would happen when the fungi offered in the laboratory were unpalatable to the animals as observed by MITCHELL & PARKINSON (1976) in *Eremaeus* spp. Further, the studies of HARTENSTEIN (1962), LUXTON (1966, 1972) and SHEREEF (1972) showed that the oribatid mites exhibited considerable selectivity to microflora. In the present study out of the seven species of fungi offered only three were consumed and of these latter *Alternaria* sp. was found to be preferable to *Cladosporium* sp. and *Trichoderma* sp. Further *All.*

TABLE 1. Gut content analysis of oribatid mites collected from the field

Sl. no.	Species studied	Types of food identified			
		Leaf	Wood	Fungus	Pollen
1.	*Epilohmannia pallida pacifica*	*	* (stem periphery)	*	
2.	*Annectacarcus trivandricus*	*	*	*	
3.	*Galumnella angustifrons*	*	**	**	**
4.	*Otocepheus trivandricus*	** (dry leaf)	**	*	
5.	*Heptacarus hirsutus*		**	*	
6.	*Allonothrus giganticus*		**	**	
7.	*Galumna fabellifera orientalis*		*	*	
8.	*Archegozetes longisetosus*	*		**	
9.	*Basilobelba retiarius symmetrica*	*		*	
10.	*Eremulus wallworki*	**		**	

* low amount

** high amount

Blank space indicates absence

giganticus and *B. retiarius symmetrica* could feed only on a single type of fungus each.

The analyses of the gut contents of the individuals collected from the field gave the impression that within a major category like the panphytophages the members would exhibit certain degree of food selection. This discrimination was first evidenced by the lack of leaf material in the gut contents of *H. hirsutus*, *All. giganticus* and *Galumna flabellifera orientalis* and lack of wood in the gut contents of *Arch. longisetosus*, *B. retiarius symmetrica* and *E. wallworki*. Regarding their restricted choice the laboratory studies confirmed the feeding preferences in the field of *Arch. longisetosus* and *B. retiarius symmetrica*, while *H. hirsutus*, *All. giganticus* and *Galumna flabellifera orientalis* showed that they could thrive on both wood and leaf in the laboratory though they fed on only one of the above two items in the field. It is possible that starvation would force some animals into accepting unnatural diets although it is not known whether such exigencies occur in nature. Feeding of *All. giganticus* on yeast and the alga *Protococcus*, of *Galumnella angustifrons* on fresh moss, *Ann. trivandricus*, *All. giganticus* and *B. retiarius symmetrica* on lichen also perhaps indicates only the ability of these mites to survive on these substances when normal food materials are not available. HARTENSTEIN (1962) and TADROS (1973) found that yeast was not acceptable to the oribatid mites studied by them while BUTCHER *et al.*

TABLE 2. Food preference of Oribatid mites in the laboratory

Sl. no.	Species studied	1 Brewer's yeast	2 *Protococcus*	3 *Trichoderma*	4 *Cladosporium*	5 *Alternaria*	6 Lichen	7 Moss	8 Decomposed leaves	9 Decomposed twigs and stems
1.	*E. pallida pacifica*								x	
2.	*Ann. trivandricus*						x		x **	xx *
3.	*Galumnella angustifrons*		x							x
4.	*H. hirsutus*								x	xx **
5.	*All. giganticus*	xx **				x **	xx *		x	xx
6.	*Galumna flabellifera orientalis*		x			xx **			xx *	
7.	*Arch. longisetosus*			x		**		x *	xx **	
8.	*B retiarius symmetrica*				x		x		x	

xx/** highly palatable
x/* lowly palatable
x indicates feeding by adult
* indicates feeding by nymph
blank space indicates rejection.

Items of food offered but rejected by all species of mites.

Penicillium, *Pythium*, *Colletotrichum*, *Agaricus*, partly decomposed cladodes & seeds of *Casurina*, bark of higher plants, faecal pellets of Oribatid mites, minced meat and small soil animals.

(1971) found that several species of oribatid mites could be reared on yeast. Similarly ROCKET & WOODRING (1966) found that nematodes are avidly eaten by some oribatid mites. In the present study none of the mites accepted animal matter dead or alive.

Out of the eight epecies of mites reared in the laboratory the feeding habits of the nymphal stages of five species could also be observed. LUXTON (1972) noted that in *Damaeus clavipes*, *Belba corynopus* and *Hypochthonius rufulus* there was considerable difference between immature and adult stages in the feeding habits under laboratory conditions while PANDE & BERTHET (1973) found no such differences in food habits between immature and adult stages of oribatid mites under field conditions. In the present study it was found that nymphs and adults generally fed on the same substances except in *Arch. longisetosus* where the nymphs fed on *Alternaria* which the adults rejected and the adults fed on *Trichoderma* which the nymphs did not feed. In *Ann. trivandricus*, *All. giganticus* and *Galumna flabellifera orientalis* there was difference in the degree of preference between the nymphs and adults for the same material. Comparing the feeding habits of adults of these ten species one would be led to believe that no two species agreed perfectly with each other in their feeding habits. It appears that not only the different species but even within the species the adults and nymphs may occupy fairly dissimilar 'food niches'. This could permit the coexistence of a large number of oribatid species under field conditions. Except *O. trivandricus* all the other species in the present study were obtained from a small bamboo grove.

The role of oribatid mites in the decomposition of organic matter has been variously estimated. EDWARDS & HEATH (1963) believed that these mites contributed little to the decomposition of organic matter in the soil. Both the nymphal and adult stages of *Arch. longisetosus* in the present study apparently could contribute much to the mechanical breakdown of the decaying leaves of certain species of plants. The suggestion of MITCHELL & PARKINSON (1976) that oribatid mites being selective feeders of fungi, would influence the composition and abundance of the fungal species in the soil and thereby influence the decomposition of the organic matter also seems to be highly probable.

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