

MITES (ARACHNIDA: ACARI) INHABITING COFFEE DOMATIA: A SHORT REVIEW AND RECENT FINDINGS FROM COSTA RICA

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ABSTRACT - Eight previously unreported domatia-inhabiting mites are reported from *Coffea arabica* L. and *C. eugenioides* S. Moore (Rubiaceae) accessions planted in Costa Rica. One of these, an *Asca* sp., was found to be carrying fungal spores on its cuticle. A review of the literature on mites in coffee domatia is presented.

Key words - Acari, Acaridae, Ascidae, Edbakerellidae, Iolinidae, Stigmaeidae, Tarsonemidae, coffee, domatia, Costa Rica.

INTRODUCTION

Coffee (*Coffea arabica* L. and *C. canephora* Pierre ex A. Froehner; Rubiaceae), planted in more than 50 countries, is the most heavily traded agricultural commodity in the world, with more than 100 million people dependent on its production for their subsistence (Vega *et al.*, 2003). Even though an enormous amount of research on this commodity has been published, a relatively unknown area is the biology of mites that inhabit the domatia of coffee plants. "The domatia are small cavities found at the acute angle junction between the midrib and secondary veins at the leaf abaxial side" (Nakamura *et al.*, 1992), and though they commonly house mites they have no other known function (Nakamura *et al.*, 1992; Walter, 1996). The domatia in the genus *Coffea* has only been studied for a few species (Lundström, 1887; Penzig and Chiabrera, 1903; De Wildeman, 1904a, 1904b; Adamoli de Barros, 1960; O'Dowd and Wilson, 1989; Nakamura *et al.*, 1992), even though more than 100 *Coffea* species have been described (Davis *et al.*, 2006). Reports of domatia-inhabiting mites in coffee are limited to Australia (12 species; O'Dowd, 1994), Brazil (21 species; Matos *et al.*, 2004, 2006; Mineiro *et al.*, 2006a, 2006b), Costa Rica (1 species; Pemberton and Turner, 1989), Hawaii (4 species; Pemberton and Turner, 1989), and Java (1 species; Penzig and Chiabrera, 1903) (Table

1). The most common mites in the domatia of coffee belong to the Phytoseiidae, Tydeidae, and Stigmaeidae (Table 1). Working with coffee plants, Brazilian scientists have reported on the beneficial effects of domatia availability on the bionomics of the phytoseiid predatory mite *Iphiseiodes zuluagai* Denmark and Muma (Matos *et al.* 2004, 2006).

One area of particular interest to us is the use of endophytic fungi for the biological control of the coffee berry borer, *Hypothenemus hampei* (Ferrari) (Coleoptera: Curculionidae) (Posada and Vega, 2006; Posada *et al.*, 2007; Vega *et al.*, 2008b). As part of this research, we became interested in learning more about domatia-inhabiting mites and their possible interactions with fungi. As a first step in this process, we were interested in surveying mites in the domatia of coffee in Costa Rica, where we intend to conduct field work.

MATERIALS AND METHODS

Coffee leaves from 19 *Coffea arabica* L. accessions and one *C. eugenioides* S. Moore plant growing at the International Coffee Germplasm Center of the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) in Turrialba, Costa Rica, were collected in February of 2005. The CATIE International Coffee Germplasm Center comprises approximately 2,000 accessions

(Vega *et al.*, 2008a), including over 190 cultivars collected in Ethiopia (FAO, 1968). Collected leaf tissues were preserved in 70% ethanol and with the aid of a stereoscope, mites were dissected from the domatia and mounted on slides using standard procedures.

RESULTS

Seven mite species (*Amblyseius perditus* Chant and Baker, *Asca* sp., *Fungitarsonemus* sp. near *iodici*, *Metatriophtydeus* sp., *Neotropacarus mumai* (Cunliffe), *Tarsonemus* sp., *Zetzellia languida* González-Rodríguez) and an unidentified species in the Iolinidae, subfamily Pronematininae were dissected from coffee domatia (Table 2). Except for *Tarsonemus* sp., none of these have been previously reported as mites in the domatia of coffee (Table 1).

Table 1. Mites reported in the domatia of *Coffea arabica* L. (unless otherwise specified in the footnote).

Australia (O'Dowd, 1994)

Acarina: Oribatulidae
Sellnickia sp.

Acarina: Winterschmidtidae
Czempinskia transversostriata (Oudemans)

Astigmata: Acaridae
Neotropacarus sp.

Mesostigmata: Phytoseiidae
Amblyseius lentiginosus Denmark & Schicha
Typhlodromus sp.

Prostigmata: Bdellidae
Bdella captiosa Atyeo

Prostigmata: Stigmaeidae
Stigmaeus sp.
Zetzellia sp.

Prostigmata: Triophtydeidae*
Triophtydeus sp.

Prostigmata: Tydeidae
Tydeus sp.

Prostigmata: Tenuipalpidae
Brevipalpus obovatus Donnadieu

Prostigmata: Tarsonemidae
Tarsonemus sp.

Brazil (Matos *et al.*, 2004, 2006)

Mesostigmata: Phytoseiidae
Iphiseiodes zuluagai Denmark & Muma

Brazil (Mineiro *et al.*, 2006a, 2006b)

Acarina: Winterschmidtidae
Saproglyphus sp.¹

Astigmata: Acaridae
Tyrophagus sp.²

Mesostigmata: Phytoseiidae
Amblyseius aerialis (Muma)
Euseius citrifolius Denmark & Muma
Euseius concordis (Chant)¹
Typhlodromus camelliae Chant & Yoshida-Shaul

Prostigmata: Bdellidae
Bdella sp.
Spinibdella sp.

Prostigmata: Iolinidae
Homeopronematus sp.

Prostigmata: Stigmaeidae
Agistemus brasiliensis Matioli, Ueckermann & Oliveira¹
Zetzellia malvinae Matioli, Ueckermann & Oliveira¹

Prostigmata: Tarsonemidae
Daidalotarsonemus sp.
Tarsonemus sp.

Prostigmata: Tenuipalpidae
Brevipalpus phoenicis (Geijskes)¹

Prostigmata: Tetranychidae
Oligonychus ilicis (McGregor)

Prostigmata: Triophtydeidae*
Triophtydeus sp.

Prostigmata: Tydeidae
Lorryia formosa Cooreman¹
Lorryia sp.¹
Lorryia sp. 2
Parapronematus acaciae Baker

Costa Rica (Pemberton & Turner, 1989)

Prostigmata: Tydeidae
Tydeus sp.

* The correct name for the family is Edbakerellidae.

Hawaii, U.S.A. (Pemberton & Turner, 1989)

Mesostigmata: Phytoseiidae

Amblydromella haramotoi (Prasad)*Amblyseius herbicolus* (Chant)³

Prostigmata: Bdellidae

Bdella sp.³

Prostigmata: Stigmaeidae

Agistemus sp.**Java** (Penzig & Chiabrera, 1903)

Prostigmata: Stigmaeidae

Stigmaeus confinis Berlese³

1. Collected both from *C. arabica* and *C. canephora*.
2. Collected from *C. canephora*.
3. Collected from *C. liberica* Bull. ex. Hiern

DISCUSSION

Even though we have not studied these particular Costa Rican mites in detail, some general roles can be surmised based on the literature (Gerson *et al.*, 2003; Zhang, 2003). The genera of Stigmaeidae associated with domatia (*Agistemus*, *Stigmaeus*, *Zetzellia* - Table 1) contain species that are predators of mites and other small inverte-

brates. This is also true of species of *Asca* (Ascidae). Tydeioidea are predators, parasites, and also feed on fungi and pollen. Similarly, phytoseiids consume small arthropods and most also feed on honeydew and pollen. Members of the Acaridae are primarily fungivores, but also feed on arthropods and on nematodes. Tarsonemids show a wide range of feeding habits, including plants, other arthropods, and fungi (Walter and Proctor, 1999).

The vast majority of the *Coffea* accessions at CATIE were introduced as seedlings that had been imported from Miami or Beltsville, where the seeds from the country of origin had been planted. Once the seedlings were certified to be pest and disease free, they were exported to Costa Rica. The earliest *Coffea* introduction relevant to this study was from 1949 (Table 2). Thus, the trees from which the mites were collected have had a maximum of 58 years to recruit mites from the local fauna of Costa Rica. It would be interesting to compare domatia-inhabiting mites from different countries, including Ethiopia, to determine what species are common to each country and which ones are shared. It is important to note that the mites identified in this study appeared to occur as unique species in the leaves in which they were collected, i.e., not more than one mite species was found on a single leaf sampled. This species exclusion needs to be corroborated in a more comprehensive study.

Table 2. Identification of mites collected from the leaf domatia of various coffee accessions maintained at the International Coffee Germplasm Center of the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) in Turrialba, Costa Rica.¹

Mite identification	<i>Coffea</i> species	CATIE accession #	Introduced from (year)
<i>Amblyseius perditus</i> (Mesostigmata: Phytoseiidae)	<i>C. arabica</i>	T.02137	Guatemala (1952)
<i>Asca</i> sp. (Mesostigmata: Ascidae)	<i>C. arabica</i>	T.02307	Brazil (1952)
<i>Asca</i> sp. (Mesostigmata: Ascidae)	<i>C. arabica</i>	T.01997	El Salvador (1951)
<i>Asca</i> sp. (Mesostigmata: Ascidae)	<i>C. arabica</i>	T.02268	Guatemala (1952)
<i>Asca</i> sp. (Mesostigmata: Ascidae)	<i>C. arabica</i>	T.02248	Ethiopia (1952)
<i>Asca</i> sp. (Mesostigmata: Ascidae)	<i>C. arabica</i>	T.02255	Ethiopia (1952)
<i>Asca</i> sp. (Mesostigmata: Ascidae)	<i>C. arabica</i>	T.04492	Ethiopia (1965)
<i>Asca</i> sp. (Mesostigmata: Ascidae)	<i>C. arabica</i>	T.01994	Brazil (1949)
<i>Metatriphtydeus</i> sp. (Prostigmata: Edbakerellidae)	<i>C. eugenioides</i>	T.21385	France (1997) ¹
<i>Neotropacarus mumai</i> (Astigmata: Acaridae)	<i>C. arabica</i>	T.04485	Ethiopia (1965)
<i>Neotropacarus mumai</i> (Astigmata: Acaridae)	<i>C. arabica</i>	T.04488	Ethiopia (1965)
<i>Neotropacarus mumai</i> (Astigmata: Acaridae)	<i>C. arabica</i>	T.04498	Ethiopia (1965)
<i>Neotropacarus mumai</i> (Astigmata: Acaridae)	<i>C. arabica</i>	T.04505	Ethiopia (1965)
Subfam. Pronematininae (Prostigmata: Iolinidae)	<i>C. arabica</i>	T.02150	Guatemala (1952)
<i>Zetzellia languida</i> (Prostigmata: Stigmaeidae)	<i>C. arabica</i>	T.00986	Ethiopia (1965)
<i>Zetzellia languida</i> (Prostigmata: Stigmaeidae)	<i>C. arabica</i>	T.04505	Guatemala (1949)
<i>Tarsonemus</i> sp. (Prostigmata: Tarsonemidae)	<i>C. eugenioides</i>	T.21385	France (1997) ¹
<i>Tarsonemus</i> sp. (Prostigmata: Tarsonemidae)	<i>C. arabica</i>	T.04492	Ethiopia (1965)
<i>Fungitarsonemus</i> sp. near <i>lodici</i> (Prostigmata: Tarsonemidae)	<i>C. eugenioides</i>	T.21385	France (1997) ¹

¹ From *in-vitro* cultures maintained at the Institut de Recherche pour le Développement (IRD; previously known as ORSTOM).

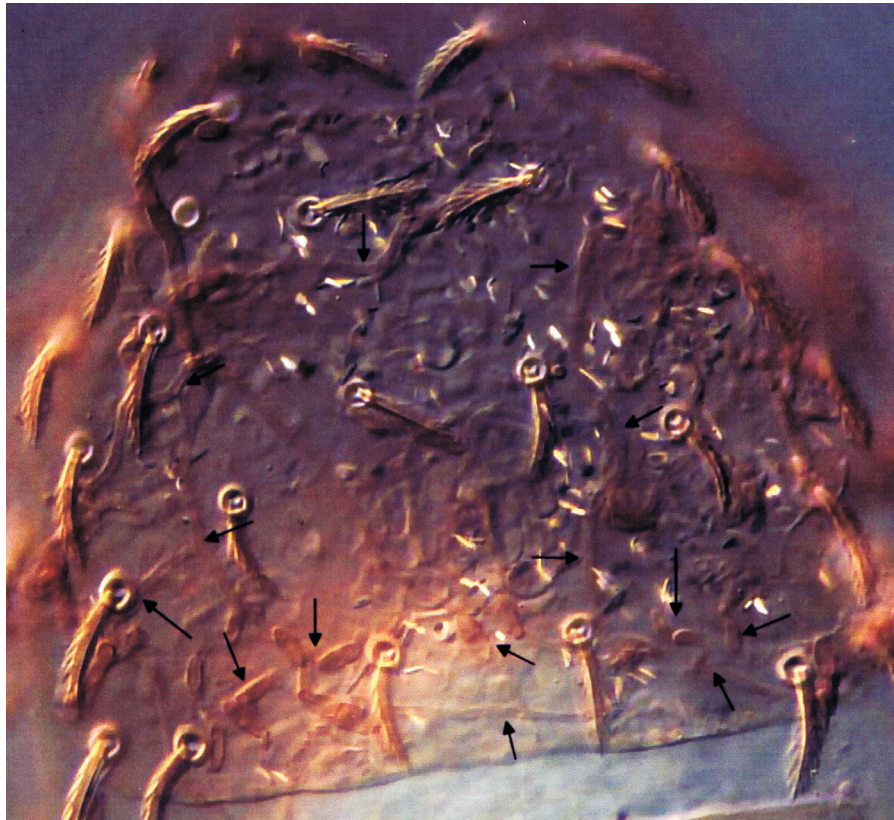


Fig. 1. Dorsal side of *Asca* sp. showing unidentified fungal spores as well as mycelial growth.

One very interesting aspect of this study was finding a large number of fungal spores on the dorsal side of the cuticle of an undescribed *Asca* species, including some that had germinated (Fig. 1). None of the mites appeared to be internally infected by the fungus. Therefore, we suspect that they are vectoring the spores. In addition to describing this new species, we are in the process of trying to isolate and identify the fungal species observed on the cuticle.

ACKNOWLEDGEMENTS

We thank Ann Simpkins (Sustainable Perennial Crops Laboratory, USDA, ARS, Beltsville, Maryland) for mounting the mites and Nit Malikul (Systematic Entomology Laboratory, USDA, ARS, Beltsville, Maryland) for teaching Ann how to mount the mites. Mite identifications by the following colleagues are greatly appreciated: Stigmaeidae: Eddie Ueckermann (Plant Protection Research Institute, Queenswood, Pretoria, South Africa); Tydeidae: Calvin Welbourn (Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida, USA); Phytoseiidae: Gregory A. Evans (USDA, APHIS, Beltsville, Maryland, USA); and Astigmata: Barry OConnor (University of Michigan, Museum of Zoology, Ann Arbor, Michigan, USA).

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