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# USE OF LEAF DOMATIA ON WILD GRAPE (*VITIS MUNSONIANA*) BY ARTHROPODS IN CENTRAL FLORIDA

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ABSTRACT

Pocket-like domatia on the underside of the leaves of wild grape, *Vitis munsoniana* Simpson, were occupied by fungivorous (47.0%), predatory (7.8%), and rarely herbivor-

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ous (0.8%) arthropods, primarily mites. At two sites in Orlando, FL, fungivorous taxa increased from low levels during the spring dry season to high levels (40-96% of domatia occupied by fungivores) after the onset of the rainy season in late May. These results support the hypothesis that leaf domatia are used primarily by mites that are potentially beneficial to the plant, and suggest that there may be a mutualistic relationship between the plant and fungivorous mites.

RESUMEN

Las domatia en forma de bolsillo en el enves de hojas de uva, *Vitis munsoniana* Simpson, se encontraron ocupadas con fungivoros (47.0%), predadores (7.8%), y muy pocos herbivoros (0.8%) artropodos, principalmente acaros. En dos localidades en Orlando, Florida, la taxa de fungivoros aumento de bajos niveles durante la primavera y estacion seca, a altos niveles (40-96% de las domatia ocupadas con fungivoros) al comenzar la estacion lluviosa a finales de Mayo. Estos resultados soportan la hipotesis de que las domatia en las hojas son usadas principalmente por acaros que son potencialmente beneficiosos a la planta, y sugiere que puede existir una relacion de beneficio mutuo entre la planta y los acaros fungivoros.

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Leaf domatia are pocket- or pit-like invaginations or tufts of hairs on the underside of the leaves of many plants. Domatia are often inhabited by mites (Acari), and it has been proposed that domatia are produced to encourage beneficial mites to remain on leaves in mutualistic association with the plant (O'Dowd & Wilson 1989, Pemberton & Turner 1989). Wild grape (*Vitis munsoniana* Simpson) is a common vine of mesic sites in central Florida. The underside of the leaf is smooth and hairless, but at vein junctures a roof-like extension of the veins and associated trichomes form pocket-like domatia.

The purpose of this study was: 1) to test the hypothesis that wild grape domatia housed beneficial arthropods; 2) determine what species of Phytoseiidae and other predatory arthropods were present on wild grape; and 3) determine if domatium use varied over a period of time.

Samples consisted of 10 leaves of *Vitis munsoniana* Simpson chosen haphazardly between 1 and 2 m above the ground from a patch of grapes between 9:00 and 16:00 hours. Unusually small leaves and leaves with extensive chewing-insect damage were avoided. Leaves were picked, placed in a plastic bag in an ice chest, and transported to the laboratory where they were frozen at –5°C. Five sites were sampled: an area of scrubby vegetation on the margin of Lake Ivanhoe in Orlando, FL (Ivanhoe), an open stand of trees along a creek above Lake Adair in Orlando (Adair), a flatwoods forest at Tosohatchie Reserve, 56 km east of Orlando (Tosohatchie), an area of scubby vegetation on the margin of Wildcat Lake (Wildcat), and an oak-pine forest near Clearwater Lake (Clearwater), both in the Ocala National Forest. The Adair site was sampled six times between mid-April and early July 1990, and the Ivanhoe site was sampled on an approximately weekly basis during the same period. Leaf surfaces were scanned under a stereomicroscope, and all phytoseiid mites were collected. Then, all domatia on each leaf were dissected under a stereomicroscope. Predatory arthropods and representatives of morphospecies of other arthropod taxa were mounted in Hoyer's medium on microscope slides for identification. The number of domatia occupied by live arthropods (including eggs), arthropod "exuvia" (cast skins, empty egg shells, or dead animals) only, and empty (no indication of past or current use by arthropods) was recorded. Leaf length was measured from the petiole to leaf tip. Voucher specimens were deposited at the Florida State Collection of Arthropods, Division of Plant Industry, Gainesville. Trophic roles were estimated from gut contents, observations of trophic interactions, and the literature.

The average wild grape leaf contained 19.97 ± 0.29 domatia. At the Ivanhoe site, there was no significant change in number of domatia per leaf over time, but at the Adair site there was a slight, but significant positive (slope = 0.063) linear relationship ($P < .003$, $r^2 = .1448$) with date.

Between 13 April and 8 July 1990 4394 domatia on 220 leaves of wild grape were dissected. Pooled over all sites and dates, 53% of these domatia were occupied by live arthropods; an additional 14% contained arthropod exuvia indicating previous occupation. Many of the taxa collected from wild grape leaves are known to feed omnivorously on foods as varied as pollen and spider mites, but most taxa could be classified by their primary food. Predatory arthropods were found in 7.8%, fungivores in 47.0%, and herbivores in only 0.8% of the domatia (Table 1). Two or more species were sometimes found in the same domatium. Eggs of thrips, phytoseiid, stigmaeid, tydeid, and winterschmidtiid mites were identified in domatia. Unidentified eggs were observed in 0.43% of domatia. Insects were found in only 1.98% of the domatia; the remainder were occupied by mites.

Preliminary observations at the Tosohatchie site in late March indicated that phytoseiid and tydeid mites were already present in domatia. Phytoseiid mites were the most abundant predatory taxa, occupying on average one domatium per leaf (1.01 ± 0.09), and being about four times as abundant in leaf domatia as on the leaf surface (0.27 ± 0.04). Nearly all egg (96.6%) and larval (87.5%) Phytoseiidae were collected in domatia. Phytoseiid and cheyletid (*Oudemansicheyla denmark* (Yunker) ) mites, *Haplothrips macroocellatus* (Watson), and a cecidiomyiid larva were all observed feeding on tydeid mites. There was no clear pattern of change in the number of domatia use by predators at either the Ivanhoe (Fig. 1) or Adair sites (Fig. 2).

Tydeid mites were observed feeding on leaf spot fungi. These mites became increasingly abundant with time, often with 30 or more eggs and molting nymphs packing a domatium. *Orthotydeus* sp. nr. *lindquisti* (Marshall) was the most abundant species. Although densities often exceeded 200 per leaf, there was no indication of leaf damage, and body colors were pale or amber with no indication of chlorophyll. Acarid, winterschmidtiid, and oribatid mite guts all contained extensive fungal material. There were significant positive linear relationships between number of domatia occupied by fungivores and date at both the Ivanhoe and Adair sites $P < .0001$ for both sites, $r^2 = .4891, .5225$, respectively). Herbivores were never abundant in domatia.

The hypothesis that leaf domatia are used preferentially by beneficial mites is supported by this study. Predatory taxa (1.55 ± 0.10 domatia per leaf) were ten times as common as herbivores (0.16 ± 0.03 domatia per leaf). Although leaf domatia comprise only a small fraction of leaf area, phytoseiid mites were four times as likely to be collected in domatia as on the leaf surface. Eggs of these mites are preferentially laid in domatia since about 95% of all eggs and larvae (the first, generally non-feeding instar) were collected there. Nearly one-half of all domatia examined contained fungivores (9.38 ± 0.48 per leaf). In the early summer samples, domatia were often completely filled by tydeid and winterschmidtiid mites. Winterschmidtiid mites ingest fungal spores and mycelium which can be observed as gut boluses. Although high densities of these mites may be associated with leaf damage (Dosse & Schneider 1957, Hughes 1962), there is no indication that these mites, or the similarly feeding acarid and oribatid mites are herbivores.

Tydeid mites ingest only fluids, so diet cannot be estimated from observations of gut contents. Schruft (1972) reported that *Tydeus goetzi* (Schruft) and *Pronematus staerki* (Schruft) were predators on eriophyid mites on grape leaves. *Homeopronematus anconai* (Baker) occurs on grape and other crops in California where it appears to feed primarily on pollen, honeydew, fungi, and eriophyoid mites, but it is a poor predator of spider mites (Knop & Hoy 1983, Hessein & Perring 1986, 1988). McCoy et al. (1969)

TABLE 1. ARTHROPODS (PERCENT OF DOMATIA CONTAINING TAXA) RECOVERED FROM LEAF DOMATIA ON *VITIS MUNSONIA* SIMPSON IN CENTRAL FLORIDA FROM 25 MARCH TO 8 JULY 1990. SOME DOMATIA WERE OCCUPIED BY MORE THAN ONE ARTHROPOD SPECIES.

- Insecta
  - Cecidomyiidae (0.30%)
    - Genus sp.
  - Thysanoptera (0.95%)
    - *Haplothrips macroocellatus* (Watson)
- OMNIVORE/FUNGIVORE (47.0%)
  - Acari
    - Tydeidae (44.37%)
      - *Afrotydeus "munsteri"* sensu Baker 1970
      - *Tydeus* Kochi Group
      - *Tydeus* spp.
    - Tarsonemidae (0.05%)
      - *Tarsonemus waitei* Banks
      - *Tarsonemus* sp. nr. *yoshidai* Ito
    - Winterschmidtiidae (2.25%)
      - *Czenspinskia transversostriata* (Oudemans)
    - Acaridae (0.15%)
      - *Tyrophagus putrescentiae* (Schrank)
      - Genus sp. undetermined
    - Oribatidae (0.05%)
      - *Scapheremaeus* sp.
      - *Dometorina* sp.
- PREDATORS (7.8%):
  - Acari
    - Phytoseiidae (5.06%)
      - *Euseius hibisci* (Chant)
      - *Euseius mesembrinus* (Dean)
      - *Galendromus annectans* (De Leon)
      - *Galendromus halveolus* (Chant)
      - *Paraseiulella elliptica* (De Leon)
      - *Proprioseius anthurus* Denmark & Muma
      - *Proprioseius meridionalis* Chant
      - *Typhlodromalus limonicus* (Garman & McGregor)
      - *Typhlodromalus peregrinus* (Muma)
    - Stigmaeidae (1.10%)
      - *Agistemus denotatus* Gonzalez
      - *Agistemus divisus* Gonzalez
      - *Agistemus floridianus* Gonzalez
      - *Agistemus terminalis* (Quayle)
      - *Eryngiopus* sp.
    - Bdellidae (0.10%)
      - *Spinibdella depressa* (Ewing)
    - Cheyletidae (0.50%)
      - *Oudemansicheyla denmarki* (Yunker)
      - *Hemicheyletia wellsi* (Baker)
- HERBIVORES (0.8%):
  - Acari
    - Tetranychidae (0.09%)
      - *Eotetranychus* sp.
  - Insecta
    - Homoptera (0.32%)
      - Diaspididae, Coccidae, Pseudococcidae
    - Thysanoptera (0.41%)
      - *Scirtothrips* nr. *citri* Moulton

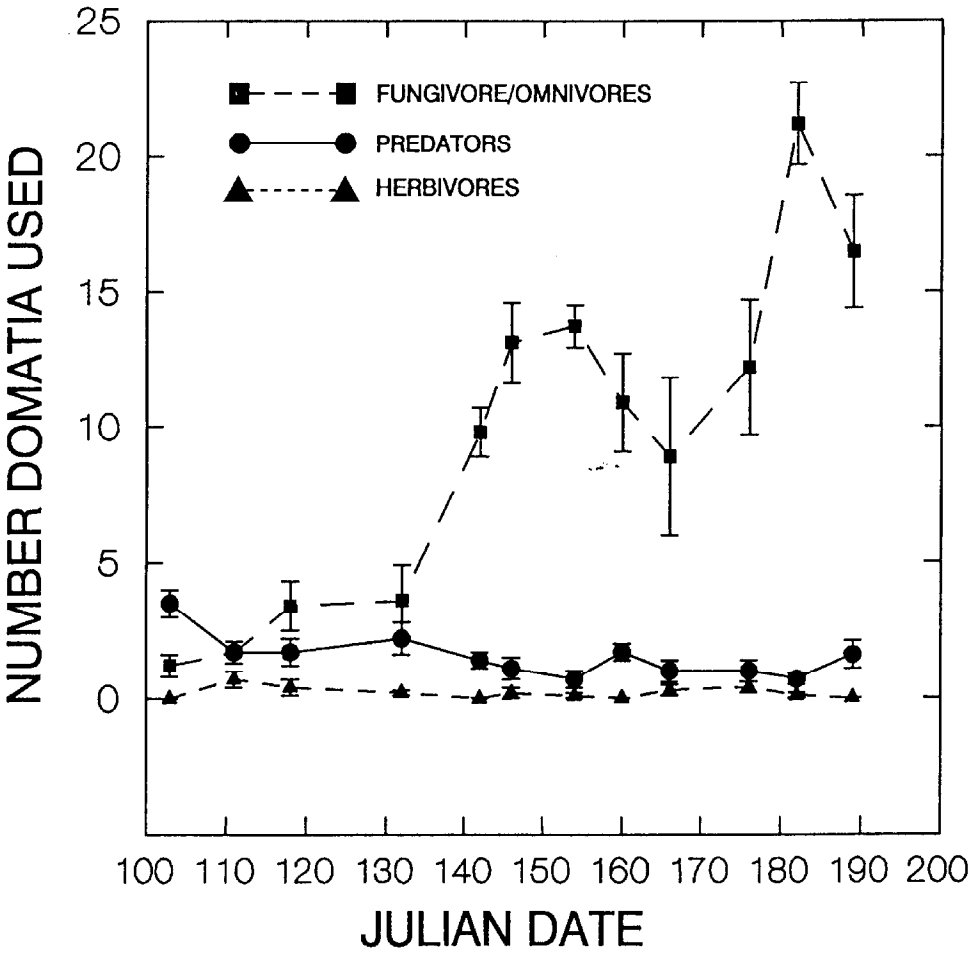


Fig. 1

found that *Parapronematus acaciae* Baker would not prey on phytophagous mites on citrus, but would develop on two common leaf-inhabiting fungi. We observed tydeid mites feeding on leaf spot fungi, and did not observe any eriophyoid mites that would serve as alternate prey. However, it is likely that the tydeid mites on wild grape are also facultatively predaceous.

In Central Florida, the winter dry season is followed by increasing rainfall in late spring, and monsoon-like conditions in summer that facilitate the growth of phylloplane fungi. At the Adair site, fungivores occupied only a quarter of the domatia during the dry season in mid-April, but occupied > 70% after the rains returned in late-May. At the Ivanhoe site, only 7% of domatia were occupied by fungivores in mid-Aprl, but 40-96% contained fungivores after late-May. A mutualistic benefit to the plant from the presence of mites remains to be experimentally demonstrated, however, the results of this study suggest that mites may help to remove fungi from the phylloplane.

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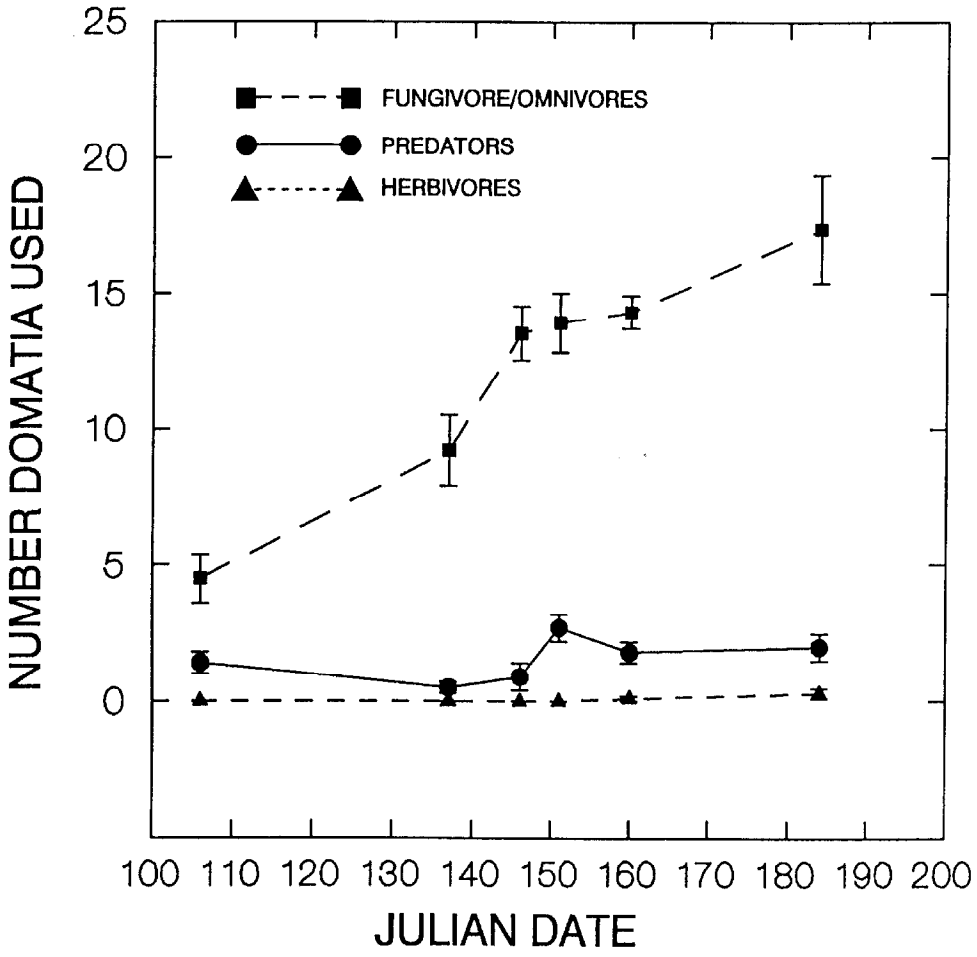


Fig. 2

Lindquist, Biosystematics Research Centre, Ottawa, Ontario, Canada for their help in determining the identity of some of the mite taxa.

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# MODIFIED REARING AND MAINTENANCE TECHNIQUES FOR *MANTISPA VIRIDIS* (NEUROPTERA: MANTISPIDAE)

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Abstract

Improved techniques were developed for the rearing and maintenance of *Mantispa viridis* Walker. These have proven highly successful and have eliminated problems encountered by other researchers working on mantispine developmental studies, and should allow subsequent studies to be conducted under standardized conditions. These techniques also have been used in maintaining colonies of beaded lacewings (Neuroptera: Berothidae), various spider egg parasitoids and predators, and are adaptable for other arthropods that require individual confinement.

Resumen

Se desarrollaron tecnicas mejoradas para la crianza y mantenimiento de *Mantispa viridis* Walker. Estas tecnicas tuvieron mucho exito y se eliminaron problemas encontrados por otros investigadores; de la misma forma estas tecnicas permitieron que se realizaran estudios subsiguientes en condiciones normales. Estas tecnicas se utilizaron tambien para mantener colonias de los insectos de encaje con borlas (Neuroptera: Berothidae), y para varios parasitos de huevos de arañas. Estas tecnicas pueden ser adaptadas para la crianza de otros artropodos que requieran confinamiento individual.

Most previous developmental data reported for members of the Mantispinae (Neuroptera: Mantispidae) are difficult to compare intra- and interspecifically due to studies having been conducted under uncontrolled conditions of temperature, photoperiod, relative humidity (RH) and larval rearing techniques. The exception is a standardized rearing technique developed by Redborg & MacLeod (1983, 1985). They constructed rearing cells by drilling wells into a hardened mixture composed of powdered, activated carbon and plaster of Paris. Spider eggs were added to the wells, a first instar mantispid was placed in each, and the top was sealed with a glass cover. Egg incubation