TREEHOPPERS (HOMOPTERA, MEMBRACIDAE) IN SOUTHEASTERN BRAZIL: USE OF HOST PLANTS

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ABSTRACT. A survey on the use of host plants by treehoppers in plants in *cerrado* (savanna) vegetation at Moji-Guaçu (São Paulo, Southeastern Brazil) was made. Fifty-two species of treehoppers were recorded in association with 40 host plant species from October 1980 to February 1982. The families Araliaceae, Asteraceae, Leguminosae, Malpighiaceae, Myrtaceae and Nyctaginaceae were the most commonly used for oviposition. *Byrsonima intermedia* A. Juss. (Malpighiaceae) had the highest number of associated treehopper species (10 species). The abundance of treehopper individuals was related to the hot and rainy season (from October to February), while during the cold and dry season (from March to September) there was a decrease in the number of these Homoptera. After the occurrence of a frost, few adults and nymphs were observed on the host plants for one to two months.
KEY WORDS. Homoptera, Membracidae, treehoppers, savanna, Brazil

The treehoppers (Homoptera, Membracidae) are phytophagous insects that suck sap from the host plants showing a preference for its younger and tender parts; thus, they are found at the base of petioles and veins of leaves, the apical branch meristem, inflorescences, and green fruits (HAVILLAND 1925; FUNKHOUSER 1950).

The family Membracidae has been poorly studied in Brazil except for taxonomic works. The ecological aspects of this group, especially host plant associations, are relatively unknown. This is particularly true for the region of the Brazilian *cerrado* (savanna) (LOPES 1984).

The goals of this work were to assess host plant associations of treehoppers in the *cerrado* vegetation, and to investigate the seasonal variation in abundance.

METHODS

The sampling was done between October, 1980 and February, 1982, in an area of *cerrado* of the Reserva Biológica de Moji-Guaçu (RBMG, São Paulo) 22°11-18'S, 47°07-10'W. (EITEN 1971). Nine transects were installed distancing about 100m from each other (Fig. 1). The transects 1 to 3 were about 200m long, while the rest were about 500m long. The marked plants, selected at random, ranged from a minimum height of 30-40cm and a maximum height of 200cm. The distance between each plant along the transects ranged from 0.5m to 3.0m. There

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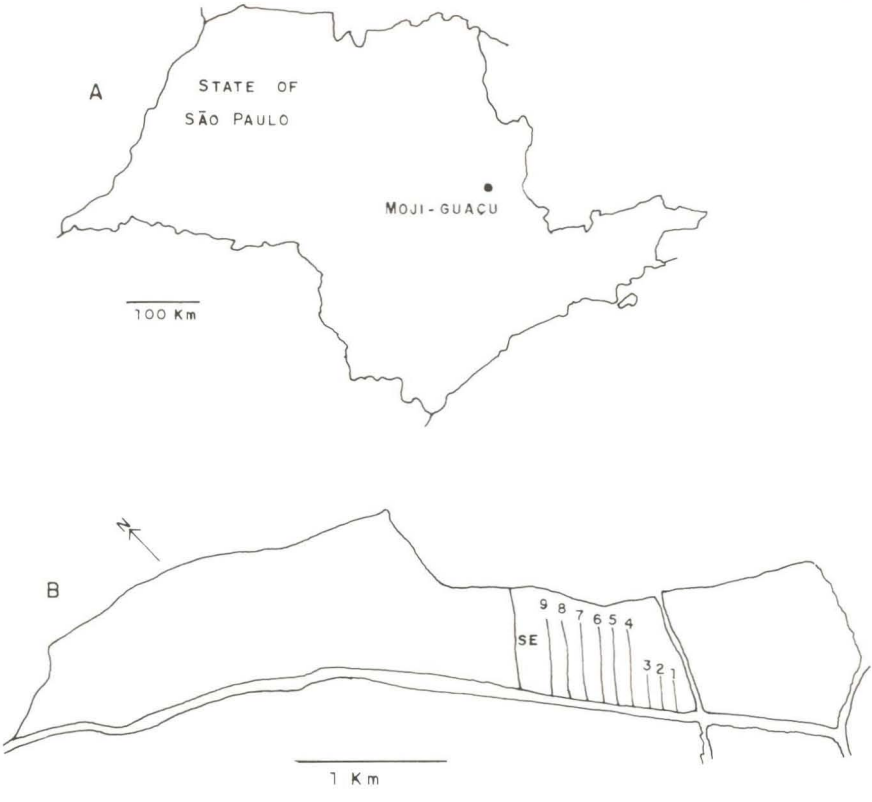

Fig. 1. Maps showing (A) the São Paulo state and the location of Moji-Guaçu City, and (B) the Reserva Biológica de Moji-Guaçu (RBMG) with the nine transects installed at the Setor de Ensino (SE).

were up to 50 individuals in the first three transects, and about 150 individuals in transects 4 to 9, adding up to 1025 marked plants observed. Five surveys were made on the plants throughout the 17 months of the work. At the first survey the following data were recorded for each plant: code number of the plant; date; species; height; phenologic state (vegetative, flowers and/or fruits); absence or presence of treehoppers (nymphs and/or adults). During the following surveys the same data were recorded, except the plant species and its height. The treehoppers were identified in the field or collected manually to be identified later. The transects were assembled at the Setor de Ensino (SE) of the RBMG, in accordance to the directions of VUONO *et al.* (1981).

The frequency of treehoppers on host plants was calculated by the relation below:

$$\frac{\textit{number of plants of species i with treehopper} \cdot 100}{\textit{number of plants of species i} \cdot 5\ \textit{surveys}}$$

RESULTS AND DISCUSSION

A total of 1025 plants, belonging to 93 different species, were marked. Table I shows the recorded plant species, the number of individuals of each plant species and their associated treehopper species.

Of the 93 plant species examined, 40 (43%) were observed with treehoppers. On 17 of these latter ones, adults, eggs and nymphs were found while on 23 plant species only adults were found.

The plant families most frequently used by treehoppers for oviposition in the *cerrado* are: Araliaceae; Asteraceae; Leguminosae; Malpighiaceae; Myrtaceae; and Nyctaginaceae. Of the 26 treehopper species observed and/or collected, 11 were found as eggs and/or nymphs, enabling the establishment of ovipositional hosts for 42.3% of treehoppers. Two of the families listed above - Asteraceae and Leguminosae - are cited by FUNKHOUSER (1917, 1950) as being among the most used families for oviposition in temperate regions. In addition to the above families, STRÜMPEL (1972) mentions that South American treehoppers can be found on the families Flacourtiaceae, Guttiferae, Melastomataceae, Monimiaceae, Rubiaceae, Sapindaceae, and Solanaceae, all of them represented in the *cerrado*.

For the 40 plant species (Tab. II), disregarding the ones represented by only one or two individuals in the transects, the most commonly used plant species by treehoppers were: *Byrsonima intermedia* A. Juss. (Malpighiaceae) (36.00%); *Eupatorium maximiliani* Schrad. ex DC. (Asteraceae) (21.05%); *Siparuna guianensis* Aubl. (Monimiaceae) (20.00%); *Eugenia bimarginata* DC. (M yrtaceae) (17.14%); *Neea theifera* Oerst. (Nyctaginaceae) (14.84%); *Guapira noxia* (Netto) Lundell (Nyctaginaceae) (11.11%); *Gochnatia pulchra* Cabr. (Asteraceae) (10.83%); *Gochnatia barrosii* Cabr. (Asteraceae) (10.67%); and *Myrcia albo-tomentosa* DC. (Myrtaceae) (10.00%). Each of the remaining species had association levels bellow 10.00%.

Byrsonima intermedia, a species of broad geographic distribution (LORENZI 1982), bears flowers and fruits during eight months of the year. Since many treehoppers appear to feed preferentially on peduncles, this may explain why this host presents a greater abundance of treehopper species. *B. intermedia* has ten associated treehopper species, followed by *G. barrosii* (seven species), *G. pulchra* (five species), *N. theifera* (four species), and *E. maximiliani* (three species) (Tab. III).

Some treehopper species have a strong association with certain host plants while others do not (Tab. IV), therefore being accounted as mild polyphagous (WOOD 1993). Individuals of *Guayaquila xiphias* (Fabricius, 1803) were found in an almost exclusive association with *Didymopanax vinosum* (Cham. & Schlecht) March (Araliaceae); *Erechtia* sp. 2 associated mainly with Guapira noxia and Neea theifera, both belonging to the family Nyctaginaceae, and also associated with *Byrsonima intermedia*; *Tylopelta* sp. 1 associated with *Miconia albicans* (Sw.) Triana (Melastomataceae), and *Cyphonia capra* Burmeister, 1833 associated almost exclusively with species of the family Asteraceae, notedly *Eupatorium maximiliani*. Asteraceae seems also to be the family of preference for *Bolbonota*

Table I. Species of *cerrado* plants studied at the Reserva Biológica de Moji-Guaçu. Between brackets is the number of individuals marked. On the column of treehoppers species, * means only adults present, and ** means eggs and/or nymphs.

Monocotyledoneae	Treehopper species
Arecaceae	
Attalea humilis Mart. (6)	-
Butia leiospatha (Mart.) Becc. (4)	*Cyphonia capra* (Burmeister, 1833) *
Diplothemium campestre Mart. (3)	-
Syagrus flexuosa (Mart.) Becc. (7)	-
Dicotyledoneae	
Annonaceae	
Annona coriacea Mart. (2)	-
Xylopia aromatica (Lam.) Mart. (18)	*Membracis dorsata* Fabricius, 1803 *
	Membracis tectigera Olivier, 1792 **
Apocynaceae	
Aspidosperma tomentosum Mart. (55)	-
Hancornia speciosa Gomez (3)	-
Araliaceae	
Didymopanax macrocarpum (Cham. & Schlecht.) Seem (12)	*Guayaquila xiphias* (Fabricius, 1803) **
	Membracis richteri Fonseca, 1949 *
Didymopanax vinosum (Cham. & Schlecht.) March (27)	*Guayaquila xiphias* **
Asteraceae	
Baccharis dracunculifolia DC. (8)	-
Eremanthus sphaerocephalus Baker (1)	-
Eupatorium maximiliani Schrad. ex DC. (19)	*Bolbonota melaena* (Germar, 1835) **
	Cyphonia capra *
	Cyphonia clavata (Fabricius, 1787) *
Eupatorium squalidum DC. (2)	*Cyphonia capra* *
Eupatorium vauthierianum DC. (1)	-
Gochnatia barrosii Cabr. (30)	*Bolbonota bituberculata* Stål, 1858 *
	Bolbonota melaena **
	Ceresa sp. 1 *
	Cyphonia capra *
	Enchenopa gracilis (Germar, 1821) **
	Erechtia sp. 2 **
	Membracis tectigera *
Gochnatia pulchra Cabr. (24)	*Bolbonota bituberculata* *
	Bolbonota melaena *
	Guayaquila xiphias *
	Hypsoprora albopleura Fonseca, 1933 *
	Membracis tectigera **
Piptocarpha rotundifolia (Less.) Baker (8)	*Bolbonota melaena* **
Vernonia ferruginea Less. (1)	-
Vernonia rubriramea Mart. (17)	*Amastris sakakibarai* Broomfield, 1976 *
	Bolbonota melaena *
	Cyphonia capra *
	Cyphonia sp. *
Bignoniaceae	
Arrabidaea brachypoda (DC.) Bur. (6)	*Guayaquila xiphias* *
Tabebuia caraiba (Mart.) Bur. (21)	-
Tabebuia ochracea (Cham.) Standl. (29)	-
Zeyhera digitalis (Vell.) Hoehne (1)	-
Bombacaceae	
Eriotheca gracilipes (Schum.) A. Robyns (8)	-
Pseudobombax longiflorum (Schum.) A. Robyns (3)	-
Burseraceae	
Protium heptaphyllum (Aubl.) March (1)	-
Caryocaraceae	
Caryocar brasiliense Camb. (1)	-

(Cont.)

Table I. Continuation.

Dicotyledoneae	Treehopper species
Celastraceae	
Austroplenckia populnea (Reiss.) Lund. (3)	-
Chrysobalanaceae	
Couepia grandiflora (Mart. & Zucc.) Benth. (4)	-
Connaraceae	
Connarus suberosus Planch. (26)	*Amastris sakakibarai* *
	Ceresa sp. 1 *
	Tylopelta monstrosa Fairmaire, 1846 **
Dilleniaceae	
Davilla elliptica St. Hil. (2)	-
Ebenaceae	
Dyospiros hispida DC. (52)	-
Erythroxylaceae	
Erythroxylum campestre St. Hil. (1)	-
Erythroxylum suberosum St. Hil. (15)	-
Erythroxylum tortuosum Mart. (34)	*Cyphonia capra* *
Euphorbiaceae	
Pera glabrata Poepp. ex Baill. (1)	*Amastris sakakibarai* *
Flacourtiaceae	
Casearia sylvestris Sw. (34)	*Leioscyta* sp. *
	Membracis richteri *
Guttiferae	
Kielmeyera coriacea (Spr.) Mart. (1)	-
Kielmeyera variabilis Mart. (10)	*Enchenopa monoceros* (Germar, 1821) *
Leguminosae (Caesalpinaceae)	
Bauhinia holophylla Steud. (61)	*Calloconophora argentipennis* Dietrich, 1991 **
	Ceresa sp. 1 *
	Enchenopa concolor Fairmaire, 1846 *
	Enchenopa gracilis **
	Membracis tectigera *
Cassia chrysocarpa Desv. (13)	*Ceresa* sp. 1 *
Copaifera langsdorffii Desf. (2)	-
Dimorphandra mollis Benth. (13)	*Cyphonia capra* *
Leguminosae (Mimosaceae)	
Anadenanthera falcata (Benth.) Speg. (10)	*Cyphonia clavata* *
	Enchenopa sp. 3 *
Enterolobium gummiferum (Mart.) Macbr. (1)	-
Stryphnodendron adstringens (Mart.) Cov. (3)	-
Leguminosae (Papilionaceae)	
Acosmium dasycarpum (Vog.) Yak. (21)	*Enchenopa gracilis* *
	Enchenopa sp. 3 *
	Procyrta pectoralis (Fabricius, 1803) *
Acosmium subelegans (Mohl) Yak. (10)	-
Andira humilis Mart. (3)	-
Bowdichia virgilioides H.B.K. (2)	-
Machaerium acutifolium Vog. (1)	*Tylopelta* sp. 1 *
Platypodium elegans Vog. (4)	*Ceresa* sp. 1 *
Vatairea macrocarpa (Benth.) Ducke (1)	*Enchenopa gracilis* *
Loganiaceae	
Strychnos pseudoquina St. Hil. (2)	-
Malpighiaceae	
Banisteriopsis variabilis Gats (3)	-
Byrsonima coccolobifolia (Spr.) Kunth (14)	*Amastris sakakibarai* *
	Enchenopa gracilis **
Byrsonima intermedia A. Juss. (20)	*Amastris sakakibarai* *
	Bolbonota melaena **

(Cont.)

Table I. Continuation.

Dicotyledoneae	Treehopper species
Byrsonima intermedia A. Juss. (20) (cont.)	*Enchenopa gracilis* * *
	Enchenopa monoceros * *
	Enchenopa sp. 3 *
	Erechtia sp. 2 * *
	Hypsoprora albopleura *
	Leioscyta sp. * *
	Tylopelta monstrosa * *
	Tylopelta sp. 2 *
Byrsonima verbascifolia L. Rich. (3)	-
Heteropteris byrsonimifolia A. Juss. (1)	*Bolbonota bituberculata* *
Melastomataceae	
Leandra lacunosa Cogn. (5)	-
Miconia albicans (Sw.) Triana (46)	*Calloconophora argentipennis* *
	Membracis tectigera *
	Tylopelta sp. 1 * *
Miconia rubiginosa (Bonpl.) DC. (5)	-
Monimiaceae	
Siparuna guianensis Aubl. (6)	*Erechtia* sp. 1 *
	Sphongophorus sp. *
Moraceae	
Brosimum gaudichaudii Trec. (3)	-
Ficus citrifolia P. Miller (1)	-
Myrsinaceae	
Rapanea guianensis Aubl. (35)	-
Rapanea lancifolia Mez (7)	-
Myrtaceae	
Campomanesia cambessedeana Berg (23)	*Amastris sakakibarai* *
Eugenia aurata Berg (4)	-
Eugenia bimarginata DC. (7)	*Amastris sakakibarai* *
	Enchenopa gracilis * *
	Erechtia sp. 2 * *
Eugenia livida Berg (2)	
Myrcia albo-tomentosa DC. (14)	*Cyphonia capra* *
	Erechtia sp. 2 * *
	Leioscyta sp. * *
Myrcia lingua Berg (6)	*Erechtia* sp. 2 *
Myrcia tomentosa (Aubl.) DC. (1)	*Ceresa* sp. 1 *
Nyctaginaceae	
Guapira noxia (Netto) Lundell (9)	*Bolbonota melaena* *
	Ceresa sp. 1 *
	Erechtia sp. 2 * *
Neea theifera Oerst. (31)	*Amastris sakakibarai* *
	Bolbonota melaena *
	Erechtia sp. 2 * *
	Tylopelta monstrosa *
Ochnaceae	
Ouratea spectabilis (Mart.) Engl. (17)	*Ceresa* sp. 1 *
	Metcalfiella pertusa (Germar, 1835) * *
Opiliaceae	
Agonandra brasiliensis Miers (4)	-
Proteaceae	
Roupala montana Aubl. (9)	-
Rubiaceae	
Palicourea rigida H.B.K. (7)	-
Rudgea viburnioides (Cham.) Benth. (7)	*Enchenopa monoceros* *
Tocoyena brasiliensis Mart. (3)	-
Tocoyena formosa (Cham. & Schlecht.) K. Schum. (10)	-

(Cont.)

Table I. Continuation.

Dicotyledoneae	Treehopper species
Sapindaceae	
Serjania erecta Radlk. (4)	-
Sapotaceae	
Pouteria ramiflora (Mart.) Radlk. (3)	-
Solanaceae	
Solanum lycocarpum St. Hil. (1)	-
Styracaceae	
Styrax ferrugineus Nees & Mart. (20)	*Bolbonota melaena* *
	Ceresa sp. 1 *
	Cyphonia capra *
	Enchenopa sp. 3 *
Verbenaceae	
Aegiphila lhotskyana Cham. (4)	-
Lippia salviifolia Cham. (5)	-
Vochysiaceae	
Qualea grandiflora Mart. (21)	-
Qualea multiflora Mart. (9)	*Erechtia* sp. 2
Vochysia tucanorum (Spr.) Mart. (7)	-

bituberculata Stål, 1858 and *B. melaena* (Germar, 1835) - again *Eupatorium maximiliani*, *Gochnatia barrosii* and *G. pulchra*.

Several treehopper species are restricted to only a few host plants, which are usually of the same family (BRUES 1972). Nevertheless, these treehoppers cannot be considered strictly monophagous because, according to WOOD (1993), this category is restricted to species associated with one single species of host plant throughout its geographic distribution. This category is better applied to treehoppers of temperate zones, since tropical treehoppers tend to: be polyphagous, use perenial or semi-perenial host plants, be social, be associated with ant mutualists and be multivoltine (WOOD 1984, 1993).

The species *Entylia bactriana* (Germar, 1833), a temperate region treehopper studied by WOOD (1977) in Ohio (U.S.A.), could only be found on Asteraceae. MATAUSCH (1910) states that the species of *Entylia* only occur on Asteraceae and specially on species of *Eupatorium*. At the *cerrado* of the RBMG and at Morro do Ferro (Poços de Caldas, Minas Gerais) (personal observation), *Entylia gemmata* (Germar, 1821) was collected primarily on Asteraceae (*Ambrosia polystachia* DC., *Gochnatia barrosii*, *Mikania cordifolia* (L.F.), *Mikania* sp., *Senecio* sp., and *Viguiera* sp.), but was also recorded twice on *Solanum erianthum* D. Don. (Solanaceae). An extreme case of treehopper feeding specialization are the three genera of the Centrodontini (Membracinae), which feed exclusively of *Larrea tridentata* (Sessé & Moç. ex DC.) Cov. (Zygophyllaceae) (DEITZ 1975).

Many species of treehoppers herein studied are very polyphagous and utilize a variety of host plants. *Ceresa* sp. 1 was sampled on nine species of host plants, which belonged to seven plant families; *Amastris sakakibarai* Broomfield, 1976 was sampled on eight species of plants of six families, and *Enchenopa gracilis* (Germar, 1821) associated with seven species of plants of four families, and even with oviposition on almost all seven species mentioned. DIETRICH & DEITZ (1991) and WOOD (1993) have stated that the genera *Bolbonota* Amyot & Serville, 1843,

Calloconophora Dietrich, 1991 and *Guayaquila* Goding, 1920 can be considered generalists since many species are associated with two or more plant families. Though the treehoppers *Bolbonota melaena*, *Cyphonia capra* and *Erechtia* sp. 2 have been observed in association with nine, nine and eight different species of host plants, respectively, they appear to generally exhibit a localized preference for just a few species of the same plant family (Tab. IV).

Table II. Treehopper host plants and the frequency of treehoppers on them. Between brackets is the number of individuals marked of each plant species. Each individual was examined five times.

Host plants	Frequency of treehoppers (%)
Byrsonima intermedia (20)	36.00
Eupatorium maximiliani (19)	21.05
Eupatorium squalidum (2)	20.00
Heteropteris byrsonimifolia (1)	20.00
Machaerium acutifolium (1)	20.00
Myrcia tomentosa (1)	20.00
Pera glabrata (1)	20.00
Siparuna guianensis (6)	20.00
Vatairea macrocarpa (1)	20.00
Eugenia bimarginata (7)	17.14
Neea theifera (31)	14.84
Guapira noxia (9)	11.11
Gochnatia pulchra (24)	10.83
Gochnatia barrosii (30)	10.67
Myrcia albo-tomentosa (14)	10.00
Vernonia rubriramea (17)	8.24
Didymopanax vinosum (27)	8.15
Byrsomima coccolobifolia (14)	5.71
Butia leiospatha (4)	5.00
Didymopanax macrocarpum (12)	5.00
Platypodium elegans (4)	5.00
Miconia albicans (46)	4.35
Anadenanthera falcata (10)	4.00
Styrax ferrugineus (20)	4.00
Ouratea spectabilis (17)	3.53
Arrabidaea brachypoda (6)	3.33
Myrcia lingua (6)	3.33
Bauhinia holophylla (61)	2.95
Acosmium dasycarpum (21)	2.86
Rudgea viburnioides (7)	2.86
Piptocarpha rotundifolia (8)	2.50
Connarus suberosus (26)	2.31
Qualea multiflora (9)	2.22
Xylopia aromatica (18)	2.22
Kielmeyera variabilis (10)	2.00
Cassia chrysocarpa (13)	1.54
Dimorphandra mollis (13)	1.54
Casearia sylvestris (34)	1.18
Erythroxylum tortuosum (34)	1.18
Campomanesia cambessedeana (23)	0.87

Table III. Most frequent host plants for treehoppers in the Reserva Biológica de Moji-Guaçu. Between brackets is the number of observations for each species of treehopper.

Host plants	Treehopper species
Byrsonima intermedia	*Tylopelta monstrosa* (10), *Erechtia* sp. 2 (8), *Enchenopa monoceros* (6), *Amastris sakakibarai* (3), *Bolbonota melaena* (3), *Leioscyta* sp. (2), *Enchenopa gracilis* (1), *Enchenopa* sp. 3 (1), *Hypsoprora* sp. (1), *Tylopelta* sp. 2 (1)
Gochnatia barrosii	*Bolbonota melaena* (7), *Ceresa* sp. 1 (3), *Enchenopa gracilis* (2), *Bolbonota bituberculata* (1), *Cyphonia capra* (1), *Erechtia* sp. 2 (1), *Membracis tectigera* (1)
Gochnatia pulchra	*Bolbonota melaena* (8), *Bolbonota bituberculata* (2), *Guayaquila xiphias* (1), *Hypsoprora albopleura* (1), *Membracis tectigera* (1)
Neea theifera	*Erechtia* sp. 2 (20), *Amastris sakakibarai* (1), *Bolbonota melaena* (1), *Tylopelta monstrosa* (1)
Eupatorium maximiliani	*Cyphonia capra* (13), *Bolbonota melaena* (6), *Cyphonia clavata* (1)

Table IV. Feeding preferences for some treehopper species at the Reserva Biológica de Moji-Guaçu. Between brackets is the number of times that the treehopper species was recorded on the host plant.

Treehopper species	Host plants
Bolbonota melaena	*Gochnatia pulchra* (8), *Gochnatia barrosii* (7), *Eupatorium maximiliani* (6), *Byrsonima intermedia* (3), *Guapira noxia* (1), *Neea theifera* (1), *Piptocarpha rotundifolia* (1), *Styrax ferrugineus* (1), *Vernonia rubriramea* (1)
Cyphonia capra	*Eupatorium maximiliani* (13), *Vernonia rubriramea* (4), *Erythroxylum tortuosum* (2), *Eupatorium squalidum* (2), *Butia leiospatha* (1), *Dimorphandra mollis* (1), *Gochnatia barrosii* (1), *Myrcia albo-tomentosa* (1), *Styrax ferrugineus* (1)
Erechtia sp. 2	*Neea theifera* (20), *Byrsonima intermedia* (8), *Guapira noxia* (3), *Myrcia albo-tomentosa* (3), *Eugenia bimarginata* (1), *Gochnatia barrosii* (1), *Myrcia lingua* (1), *Qualea multiflora* (1)
Guayaquila xiphias	*Didymopanax vinosum* (11), *Didymopanax macrocarpum* (2), *Arrabidaea brachypoda* (1), *Gochnatia pulchra* (1)
Bolbonota bituberculata	*Gochnatia pulchra* (2), *Gochnatia barrosii* (1), *Heteropteris byrsonimifolia* (1)
Tylopelta sp. 1	*Miconia albicans* (8), *Machaerium acutifolium* (1)
Erechtia sp. 1	*Siparuna guianensis* (5)

The percentage of plants with treehoppers tends to increase during the rainy season, from October to February every year, and tends to fall to low numbers from March to September, when the weather is drier and colder (Fig. 2). During the rainy season there is a higher rate of plants sprouting anew, flowering and fruiting on *cerrado* (RIZZINI 1979). These events are suitable for feeding and breeding for the adult treehoppers. TSAI & KOPP (1981), in their study on two species of treehoppers (*Acutalis tartarea* Say, 1830 and *Micrutalis malleifera* Fowler, 1895), in the subtropical region of Florida (U.S.A.), have verified that these treehoppers, like the ones in the present work, are less abundant during fall (September to December on the North Hemisphere). WOOD (1976) suggests synchronism between the life history timing of *Platycotis vittata* Fabricius, 1803 and the growth pattern of its host plant, *Quercus* sp.: this treehopper has two yearly generations, each of them being in direct temporal association with one of the two fases of seasonal growth of the host plant.

In figure 2 one can clearly see a decrease in the percentage of plants with nymphs along the summer of 1981. This may suggest a decrease in the number of

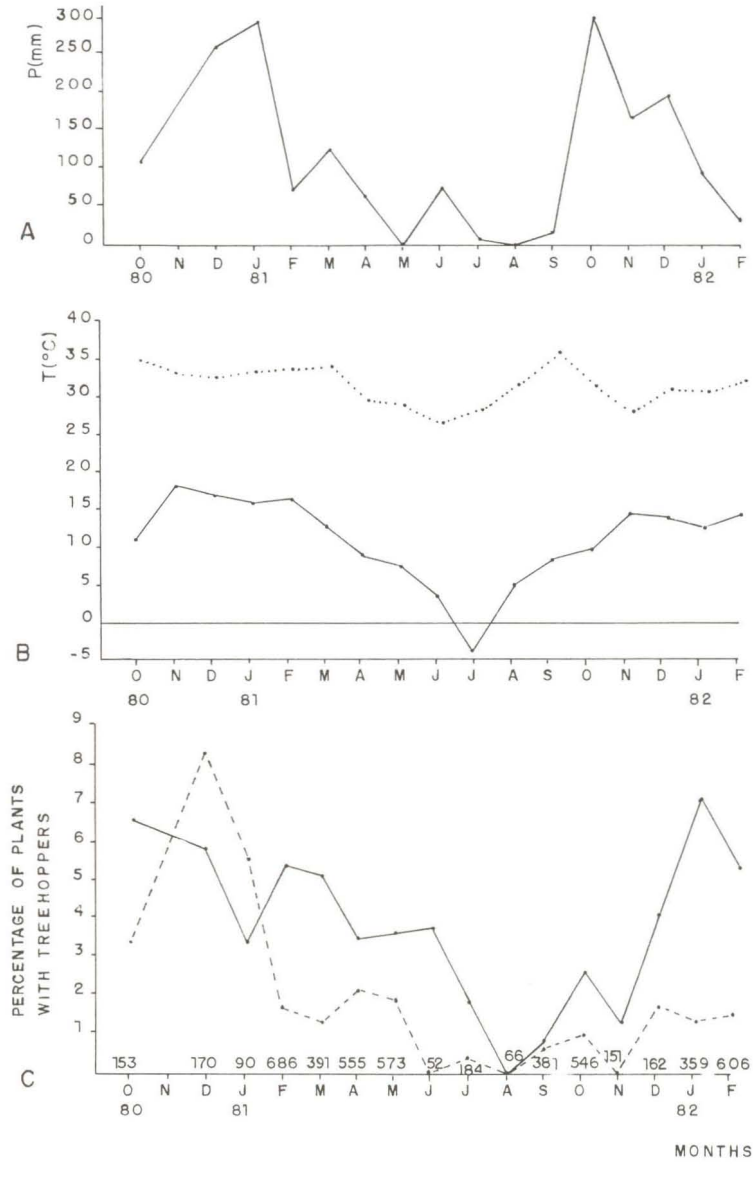

Fig. 2. Climatic data and frequency of the presence of treehoppers on *cerrado* plants of Reserva Biológica de Moji-Guaçu. (A) Total precipitation for each month; (B) maximal temperature (doted line) and minimal temperature (continuous line) for each month; (C) frequency of the presence of nymphs (broken line) and adults (continuous line). In C, close to the abscissa is the number of plants studied in each month. No observations were made in November, 1980.

nymphs. The weather data of this season (December, 1980 to March, 1981) show high levels of precipitation and high levels of minimal (above 15°C) and higher maximal temperature. These climatic factors may promote biotic mortality factors (pathogens, specially fungi and entomophagous insects, whether parasites or predators) (DEBACH 1964; HUFFAKER & MESSENGER 1976). Although the life histories of individual treehopper species were not analysed here, mortality of nymphs and adult treehoppers due to mycotic diseases were observed. In the same way, predation and parasitism were observed in the studied area, apparently contributing to the reduction of treehoppers.

The marked decrease in the frequency of adult treehoppers in host plants in the *cerrado* during August, 1981, was probably due to a frost that occurred along the last days of July of that year. Considering that this decrease began well before August and that immediately afterwards it was followed by a marked recuperation in the frequency of adult treehoppers, seemingly the frost had just a temporary effect, though intense, on the fauna of these homoptera. It is suggested (Dr. T.K. Wood, personal communication) that some eggs may have been dormant and hatched with increasing temperature. FUNKHOUSER (1917), in a work carried out in a temperate zone, points out that frost can kill treehoppers, while GOTWALD (1968) shows that the number of individuals of *Vanduzea arquata* Say, 1830 decreases in winter, though he does not explain the cause of this populational decline.

Also, frosts in subtropical *cerrados* may indirectly alter the life cycle of the treehoppers, considering that the harm caused to the host plants can be severe (SILBERBAUER-GOTTSBERGER *et al.* 1977). During the weeks that immediately followed the frost at the RBMG, it was observed the occurrence of blackening and falling of the foliage of most of the plants. Though they might have suffered some harm due to the frost, some plant species did not loose leaves. Among these, the most prominent were the species of the families Asteraceae and Myrtaceae. SILBERBAUER-GOTTSBERGER *et al.* (1977) have classified as "mildly harmed" by frosts the plants of the family Myrtaceae, which were studied at a *cerrado* close to the city of Botucatu (São Paulo). From one and a half to two months after the frost almost all plants of the *cerrado* at the RBMG were sprouting anew.

Concerning the treehopper nymphs, the greater abundance occurred through December, 1980, and January, 1981, followed by a quick reduction during fall. After the frost in July, 1981, few plants exhibit nymphs and these frequencies were not the same as the preceding year, while the frequencies of adults were. One should note that some species of plants suffered severely the effects of the frost, only sprouting again after two months. Thus, through the months following the frost, in addition to a fewer number of adults, it seems that there were also less host plants suitable for oviposition and to sustain treehopper nymphs.

FUNKHOUSER (1917) and WOOD & PATTON (1971) suggest that most of the species of treehoppers living in temperate regions overwinter as eggs. In fact, many temperate treehoppers have life histories that are tightly coordenated with the phenology of their host plants (WOOD 1993). Hence, the treehoppers and their host plants are well adapted to survive severe adverse climatic conditions. This

situation is in contrast to what is known about tropical and subtropical treehoppers, which tend to breed throughout the whole year, or to endure the adverse seasons as adults (WOOD 1984, 1993).

CONCLUSIONS

The moderate degree of host specialization among the treehopper species suggests that the distribution of some of them reflects the distribution of suitable host plants in the *cerrado*.

There is neither strong evidence supporting seasonal differences in the richness of the treehoppers in the community studied, nor for significant differences in the composition of the community of treehoppers between winter and summer. These results argue against the idea of a seasonal specialization where the same or different resources are used by diverse species in the different seasons of the year. The results also suggest that adult individuals of the more characteristic species of the community are active throughout the year, apparently without depending on diapause or dormancy during the immature stages - particularly eggs - during the less favorable periods of the year.

There seems to be a specialization, or at least a preference, in the studied community of treehoppers, for certain families of host plants and, among these, for some specific species. That means that certain species of treehoppers can be found almost exclusively associated with one to a few species of plants, generally of the same botanical family. On the other hand, there are other non-specialist species of treehoppers that can be found on several plant species, almost always belonging to distinct families.

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