A FLOWERING CALENDAR OF PLANTS GROWING NEAR HIVES OF NATIVE BEES IN THE LOWER AMAZON REGION, PARÁ STATE, BRAZIL

Brezilya, Aşağı Amazon Bölgesi, Para Eyaletindeki Doğal Arı Kovanlarının Etrafında Yetişen Bitkilerin Çiçeklenme Takvimi

(Genişletilmiş Türkçe Özet Makalenin Sonunda Verilmiştir)

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ABSTRACT

We followed the flowering of 46 plant species growing near hives of native bees in the Lower Amazon region in Brazil during a complete year. The months with the largest numbers of flowering species were July, August, December and January. The study area contained many ruderal, ornamental, and edible fruit species, many of them typical of the Amazon region. According to our field observations, local meliponiculturists and palynological literature, species such as *Tachigalia* sp., *Tapirira guianensis* Aubl. and *Vismia guianensis* (Aubl.) Pers. are good examples of plants frequently visited by native bees in the Brazilian Amazon.

***Keywords*:** Bee Flora, Meliponiculture, Stingless Bee, Beekeeping, Phenology.

INTRODUCTION:

Bees have existed for more than 80 million years and have coevolved with flowering plant (Poinar Jr. and Danforth 2006, Michener 2007). According to Roubik (1995), more than one third of the world's flowering plants are pollinated by insects, and it is estimated that up to 90% of the angiosperms in certain areas of the Amazon region depend on pollination by stingless bees (Meliponinae) (Kerr et al. 2001). There are believed to be more than 100 species of native Meliponinae bees in the Amazon region (Silveira et al. 2002) that could be managed in rational manners to produce honey, pollen, propolis, colonies, wax, and for pollination services.

It is very important to know which plant species are used by a given bee species as the meliponiculturists can then position their colonies in sites closer to their preferred pastures or invest in cultivating those plants to increase honey production.

Venturieri (2004) observed that there were approximately 70 species of indigenous stingless bees in Pará State (PA), Brazil, although not all of them produced honey appropriate for human consumption. Belterra is one of the principal municipalities in western Pára State for meliponiculture, with constantly increasing numbers of hives and growing honey production (Ferreira and Rebello 2005, Lopes et al. 2005).

Brazilian ecosystems, including those of the Amazon basin, detain many characteristics favorable to beekeeping, such as warm climates, floras that are rich in species that produce nectar, pollen, and resins, flowering distributed throughout the entire year, and large numbers of native stingless bee species (Venturieri 2005). The occurrence of plant species with mass flowering and extensive areas with favorable climatic conditions are important considerations in designating sites with apicultural potential (Freitas and Silva 2006).

Studies that can contribute to our knowledge of the melliferous Amazonian flora and furnish useful information concerning the management of native bees will be fundamental to amplifying the production of honey and other bee products. Due to the general lack of studies focusing on the plants utilized by stingless bees in the Amazon region, and as a contribution to growing regional meliponiculture efforts in the Lower Amazon region, the present work sought to produce a flowering calendar for the plants potentially useful to commercially kept Meliponinae species in the municipality of Belterra, PA.

MATERIALS AND METHODS:

Monthly visits were made to Belterra, PA (02º38'07" S x 54º55'53.2" W) (Figure 1) between March/2011 and February/2012 in order to identify the species of flowering plants encountered near a stingless bee apiary (meliponary) installed near the headquarters of the Belterra Meliponiculturist Association (AMEMBEL). That is one of the most important meliponary in Belterra municipality.

Figure 1. Map showing Belterra municipality location in Pára State (PA), Brazilian Amazon.

The first phase of fieldwork involved non-directional excursions into the vegetation within a 2 km radius of the meliponary, accompanied by the president of the AMEMBEL Association to identify the plant species that would be observed on a monthly basis.

The survey initially considered the common names of the species as indicated by experienced meliponiculturists in the region – to facilitate the use of the information gathered in our study by the local meliponiculturists themselves. When the common name of a given species was not known, it was simply assigned its botanical identity. In addition to recording flowering data, specimens were collected and prepared for herbarium storage and floral buds were harvested to prepare reference slides to subsidize palynological studies of the honey produced by regional native bees.

Herbarium collections of the plant specimens collected in the area were prepared using traditional techniques (Mori et al. 1985) for analysis in the Laboratory of Taxonomic Botany (LABOT) at the Federal University of Western Pará (UFOPA), and will be subsequently deposited in the herbarium there.

RESULTS

A total of 46 plant species were collected and identified during the study period: 18 trees, 2 sub-

arboreal species, 8 shrubs, 13 sub-shrubs, 4 herbs, and 1 vine (Table 1). The months with the greatest numbers of flowering species were July (30), August (27), December (25) and January (25), while the months with the smallest numbers of flowering species were March (19), November (19), and September (20). The study area was occupied principally by ruderal species-growing in waste places or disturbed lands (e.g. *Commelina erecta* L., *Emilia fosbergii* Nicolson, *Sida spinosa* L. and *Spermacoce capitata* Ruiz & Pav.), ornamentals (e.g. *Bougainvillea glabra* Choisy, *Hibiscus rosa-sinensis* L., *Ixora* sp., *Lophanthera lactescens* Ducke and *Tecoma stans* (L.) Juss. ex Kunth), and edible fruit species (e.g. *Anacardium occidentale* L., *Astrocaryum aculeatum* G. Mey., *Bactris gasipaes* Kunth, *Bertholletia excelsa* Bonpl., *Byrsonima* sp., *Endopleura uchi* (Huber) Cuatrec., *Genipa americana* L., *Spondias mombin* L., *Syzygium malaccense* (L.) Merr. & L.M. Perry and *Theobroma grandiflorum* (Willd. ex Spreng.) K. Schum.). The local meliponiculturists reported that some of these species were heavily visited by stingless bees during their flowering periods, such as *Jacaranda* sp. (Bignoniaceae), *Vismia guianensis* (Aubl.) Pers. (Hypericaceae), *Tachigalia* sp. (Fabaceae), *Tapirira guianensis* Aubl. (Anacardiaceae), and *Myrcia* sp. (Myrtaceae). Our field observations have confirmed these data.

Table 1. Flowering calendar of plant species encountered near a meliponary in Belterra, Pára State, Brazil.

Common Name	Family	Plant Species	Habit	Flowering (Mar/2011 to Feb/2012)											
				M	A	M	J	J	A	S	O	N	D	J	F
acácia-manjo	Fabaceae	*Acacia mangium* Willd.	tree	+	+	+	+	+	+	-	-	-	-	+	+
apocinácea	Apocynaceae	*Allamanda cathartica* L.	shrub	+	+	+	+	-	+	+	-	-	+	+	+
Caju	Anacardiaceae	*Anacardium occidentale* L.	sub-arboreal	-	+	+	+	+	+	+	+	+	+	+	-
canela	Lauraceae	*Cinnamomum zeylanicum* Blume	shrub	-	-	-	-	+	+	-	+	-	+	-	-
capim	Commelinaceae	*Commelina erecta* L.	herb	+	+	+	+	+	+	+	+	-	+	+	+
castanha	Lecythidaceae	*Bertholletia excelsa* Bonpl.	tree	+	-	-	¨	-	-	-	-	-	+	-	-
culhão-de-bode	Apocynaceae	*Ambelania grandiflora* Huber	sub-shrub	-	+	-	-	+	+	+	+	+	+	+	+
cumaru	Fabaceae	*Dipteryx odorata* (Aubl.) Willd.	tree	-	-	+	-	-	-	+	-	-	-	-	-
cupuaçu	Malvaceae	*Theobroma grandiflorum* (Willd. ex Spreng.) K. Schum.	sub-arboreal	-	-	-	-	-	-	-	-	-	-	-	-
embaúba	Urticaceae	*Cecropia* sp.	tree	-	-	-	+	-	-	-	+	-	-	+	-
fabácea	Fabaceae	*Zornia* sp.	herb	+	+	+	+	+	-	-	-	+	+	-	+
gergelim	Pedaliaceae	*Sesamum orientale* L.	sub-shrub	+	+	-	-	-	+	-	+	+	+	-	+
girassol	Asteraceae	*Tithonia diversifolia* (Hemsl.) A.Gray	shrub	+	+	+	+	+	+	+	+	+	+	+	+
hibisco	Malvaceae	*Hibiscus rosa-sinensis* L.	sub-shrub	-	-	-	-	+	-	`	+	+	+	+	+
ingá-rabo-de-macaco	Fabaceae	*Inga* sp.	tree	-	-	-	+	+	-	+	+	-	-	-	-
ingá-xixica	Fabaceae	*Inga* cf. *heterophylla* Willd.	tree	-	-	-	¨	+	-	-	-	-	-	-	-
jacarandá	Bignoniaceae	*Jacaranda* sp.	tree	-	+	-	-	-	-	-	-	-	-	-	-
jambo	Myrtaceae	*Syzygium malaccense* (L.) Merr. & L.M. Perry	tree	-	-	+	+	-	-	-	-	-	-	+	-
jenipapo	Rubiaceae	*Genipa americana* L.	tree	-	-	-	-	-	-	-	-	-	-	-	-
Jucá	Fabaceae	*Caesalpinia ferrea* Mart.	tree	-	-	-	-	+	-	-	-	-	-	-	+
jurubeba sp. 1	Solanaceae	*Solanum paniculatum* L.	sub-shrub	-	+	+	+	+	+		+	+	+	+	+
jurubeba sp.2	Solanaceae	*Solanum* cf. *lycocarpum* A. St.-Hil.	sub-shrub	-	-	+	-	+	+	-	-	-	+	+	+
lacre	Hypericaceae	*Vismia guianensis* (Aubl.) Pers.	shrub	-	-	-	-	+	+	+	-	-	+	-	-
lamiácea	Lamiaceae	*Eriope* sp.	herb	+	+	+	+	+	+	-	-	+	+	+	+
lanterneira	Malpighiaceae	*Lophanthera lactescens* Ducke	shrub	+	+	+	+	+	+	+	+	+	+	+	+
malvácea	Malvaceae	*Urena lobata* L.	sub-shrub	+	+	+	+	+	-	+	+	+	+	+	+
manga	Anacardiaceae	*Mangifera indica* L.	tree	-	-	-	+	-	+	+	-	-	-	-	-

maracujá -do-mato	Passifloraceae	*Passiflora* sp.	vine	+	-	-	+	+	+	+	+	+	+	-	+
maria-fecha-a-porta	Fabaceae	*Mimosa* sp.	sub-shrub	-	+	+	+	+	-	-	-	-	-	+	+
melastomatácea	Melastomataceae	*Clidemia* sp.	sub-shrub	-	-	-	+	+	-	-	-	+	-	+	+
mini-ixora	Rubiaceae	*Ixora* sp.	sub-shrub	+	+	+	+	+	+	+	+	+	+	+	+
muruci	Malpighiaceae	*Byrsonima* sp.	shrub	+	+	+	-	+	+	+	+	+	+	+	+
ornamental	Bignoniaceae	*Tecoma stans* (L.) Juss. ex Kunth	sub-shrub	+	+	+	-	+	+	+	+	+	+	+	+
piqui	Caryocaraceae	*Caryocar brasiliense* Cambess.	tree	-	-	-	-	+	-	-	-	-	-	-	-
pupunha	Arecaceae	*Bactris gasipaes* Kunth	tree	-	-	-	-	-	-	-	-	-	-	-	-
relojoeiro	Rubiaceae	*Spermacoce capitata* Ruiz & Pav.	sub-shrub	+	+	+	+	+	+	-	+	+	+	+	+
tabaco-de-lagarta	Asteraceae	*Emilia fosbergii* Nicolson	herb	+	+	+	-	+	+	+	+	-	-	+	+
tachi	Fabaceae	*Tachigalia* sp.	tree	-	-	-	-	-	-	-	-	+	+	+	-
taperebá	Anacardiaceae	*Spondias mombin* L.	tree	+	-	-	-	-	-	-	+	-	-	-	-
tapiririca	Anacardiaceae	*Tapirira guianensis* Aubl.	tree	-	-	-	-	+	+	+	+	-	-	-	-
trepadeira	Nyctaginaceae	*Bougainvillea glabra* Choisy	sub-shrub	+	+	+	+	+	+	+	+	+	+	+	-
tucumã	Arecaceae	*Astrocaryum aculeatum* G. Mey.	tree	-	-	-	-	-	+	-	-	-	-	-	-
uchi	Humiriaceae	*Endopleura uchi* (Huber) Cuatrec.	tree	-	-	-	+	-	+	+	+	-	-	-	-
urucum	Bixaceae	*Bixa orellana* L.	shrub	-	-	+	-	+	+	-	-	-	-	-	+
vassoura	Myrtaceae	*Myrcia* sp.	shrub	-	-	-	-	-	+	+	+	-	+	+	-
vassoura-da-bahia	Malvaceae	*Sida spinosa* L.	sub-shrub	+	+	+	+	+	+	-	-	+	+	+	+

Three species were observed flowering during all of the monthly visits: *Tithonia diversifolia* (Hemsl.) A.Gray (Asteraceae), *L.lactescens* (Malpighiaceae) and *Ixora* sp. (Rubiaceae). Also three species were not observed flowering at any time during the study period (*B. gasipaes*, *G. americana* and *T. grandiflorum*) although it is possible that some of these species flowered during the intervals between our field trips.

Figure 2. Detail of artificial beehives used by stingless bee species being managed in the Brazilian Amazon (Belterra, Pára State, Brazil.

The months between September and December had the largest number of species with flowering percentages above 50%, and it is important to note that these months correspond to the principal period of honey production in the region.

Thirteen different native bee species are presently being managed in the study region (Figure 2). Beehives are commonly placed near trees such as *A. occidentale* (Anacardiaceae) and *Inga* spp. (Fabaceae), which provided them with shade.

DISCUSSION

Some plant species studied in this work have been cited as important to bees. Pollen types identified with species such as *T. guianensis* and *V. guianensis* have been encountered in palynological analyses of stingless bees products from the Amazon region (Absy et al. 1980, Marques-Souza 1996, Oliveira et al. 2009, Rech and Absy 2011).

Also *B. gasipaes*, *G. americana*, *S. mombin*, *Myrcia* sp., *Syzygium* sp. and *T. guianensis* pollen types

were found by Marques-Souza et al. (2007) among the pollen collected by *Scaptotrigona fulvicutis* Moure, 1964 in the Brazilian Central Amazon. Meanwhile, analyzing pollen stored by 24 stingless bees species in the Middle Amazon region, Absy et al. (1984) noticed some plants also studied in our work, such as *B. gasipaes*, *B. excelsa*, *Byrsonima* sp., *Inga* spp., *Solanum* spp., *S. mombin*, *Syzygium* sp., *T. guianensis* and *V. guianensis*. For honeys of *Melipona fasciculata* Smith, 1854 from an Amazonian region in Maranhão State, Martins et al. (2011) found pollen types from *Anacardium* sp., *Myrcia* spp., *Solanum* spp., *Spermacoce* sp. and *T. guianensis*.

Asteraceae, Malpighiaceae and Rubiaceae have frequently been cited in palynological studies as being important to different bee species (Novais et al. 2010, D'Apólito et al. 2010, Rech and Absy 2011).

Species with intense flowering (e.g., *Mimosa* spp.) are important for maintaining large numbers of bees, especially during times of climatic adversity (Freitas and Silva 2006). Also species providing beehives with shade is a condition considered extremely important for colony development (Freitas and Silva 2006, Lopes et al. 2008, 2011).

CONCLUSION

The municipality of Belterra has a diversified flora where flowering is distributed satisfactorily throughout the year – which helps sustain many native bee species. Ornamental and ruderal plants appear to be important to bees, especially native species occupying hives located near residences and/or urban areas, and future melissopalynological studies are expected to corroborate this supposition.

Acknowledgments

The authors would like to thank the president of the AMEMBEL Association, Mr. Geancarlo Vidal, for allowing us access to the study area and for his valuable contribution to our field work; Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for awarding an Iniciação Científica Júnior grant to the second author while studying at the Escola Estadual de Ensino Fundamental e Médio Pedro Álvares Cabral; Prof. M.Sc. Chieno Suemitsu and the students of LABOT/UFOPA for their help with botanical questions.

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GENİŞLETİLMİŞ ÖZET

AMAÇ: Amazon bölgesindeki iğnesiz arıların kullandığı bitki türleri üzerindeki çalışmaların yetersiz olması ve Aşağı Amazon Bölgesindeki bölgesel büyüyen meliponikültüre (iğnesiz arıcılık uygulaması) katkı için bu çalışma ile Brezilya Para Eyaleti (PA) Belterra belediyesi bölgesinde ticari amaç için tutulan iğnesiz arı türlerine yararlı olası bitkilerin çiçeklenme takvimi yapılmaya çalışılmıştır.

MATERYAL ve METOT: Belterra Meliponikültür Birliği (AMEMBEL)'nin merkezi yakınlarında kurulan iğnesiz arı arılığı (meliponari) yakınlarında karşılaşılan bitki türlerini teşhiş için 2011 mart ve 2012 şubat arasında Belterra, PA'ya aylık ziyaretler yapılmıştır. Arazi çalışmaları aylık periyotta gözlenen bitki türlerini teşhis etmek için arılık etrafında yarıçapı 2 km'lik yeşil alana yapılan yönlendirmesiz gezileri içermektedir. Çiçeklenme veri kayıtlarına ek olarak, örnekler toplanmış ve herbaryum materyalı olarak hazırlanmış ve çiçek budları toplanmış ve bölgesel doğal arılar tarafından üretilmiş balın palinolojik çalışmaları için referans örnekler hazırlanmıştır.

BULGULAR: Çalışma süresi boyunca toplam 46 bitki türü tanımlanmıştır: 18 ağaç, 2 ağaç-altı, 8 çalı, 13 çalı-altı, 4 otsu ve 1 sarmaşık (Tablo 1). En fazla sayıda çiçek açan türün bulunduğu aylar Temmuz (30), Ağustos (27) ve Ocak (25) olmasına rağmen en az sayıda çiçek açan tür Mart (19), Kasım (19) ve Eylül (20) olarak bulunmuştur. Alan genellikle verimsiz topraklarda–atık alanlarında ya da bozuk alanlarda büyüyen (örneğin, dekoratifler (örneğin *Bougainvillea glabra* Choisy, *Hibiscus rosa-sinensis* L., *Ixora* sp., *Lophanthera lactescens* Ducke ve *Tecoma stans* (L.) Juss. ex Kunth), ve yenilebilen türler (örneğin *Anacardium occidentale* L., *Astrocaryum aculeatum* G. Mey., *Bactris gasipaes* Kunth, *Bertholletia excelsa* Bonpl., *Byrsonima* sp., *Endopleura uchi* (Huber) Cuatrec., *Genipa americana* L., *Spondias mombin* L., *Syzygium malaccense* (L.) Merr. & L.M. Perry ve *Theobroma grandiflorum* (Willd. ex Spreng.) K. Schum, türler ile kaplıdır. Amazon bölgesindeki iğnesiz arılardan elde edilen ürünlerde yapılan palinolojik analizlerde *Tapirira guianensis* Aubl. (Anacardiaceae) ve *Vismia guianensis* (Aubl.) Pers. (Hypericaceae) bitki türü polenleri belirlenmiştir. Eylül ve Aralık arasındaki zamanda en fazla türün çiçeklenme gösterdiği (%50) zamandır ve bu zamanın bölgede bal üretimi için en temel zamanlara denk gelmesi dikkat çekicidir. Çalışma alanı içinde 13 farklı iğnesiz arı türü arıcılıkta kullanılmaktadır. Arıkovanları *Anacardium occidentale* L. (Anacardiaceae) ve *Inga* spp. (Fabaceae) gibi ağaçların yakınına konulması çok yaygındır.

SONUÇ: Belterra belediyesi çiçeklenmesi bir yıl boyunca başarılı bir şekilde dağılan çok çeşitli bitki zenginliğine sahiptir ve bu bir çok doğal arı türünün devamlılığını sağlanmaktadır. Dekoratif ve verimzsiz topraklarda büyüyen türler, özellikle yerleşim alanların yakınlarında bulunan kovanları işgal eden doğal türler arılar için çok önemlidir ve gelecek melissopalinoplojik (iğnesiz arıcılık pollen analizler) çalışmaların bu varsayımı destekleyeceği beklenmektedir.

***Anahtar kelimeler*:** Arı Florası, Meliponikültür, İğnesiz arılar, Arıcılık, Fenoloji.