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OBSERVATIONS ON THE BIG BANG FLOWERING OF MICONIA MINUTIFLORA (MELASTOMATACEAE)

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Mori, Scott A. and John J. Pipoly (New York Botanical Garden, Bronx, NY 10458). Observations on the big bang flowering of *Miconia minutiflora* (Melastomataceae). Brittonia 36: 337–341. 1984.—Trees of *Miconia minutiflora* produced abundant flowers for only one to three days during mid-April 1983 in the vicinity of Saül, French Guiana. They attracted large numbers of at least 14 species of bees that collected nectar or pollen or both. Nectar production is uncommon in the Melastomataceae and not previously reported for *Miconia.* Peak bee activity at the trees was in the morning and by afternoon most visits were limited to those bees in search of remnant pollen, especially species of *Trigona.* As has been shown for other neotropical plants, heavy rains may trigger flowering in this species. It is suggested that the flowering system of *M. minutiflora* promotes outcrossing because of interactions among the numerous species of bees visiting the trees and because of inter-individual variation in nectar and pollen availability. Therefore, bees may fly to other trees instead of becoming satiated with nectar or pollen from a single tree.

Massive flowering for short periods in neotropical plants has now been documented for numerous species since Gentry (1974) named this the "big bang" flowering strategy. Although his original observations were on large-flowered species of Bignoniaceae, others have noted that smaller-flowered species may also possess the same phenology. Opler et al. (1976), Augspurger (1981, 1982), and Frankie and Haber (1983) have reported on a number of species with this flowering strategy and Bawa (1983) has discussed its evolutionary implications in relation to other flowering patterns.

In this paper, we report our observations on the big bang flowering of *Miconia minutiflora* (Bonpl.) DC. during mid-April 1983 near Saül, French Guiana.

Saül is located in the geographic center of French Guiana, South America. It is a small village of 52 inhabitants surrounded by relatively undisturbed lowland rain forest. Based on data from 1956 to 1975, the average annual precipitation is 2313 mm and there are two well-defined seasons, a dry one from August through November and a wet one from December through July (Paul, 1981). Temperature is relatively constant throughout the year with the daily fluctuation greater than the annual. In 1982, the average annual monthly temperature was 27.1°C and the average monthly minimum and maximum temperatures were 20.9°C and 31.5°C, respectively (data from the meteorological service of French Guiana which maintains a station at Saül). The difference between the longest and shortest days of the year is approximately 35 minutes (List, 1950).

Methods

On 12 April 1983 we were attracted to trees of *Miconia minutiflora* (*Mori & Pipoly 15622*) by the loud buzzing of many individuals of numerous species of bees visiting the newly opened flowers. For the next four days we visited each of five trees every half hour and counted the total number of bees, regardless of species, observed while circling their low and easily observable crowns. Other trees were marked and observed but detailed counts of their bee visitors were not made. In this way we obtained an index of relative bee activity by dividing the count in a given time interval by the total number of bees observed throughout the plant's flowering cycle (Fig. 1).

All species of bees visiting the flowers of *Miconia minutiflora* that were observed were captured. Nevertheless, additional species are to be expected as visitors to this plant.

Peak flower production was estimated by counting the number of open flowers in twenty inflorescence groups (defined as all of the flower-bearing axes at the end of a branch) from a single tree at peak flowering and by averaging two separate counts of the number of inflorescence groups on four separate trees at peak flowering. Flower production at peak flowering (the morning of the first day of bee activity) is the product of the average number of flowers per inflorescence group and the average number of inflorescence groups per tree.

Floral structure and size were obtained from flowers preserved in F.A.A. Vouchers for the plant and the bees are deposited at the New York Botanical Garden (NY), the latter in the collection of the senior author.

Results

Miconia minutiflora is a shrub or small tree, usually less than five meters tall, found in disturbed habitats throughout northern South America and southward to Brazil and Bolivia (Gleason, 1928).

The flowers of *Miconia minutiflora* are small. At anthesis their diameter does not exceed 2.5 mm. The calyx is fused into a cup that measures 1.5 mm long by 1.5 mm in diameter and has five inconspicuous apical teeth. The five white petals are reflexed whereas the ten white stamens are erect to somewhat spreading at anthesis. The ovary is half-superior. Its style, ca 4 mm long, supports the stigma at nearly the same level as the pores of the anthers.

Flower production is massive. The 20 inflorescence groups for which we counted flowers yielded an average of 723 $\pm$ 296 blooms (range 417–1786). Trees 1, 2, 4, and 11 produced 699, 645.5, 393.5, and 135 inflorescence groups which gives a range of 96,505 to 505,377 open flowers per tree at peak anthesis.

The flowers lasted for one day and by mid-afternoon bee visitors dislodged many petals on their visits. In addition, nectar production and odor appeared to be strongest in the morning, especially from 0730 to 1030. Little bee activity was registered before 0630 and by early afternoon activity had dropped to near zero (Fig. 1).

Although some trees produced at least some flowers for up to three days, the greatest floral production was always on the first day of flowering. Individual trees flowered in synchrony with others, e.g., trees 1 and 2, or out of synchrony, e.g., tree 5 (Fig. 1). Nevertheless, these and other trees in the same area mostly flowered within a two-week period during our five month stay at Saül. We do not know if the species flowered again after our departure.

Fourteen different species of bee were captured visiting the flowers of *M. minutiflora* (Table I). The bees collected nectar or pollen or both. *Xylocopa frontalis* made very fleeting morning visits to the flowers to collect nectar, whereas the species of *Trigona* tended to collect pollen later in the day. More detailed study is needed in order to determine what rewards the other species of bee collect and to determine if the bees have preferential visitation times.

Discussion

Individuals of *Miconia minutiflora* burst into anthesis overnight and only remain in flower for one to three days (Fig. 1). Flowering synchrony among trees prevails but is not absolute. This flowering phenology is similar to that reported by Augspurger (1981, 1982) for *Hybanthus prunifolius* (Schult.) Schulze (Violaceae). During this short time *M. minutiflora* attracts many individuals of at least

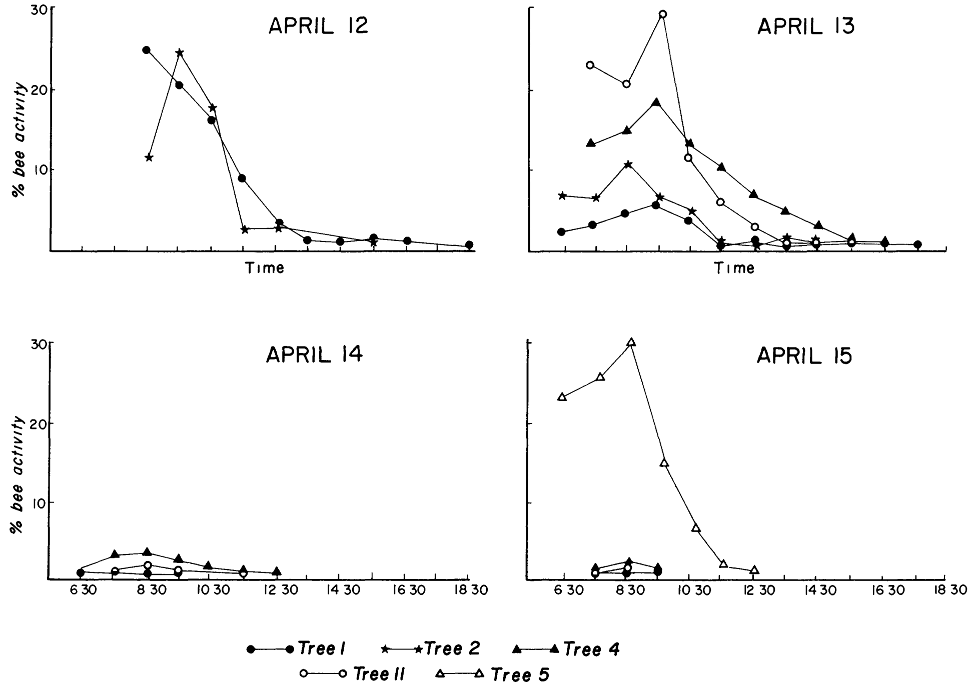

FIG. 1. Per cent of total bee activity observed each half-hour throughout the flowering cycle of five trees of *Miconia minutiflora.*

14 species of bee (Table I) that come to collect pollen and nectar. This contrasts with most species of Melastomataceae which typically produce no nectar and are therefore pollinated only by pollen-gathering bees (Renner, 1983). Nevertheless, nectar-producers are known in the Melastomataceae in the genera *Blakea* (Lumer, 1980), *Brachyotum,* and *Tibouchina* (sect. *Purpurella*) (Renner, 1983). Nectar production in *M. minutiflora* is sufficient enough to attract the very large *Xylocopa frontalis* which makes no attempt to gather pollen.

Flowering in some species of tropical plants is clearly triggered by heavy rains. Opler et al. (1976) have shown that rainfall, either directly or indirectly, is an important timing and spacing mechanism for the flowering of at least some species of tropical plants and Augspurger (1979, 1981, 1982) has experimentally demonstrated that flowering in *Hybanthus prunifolius* is triggered by the first heavy rains following the dry season. *Miconia minutiflora* appears to be another species in which flowering is induced by rain. In 1982–83, the months from September through February were dry with only four days during this period having rainfall greater than 20 mm. In March and April rainfall increased and heavy precipitation fell on the 7th (25.0 mm), 21st (65.9 mm), 22nd (33.1 mm), 31st (23.4 mm), 2nd (37.7 mm), 11th (31.2 mm), and 12th (54.2 mm). Although the heavy rains of 11–12 April probably triggered the 12–15 April flowering of *M. minutiflora* we observed, it is clear that other factors are involved; if only heavy rain were needed the downpours of 21–22 March should have induced flowering.

Transfer of pollen from one tree to another is probably important in the reproductive biology of *M. minutiflora.* Renner (1983), in her detailed study of pollination and reproductive systems in central Amazonian species of Melastomataceae, reports that this species is facultatively outcrossed as well as agamo-

TABLE I
SPECIES OF BEE COLLECTED ON *Miconia minutiflora*[a]

Halictidae	*Augochloropsis* sp. 1 (126–127)
	Augochloropsis sp. 2 (128)
Anthophoridae	*Epicharis flava* Friese (120)
	Exomalopsis sp. 1 (133)
	Xylocopa frontalis (Olivier) (161–162)
	Xylocopa sp. 1 (112)
Apidae	*Bombus cayennensis* Spinola (113–114, 182–188)
	Melipona captiosa Moure (125, 164–166, 171–173)
	M. compressipes interrupta Latreille (180)
	M. fuliginosa Lepeletier (115–119, 189)
	M. lateralis Erickson (121)
	M. rufiventris paraensis Ducke (122–124, 163, 174–175, 179, 190–191)
	Trigona (*Trigona*) *fulviventris guianae* Cockerell (135)
	Trigona sp. 1 (129–132, 176–178)

[a] Numbers in parentheses refer to the collection number in S. Mori's insect collection series.

spermous. However, she only observed *Augochloropis callichroa* (Cockerell), *Melipona* sp., and *Trigona* sp. visiting her study trees.

At Saül the big bang flowering strategy of *M. minutiflora,* with the concomitant attraction of numerous pollinators, appears to increase intertree movement of pollinators, and thereby outcrossing, as a result of interactions among the diverse bees attracted to the plant. These interactions take the form of attacks of one species of bee on another (Roubik, 1980) or may simply be displacement of bees as a result of overcrowding. We observed such encounters between different species and in some cases noted bees flying to nearby trees of the same species. Roubik (1980) has shown that aggressive interactions among French Guianan bees do occur and others (Frankie & Baker, 1974; Frankie, 1976; Gentry, 1978) have suggested that interactions among floral visitors account for some intertree pollinator movements.

Frankie and Haber (1983) have shown that nectar flow patterns vary within and between species of trees in the Costa Rican dry forest they studied. They hypothesize that differences in nectar quantity, quality, and availability among trees of the same species may be largely responsible for the movement of pollinators, especially bees, from one tree to another. The same reasoning can be extended to non-nectar producing plants. For example, Mori et al. (1981) have demonstrated phenological variability in five individuals of *Lecythis pisonis* Cambess. This species produces numerous, nectarless flowers for about a month (the "cornucopia" phenology of Gentry, 1974). Although it always blooms during the southern hemisphere's spring, there is never an exact overlap in the phenologies of individuals in the population. Our observations of *M. minutiflora* support Frankie and Haber's hypothesis (1983) as none of the five individuals studied had exactly the same phenological pattern (Fig. 1).

From the foregoing we conclude that pollinator movement among trees of *M. minutiflora* is promoted by variability in nectar and pollen production as well as by interactions among floral visitors, especially the numerous species and individuals of bees attracted to the plants.

There is still much to be learned about the phenology and floral biology of *M. minutiflora.* We hope that our initial observations will stimulate more detailed study of this species.

Acknowledgments

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Literature Cited

Augspurger, C. K. 1979. Irregular rain cues and the germination and seedling survival of a Panamanian shrub (*Hybanthus prunifolius*). Oecologia 44: 53–59.

———. 1981. Reproductive synchrony of a tropical shrub: experimental studies on effects of pollinators and seed predators on *Hybanthus prunifolius* (Violaceae). Ecology 62: 775–788.

———. 1982. A cue for synchronous flowering. Pages 133–150. *In:* E. G. Leigh, Jr., A. S. Rand & D. M. Windsor, editors. The ecology of a tropical forest: seasonal rhythms and long-term changes. Smithsonian Institution Press, Washington, D.C.

Bawa, K. S. 1983. Patterns of flowering in tropical plants. Pages 394–410. *In:* C. E. Jones & R. J. Little, editors. Handbook of experimental pollination biology. Scientific and Academic Editions, New York.

Frankie, G. W. 1976. Pollination of widely dispersed trees by animals in Central America, with an emphasis on bee pollination systems. Pages 151–159. *In:* J. Burley & B. T. Styles, editors. Variation, breeding and conservation of tropical forest trees. Academic Press, London.

——— & H. G. Baker. 1974. The importance of pollinator behavior in the reproductive biology of tropical trees. An. Inst. Biol. Univ. Nac. Auton. Mexico 45 (ser. Bot.): 1–10.

——— & W. A. Haber. 1983. Why bees move among mass-flowering neotropical trees. Pages 360–372. *In:* C. E. Jones & R. J. Little, editors. Handbook of experimental pollination biology. Scientific and Academic Editions, New York.

Gentry, A. 1974. Coevolutionary patterns in Central American Bignoniaceae. Ann. Missouri Bot. Gard. 61: 728–759.

———. 1978. Anti-pollinators for mass-flowering plants? Biotropica 10: 68–69.

Gleason, H. A. 1928. *Miconia minutiflora* and allied species. Bull. Torrey Bot. Club 55: 117–118.

List, R. J. 1950. Smithsonian meteorological tables, 6th ed. Smithsonian Institution, Washington, D.C.

Lumer, C. 1980. Rodent pollination of *Blakea* (Melastomataceae) in a Costa Rican forest. Brittonia 32: 512–517.

Mori, S. A., L. A. Mattos Silva & T. S. dos Santos. 1981. Observações sobre a fenologia e biologia floral de *Lecythis pisonis* Cambess. (Lecythidaceae). Revista Theobroma 10: 103–111.

Opler, P. A., G. W. Frankie & H. G. Baker. 1976. Rainfall as a factor in the release, timing, and synchronization of anthesis by tropical trees and shrubs. J. Biogeography 3: 231–236.

Paul, X. 1981. Annuaire statistique de la Guyane. Institut National de la Statistique et des Etudes Economiques, I.N.S.E.E. Service Interrégional Antilles Guyane.

Renner, S. S. 1983. Phänologie, Blütenbiologie und Rekombinationssysteme einiger zentralamazonischer Melastomataceen. Ph.D. dissertation, University of Hamburg, West Germany.

Roubik, D. W. 1980. Foraging behavior of competing africanized honeybees and stingless bees. Ecology 61: 836–845.

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