Ants Like Flower Nectar

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ABSTRACT

Janzen (1977) speculated that ants generally do not feed on floral nectars in lowland tropical habitats because the nectars contain repugnant, indigestible, or toxic chemicals. We report numerous ant species taking floral nectar from 27 plant species in primarily a lowland dry forest habitat in Costa Rica. Floral nectar from 21 plants was readily accepted by ants in all but two cases. In these studies, some of the nectars were known to contain phenolic compounds and alkaloids. We find little evidence to support Janzen's speculation.

JANZEN (1977) stated that ants generally do not feed on floral nectar in lowland tropical habitats. He used lack of observations of ants visiting flowers as a premise to propose the hypothesis that floral nectars in general contain chemicals that make them unpalatable to ants. Baker and Baker (1978) pointed out that ants may, in fact, not be uncommon flower visitors, but they also noted that floral nectars frequently contain non-nutritive, potentially toxic compounds such as alkaloids, phenolics, and non-protein amino acids that may deter unwanted flower visitors. Feinsinger and Swarm (1978) found that ants readily fed on floral nectars of three of four plant species tested in Trinidad. They also cited seven species of hummingbird-pollinated plants whose flowers were visited by ants. Guerrant and Fiedler (1981) offered floral nectar of 25 plant species to foraging ants in wet and dry forests in Costa Rica, and found in general that the nectars were palatable. They also suggested that chemical and morphological modifications of the floral parts may provide protection from thievery by chewing insects.

During a 1976-1979 study of pollination systems in the lowland dry forest in northwestern Costa Rica (Frankie, Haber, Opler, and Bawa, in prep.) and elsewhere in Costa Rica, we frequently observed ants feeding on floral nectar. Thus, our experience is somewhat different from that of Janzen. We present information on flowers visited by ants for nectar; acceptability of various floral nectars to ants; and, responses of ants to potentially toxic compounds in nectar.

FLOWERS VISITED BY ANTS.—Ants were observed feeding on nectar of 27 species of flowers (table 1). The list contains examples of most pollination systems in the area: large bee, small bee, butterfly, hummingbird, small moth, sphingid, bat, and generalist. Some flowers had hidden nectar and some had exposed nectar; 14 species had flowers with shallow corollas that expose nectar to unspecialized visitors, including ants; 13 species had tubular corollas or other structures that hide the nectar. Ants were observed feeding in flowers at night as well as during the day (figs. 1 and 2).

TESTS OF NECTAR FED TO ANTS.—Because ants were not observed feeding on flowers of all species, palatability of nectars in these flowers was tested by either cutting the corolla of tubular flowers to allow ants access to nectar reservoirs, or removing nectar from flowers with micro-capillary tubes and placing droplets (about 2 μl in volume) on stems and branches of ant acacias where ants foraged. Nectars of 21 species were tested (table 2). In all but two species, ants consumed the nectar droplets in less than five minutes.

Nectar of *Caesalpinia pulcherrima*, which ants rejected, was hidden at the base of an extremely narrow tube formed from the flag petal. In cutting the tube to remove nectar, contaminants from broken flower tissue probably mixed with nectar and may have influenced its acceptance. Nectar of *Byrsonima crassifolia*, also rejected by ants in these tests, was a thick secretion of the calyx lobes which is high in lipids, low in sugar (Baker 1978). This liquid also contained alkaloids and phenolics. Nevertheless, ants were observed feeding naturally on this secretion (table 1).

Apart from *B. crassifolia*, nectars of the other four tested species with exposed floral nectars (table 2) were received favorably by ants. Yet it is these species that might be expected to have nectar with ant-repellant properties since structural defenses

TABLE 1. *Plant species visited by ants for nectar. Flowers have exposed (E) or hidden (H) nectar.* (LDF = Lowland dry forest, Guanacaste Prov., elevation 100-200 m, MEF = Mid-elevation forest, Puntarenas Prov., elevation 1400-1600 m.)

Plant species	Locality	Pollinators	Flower type	Ants taking nectar
Asclepias curassavica L. (Asclepiadaceae)	MEF	butterfly	H	*Monomorium floricola* (Jerdon) *Pheidole* sp.
Bauhinia ungulata L.[a] (Caesalpiniaceae)	LDF	bat	E	*Camponotus* sp.
Bromelia pinguin L. (Bromeliaceae)	LDF	hummingbird	H	*Ectatoma ruidum* Roger
Byrsonima crassifolia (L.) HBK[a, b] (Malpighiaceae)	LDF	bee	E	*Crematogaster* sp., and small red unidentified sp.
Calycophyllum candidissimum (Vahl.) DC (Rubiaceae)	LDF	generalist	H	not identified
Capparis indica (L.) Fawc. and Rendle (Capparidaceae)	LDF	sphingid	E	not identified
C. odoratissima Jacq.	LDF	small moth, beetle	E	not identified
Coccoloba caracasana Meisner (Polygonaceae)	LDF	small bee	E	*Camponotus* sp.
C. venosa L.	LDF	small bee, wasp	E	*Pseudomyrmex gracilis* (Fabricius)
Combretum farinosum HBK (Combretaceae)	LDF	hummingbird	E	*P. gracilis, Camponotus* sp.
Crataeva tapia L. (Capparidaceae)	LDF	bat	E	*Camponotus* sp.
Euphorbia pulcherrima Willd. (Euphorbiaceae)		butterfly	E	*Brachymyrmex* sp., *Myrmelachista* sp.
Godmania aesculifolia (HBK) Standl. (Bignoniaceae)	LDF	bee	H	*Paratrechina longicornis* (Latreille)
Hasseltia floribunda HBK (Flacourtiaceae)	MEF	small bee	E	*Myrmelachista* sp.
Helicteres guazumaefolia HBK[b] (Sterculiaceae)	LDF	hummingbird	H	4 spp. including *P. gracilis*
Hymenaea courbaril L,[a, b] (Caesalpiniaceae)	LDF	bat	E	*Camponotus abdominalis* (Fabricius), *Crematogaster* sp., *Pheidole* sp.
Inga vera Willd. (Mimosaceae)	LDF	bat, sphingid	H	not identified
Laetia thamnia L. (Flacourtiaceae)	LDF	bee	E	*Monomorium* sp.
Luehea seemannii Tr. and Pl. (Tiliaceae)	LDF	moth, bee	H	*Cryptocerus* sp.
L. speciosa Willd.	LDF	sphingid	H	*Crematogaster* sp.
Muntingia calabura (Sw.) DC (Elaeocarpaceae)	LDF	generalist	E	*Camponotus* sp.
Passiflora adenopoda (Passifloraceae)	MEF	bee	H	not identified
Perrottetia longistylis Rose (Celastraceae)	MEF	small bee?	E	*Camponotus* sp.
Psychotria carthagenensis Jacq. (Rubiaceae)		bee, butterfly	H	not identified
Stachytarpheta jamaicensis (L.) Vahl. (Verbenaceae)	MEF	butterfly, hummingbird	H	*Paratrechina longicornis*
Swietenia humilis Zucc. (Meliaceae)	LDF	moth, beetle	H	not identified

[a]Nectar contains alkaloids.
[b]Nectar contains phenolic compounds.

TABLE 2. *Plants whose floral nectar was tested for palatability to ants. All but* Byrsonima crassifolia *and* Caesalpinia pulcherrima *were accepted. Nectar is designated as exposed (E) or hidden (H).* (LDF = Lowland dry forest, Guanacaste Prov., elevation 100-200 m, MEF = Mid-elevation forest, Puntarenas Prov., elevation 1400-1600 m.)

Plant species	Locality	Pollinators	Flower type	Ants tested
Anacardium excelsum (Bert. and Balb.) Skeels.[a, b] (Anacardiaceae)	LDF	bee	H	*Monomorium floricola*
Bourreria quirosii, Standl. (Boraginaceae)	LDF	hummingbird	H	*Pseudomyrmex belti* (Emery)
Byrsonima crassifolia (L.) HBK[a, b] (Malpighiaceae)	LDF	bee	E	*P. belti, P. ferruginea* (Fredrick Smith)

TABLE 2 (Continued)

Caesalpinia pulcherrima (L.) Swartz (Caesalpiniaceae)	LDF	butterfly	H	*Crematogaster* sp., *Camponotus* sp.
Cordia pringlei Robins (Boraginaceae)	LDF	butterfly	E	*P. belti*
Crescentia alata HBK[b] (Bignoniaceae)	LDF	bat	H	*P. belti, P. ferruginea*
Delonix regia (Bojer) Ref. (Caesalpiniaceae)	LDF	butterfly	H	*P. belti*
Erythroxylon havanense Jacq. (Erythroxylaceae)	LDF	bee	E	*P. ferruginea, Iridomyrmex* sp., *Solenopsis* sp.
Genipa americana HBK (Rubiaceae)	LDF	bee	H	*Camponotus* sp., *Crematogaster* sp.
Hippobroma longiflora (L.) G. Don (Lobeliaceae)	LDF	sphingid	H	*Camponotus* sp., *Monomorium floricola, Crematogaster* sp.
Hymenaea courbaril L,[a, b] (Caesalpiniaceae)	LDF	bat	E	*P. belti, P. ferruginea*
Inga vera Willd. (Mimosaceae)	LDF	bat, sphingid	H	*P. ferruginea*
Ipomoea carnea Jacq. (Convolvulaceae)	LDF	bee	H	*P. ferruginea, Solenopsis* sp.
Lindenia rivalis Benth. (Rubiaceae)	LDF	sphingid	H	*P. ferruginea*
Muntingia calabura (Swartz)DC[a] (Elaeocarpaceae)	LDF	generalist	E	*P. ferruginea*, one species not identified
Pithecellobium saman (Jacq.) Benth. (Mimosaceae)	LDF	sphingid	H	*Ectatoma ruidum*
Psychotria carthagenensis Jacq. Sml. (Rubiaceae)		bee, butterfly	H	*Camponotus* sp.
Stemmadenia obovata (Hook and Arn.) K. Schum. (Apocynaceae)	LDF	bee	H	*Camponotus* sp., *P. ferruginea*
Tabebuia ochracea (Cham.) Standl. (Bignoniaceae)	LDF	bee	H	*P. ferruginea, Iridomyrmex* sp., *Solenopsis* sp.
T. rosea[b] (Vertol.) DC	LDF	bee	H	*Camponotus* sp.
Thevetia ovata (Cav.) A.DC. (Apocynaceae)	LDH	bee	H	*Camponotus* sp., *P. ferruginea*

[a]Alkaloids in nectar.
[b]Phenolics in nectar.

FIGURE 1. *Camponotus* sp. visiting a flower of *Coccoloba caracasana.*

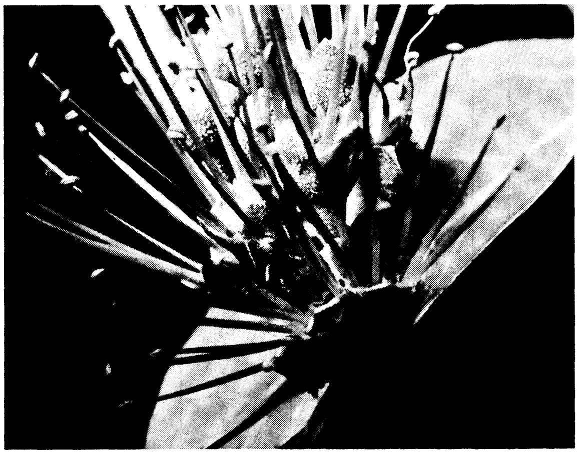

FIGURE 2. *Camponotus* sp. visiting a flower of *Combretum farinosum.*

against nectar thieves are lacking. Flowers with morphological features that prevent unspecialized visitors from reaching nectar may be less likely to contain chemical defenses against ants (Feinsinger and Swarm 1978).

POTENTIALLY TOXIC COMPOUNDS IN NECTAR.—Nectars of the species listed in tables 1 and 2 were tested for presence of alkaloids and phenolics in the laboratory or in the field (Dragendorff's test for alkaloids, p-nitraniline test for phenolics). Four species in table 1 and seven in table 2 produced floral nectars containing alkaloids, phenolics, or both. These compounds in nectar apparently did not deter ants.

One individual of *Tabebuia rosea* produced nectar that contained high levels of phenolics compared with two nearby trees (Frankie *et al.* 1981). Despite the phenolics, ants consumed nectar from this tree. Numbers of anthophorid bees (pollinators of this species) were much lower on the tree with the most concentrated phenolics than the two individuals with weaker concentrations of the chemicals (Frankie *et al.* 1981). It is speculated that the phenolics may have deterred the natural pollinators of the tree, and not the ants. Flowers of *T. rosea* have long, campanulate tubes with a hair-filled constriction at the base, a form that effectively excludes ants. For this reason, we doubt that phenolics in nectar of *T. rosea* function as an ant repellant.

Non-protein amino acids in nectars could also serve as ant-deterrent chemicals (Baker and Baker 1978). However, Baker (1978) and Baker *et al.* (1978) found that non-protein amino acids are in general more abundant in extrafloral nectars than in floral nectars. Since extrafloral nectaries primarily attract ants as a defense of plants against herbivores (Bentley 1977), non-protein amino acids may not be important in repelling ants from floral nectar.

Feinsinger and Swarm (1978) reported that ants rejected nectar of *Hippobroma longiflora.* We tested nectar of *H. longiflora* from lowland Pacific and Atlantic populations and found that in each instance ants drank the nectar without hesitation. However, the corolla wall of the flowers is so delicate that it is difficult to remove nectar without it being contaminated by the copious white sap. According to L. D. Gomez (pers. comm.) the sap contains cardiac glycosides; however, we failed to get a positive reaction with the Kedde reagent (Stahl 1969) which is used for detecting such glycosides. If present, these could defend the plant against herbivores as well as nectar robbers. Guerrant and Fiedler (1981) tested nectar of *H. longiflora* from southeastern Costa Rica with results that parallel ours. When nectar samples were contaminated with sap from broken tissues, ants rejected the nectar.

Our results suggest that ants frequently and regularly feed on floral nectar in the lowlands of Costa Rica; that exposed nectars appear to be as acceptable to ants as are hidden nectars; and that the natural occurrence of potentially toxic compounds in floral nectar often does not inhibit nectar consumption by ants.

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