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Floral visitation by Chihuahuan Desert ants

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Introduction

Janzen (1977) hypothesized that the lack of observations of ants feeding on floral nectar in lowland tropical forest plants might be due to the presence of allelochemics in the nectar. Ants are generally considered as unreliable agents of pollination (Proctor and Yeo 1972, Hickman 1974, Faegeri and van der Pijl 1979). Thus, plants should limit nectar pilferage by ants to conserve nectar and promote pollination by offering it to more specific and/or long-ranging dispersal agents. In deserts, where both a favourable plant water balance, necessary for nectar production, and synchrony with the life cycles of their pollinators are extremely important, floral nectar pilferage by ants should be as energetically expensive, or more so, to desert plants as to their tropical counterparts. If so, do desert plants minimize nectar pilferage by ants by producing deterrent compounds in their nectar?

Experimental and observational tests with tropical lowland plant species and ants have generally rejected Janzen's (1977) hypothesis of deterrent chemicals in floral nectars (Feinsinger and Swarm 1978, Schubart and Anderson 1978, Baker and Baker 1978, Rico-Gray 1980, Guerrant and Fiedler 1981, Haber *et al.* 1981). Here we address the following two questions for desert plants: (1) do ants naturally visit desert flowers for floral nectar?, and (2) are floral nectars of desert plants repellent to ants?

Materials and methods

Observations of ants visiting floral nectars were made over a one year period (1978–1979) from weekly visits to the Jornada Experimental Range, 40 km north of Las Cruces, N.M. When ant visitation of flowers was encountered, flowers of the plant species visited were placed in a vial with 5 cc of distilled water, macerated, allowed to stand for 10 min., and agitated for 2–3 min., and then removed, leaving only a floral nectar solution. For large flowers, petals and sepals were removed prior to nectar extraction. Due to this methodology, the concentration of floral nectar undoubtedly varied greatly from species to species.

Bioessays were conducted by placing a drop of the floral nectar solution and a drop of distilled water, as a control, on opposite ends of a microscope slide. Slides were then placed near active colonies of ants, and were scored for feeding. Two hypotheses were then tested: (1) floral nectar solutions should be less preferred (repellent) than water controls; and, if false, then (2) floral nectar solutions should be taken at the same rate as water controls, i.e., that they would not be more attractive, or that the stimuli would be the water itself.

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Floral visitations and nectar acceptability of some Chihuahuan Desert plants by ants. Probability given is based on the binomial test (Siegel 1956).

Plant species	Ant visitors	Number of times with more ants on nectar	Number of times with more ants on water	Probability
ANACARDICEAE				
Rhus microphylla	*Myrmecocystus depilis*	19	6	0·007
CACTZCEAE				
Opuntia spp.	*Crematogaster* spp.	13	2	0·004
	Conomyrma insana	9	2	0·001
	Iridomyrmex pruinosum	9	3	0·073
ZYGOPHYLLACEAE				
Larrea tridentata	*Conomyrma bicolor*	10	9	0·500
	Solenopsis aurea	12	3	0·018
FABACEAE				
Prosopsis glandulosa	*Myrmecocystus mimicus*	11	4	0·059
	Conomyrma insana	18	7	0·022
	Solenopsis xyloni	8	2	0·011
	Formica perpilosa	18	7	0·022
Astragalus spp.	*Solenopsis aurea*	17	4	0·004
	Solenopsis krockowi	7	0	0·008
	Iridomyrmex pruinosum	9	2	0·033
	Conomyrma bicolor	15	2	0·001
BIGNONIACEAE				
Chilopsis linearis	*Myrmecocystus depilis*	21	4	0·001
	Myrmecocystus mimicus	12	2	0·006
	Conomyrma insana	15	3	0·004
	Crematogaster sp.	9	0	0·002
	Iridomyrmex pruinosum	14	2	0·002
	Solenopsis xyloni	18	5	0·005
AGAVACEAE				
Yucca baccata	*Solenopsis xyloni*	13	4	0·025
	Conomyrma bicolor	4	1	0·188
	Iridomyrmex pruinosum	10	3	0·046
	Myrmecocystus depilis	7	0	0·008
	Crematogaster sp.	8	3	0·046
Yucca elata	*Solenopsis aurea*	8	0	0·004
	Conomyrma insana	10	1	0·006
	Iridomyrmex pruinosum	6	0	0·016
	Crematogaster sp.	9	4	0·274
	Formica perpilosa	6	1	0·008
	Myrmecocystus mimicus	5	2	0·227
Dasylirion wheeleri	*Crematogaster* sp.	10	0	0·001
	Iridomyrmex pruinosum	12	2	0·006
	Conomyrma bicolor	11	3	0·029
	Myrmecocystus depilis	7	0	0·008

Results and discussion

The results of fields observations and experiments (see table), indicate that Chihuahuan Desert ants visit a wide array of species for floral nectar. Moreover, in no case was the first hypothesis (repellency) found to be validated. The second hypothesis (not attractive) was also rejected in the majority of cases.

The results of those studies on tropical plants listed in the introduction failed to document ant repellency in floral nectars, and we did not find desert plants to differ from tropical lowland plants. Perhaps in desert species, more than in tropical species, ants should be expected to consume nectar not only for carbohydrates, but also to maintain water balance (Whitford *et al.* 1975). In any case, nectar pilferage by ants may result in a drastic reduction of pollinization in desert flowers, as has been found for mesic milkweeds (Fritz and Morse 1981).

Whitford (1978) lists 4 species of obligate honeydew of exudate feeders of the 24 resident species of ants in the Chihuahuan Desert (16·7%). However, he also lists 9 species as being omnivores. Of these, species which use floral nectar are *Crematogaster* sp., 3 species of *Solenopsis*, 2 species of *Conomyrma*, *Iridomyrmex pruinosum* and *Formica perpilosa*. Thus, as many as 12 species (50%) of Chihuahuan Desert ants may depend upon floral nectar to some extent. Comparative data from other biomes would test whether desert ants depend more frequently upon floral nectar than ants from more productive, mesic habitats.

Summary

Janzen's (1977) hypothesis that ants do not feed on lowland tropical floral nectar is extended to desert flowers, and tested by field observations and experimentation. Based on our results, no evidence was found to suggest that nectar palatability to ants may be reduced by repugnant, indigestible, or toxic chemicals (Janzen 1977). Floral nectar may serve as an important carbohydrate and water source for desert ants.

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References

Baker, H. G., and Baker, I., 1978, Ants and flowers, *Biotropica*, 10, 80.

Faegri, K., and Van Der Pijl, L., 1979, *The principles of pollination biology*, Toronto: Pergamon Press.

Feinsinger, P., and Swarm, L. A., 1978, How common are ant-repellent nectars?, *Biotropica*, 10, 238–239.

Fritz, R. S., and Morse, D. H., 1981, Nectar parasitism of *Asclepias syriaca* by ants: effect on nectar levels, pollinia insertion, pollinaria removal and pod production, *Oecologia*, 50, 316–319.

Gilbrant, E. O., and Fiedler, P. L., 1981, Flower defences nectar pilferage by ants, *Biotropica*, 13, (Reproductive Botany Suppl.), 25–33.

Haber, W. A., Frankie, G. W., Baker, H. G., Baker, I., and Koptur, S., 1981, Ants and floral nectar, *Biotropica*, 13, 211–214.

Hickman, J., 1974, Pollination by ants: a low energy system, *Science*, 184, 1290–1292

Janzen, D. H., 1977, Why don't ants visit flowers?, *Biotropica*, 9, 252.

Proctor, M., and Yeo, P., 1973, *The pollination of flowers*, New York: Taplinger Publ. Co.

Rico-Gray, V., 1980, Ants and flowers, *Biotropica*, 12, 223–234.

Schuhart, H. O. R., and Anderson, A. B., 1978, Why don't ants visit flowers? A reply to D. H. Janzen, *Biotropica*, 10, 58–61.

Siegel, S., 1956, *Nonparametric statistics for the behavioural sciences*, New York: McGraw-Hill.

Whitford, W. G., 1978, Structure and seasonal activity of Chihuahua Desert ant communities, *Insectes Sociaux*, 25, 79–88.

Whitford, W. G., Kay, C. A., and Schumacher, A. M., 1975, Water loss in Chihuahuan Desert ants, *Physiological Zoology*, 48, 390–397.