LIPID CUES FOR SEED-CARRYING BY ANTS IN
*Hepatica americana*

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(Received August 5, 1987; accepted October 14, 1987)

**Abstract**—We investigated the chemical basis for ants carrying the seeds of *Hepatica americana*, an ant-dispersed plant of eastern North America. A laboratory bioassay of seed and elaiosome extracts was based on the distance test items were carried by *Pogonomyrmex rugosus*. Ants responded equally to isolated elaiosomes and to the diglyceride fraction. Diolein was a major component of the diglyceride fraction, which is consistent with a finding that 1,2-diolein releases seed-carrying by *Aphaenogaster rudis*. Ants' response to the free fatty acid fraction was less intense. Gas chromatography of the fatty acid fraction indicated that oleic acid was a primary component, and oleic acid is known to elicit necrophoric behavior. No evidence supports an earlier suggestion that ricinoleic acid stimulates seed-carrying behavior. Ants failed to respond to seeds from which elaiosomes were removed.

**Key Words**—Hymenoptera, Formicidae, *Pogonomyrmex*, *Hepatica americana*, ants, Ranunculaceae, diglyceride, elaiosome, myrmecochory, seed dispersal

**INTRODUCTION**

The dispersal of seeds by ants is a widespread phenomenon involving many taxa (Beattie, 1985). Many species of plants, especially forest herbs of mesic forests, are dispersed by ants that are not granivorous. In these systems, ants usually are attracted to external appendages on seeds called elaiosomes (Sernander, 1906). Elaiosomes have evolved independently in several plant taxa,
but generally elaiosomes are rich in lipids and carbohydrates (Bresinsky, 1963). Many species of ants that encounter elaiosomes quickly remove them (and the attached seeds) to nests, where the elaiosomes are fed to larvae. After elaiosomes are removed from seeds, the seeds may be scattered on refuse piles near ant nests or abandoned underground in the nest. The potential benefits to the plant include removal from parents with associated reduction of risks from parent–offspring competition or seed predation by rodents, and deposition in better microsites for germination and establishment (see Beattie, 1985, for a review).

Chemicals mediate the specific behavior of ants toward elaiosomes or any other potential food item (Wilson, 1971). Ants’ possible responses to seeds include ignoring it, eating the elaiosome in situ, carrying the seed directly to a nest refuse area, carrying the seed to a nest, and recruiting other workers to the seed depot. Specific chemical releasers are known for each of these reactions, although only a relatively small number of species have been evaluated (Bradsaw and Howse, 1984). The fate of a seed is related to whether the elaiosome elicits feeding, necrophoric behavior, foraging, or recruitment, each of which may have chemical releasers.

The two previous studies of ants’ response to elaiosomes disagree about the chemical that stimulates carrying behavior. Bresinsky (1963) identified ricinoleic acid as the primary stimulus for *Lasius fuliginosus* to carry elaiosomes of several plants, including *Viola odorata* (Violaceae). Marshall et al. (1979) found that the ant *Aphaenogaster rudis* did not respond to ricinoleic acid. Instead, they identified 1,2-diolein as the specific and only compound from *Viola odorata* elaiosomes that elicited carrying behavior.

Our study has two purposes. The first is to test whether the elaiosomes of *Hepatica americana* (Ranunculaceae) contain factors to elicit seed-carrying behavior and identify the active components. Second, we have modified the bioassay techniques reported by Marshall et al. (1979) to eliminate the need to define a complex behavioral index and the associated requirement of long periods of direct observation.

**METHODS AND MATERIALS**

*Organisms.* *Hepatica americana* is a spring-flowering, perennial herb, common in wooded habitats from Nova Scotia to northern Florida and west to Manitoba, Iowa, and Missouri. The flowers are without nectar, frequently opening before the last snows of spring, and seeds are produced through autogamy (Motten, 1982). Flowers in an outdoor experimental plot in Ohio produced an average of 9.7 seeds per flower (maximum = 20, N = 54). Seeds mature by late May and are dispersed by early June in Ohio and West Virginia.