

短 報(Note)

Seed dispersal of *Epigaea asiatica* (Ericaceae) by ants

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Abstract

The shrub genus *Epigaea* (Ericaceae) comprises only three species, of which one is distributed in North America, one in the Caucasus, and one in Japan. Seeds of the North American species, *E. repens* L., are dispersed by ants. Seed dispersal by ants has not been recorded from the family Ericaceae excluding *E. repens*. To ascertain whether ants disperse the seeds of the Japanese species, *E. asiatica* Maxim., we observed visitors to *E. asiatica* fruits in late May in a deciduous secondary forest in Kyoto, central Japan. Five species of ants visited the fruits of *E. asiatica*. We observed workers of the species *Aphaenogaster japonica* Forel carrying seeds with flesh, suggesting that *A. japonica* was a seed disperser of *E. asiatica*. However, *E. asiatica* may also be dispersed by animals other than ants, because the fleshy fruits, which have placental tissue that is distinctly sweet, may be attractive to birds or mammals.

Key words : *Aphaenogaster japonica*, *Epigaea asiatica*, myrmecochory, seed dispersers

Introduction

Seeds of many plants are dispersed by various animals, such as birds, mammals, and insects (Howe & Smallwood, 1982). Ants have been considered as important seed dispersers. Seed dispersal by ants is termed myrmecochory (e.g., Beattie, 1985). Myrmecochorous plants generally produce seeds with individual elaiosomes, which attract ants (e.g., Beattie, 1985). Myrmecochory has been described for many herbaceous species that flower in spring (reviewed by Nakanishi, 1988), including *Asarum* (Aristolochiaceae), *Corydalis*, *Chelidonium* (Papaveraceae), *Lamium* (Labiatae), *Viola* (Violaceae), *Trillium*, and *Erythronium* (Liliaceae).

The genus *Epigaea* (Ericaceae) comprises only three species: one is distributed in North America, one in the Caucasus, and one in Japan (Satake et al., 1981). The North American species, *Epigaea repens* L., is a sprawling shrub that grows in dry woodlands dominated by other species of Ericaceae (Clay, 1983). Clay (1983) observed ants carrying *E. repens* seeds, although seeds of *E. repens* do not have the elaiosomes. Seeds of *E. repens* are embedded in a sweet, jelly-like, placental tissue that fills the fruit, attracting ants. Such dispersal has not been recorded from the family Ericaceae excluding *E. repens*. Seed dispersal by ants is therefore also expected in the Japanese species, *Epigaea asiatica* Maxim., which is quite similar to *E. repens* in morphological respects (Clay,

1983). To determine whether ants disperse the seeds of *E. asiatica*, we observed visitors to fruits of this species in a deciduous secondary forest in Kyoto, central Japan.

Materials and methods

Observations were conducted in a temperate secondary forest at the Kamigamo Experimental Forest Station of Kyoto University (35°04' N, 135°46' E, ca. 150 m above sea level) in Kyoto Prefecture, central Japan. This secondary forest was dominated by *Quercus serrata* Murray, *Chamaecyparis obtusa* (Sieb. et Zucc.) Endlicher, and *Ilex pedunculosa* Miq. Trees and shrubs were the main component plants (Osada et al., 2003). *E. asiatica* is a relatively rare shrub at the edges of secondary forests (comprising 3.3% of flowering/fruited trees; Osada et al., 2003). This species is a sprawling shrub that flowers from April to May, and its fruit matures from May to June (Kitamura & Murata, 1971). At the study site, *E. asiatica* flowers 20–60 mm above the ground from late March to early April (Photo 1a; Osada et al., 2003) and its fruit ripens in mid-May (Photo 1b,c); this is in contrast to most of the other fleshy-fruited species, whose fruits ripen in autumn (Sugiura, unpublished data). When mature, *E. asiatica* fruits begin to dehisce along five sutures, starting at the point of style attachment and proceeding downward (Photo 1b). The interior of *E. asiatica* fruit consists of hundreds of tiny brown seeds (ca. 0.5 mm

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in length) embedded in the surface of the sticky, white, placental tissue that fills the locules (Photo 1c; Kitamura & Murata, 1971). The placental tissue is succulent and has a distinctly sweet taste (Kitamura & Murata, 1971).

To determine whether ants disperse the seeds of *E. asiatica*, we observed fruit visitors on eight plants of *E. asiatica* on 21–26 May 2004. We randomly collected individual fruit visitors for identification. In addition, we observed the behavior of fruit visitors and measured the distance that seeds were carried from the plants. We used a digital camera (Coolpix995; Nikon, Tokyo, Japan) to record the fruit visitors and their behavior.

Results and discussion

On 21 May, we observed ant workers on four out of eight (50%) *E. asiatica* plants (Photo 1d–f) and collected five species of ants on *E. asiatica* fruits (Table 1). These ant workers visited and foraged for *E. asiatica* fruits (Photo 1d–f). We frequently observed workers of *Aphaenogaster japonica* Forel carrying pieces of fruit, including placental tissues with seeds (Photo 1g). Furthermore, we observed three workers of *A. japonica* carrying this material to their nest, which was located in the soil about 2.0 m from the plant, on 23 May. *A. japonica* is considered to be a typical seed disperser in Japan (Nakanishi, 1993). This species has been observed carrying the seeds of myrmecochorous *Trillium* species (Liliaceae) to its nest; although the elaiosomes are completely removed, the seeds themselves remain intact (Ohara & Higashi, 1987; Higashi et al., 1989; Nakanishi, 1993). The seed-dispersal distance (2.0 m) of *E. asiatica* by *A. japonica* did not differ from the average distance of myrmecochorous plants (Andersen, 1988; Ohara & Higashi, 1987). Few seeds remained on the plants after *A.*

japonica workers had foraged on *E. asiatica* fruits (Photo 1h), whereas many seeds remained after other small ants (e.g., *Monomorium intrudens* F. Smith, *Crematogaster osakensis* Forel, and *Paratrechina flavipes* F. Smith) had foraged. Although *Camponotus obscuripes* Mayr is large enough to carry the seeds, it was rarely observed to forage on *E. asiatica* plants (Table 1). Therefore, *A. japonica* was thought to be an important seed disperser in ants visiting *E. asiatica*.

Seed dispersal by ants may be common in *Epigaea* plants, since ants were observed to carry their seeds both in North America and in Japan. However, unlike other species known as myrmecochory, *Epigaea* plants do not produce seeds with individual elaiosomes. Clay (1983) suggested that the placental tissue of *Epigaea* fruits acts as an elaiosome in attracting ants. However, as Clay (1983) pointed out, the fleshy fruits, which have placental tissue that is distinctly sweet, may also be attractive to birds and rodents. Therefore, *Epigaea* plants appear to have multiple patterns of seed dispersal, i.e., by birds, mammals, and ants, which has also been observed in several other fleshy-fruited plant species that attract both vertebrates and ants (Kaufmann et al., 1991; Aronne & Wilcock, 1994). The relative significance of ants in the seed dispersal of *Epigaea* remains unclear, and further research is necessary.

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Table 1 Ant species visiting the fruits of *Epigaea asiatica*

Species	Individuals (%) N = 27	Body length (range: mm)
<i>Camponotus obscuripes</i> Mayr	3.7	12.0
<i>Paratrechina flavipes</i> (F. Smith)	25.9	1.7 - 2.2
<i>Crematogaster osakensis</i> Forel	18.5	2.2 - 2.9
<i>Monomorium intrudens</i> F. Smith	25.9	1.7
<i>Aphaenogaster japonica</i> Forel	25.9	4.1 - 5.2
Total	100.0	

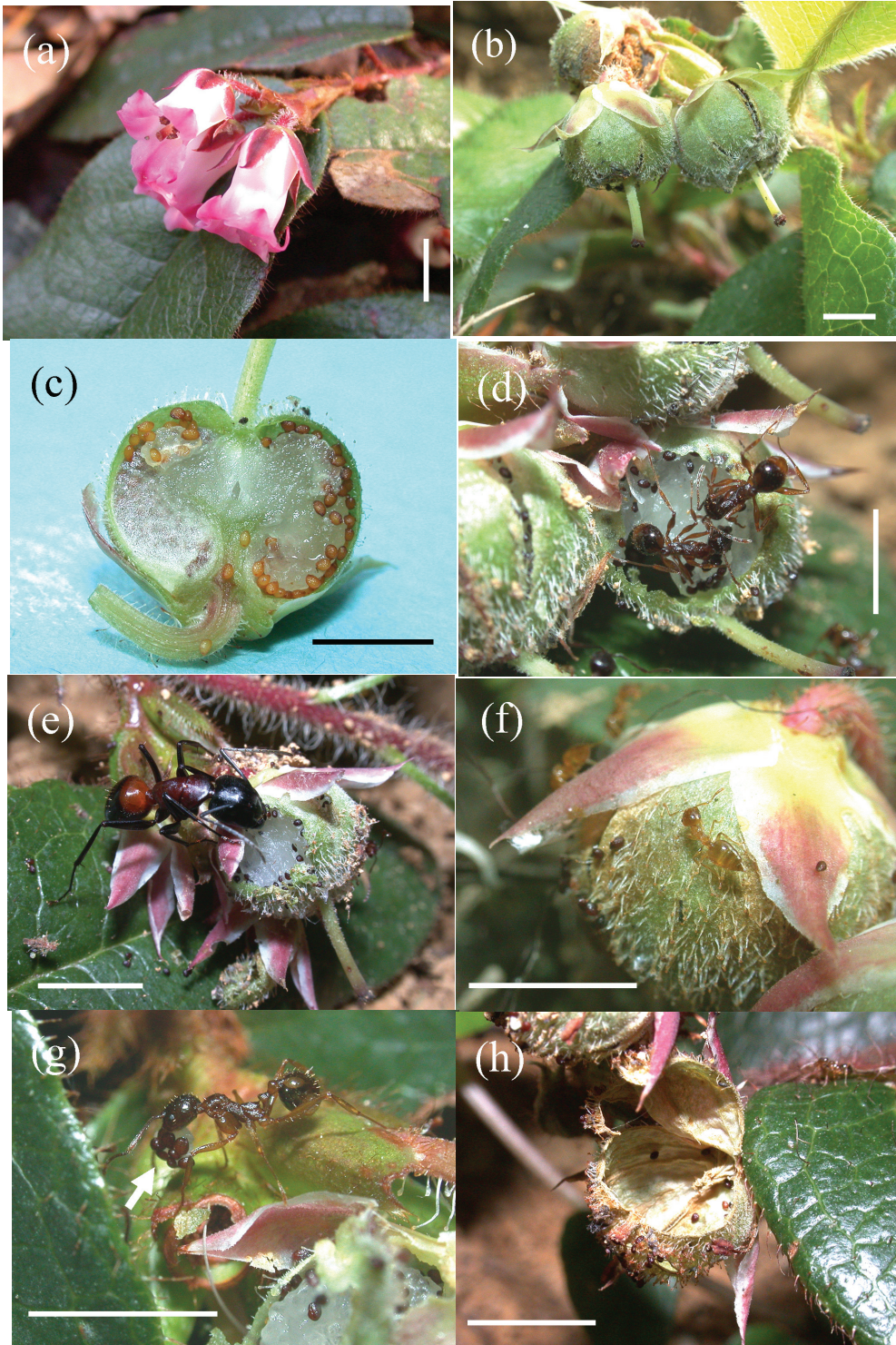


Photo1 Seed dispersal of *Epigaea asiatica*. (a) Flowers; (b) fruits; (c) longitudinal section of a fruit; (d) workers of *Aphaenogaster japonica* foraging on a fruit; (e) a worker of *Camponotus obscuripes* foraging on a fruit; (f) a worker of *Crematogaster osakensis* foraging on a fruit; (g) a worker of *A. japonica* carrying a piece of fruit with seeds (seeds are indicated by an arrow); (h) the remainder of the fruit after visitations by *A. japonica* workers. Scale bars: 5.0 mm.

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アリによるイワナシ（ツツジ科）の種子散布

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要旨

イワナシ属 *Epigaea* はわずか 3 種を含むツツジ科の小低木で、北米、コーカサス、日本にそれぞれ分布する。北米産アメリカイワナシ *E. repens* の種子はアリにより散布されることが知られている。ツツジ科の中でアリによって種子散布が行われる種は他に全く知られていない。日本産イワナシ *E. asiatica* の種子もアリによって散布されるかどうかを明らかにするために、2004 年 5 月に京都市郊外の二次林林床に生育するイワナシの果実訪問者を調査した。その結果、5 種のアリのワーカーがイワナシの果実を訪れ、果肉を摂食しているのを観察した。さらに、ヤマトアシナガアリ *Aphaenogaster japonica* のワーカーが果肉と一緒に種子を運んでいた。ヤマトアシナガアリは日本産アリ散布植物の散布者として、しばしば記録されている種類である。これは、日本産イワナシの種子もアリによって散布されていることを示唆している。しかし、イワナシの果肉のある甘い果実は、他の動物も誘引する可能性がある。

キーワード：アリ散布、イワナシ、動物被食散布、ヤマトアシナガアリ

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