

Odor of achlorophyllous plants' seeds drives seed-dispersing ants

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Abstract

Seed dispersal by ants is an important means of migration for plants. Although many 34 myrmecochorous plants have seeds containing elaiosome, a nutritional reward for ants, some 35 non-myrmecochorous seeds without elaiosomes are also dispersed by ant species. However, the 36 mechanism by which seeds without elaiosomes enable efficient dispersal by ants is scarcely 37 investigated. The seeds of the achlorophyllous and myco-heterotrophic herbaceous plant 38 *Monotropastrum humile* are very small without elaiosomes and require a fungal host for 39 germination and survival. We performed a bioassay using seeds of *M. humile* and the ant 40 *Nylanderia flavipes* to demonstrate ant-mediated seed dispersal. We also analyzed the volatile 41 odors emitted from *M. humile* seeds and conducted bioassays using dummy seeds coated with 42 seed volatiles. Although elaiosomes were absent from the *M. humile* seeds, the ants carried the 43 seeds to their nests. They also carried the dummy seeds coated with the seed volatile mixture to 44 the nest, and left some dummy seeds inside the nest and discarded the rest of the dummy seeds 45 outside the nest with a bias toward locations with moisture conditions, which might be 46 conducive to germination. We concluded that seeds of *M. humile* were dispersed by the ants, 47 and that seed odors were sufficient to induce directed dispersal even without elaiosomes. It is 48 probable that the fleshy fruit producing genus *Monotropastrum* evolved from the related 49 anemochorous genus *Monotropa*, which produces capsule fruit. This transformation from 50 anemochory to myrmecochory presents a novel evolutionary pathway toward ant-mediated seed 51 dispersal in an achlorophyllous plant.

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