

Parasitic plants rely on unusual method to spread their seeds

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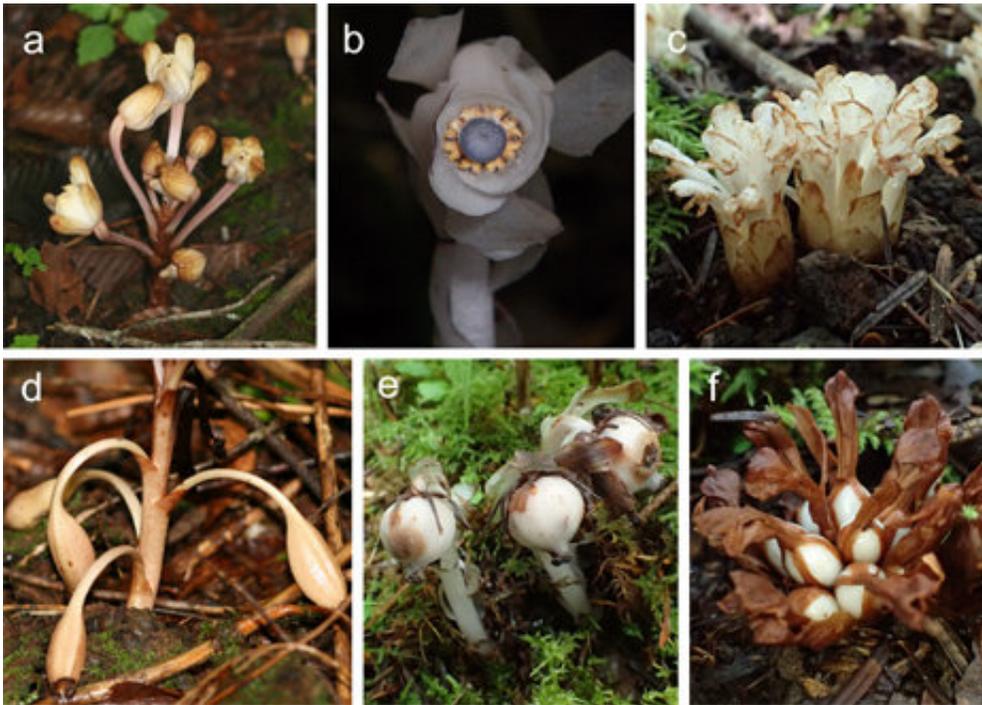


Figure 1: (a) flowers of *Yoania amagiensis*, (b) flowers of *Monopastrum humile*, (c) flowers of *Phacellanthus tubiflorus*, (d) fruit of *Y. amagiensis*, (e) fruit of *M. humile*, (f) fruit of *P. tubiflorus*. Credit: Kobe University

Three species of non-photosynthetic plants rely mainly on camel crickets to disperse their seeds, according to new research from Project Associate Professor Suetsugu Kenji (Kobe University Graduate School of Science). These findings were published on November 9 in the online edition of *New Phytologist*.

Most non-photosynthetic [plants](#) have very small seeds that can be dispersed by the wind like dust particles. However, some achlorophyllous plants grow in the dark understory of forests, and have abandoned the dependence on the wind for [seed](#) dispersal. In this study, Professor Suetsugu investigated the seed dispersal method for three such plants: *Yoania amagiensis*, *Monotropastrum humile* and *Phacellanthus tubiflorus*. He identified the camel cricket as their main seed disperser, the first evidence of camel crickets being used for seed dispersal in the flowering plants.

The most famous example of insect carriers is ants, but the ants do not eat the seeds: they carry them to their nests in their mandibles. Insects who carry seeds by eating them are very rare. One example is the New Zealand weta, but this is a special case: normally this role would be taken by mammals, but in New Zealand the only native mammals are bats.

Professor Suetsugu's study was carried out in Fuji city, Shizuoka, where they investigated the seed dispersal methods for three [species](#) of non-photosynthesizing plant (figure 1). They found that birds and mammals, usually responsible for carrying these seeds, showed no interest in the fruits of these plants. Meanwhile, invertebrates, especially the camel crickets regularly ate the fruits (figure 3). However, eating the fruits is different from being a carrier – the seeds must also be preserved unharmed in the excrement. The researcher captured camel crickets, checked whether they were excreting the seeds whole, and found many intact seeds.

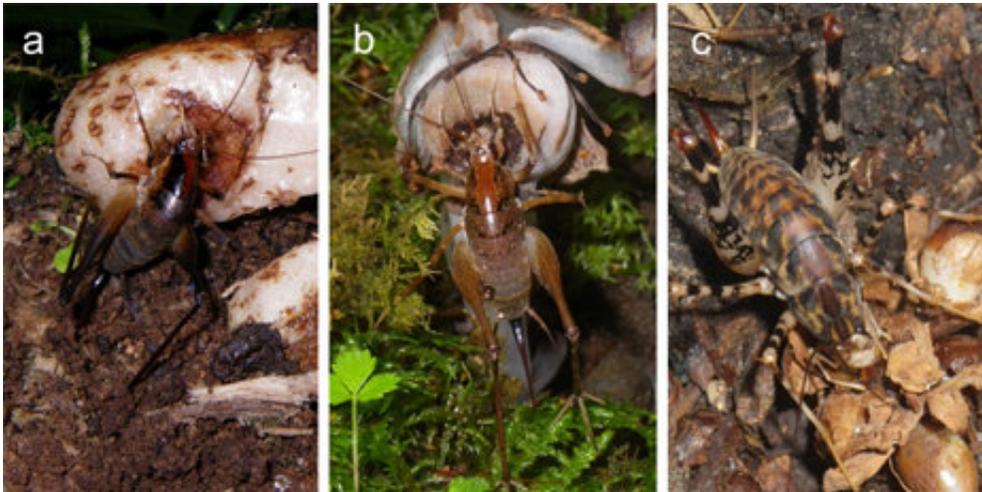


Figure 2: *Tachycineta elegantissima* feeding on (a) *Y. amagiensis* fruit and (b) *M. humile* fruit (c) *Diestrammena japonica* feeding on *P. tubiflorus* fruit. Credit: Kobe University

The three species of plants surveyed (*Y. amagiensis*, *M. humile* and *P. tubiflorus*) are all non-photosynthesizing species. They can survive in a pitch-black habitat, and are mainly found in the forest floor beyond the reach of sunlight. The habitat of the three species surveyed this time has very limited wind flow, so the plants needed to develop [fruit](#) and rely on animal carriers. However, these parasitic plant species do not have resources to spare, so they cannot create attractive fruits full of nutrients that would appeal to birds and mammals. The next best option was to use wandering insects who would eat low-quality fruits. (In fact, the Japanese field mouse, a popular seed carrier, noticed these fruits, but it did not try to eat them.)

Insects have not been considered as internal seed carriers before because due to the small size of their bodies and mandibles, it was thought that they chewed up the seeds. However, the seeds of non-photosynthesizing plants are extremely small, so they can pass through the digestive system unharmed (figure 3).

Y. amagiensis, *M. humile* and *P. tubiflorus* belong respectively to the Ericaceae family, the Orchidaceae family and the Orobanchaceae family. They are very different species, and they each abandoned photosynthesis as part of their independent evolutionary patterns. In other words, three unrelated non-photosynthesizing plants have independently developed to rely on insect carriers for [seed dispersal](#). This suggests that the evolutionary step of giving up photosynthesis (and the characteristics that accompany it – small seed sizes, the move to a dark forest floor with ineffective wind dispersal) have allowed them to occupy a unique biological niche.

These findings show that the evolutionary step of loss of photosynthesis is not simply a loss of functions through loss of chloroplast: it dramatically changes the plant's relationship with other organisms. By continuing to study plants that do not photosynthesize, we plan to clarify the changes that took place during the process of making the extreme choice to give up photosynthesis.

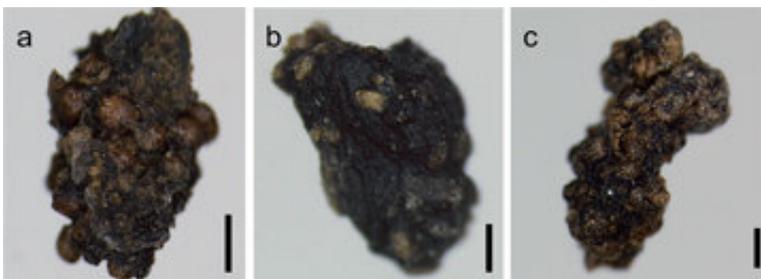


Figure 3: Feces of camel crickets. Many small seeds are excreted intact. The bar is 0.5mm. (a) *Y. amagiensis*, (b) *M. humile* and (c) *P. tubiflorus*. Credit: Kobe University

More information: Kenji Suetsugu. Independent recruitment of a

novel seed dispersal system by camel crickets in achlorophyllous plants,
New Phytologist (2017). [DOI: 10.1111/nph.14859](https://doi.org/10.1111/nph.14859)

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