

Ant farmers boost plant nutrition

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Domatium sections showing the warts, the hyper-absorbent structures, that evolved in farmed ant-plants on which ants defecate. Credit: University of Oxford

Humans began cultivating crops about 12,000 years ago. Ants have been at it rather longer. Leafcutter ants, the best-known insect farmers, belong to a lineage of insects that have been running fungus farms based on

chopped-up vegetable matter for over 50 million years. The ant farming of flowering plants, however, started more recently, about 3 million years ago in the Fiji Islands.

Research, led by Dr. Guillaume Chomicki from the Department of Plant Sciences, University of Oxford, has demonstrated that millions of years of ant agriculture has remodelled [plant physiology](#). Farming ants deposit nitrogen-rich faeces directly inside [plants](#), which has led to the evolution of these ultra-absorptive plant structures. This means that ant-derived nutrients are actively targeted on the hyper-absorptive sites, rather than deposited as a result of by-products. This new understanding may offer important clues in our fight for food security.

Dr. Chomicki, the lead author of the study, says: "The speed at which plants can take up nitrogen is a key limitation to plant growth rate. Most plants, including our crops, take up nitrogen from the soil and are thus not naturally exposed to very high nitrogen concentrations. Here, for millions of years, ants have deposited nitrogen-rich faeces directly inside the plants." Ongoing work aims to decipher the genetic basis of the ultra-absorptive plant structures discovered in this study, which may ultimately be transferred to our crops and thereby increase their nitrogen uptake rate.

It's a unique kind of farming where the ants grow not only their food, but also their home: the plants provide ready-made cavities in which the ants nest. This relationship is essential for both parties: the ants have lost the nest-building ability that most other tropical tree-dwelling ants have, and the plants—which are epiphytes (plants growing on the surface of trees) - rely on ants for nutrients and defence.

To test whether the ant-farmed plants' nutrition has itself changed, Chomicki tracked the deposition of nutrients by ants inside these Fiji-island plants. In the farmed plant species, specialized ants exclusively

defecate on hyper-absorptive warts on the walls inside the plant. In closely-related non-farmed [plant species](#) living in the same Fijian rainforests, the ants do not show this farming behaviour. This research shows that similar hyper-absorptive warts have evolved repeatedly in plants colonized by farming ants.

The research published today in *New Phytologist*, reveals that because insect farmers supply their crops with nutrients, they have the potential to modify crop nutrition, and in the case of ants, this has led to evolutionary changes in both partners; the ants and the plants.

Professor Renner, from the University of Munich, and senior author of the study, said: "Domestication of plants by ants has led to a >2-fold increase in uptake of ant-derived nitrogen, and this tight [nutrient](#) recycling is a key asset for the epiphytes to live in soilless canopies."

This supports the notion that millions of years of ant agriculture have remodelled plant physiology, shifting from ant-derived nutrients as by-products to active and targeted fertilization on hyper-absorptive sites. Much like our emerging 'precision agriculture' where computer-controlled devices and drones are used to target nutrients to the spots in the field where they are most needed, these [ants](#) have evolved a special kind of precision farming. They target nutrients to specific tissues in the plants that are hyper-absorptive.

More information: *New Phytologist* (2019).
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