Farming fungi in a new Azteca ant colony

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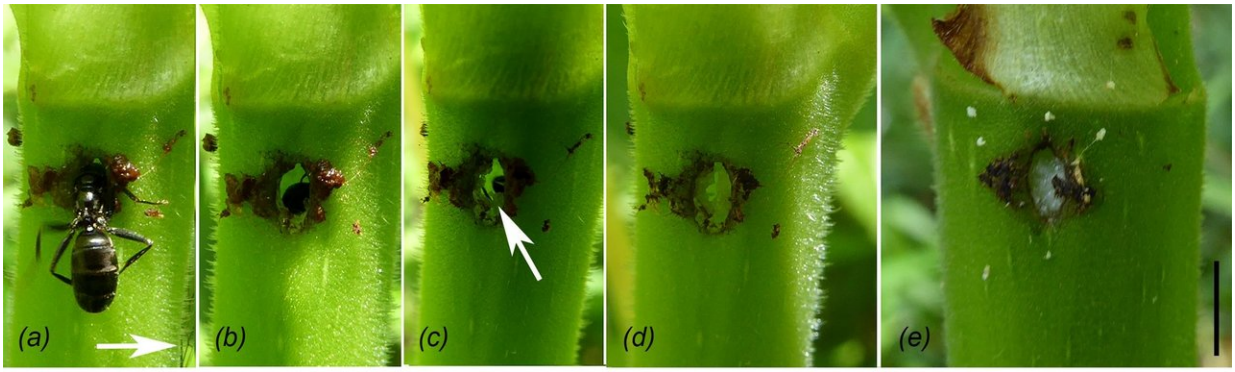
Moving to a new home is usually accompanied with a long to-do list, from painting the walls to unpacking boxes. For young queen Azteca ants however, one important job is to start growing fungus. Many tropical ant species are famous for their mutualistic relationship with fungi, carefully cultivating and farming different fungi species to use as food or building materials or even to trap prey. However, when and how the fungiculture is started is still a mystery. Do new queens culture fungi that just happen to be around in their new home at the time of colonization? And how soon after their arrival do queens start flexing

their agriculture prowess? To answer these questions, Veronika Mayer from the University of Vienna and some of her colleagues set off to the tropics of Costa Rica in the hunt of young Cecropia plants that make ideal new homes for young queen ants.

In total they sampled 64 plants finding 212 foundress queens at various stages of colonizing small chambers within the plant stem. In two instances, the researchers were lucky enough to catch the colonization process from start to finish. They watched as the young queens bored their way into the hollow stem of the Ceropia trees and then scrap away the white parenchyma lining the stems to plug the hole. In addition to using the parenchyma to patch up the hole, the team also observed the queens carefully amassing little piles of parenchyma within the cavity itself.

To see if these piles contained fungus and if so, what type of fungus, the researchers collected 52 samples of the parenchyma to look for traces of fungal hyphen and to extract DNA. They found that fungus was only present in parenchyma samples taken from chambers where a queen was also present. Unfortunately, the researchers couldn't trace foundress ants back to their mother colonies to directly compare the fungal species but they were able to compare DNA sequences obtained from new colonies to DNA sequences obtained from a sample of established colonies. The team found a great deal of overlap between the two, suggesting that the new queens used very similar fungal species as used as in established colonies. Given the similarity with established colonies and the fact the fungi found only represent a small percent of all fungi species, it seems likely that fungi are transported in some way by queens from their mother colony. When Mayer and her colleagues examined the contents of the infrabuccal cavity of four foundress ants they also found traces of fungal spores and hyphens. Like a hamster, it's possible that these ants can squirrel away and transport fungal elements that could be useful for setting up a little fungi farm.



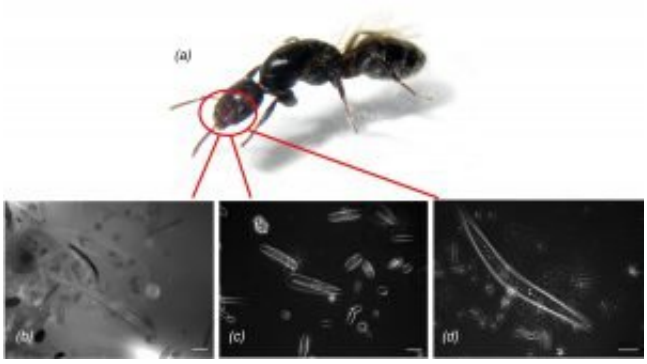
Azteca ant caught in the process of colonizing a Ceropia plant.

Next, the researchers labelled the fungiculture patches with 15N isotope to trace who exactly was eating the fungal crop. Interestingly, the team didn't find any trace of 15N in the foundress queens but they did find an accumulation of 15N in the larvae of future worker ants. It seems that queens aren't directly profiting from their farming skills but are using the fungal food to feed their future workforce instead. Setting up a new colony is a dangerous experience for foundress queens as it requires a lot of energy. Without her workers, the queen herself has no way to replace her energy and risks her own death, so making sure her larvae are well fed to support their growth and development is a high priority for any new queen.

Overall the team's observations have helped unravel the mystery behind fungiculture in Azteca ants. Their research suggests that fungal growth doesn't occur serendipitously from fungal spores or hyphen already present in the plant cavity, but because foundress ants bring fungi with them from their home nest. The fact that new queens start stockpiling parenchyma straight away is testament to fungiculture's importance in the colony's survival. So, next time you're moving house and bemoaning

your to-do list, spare a thought for the Azteca ant farming away to ensure her survival, when you can just order a take-away pizza.

Piling up parenchyma in the cavity of the Cecropia plants (panels A & B) Evidence of fungus (panels B, D & C)



Evidence of fungal spores and hyphen from the infrabuccal cavity of foundress queen Azteca ants

More information: Veronika E. Mayer et al. Transmission of fungal partners to incipient Cecropia-tree ant colonies, *PLOS ONE* (2018). DOI:

10.1371/journal.pone.0192207 Veronika E. Mayer et al. Transmission of fungal partners to incipient Cecropia-tree ant colonies, *PLOS ONE* (2018). DOI: 10.1371/journal.pone.0192207