

Subterranean farmers

Ants invented agriculture some 50 million years before the humans

ONE of the most important chapters in the story of human development began 10,000 years ago, when human beings, through trial and error, discovered agriculture. A steady supply of food brought them security and stability, and soon our primitive forefathers abandoned their nomadic, chaotic life to settle down.

Since then, agriculture has witnessed impressive progress. Cultivated crops not only exchanged hands, but continents too. Coffee, originally a crop from Ethiopia, soon found its way into Europe's living rooms, while Mexico's

beetles. While the beetles are few and are not of comparable importance, the fungus-growing ants and termites are very dominant ecologically.

With a few exceptions, all fungus-growing ants are also leafcutters — they cut pieces of leaves, bring them to the nest, using them as a substratum to grow the fungi. These ants get their nutrition only from the fungi and not from the leaves themselves.

There are some 200 species of these ants, which practice fungus farming exclusively and do not have any other sources of food. Because of their ecolo-



Whistle while you work: ants carrying leaves to their nest

tobacco cultivation became a worldwide phenomenon. And everyone knows how potato, after originating in Latin America, became one of the most widely travelled crops.

Over the centuries, sociologists have sung various eulogies to agriculture for triggering civilisation as we know it. But reserve the pat on the back for someone else. Humans were not the first to discover the Earth's fertility. Ants, by doing so first, beat humans by some 50 million years.

Scientists know of three insect groups that cultivate and eat fungi. These include ants (*Attini*), macrotermite termites and some wood-boring

gical dominance and their insatiable appetite for leaves, leafcutter ants are also major pests. They maintain 10 or more colonies per hectare with a million ants or more per colony. Together, the leafcutter ants consume more vegetation than any other group of insects or even mammals. Many Latin American countries have passed national laws declaring leafcutter ants as plague insects.

But as in the case of humans, agriculture has affected the evolution of leafcutter ants significantly. Today, the leafcutter ants are among the most advanced and sophisticated social insects. And they have to be, as the

process of fungus cultivation is pretty complicated.

In the field, the ants cut the leaves down to a size most suitable for carrying. Once in the nest, these leaf fragments are further shredded into pieces 1-2 millimetre in diameter. Then the ants apply their oral secretions and inoculate the fragments by plucking tufts of fungal mycelia from their garden. The insects usually maintain a pure culture of the fungus they prefer and diligently prevent its contamination from bacteria and other fungi. Though how they achieve this remarkable feat remains poorly understood. Not surprisingly, the ants fertilise their fungus gardens with their own faecal pellets. These ants appear to have asexually propagated certain fungi for millions of years. What kind of fungi do they ants cultivate? Do all ants cultivate the same type of fungi? As in the case of human beings, have there been multiple events of cultivating wild species? Like humans, do the ants exchange fungi cultures among themselves?

Today, with powerful Deoxyribose Nucleic Acid (DNA) technology available, many of these questions can be easily answered. And recently, Ulrich Mueller, Stephen Rehner and Ted Schultz have attempted to study these ants in detail (*Science*, Vol 281, p2034).

First, they collected 553 samples of fungi from the fungus gardens of seven genera of lower *Attine* ants, as there was a possibility that these lower ants still had the ancient fungi cultures intact. Next, they compared variable regions in the DNA of each sample and also sequenced and compared portions of two genes from 25 free-living and 57 ant-cultivated fungi.

Their results suggested that ants cultivated as many as five different types of fungi and not just one, as was thought previously. Even more interesting, their results suggest that ants even exchange fungi among themselves so that different nests of the same species contain different fungi. Whether the ants deliberately borrow fungal cultures from their neighbours or whether these transfers occur accidentally is not known. There is also evidence that new fungi cultures have been added to the ant fungal gardens from time to time. The foremost interest of these studies is clearly the parallels between human and ant agriculture. ■