The Mycorrhizal Black Market

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The mycorrhizal black market refers to the illegal or unregulated trade of mycorrhizal fungi products, often involving mislabelling, poor quality inoculants, and unauthorized commercialization. Such practices threaten agricultural sustainability, soil biodiversity, and farmer trust. Ensuring quality control, scientific validation, and regulatory monitoring is essential for promoting safe and effective mycorrhizal applications.

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Introduction

Beneath every vegetable garden, something remarkable is happening that most people never think about. The roots of plants like tomatoes, onions and carrots are quietly connected to fungi living in the soil. These fungi are not harmful; they are partners. Together, they have been running the same underground deal for over 400 million years. The deal is simple. The fungi send out millions of tiny thread-like structures called hyphae deep into the soil, reaching places that plant roots simply cannot go. Through these threads, they collect nutrients, especially phosphorus, which plants need to survive and deliver them to the plant roots. In return, the plant shares some of the sugar it makes through photosynthesis with the fungi, because fungi cannot make their own food. It works like a marketplace. The plant feeds the fungus with food. The fungus feeds the plant with nutrients. Both benefit. Scientists call this relationship mycorrhiza, from the Greek words for fungus and root. It is one of the most successful partnerships in the history of life on Earth.

When the plant stops paying

Plants are not blindly loyal partners. They are actually quite smart about when to invest in this relationship and when to pull back. When there is already plenty of phosphorus available in the soil, for example, when a farmer adds chemical fertilizer, the plant no longer really needs the fungus's help. So, it does something surprisingly calculated: it gradually reduces the sugar it sends to the fungus. It quietly discourages the fungus from growing too

much inside its roots. Over time, the partnership shrinks, and the plant essentially stops paying for a service it no longer needs. This is what scientists informally call cheating.

The plant takes advantage of the good times when the fungus helps, then backs out of the deal once it feels comfortable on its own. The fungus, which has already spent energy building connections into the roots, ends up with very little reward. Plants also play favourites. When several different fungi are connected to the same root at once, which is very common in soil, the plant sends more sugar to whichever fungus is delivering the most nutrients, and less to the ones that are underperforming. It is a simple reward system: better service gets better payment.

The fungus has its own tricks

Fungi are not helpless in this relationship. They have their own way of keeping the plant dependent on them. A single fungus can connect itself to the roots of many different plants at the same time, spreading across a large area of soil. This means it is never entirely dependent on just one plant. If one plant reduces its sugar payments, the fungus simply draws a little more from its other connected plants nearby. It spreads its risk, just like a business that works with multiple clients.

This also makes it very difficult for a plant to simply walk away from the partnership. Even if the plant reduces its own payments, it still benefits from the enormous nutrient-gathering network the fungus has built, a network that reaches far beyond what the plant's own roots can manage. The plant is, in a sense, trapped in a relationship it cannot fully escape, even when it is not playing entirely fair.

Why farmers should care

All of this underground drama has very real consequences for farming, especially for vegetable growers who depend on healthy soil. When farmers apply large amounts of chemical phosphorus fertilizer to their fields year after year, they are unknowingly triggering the plant's cheating response on a massive scale. Every plant in the field reduces its investment in the fungal partnership. The fungi slowly disappear from the soil. The underground network collapses. After many seasons, the soil loses the biological system that once delivered nutrients naturally and for free. Now the farmer has to apply even more fertiliser to replace what the fungi used to provide. It becomes a cycle that gets more expensive every year. In India, fertiliser costs have risen sharply in recent years, making this cycle a serious burden for small farmers growing vegetables like tomatoes, onions, and brinjal. Repeated ploughing makes this problem worse. Every time the soil is turned over, the fungal threads are broken apart and destroyed. The fungi have to start over from scratch with

each new crop. The underground network never gets the chance to develop and do its job properly.

A smarter way to farm

The good news is that understanding this partnership gives farmers practical tools for growing vegetables more sustainably and more cheaply. The most important step is to reduce chemical phosphorus fertiliser and use slower, organic sources instead, things like compost, farmyard manure, or bone meal. These release nutrients gradually, which keeps the plant just interested enough in its fungal partners to maintain the relationship. The partnership stays alive, and the fungi keep delivering nutrients naturally. Reducing or avoiding deep ploughing helps too. When the soil is not constantly disturbed, the fungal threads can grow and spread across seasons, building the kind of rich underground network that genuinely benefits the crop. Many farmers practising reduced tillage in India report healthier soils and lower input costs over time. Keeping the soil covered with plants between crop seasons using cover crops like grasses or legumes also matters. Fungi need living plant roots to feed on. When the soil is left bare between crops, the fungi starve and their populations crash. Cover crops keep them alive and active, ready to support the next vegetable crop when it is planted.

The bottom line

The mycorrhizal black market is not really about good guys and bad guys. Plants and fungi are each doing what nature designed them to do, looking after their own interests while generally keeping the partnership alive. The cheating, the favouritism, the strategic timing, all of it is simply the natural behaviour of two living things negotiating a deal that has worked, on balance, for hundreds of millions of years. What modern science has helped us understand is that conventional farming habits, heavy fertiliser use, constant ploughing, and bare soils repeatedly disrupt this ancient deal. And when the deal breaks down, farmers end up paying more to replace what the soil biology used to provide for nothing.

Working with mycorrhizal biology rather than against it is not complicated. It simply means treating the soil as a living system, feeding it gently, disturbing it less, and keeping it covered and active. When farmers do this, they are not just helping fungi. They are rebuilding the underground economy that has quietly supported vegetable growth since long before humans ever picked up a plough.