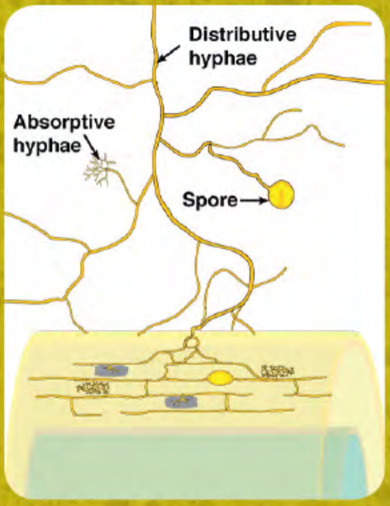
Hand in hand with the soil

By encouraging mycorrhizal fungi in nursery production, growers can reduce fertilizer requirements and grow healthier plants



Mycorrhizae are tiny, beneficial organisms that live in the soil and connect to plant roots, providing them with moisture and nutrients. The tiny fibers are called hyphae.

By Rogell Rogers

Living soil is very important to plant care. It is no surprise, then, that nursery professionals continue to increase their understanding of it.

Living soil includes a myriad of soil-dwelling organisms, including bacteria, fungi, soil arthropods and a wide variety of others. One of the most intensively studied groups in recent years also has the most potential for use by nursery professionals: mycorrhizal fungi.

My-co-RISE-ee

There is a special relationship that exists between plant roots and certain types of fungi, which are called mycorrhizae. The name is pronounced my-co-RISE-ee. Its literal meaning is "fungus root" ("myco" meaning fungus and "rhiza" meaning root).

These fungi are a major component of a multitude of hard-working armies of beneficial soil organisms largely invisible to us beneath the soil surface.

The mycorrhizal relationship is a symbiotic relationship. Both the plant and the fungus benefit. Nearly all horticulturally important plants, and approximately 90 percent of all higher plants, depend on mycorrhizal relationships in their natural habitats.

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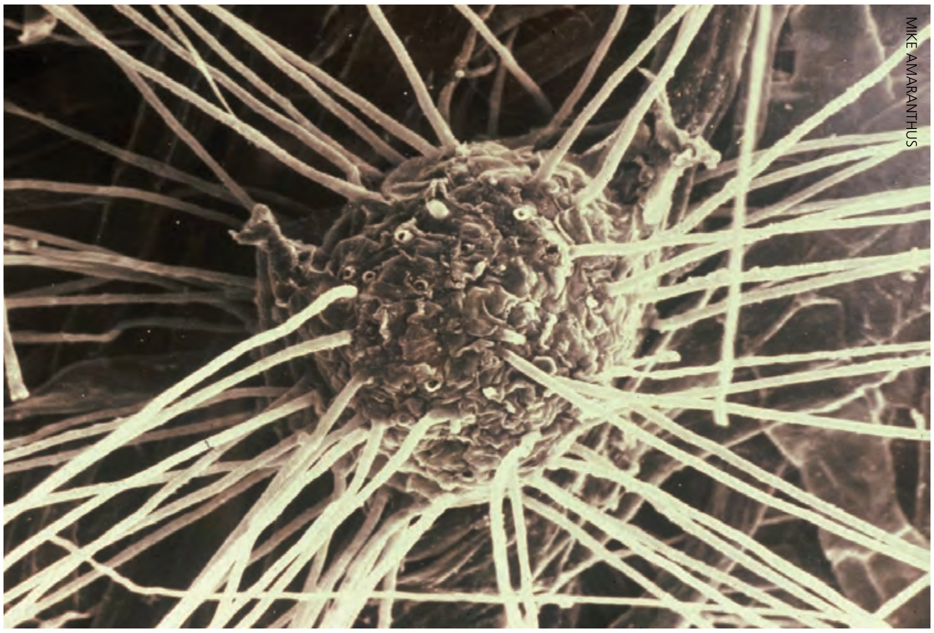

MIKE AMARANTHUS

Mycorrhizal fungi attach themselves to plant roots and radiate out into the soil, helping their host plants absorb water and nutrients. In return, the host plant feeds the fungi with sugars, proteins, amino acids and other needed substances. The relationship is mutually beneficial to both fungi and host plants.

These hard-working fungi provide the cornerstone for sustainability of our plant communities. They provide the moisture and nutrients needed to keep plants in our natural areas healthy and functioning through tiny absorptive threads called hyphae.

We could not survive a day without them. Without their diligent munching in the soil, plants in native ecosystems all over the world would go hungry and die of thirst.

Ancient workers

Since the early days, 460 million years ago, these mycorrhizal fungi have been amazingly prolific. Miles of fungal filaments can explore a single thimbleful of healthy soil. They pluck phosphorus, nitrogen and micronutrients out of the soil with a specific arsenal of designer enzymes just right for the job.

Mycorrhizal fungi process waste and make it usable again, purify our water, and keep our plant communities productive. The wide variety of nursery plants will thrive when given the right source of mycorrhizal inoculum in areas where it has been lost to disturbance or not present in sterile soil mixes.

Mycorrhizal fungi attach themselves to the roots of plants and radiate out into the soil, helping their host plants absorb water and nutrients. In return, the host tree feeds the fungi with sugars, proteins, amino acids and other organic substances.

Fungi are made up of filaments called hyphae. A mass of hyphae is a mycelium, which can grow very rapidly. A fungus colony can produce more than a kilometer of new mycelium in 24 hours!

This growth form has a very high surface area. This is one of the attributes that makes the symbiotic relationship so successful. Mycorrhizae can spread their net of hyphae far and wide in the soil, penetrating tiny spaces in the soil where plant roots can't go.

In addition, fungi are also capable of breaking down, or converting, some nutrients such as nitrogen and phosphorus to forms usable by plants.

The good news and the bad news

The good news is when water and soluble nutrients are amply provided, non-mycorrhizal plants can grow well under nursery conditions. However, until they form mycorrhizae, they don't efficiently take up water and nutrients at the nursery or upon being planted in the ground.

Routine nursery practices such as fumigation, sterile soilless growing media and certain chemical use produce non-mycorrhizal plants. The bad news is that target plants do not utilize much of the fertilizer used in the nursery industry because the root/mycorrhizal system is underdeveloped.

In addition, many nursery-grown plants (and their roots) are adapted to nursery conditions and not to the highly disturbed and sometimes hostile environment found in many urban and suburban settings. In these settings, the chance of a beneficial mycorrhizal fungus colonizing the roots can be low because there may be no source of inoculum readily available.

To confirm the effectiveness and benefits of mycorrhizal treatment, I conducted a test of a mycorrhizal inoculant for four important horticultural species at Village Nursery in Sacramento, Calif.

My hypothesis was that mycorrhizal fungi could be established under nursery conditions and would increase the plants' root system capacity to effectively uptake nutrients at levels considered by conventional standards to be lower than optimum rates. I wanted to test whether inoculated plants' growth and development would be adversely affected as a result of reduced fertilizer inputs.

The experiment

Four plant families were tested because of their popularity in the landscape industry: 1) *Cotoneaster apiculata*, 2) *Trachelospermum jasminiodes*, 3) *Pittosporum variegate*, and 4) *Escallonia*

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fradesii. The experiment had three fertilizer treatments.

1) Grower standard practice (GSP). For this control group, I applied 8 pounds Apex 23-6-12 per cubic yard (equivalent to 0.23 pounds nitrogen per cubic yard over an 8 month period). Because this was the control group, there was mycorrhizal inoculation.

2) Apex mixed at 20 percent below GSP. I added a fertilizer ratio of 6.5 pounds Apex 23-6-12 per cubic yard (equivalent to 0.19 pounds nitrogen per cubic yard over an 8 month period) with mycorrhizal inoculation

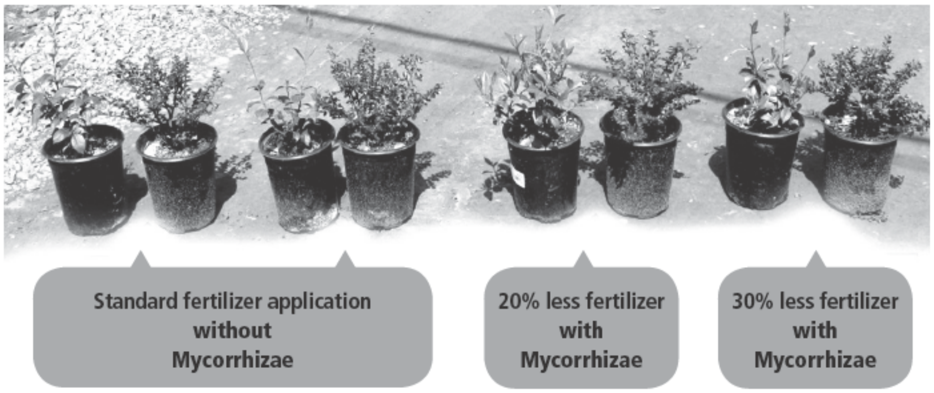
3) Apex mixed at 30 percent below GSP. I fertilized with 5.5 pounds 23-6-12 per cubic yard (equivalent to 0.15 pounds nitrogen per cubic yard over an 8 month period) with mycorrhizal inoculation.

How the experiment was conducted

For each plant species and fertilizer/mycorrhizal treatment there were 50 replications. Mycorrhizal inoculum was watered in (drenched), until water began dripping from the bottom of the 2-inch liner pots. MycoApply® soluble Maxx was used at a rate of 1 pound per 200 gallons of water. Each pound treated approximately 2,000 square feet of nursery plants.

The standard fertilization (GSP) rate was not inoculated. The plots with Apex mixed at 20 percent below standard and 30 percent below standard were inoculated with MycoApply® soluble Maxx. For all treatments, lime was added to the soil at the standard 7 pounds per cubic yard of soil. A premix containing other nutrients was added. It included 1 pound Nitroform fertilizer, 1 pound $FeSO_4$ (iron sulfate) , 0.75 pounds Tiger-90 sulfur fertilizer, and 1 pound triple phosphate (fertilizing supplemental blend) per cubic yard.

All plants were allowed to continue growing for 90 days. At the end of 90 days, root systems were sampled, cleared and stained to determine the percent of mycorrhizal colonization of the plant root systems. Afterward, plants



Research performed by Rogell Rogers supports the idea that plants will grow as well if not better with less fertilizer, if mycorrhizal fungi are applied.

were transplanted as 2-inch liner pots into 1-gallon containers. Plants were set up aside the GSP in the grow grounds under the typical Rain Bird irrigation system. These plants were monitored for visual differences in growth and development. Random subsamples of *Escallonia fredesii* were selected for biomass measurements.

Results

Mycorrhizal colonization averaged 48 percent and 56 percent for the MycoApply Mycorrhizal treatments with fertilization reductions of 20 percent and 30 percent. In the untreated, or control plants, there was only 3 percent mycorrhizal root colonization. No significant visual differences were detected in plant growth development between standard growing practices and 20 and 30 percent reduction in fertilizer with Mycorrhizal inoculation. In fact, in nearly all cases, plants grown with fertilizer reduction treatments with mycorrhizal inoculation looked as good or better than the GSP.

A subsampling of *Escallonia* species biomass indicated that the plants treated with 20 percent less fertilizer had 15 percent greater biomass than plants receiving the GSP treatment.

Conclusions

Mycorrhizal inoculants are not a silver bullet, but are another valuable tool available to the nursery professional. Mycorrhizal colonization was achieved by a simple inoculum drenching of the plant material. In this experiment, a significant reduction of fertilizer inputs accompanied by mycorrhizal inoculation of a plant's root system achieved a high level of mycorrhizal colonization. The plants that received mycorrhizal inoculations and were treated with 20 percent or 30 percent less fertilizer than standard practice did not suffer adverse plant growth or development.

Establishing nursery plants on disturbed sites requires an understanding of the many soil processes important in facilitating uptake, storage and cycling of nutrients and water. In natural areas, these activities are largely performed by a diversity of beneficial soil organisms. These include mycorrhizal fungi working hard below the living soil surface.

In past decades, clearing of natural areas, compaction and disturbances in suburban and urban environments have substantially reduced mycorrhizal populations. Reestablishing these beneficial fungi can occur at the nursery. The result can be substantial fertilizer savings without adversely affecting plant growth and development. The resulting will have root and mycorrhizal systems that are well suited for the outplanted environment.

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