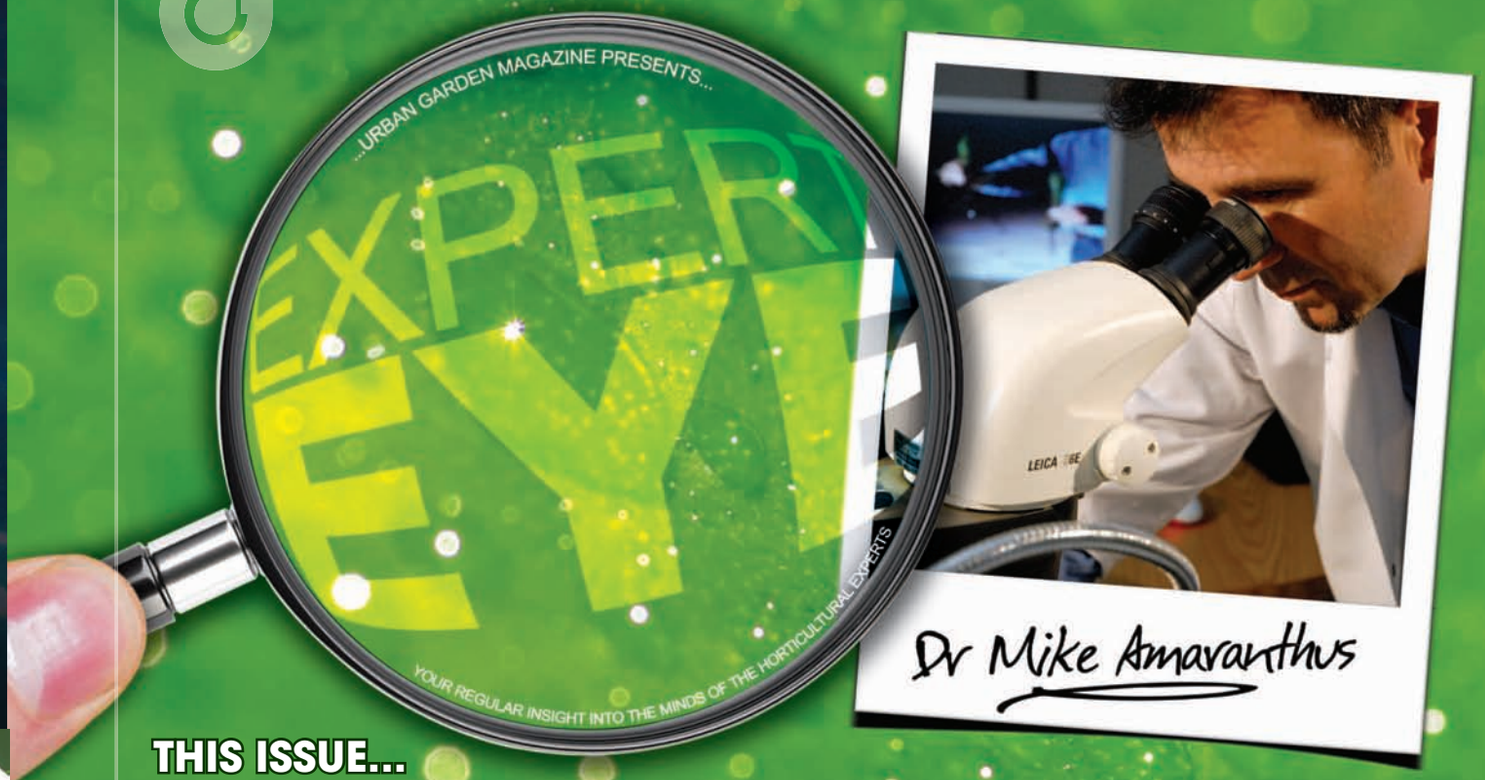

THIS ISSUE...

Declaration of "Interdependence"

Mycorrhizal fungi are the "little secrets" for superior plant performance

By Mike Amaranthus Ph.D & Tim Eagan

The more we learn about life on Earth, the more we learn about the mechanics of superior plant performance. We now realize that in natural systems, organisms work not INDependently but INTERdependently. There is no doubt that nature is less a battleground and more a marketplace. Symbiotic organisms that exchange materials and services in a mutually advantageous living arrangement can be the key to successful planting and growing. Hydroponic growers are gaining increased appreciation of the living soil and more frequently incorporating soil biology and mycorrhizal products into their practices.

Fig. 1 - Picture of a mycorrhizal colonized root. Mycorrhizal fungal filaments radiate into the soil from the mycorrhiza root tip.

What are mycorrhizae?

More than 90 percent of plant species form a symbiotic arrangement with beneficial soil fungi called mycorrhizal fungi. The roots are colonized by the soil fungus, which attaches to the roots and whose threads or "hyphae" extend far into the surrounding soil environment (figure 1). The colonized root is called a mycorrhiza. Mycorrhizal fungi are the dominant microbes in undisturbed soils accounting for 60 percent to 80 percent of the microbial biomass. Mycorrhizae are fundamental for superior plant performance, supplying the water and nutrients needed for superior growth, flowering and fruiting and in exchange, receiving essential sugars and other compounds supplied by the plant.

While many plants enjoy an air temperature of around 75-82°F, the root zone needs to be cooler – in many cases at around 68°F. How to keep your root-zone cool? Keep your nutrient solution cool! Try and maintain it around 66°F (or slightly cooler than your desired root zone temperature) as irrigation and system heating will warm the nutrient solution by the time it reaches the roots.

High-quality commercial mycorrhizal inoculum is now available from a variety of sources.

Fig. 2 - The white threads on this seedling grown in a glass box are mycorrhizal hyphae.

What do they do for plants?

These mycorrhizal fungi increase the surface absorbing area of roots 10 to 1,000 times, thereby greatly improving the ability of the plants to use the nutrients and water (figure 2). Estimates of amounts of mycorrhizal filaments present in soil associated with plants are astonishing. Several miles of fungal filaments can be present in less than a thimbleful of soil. Mycorrhizal fungi increase nutrient uptake not only by increasing the surface absorbing area of roots. Mycorrhizal fungi also release powerful chemicals into the surrounding environment that capture nitrogen, phosphorous, magnesium, iron and other plant nutrients. This extraction process is particularly important in plant nutrition, flowering and fruiting and explains why mycorrhizal inoculations have been so successful in hydroponic operations.

What other functions do mycorrhizal fungi perform?

Suppression of diseases and pathogens are additional benefits for a mycorrhizal plant. Mycorrhizal fungi attack pathogen or disease organisms entering the root zone. For example, excretions of specific antibiotics produced by mycorrhizal fungi can immobilize and kill disease organisms. Many practical benefits can be expected from using mycorrhizal fungi in common practices. These include improved rooting.

Where's the beef?

The plant-mycorrhizal fungi relationship is the best understood in the field of soil biology. There are more than 60,000 studies in literature on the subject, but there is even more important proof. The mycorrhizal relationship with plants is one of nature's longest and most successful experiments. The earliest fossil record of the roots of land plants contain mycorrhizae almost identical to what is found today. Most scientists believe the plant-mycorrhiza relationship allowed aquatic plants to make the transition to the relatively harsh terrestrial environment some 460 million years ago. In nature, mycorrhizae make plant growth possible, linking the roots of plants to the surrounding soil. In nature, neither can survive or grow without the other. Now hydroponic growers can benefit from this essential relationship.

Fig. 3 Rooting of hydronically grown mycorrhizal tomatoes with (a) and (b) without mycorrhizal inoculation, flowering and fruiting.

(Fig. 4 Marigold flowering with mycorrhizal inoculation (right) compared to non inoculated marigold), and protection against diseases.

How do I use mycorrhizal products most effectively?

High-quality commercial mycorrhizal inoculum is now available from a variety of sources. Inoculums containing mixtures of species of mycorrhizal fungi often give the best response. Mycorrhizal inoculum comes in granular, powder, liquid and tablet forms. The most important factor when using a product is to get the mycorrhizal propagules near the root systems of target plants. Most mycorrhizal propagules will stay dormant until root activity begins. The chemicals pumped into the soil by active roots cause mycorrhizal propagules to become active and grow. Inoculum can be injected into the rooting zone of hydroponic systems, watered into porous soil-less mixes, mixed in granular form into soilless mixes or directly dipped on root systems using gels during transplanting. The form and application of the mycorrhizal inoculum depends upon the needs of the applicator. What is clear is that mycorrhizal inoculation is highly effective.

Micro reality

Growing plants hydroponically requires an understanding of the many interdependent processes important in facilitating uptake, storage and cycling of nutrients and water by the target plant species. In nature, these activities are largely performed by the "tiny secrets," working hard below in the root zone of plants. Hydroponic growers can now make a "Declaration of Interdependence" and incorporate mycorrhizal fungi into their programs.

Dr. Mike Amaranthus spent 20 years with Oregon State University and the U.S. Department of Agriculture Forest Service, and has written more than 60 research papers on mycorrhizae. He is the recipient of the USDA Highest Honors for scientific achievement and has been featured on several major national and international television programs. He is president and chief scientist for Mycorrhizal Applications Inc., located on the Web at www.mycorrhizae.com. Tim Eagan is an expert in the practical application of mycorrhizal fungal inoculums and is Vice President of Plant Revolution Inc. located on the web at www.plantrevolution.com. All photographs accompanying this article are courtesy of Mycorrhizal Applications Inc.