PREMIER TECH

PRO-MIX®

Optimize Nutrient Uptake

Susan Parent

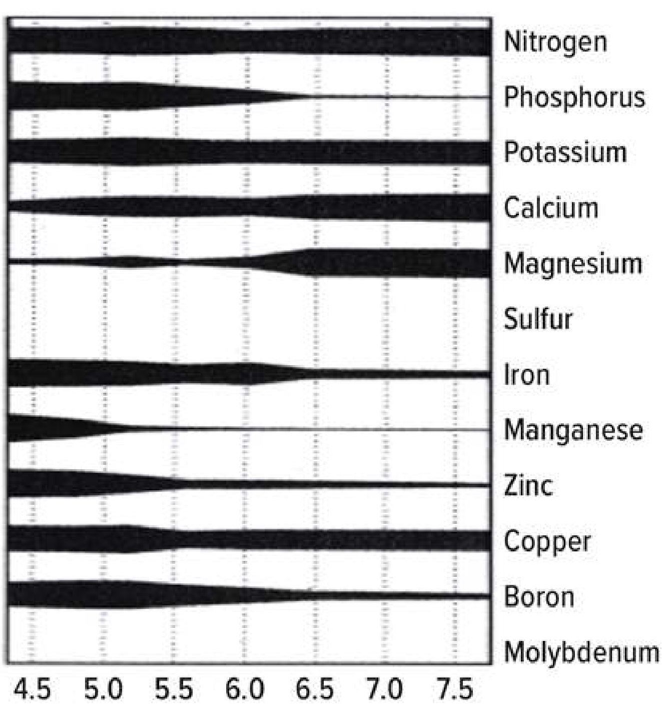
Are your plants reaching those nutrients?

A considerable number of fertilizers are on the market, providing plants with programs either general or specific to crops, but plants can have challenges to absorb these nutrients. What are the causes?

Growing media pH

Traditionally, plant nutrition is based on three major plant nutrients of N, P and K; secondary elements Ca, Mg, and SO4; and minor elements Fe, Mn, B, Cu, Mo and Zn. Even though the required quantity of minor elements is less in comparison with major elements, their importance in plant nutrition is crucial. Nutrient availability is dependent on pH, so the optimal pH range of 5.5 to 6.2 for growing media is ideal for most plants to obtain nutrients. Table 1 shows how nutrient availability will vary according to the pH of the growing medium.

Table 1. Availability of mineral nutrients according to the pH of growing media.



Source: William R. Argo, Paul Robert Fisher, "Understanding pH Management for Container-grown Crop"

Different plant species have different ideal pH ranges due to the availability of micronutrients. Plants have different abilities to absorb nutrients, especially micronutrients, and pH is a strong determinant in their capacity to use fertilizers provided.

Plants can be divided into three groups:

1. **Geranium plant group:** This plant group requires a growing pH of 6.0 to 6.6. This group becomes sensitive to iron and manganese toxicity if the pH goes down below this pH range. Plants in this group include geranium, new guinea impatiens, marigold, lisianthus, pentas, etc.
2. **Petunia plant group:** This plant group is prone to iron deficiency, which means they require a more acidic growing medium pH of 5.4 to 6.0. If the pH is higher, then these plants may exhibit iron deficiency. Plants in this group include calibrachoa, petunia, bacopa, diascia, dianthus, nemesia, pansy, scaevola, verbena, vinca, etc.
3. **General plant group:** Plants in this group can grow at a pH of 5.8 to 6.2 and aren't prone to iron and other micronutrient toxicities or deficiencies. Plants in this group include chrysanthemum, impatiens, ivy geranium, osteospermum, poinsettia, etc.

Other factors that affect nutrient availability

When using growing media made with peat moss and other organic-based materials, a wetting agent is added to reduce the surface tension, so it will have more uniform water absorption and distribution. Fertilizer elements come from the fertilizer solution, so the more fertilizer solution absorbed, the more nutrients are available to plants. As a growing medium ages, the wetting agent is broken down so less fertilizer solution is absorbed by the growing medium and this can cause symptoms of nutrient deficiency.

There are also stresses related to plant root pathogens that can cause deficiency symptoms because the roots become damaged and are no longer capable of providing the nutrients to plants. Figure 1 shows chlorosis of seedlings that are affected by root disease that causes brown root rot.

Microorganisms in the growing media or soil

Another side of plant nutrition that's less considered is the role played by the microorganisms. However, more and more studies have shown crops perform better, especially under stressful conditions, when microorganisms or mycorrhizal fungi are used. Among the microorganisms available, mycorrhizal fungi is best known for increasing the absorption area of the root systems, so it helps improve efficiency of nutrient absorption in a soil or soilless growing media.

In organic growing conditions, mycorrhizal fungi, as well as microorganisms, naturally present in soils or growing media play an important role in mineralization of organic nutrients.

Figure 1. Root disease is damaging the roots of these seedlings and they're chlorotic because they're incapable of absorbing the nutrients.

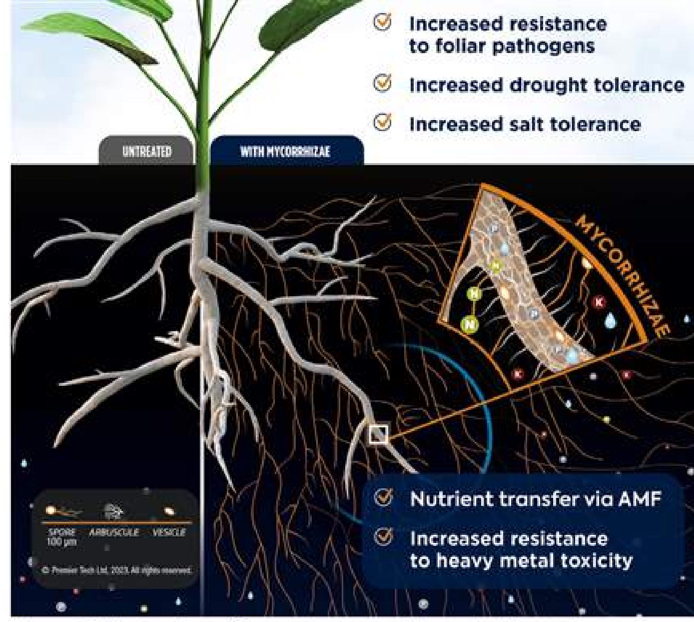


Figure 2. Illustration of a root system with and without the presence of Arbuscular Mycorrhizal Fungi (AMF). The hyphae in orange illustrate the extension provided by the fungi into the soil to access the nutrients.

Mycorrhizal fungi increases the root zone absorption area.

Figure 3. The plant on the right is inoculated with mycorrhizal fungi, but the one on the left was not. Stresses were the same for both plants—the presence of the mycorrhiza was helpful in acquiring water and nutrients, so the inoculated plants were larger by the end of the growing season.

How does mycorrhizae work in growing media?

In soil that's been tilled or rototilled for new planting beds and commercial growing media, Arbuscular mycorrhizal fungi (AMF) are almost always absent. Using a growing medium pre-inoculated with AMF, such as PRO-MIX with MYCORRHIZAE, is the quickest way to get the plant roots colonized and subsequently receive benefits.

AMF spores germinate after planting and produce hyphae that reach out to colonize plant roots. Within a couple of weeks, new hyphae are formed that explore the soil to acquire nutrients that aren't available to plant roots.

With this extension in the soil through the hyphae, water and nutrients that are less mobile become accessible to the hyphae and brought back to the plant roots (Figure 2). This is of great importance, especially when plants are under stress from drought, nutrition or heat (Figure 3).

To maximize the investment in fertilizers, use of mycorrhizal fungi inoculants at the beginning of the crop cycle will provide plants with more resistance to stressful growing conditions. Even under the best growing conditions, most plants cannot reach all the nutrients provided. The following factors should be considered when growing horticultural crops:

- Monitor the pH of the growing medium and ensure it's within the proper range for the crop grown. Irrigation water should be analyzed for bicarbonates, as high levels can quickly increase the pH of the growing medium.
- Hard-to-wet growing medium with insufficient wetting agent can contribute to nutrient disorders. Adding wetting agent can be a good way to make better use of the fertilizer applied.
- Plants under stress (disease, heat, water stress) won't be able to absorb all the nutrients available from the growing medium or soil, leading to potential nutrient disorders. Be sure the greenhouse environment doesn't encourage disease by implementing good ventilation, plant spacing and use of biocontrol programs.
- Using mycorrhizal fungi or other biostimulants in the growing media will provide roots with greater access to plant nutrients, or in the case of mycorrhizae, transfer nutrients to plant roots, especially under stressful growing conditions. GT

For more information about mycorrhizae, biostimulants and plant culture, check our website at pthorticulture.com or contact one of our Grower Services representatives for assistance.

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Biofungicides: What to Consider

This article was originally published in the first edition of our Biosolutions Guide, which came out with the June issue of *GrowerTalks*. Scan the QR code to get a digital version of the guide.

Powdery mildew on rosemary.

Sclerotinia blight on petunia.

We're hearing more today about biopesticides than ever before—especially if you're growing organically. But what if you aren't trying to grow crops with biopesticides, exclusively? They can definitely be used in a "conventional" production setting, as well; you just have to be mindful that the conventional products don't interfere with the biopesticides.

Most biopesticides are OMRI-listed and can include biological agents like bacteria, fungi and predatory mites and insects. They can also be extracts from a biological organism such as a plant.

You should be aware of some considerations before trying biopesticides in your operation. It might be simpler to convert completely to biopesticides, but it's rarely practical due to limitations in controlling a wide array of diseases. There are some facts you need to know to make the most successful use of any pesticide—biological or conventional.

Myths & misconceptions

Here are a few of the statements I've heard from a variety of growers, researchers and manufacturer representatives regarding biopesticides (especially those classified as true biologicals):

- Biopesticides don't work as well as synthetic or conventional products.
- Biopesticides don't have a good shelf life.
- Biopesticides aren't compatible with synthetic or conventional products.
- Applying biopesticides once is enough for the life of the crop.
- We don't know what biopesticides are doing. They're magic.
- Biopesticides are never phytotoxic and are inherently safe for the environment, plants and humans.

Each of these statements is wrong, at least as applied to some of the biopesticides registered today.

In contrast, the following characteristics are true for many biopesticides, including:

- Some biologicals or biopesticides must be used before the pest pressure arrives (at seedling, at planting in plug trays).
- Biopesticides should be used following (or sometimes with) chemical fungicides.
- Under high disease pressure, biopesticides may not perform well.
- Many things affect efficacy of biopesticides, including fertilizer, host plant, pathogens and even pathogen species.
- Being a better grower makes using biologicals (and really all) fungicides and bactericides more likely to succeed.

Although some products are biologicals, biopesticides and organics—not all biopesticides are biological and not all organic products are biopesticides. Biopesticides that aren't biological control agents (BCAs) act more like synthetic products, making them simpler to use in many cases. These products are typically a combination of a variety of chemicals they (biological agents) make in culture or are extracted from them (like plant extracts).

Biopesticides can be simple, but are more likely to provide a variety of direct and indirect effects. An example of direct effects would be lipopolysaccharides that destroy bacterial and fungal cells, for example *Bacillus*.

Indirect effects are those that such products trigger in the host—often referred to as SAR (systemic acquired resistance) factors. *Trichoderma*, *Bacillus* and some plant extracts have been proven to trigger plant defense responses.

One of the best examples of how much our knowledge has improved over the past 20 years is the understanding of T-22 (one of the BCAs in RootShield Plus). Here's a summary of the ways that researchers (often at universities here and internationally) have discovered they work. This particular summary was prepared by BioWorks Inc:

- **Excludes pathogens:** RootShield Plus takes up space in the rhizosphere and crowds out pathogens. It not only overtakes that space, it eats nutrients as well, causing pathogens to starve.


Xanthomonas on Hedera (ivy).


Pythium root rot (on left).

- **Shields roots:** Not only does RootShield Plus grow on the roots, it shields them from pathogens. It acts as a barrier that pathogens cannot get through.
- **Hunts and eats pathogenic fungi:** RootShield Plus seeks out, attacks and eats fungal pathogens.
- **Antagonizes pathogens:** RootShield Plus releases anti-pathogen substances, creating a zone that is inhospitable to pathogens.
- **Induces host resistance:** RootShield Plus, with its presence in the rhizosphere, signals the plant to accumulate defensive compounds, which gives the plant a better defense response in subsequent encounters with pathogens.

What factors affect the use of biopesticides?

The answer is: exactly everything that affects how conventional products work, including: timing, rate and interval, inoculum pressure and crop, tank-mixing or alternation with conventional/synthetic fungicides, the potting medium, irrigation method and fertility regime, and finally, even the exact species of the pathogen causing the disease. This list is the same for biopesticides since what's being described is how the course of a plant disease is affected.

Dr. Mary Hausbeck and her team at Michigan State University performed extensive research with a few biologicals and a few conventional fungicides. They tested the ability of each product to control several species of Pythium on two crops (snapdragon and geranium). The best biological OR fungicide for one species of Pythium on geranium wasn't the same as the best for another species of Pythium on the same crop or even the same Pythium species on another crop. Consistency wasn't better for the conventional fungicides than for the biologicals. So the picture of choosing what biological or conventional products work best is based on what your crop(s) is and what the exact cause of the disease might be. Unfortunately, however, we don't know the exact product for a specific situation that would perform the best.

If the biopesticide is a biological control agent and alive, there are factors that must be considered to ensure their effective use. First, you must realize that everything that affects the crop or the plant pathogen can affect another living organism—the BCA. This includes water level, salinity, potting medium characteristics and, of course, conventional fungicides or bactericides. GT

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The biggest disease challenges for biopesticides (and conventional products as well)

There are a number of very challenging diseases for conventional products to control and they're difficult for biofungicides, as well. Some of these are listed below with the most effective biopesticides or biologicals and their level of control—none, some, good, very good and excellent. These efficacy summaries are based on reported trials for ALL crops—greenhouse, field edibles and ornamentals. Diseases for which you have many very good biofungicide choices (like bacterial leaf spot, powdery mildew and rust, as well as Pythium, Rhizoctonia and Phytophthora root rot) are not included.

- Anthracnose: MilStop (poor to good) or Triact 70 (some to good)
- Black root rot: Obtego (some to good) or LALSTOP K-61/MycoStop (none to good)
- Black spot on rose: NONE
- Cylindrocladium root/crown rot: NONE
- Downy mildew: MilStop (some to very good) or Regalia (none to very good)
- Fusarium root rot, crown rot, wilt: LALSTOP G46 (previously PreStop; very good to excellent) or RootShield Plus (none to very good)
- Phytophthora aerial blight: Camelot O (poor to good)
- Southern blight (Sclerotium): NONE