

Doing the Math

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Recently, we've seen the introduction of various biological additives to the agriculture and horticulture industries. With this new technology, it can be a bit confusing understanding what these microbes are and what they do. Some can be applied above the soil line to reduce plant diseases; other biologicals can be incorporated into growing media to enhance plant growth and/or reduce plant disease. The question is, can these biologicals replace chemical treatments and can you save money by using them?

Where did they come from?

If we compare growing media used in greenhouses and nurseries to mineral soil, it's "constructed" with organic-based materials, such as peat moss, bark, coconut coir and/or other materials. Other ingredients—such as aggregates, fertilizers, limestone, etc.—are added to make blends that have specific physical and chemical properties. However, unless microbes are added, growing media contains low levels of microbes, making them virtually free of the biological component.

If we were to take a sample of mineral soil from an untouched environment, we would find a wide array of diverse biology. Some microbes convert organic matter into nutrients for plants, some fix nutrients in the soil and others interact to protect plant root systems. In mineral soil, there can be any combination of microbes consisting of actinomyces, bacteria and/or fungi. Of these microbes, there are saprophytes, which feed on dead material; pathogens that feed on and damage plants; symbionts that assist plants; and competitors, which can attack or compete with other microorganisms.

Microbes can be added to growing media

Over the years, scientists have isolated and cultured various beneficial microbes for use in agriculture and horticulture. These microbes are produced in laboratories to be sure that strains remain true and continue to provide benefits desired. If we review the various microbes commercially available to growers, we can place them into two general categories by the benefits they provide: Biocontrols and Growth Enhancers.

Biocontrols are biological additives that reduce the incidence of plant disease or control insects. They may directly attack the pathogen or insect, or indirectly control by creating barriers, blocking a food source or exclude a pathogen. Compared to growth enhancers, these microbes assist plants by stimulating plant growth, or acquiring nutrients and/or water to improve the overall growth of plants.

Advantages and disadvantages

One of the main advantages of using beneficial organisms is that they're safe to use. They have little to no plant, human or animal toxicities. Most have been discovered in mineral soil and are natural, not genetically modified. Because they're part of the normal checks and balances of soil biology, there's less potential for pathogen resistance.

Most beneficial microbes are preventative, not curative, therefore, they prevent the onset of plant disease before it has a chance to affect crops. Most beneficial microbes remain in the root zone of the plant for an extended period, while some will remain with the plant for life. If you're growing organic certified crops, a major advantage is that most biological additives are certified organic with OMR1 and offer an option to control plant disease where chemicals cannot be used.

Some of the disadvantages of beneficial organisms is that these are live "bugs" and they may require special storage and use conditions. Almost all beneficial microbes have a shelf life for their optimal use, so users need to respect the expiration date.

If you recall your basic biology, fungi are more fragile than bacteria. Keep this in mind, since fungal organisms are sensitive to warm temperatures and may require cool storage temperatures. Fungal organisms may also desiccate, easily reducing their effectiveness.

Bacteria and actinomycetes are more robust and forgiving when handling, storing and applying due to the thick cell walls of their spores. When incorporated into growing media, microbes work best when growing medium temperatures are above 50F (10C).

Unlike chemical fungicides that are wide spectrum, biological controls generally interact with specific pathogens; therefore, their range of pathogen control can be more narrow than their chemical counterparts. If used in combination with chemical controls or other biological additives, be sure to check the compatibility of the microorganism with the chemistry and other bio-additives used. Some chemicals and other bio-additives may reduce populations, while others may eliminate the beneficial microbes.

Adding beneficial microbes to growing media

The major advantage of having microbes added to growing media before you plant is that these microbes are present in the root zone before root disease has a chance to get established. Most beneficial microbes are packaged in granular and powder forms; there are some that can be applied in a liquid format. It's easiest to apply beneficial microbes in the potting area with feeder on your mix equipment. Some of the liquid products can be applied in the greenhouse with injectors through the irrigation system. Most of the powder can be drenched; however, there's added labor and time to apply products in this method. If you add beneficial microbes yourself, the easiest method is to add products to the mixing line.

Another choice is to speak with your growing media supplier, since most growing media manufacturers can add beneficial microbes to growing media for you. In most cases, it's a better value to have the beneficial microbes added for you, since the cost of the product and the labor may be less from the economy of scale for a manufacturer to add it for you. Keep in mind that if the product you're adding to growing media is an EPA-registered biopesticide, handling and use regulations must be respected.

Cost to add to growing media

The cost of biological additives is generally inexpensive, compared to some chemical controls. If we compare the costs of various fungi and bacteria available, the cost per cubic yard is between \$8.50 to \$26.00 for the active ingredient. If we use an average cost of \$17.25/cu. yard, we can compare the cost for various crops.

One cubic yard of growing media will fill approximately 1,944 4.5-in. azalea pots or 141 10-in. hanging baskets. With an average cost of \$17.25/cu. yard for the active ingredient, the cost per 4.5-in. azalea pot is \$0.0089 and \$0.1289 for a 10-in. hanging basket.

If we refer to the USDA Floriculture Survey from 2016, the average wholesale selling price for a "less than 5-in." potted flowering plant sold for an average of \$1.38, based on the top producing 15 states. A hanging basket of flowering and foliage plants had an average wholesale selling price of \$7.67. If we take the cost of adding an active ingredient to these pots, the cost represents 0.6% for the 4.5-in. azalea pot and 1.7% for the 10-in. hanging basket.

Plant loss versus cost of biologicals

The average plant loss due to root disease is 3% for most growers. Based on a cubic yard of growing medium, this is equal to approximately 58 4.5-in. azalea pots valued at \$80.04 or 4.2 hanging baskets valued at \$32.21.

If a biological additive could reduce root disease and plant losses by two thirds, the cost of \$17.25/cu. yard for the biological additive added to growing media would be offset by the savings of \$35.58 for plants sold ($\$80.04 \times 0.66 = \52.83 savings minus $\$17.25/\text{cost}/\text{cu. yard} = \35.58 additional profit). For the 10-in. hanging basket, the losses would be reduced, resulting in additional revenues of \$4.01 per cu. yard ($\$32.21 \times 0.66 = \21.26 savings minus $\$17.25/\text{cost}/\text{cu. yard} = \4.01). Averages were used for this exercise; however, actual savings can be much higher depending on the biological additive used, its effectiveness to control disease and the wholesale selling price of crops you're growing.

The use of biological additives has multiple advantages and they are becoming popular options to chemical controls for plant disease. They're readily available, predictable in the results they provide and are cost effective, offering growers a safer alternative and an additional tool in the integrated pest management toolbox. **GT**

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