

# THE NUTS AND BOLTS OF BIO-FUNGICIDES

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There is much talk about the development and use of biological controls for the management of disease in greenhouse bedding plant production. Each growing season new bio-control products are introduced that are labeled for use on a wide variety of plant pathogenic organisms. Some of these products have had labels for years. Regardless, biocontrol products for the control of plant diseases in greenhouses are here to stay and the more we are educated on how they do and do not work, the wiser our choices will be.

According to the United States Department of Agriculture, biological control of plant disease is defined as “the involvement of the use of beneficial microorganisms, such as specialized fungi and bacteria, to attack and control plant pathogens and the diseases they cause.” So what are these “specialized fungi and bacteria” that can attack and control plant pathogens? It sounds as if they have been conjured up in some super secret laboratory by some mad scientist. Just think, fungi and bacteria that have been genetically altered so that they will seek out a plant pathogen and kill it before the pathogen has a chance to attack its host. Sounds great, however, that is not quite the way it really is. These “specialized” fungi and bacteria are microorganisms that normally inhabit most soils. They are not genetically engineered. In their natural habitat they compete with other microorganisms for space and food. Some biocontrol agents produce toxic substances that parasitize and/or kill other soil-inhabiting microorganisms such as *Pythium* sp., *Phytophthora* sp., *Rhizoctonia* sp., and other plant pathogens. Scientists have known about these parasitic microorganisms and studied them for many years. They have shown that these microorganisms play a vital role in the make-up of the soil environment and are part of the normal checks and balances that make up a healthy soil.

For years these parasitic fungi and bacteria have been isolated from the soil and tested in private and university-based laboratories as to their ability to control plant pathogens. Recently, some of the more promising of these biocontrol fungi and bacteria have been further developed and marketed to ornamental plant growers as an alternative to the traditional chemical-based fungicides.

## How They Work:

There are four different mechanisms by which biocontrol agents control other microorganisms. Most biocontrol agents apply one or more of these mechanisms in the process of interacting with their fellow microorganisms.

**1. Direct Competition with the Target Organism.** In this case the biocontrol agent out competes the target organisms for nutrients and space. This is typically a fungus or bacteria that grows very fast and just overwhelms the target organism. The target organism is suppressed due to lack of food and space. The target organism may not die out completely, however, the population becomes so low it is no longer a problem.

**2. Antibiosis.** With antibiosis, the biocontrol agent produces a chemical compound such as an antibiotic or some type of toxin that kills or has some sort of detrimental effect on the target organism. Many microorganisms produce antibiotics and toxins. Some of the more common antibiotics that we humans use to warrant off infections came originally from fungi and bacteria.

**3. Predation or Parasitism of the Target Organism.** This is the mechanism that most of us envision in our minds when we think of biocontrol agents. In this case the biocontrol agent attacks and feeds directly on the target organism. It's a cruel world under our feet.

**4. Induced Resistance of the Host Plant.** It has been known for decades that when a plant is infected with a pathogen, that infection triggers some sort of reaction in the infected host plant that helps keep it from being infected with other pathogens. The infected plant becomes more “resistant” to other infections. Plants do not have immune systems to protect them from infection as we do, however, they do have physiological and biochemical systems that helps inhibit infection. Some biocontrol agents trigger these mechanisms and in the case of induced resistance, host plants are purposely inoculated with this agent in an effort to trigger this resistant response. Induced resistance is currently a very exciting area of research throughout the scientific community.

## Advantages and Disadvantages of using Biological Control Agents.

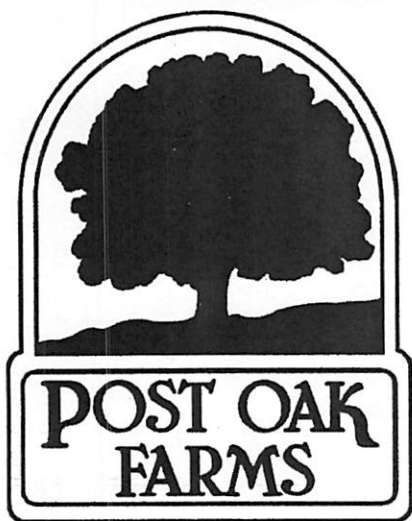
Even though it appears as if these biocontrol agents are the cure-all, there are distinct advantages and disadvantages in using these productions when compared to traditional chemical controls.

### Advantages of using Biocontrols.

- They help reduce the use of chemical-based fungicides.
- They help reduce the risk of developing pathogen resistant to traditional chemicals.
- In most cases they are safer to use.
- They tend to be more stable than chemical pesticides if stored properly.
- In most cases they have lower re-entry interval (R.E.I.) times.
- In most cases they are less phytotoxic.

### Disadvantages of Biocontrols.

- Biocontrol agents tend to be more difficult to implement when compared to chemicals.
- In most cases they have a narrower target range.
- They may not work as quickly as chemicals.
- These products do not eradicate the pathogen or rescue the host from infection.
- They may have a shorter shelf live if not stored properly.



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- In most cases biocontrol products are more expensive to use.
- They may not be compatible with the use of other chemical fungicides and bactericides.

### The Products.

To date there are over 40 commercial products that are marketed as biological controls. Not all of these are available in the United States. In the area of greenhouse floriculture and perennial production there are about a less than dozen products that are popular (Table 1.) Of these PlantShield appears to be the most widely used. Plantshield is the T-22 strain of the soil inhabiting fungus *Trichoderma harzianum* (TH). TH uses both antibiosis and predation against many common soil-borne pathogens that cause root and crown rots such as *Pythium*, *Rhizoctonia*, *Fusarium*, and *Sclerotinia*. It also has activity towards many foliar pathogens. It appears to be one of the most popular biofungicides in the greenhouse industry and can be an asset to a disease management program if used properly.

### Keys to Successful use of Biocontrol.

In order for any of these biological control agents to work for you, two simple rules **MUST** be followed. **First off**, all of these products **MUST** be used in conjunction with standard disease cultural controls. **Secondly**, All of these biocontrol products **MUST** be applied prior to the onset of disease. They will not rescue plants that are already infected. If you abide by these two critical conditions, the likelihood of you having success with a biocontrol agent is good. If you don't, they won't work.

In summary many manufactures that have traditionally been the source of chemical fungicides will be producing and marketing biofungicides. Growers need to be aware of what products are available, the way they work, and their limitations. It may be a while before we see a biofungicide that controls *Pythium* sp. as good as Subdue did. However, under the proper growing conditions biofungicides can be a viable alternative to chemicals.

For further information on biological controls log onto the U.S.D.A. web site @ [www.barc.usda.gov/psi/bpdl/bpdl.html](http://www.barc.usda.gov/psi/bpdl/bpdl.html)

**Table 1. Current Floriculture Biological Control Products and Their Uses.\***

Product Name**	Contents	Pathogen(s) Controlled
AQ 10	M-10 isolate of the fungus <i>Ampelomyces quisqualis</i>	powdery mildew***
Companion	<i>Bacillus subtilis</i> GB03	Many root and stem pathogens ****
Galltrol-A	Strain 84 of the bacteria <i>Agrobacterium radiobacter</i>	crown gall disease
Mycostop	Strain K61 of fungus <i>Streptomyces griseoviridis</i>	many root, stem and leaf pathogens *****
PlantShield	Strain T-22 of the fungus <i>Trichoderma harzianum</i>	root rot pathogens ****
Primastop	<i>Gliocladium catenulatum</i>	<i>Pythium</i> sp., <i>Rhizoctonia solani</i> , <i>Botrytis</i> sp., <i>Didymella</i> sp.
SoilGard	Strain GL-21 of the fungus <i>Gliocladium virens</i>	<i>Rhizoctonia</i> & <i>Pythium</i> sp.
T-22 Planter Box	Strain T-22 of the fungus <i>Trichoderma harzianum</i>	same as PlantShield with the addition of <i>Sclerotinia homeocarpa</i>

\* labeled in the United States

\*\* in alphabetic order

\*\*\* only on selected ornamental crops

\*\*\*\* *Pythium* sp., *Rhizoctonia* sp., and *Fusarium* sp.

\*\*\*\*\* *Fusarium* sp., *Alternaria* sp., *Phomopsis* sp., *Botrytis* sp., *Pythium* sp., and *Phytophthora* sp.