

Many beneficial 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 beneficial fungi and bacteria have been further developed and marketed to ornamental plant growers as an alternative to traditional chemical-based fungicides.

What are biofungicides?

Biofungicides are **formulations of living organisms that are used to control the activity of plant pathogenic fungi and bacteria**. The concept of biofungicides is based upon observations of natural processes where beneficial microorganisms, usually isolated from soil, hinder the activity of plant pathogens. **Through direct competition, biofungicides grow a defensive barrier around the root system, or rhizosphere, thereby shielding the roots from harmful attacking fungi**. Biofungicides also produce a chemical similar to an antibiotic, which is toxic to the invading pathogen. This process is called antibiosis.

Below is a better understanding of the current crop of beneficial organisms (biofungicides) — how they work and, most importantly, their advantages and disadvantages when compared to traditional chemical fungicides.

How They Work

There are four different mechanisms by which beneficial or bio control agents interact with other microorganisms. Most bio control agents apply only one of these four mechanisms; however, some may employ more than one. Also for the purpose of this article, I will refer to the plant pathogen as the target organism.

1. Direct competition.

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 overwhelms the target organism with sheer numbers. The target organism is suppressed due to lack of food and space. The target organism may not die out completely, but its population becomes so low it is no longer a legitimate threat to the host plant. In order for this type of biocontrol agent to be most effective, the environmental conditions must favour the growth and reproduction of the biocontrol agent.

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 humans use to ward-off infections came originally from common soil-inhabiting fungi and bacteria. In some cases, antibiosis can be accompanied by other detrimental mechanisms. Antibiosis is one of the most effective methods of controlling microorganisms.

3, Predation or parasitism

This is the mechanism that most of us envision when we think of biocontrol agents. In this case, the biocontrol agent attacks and feeds directly on the target organism, or the agent produces some sort of toxin that kills the target organism and then feeds on the dead target. Like direct competition, the environment must favour growth and development of the predator or parasite since populations need to be high enough to overwhelm the target organism.

4. Induced resistance of the host plant

Scientists have known for decades that once a plant is infected with a pathogenic microorganism, infection triggers some sort of biochemical reaction in the infected host plant that helps keep it from being infected with further pathogens (super infection). The infected plant becomes more “resistant” to other infections. Plants do not have immune systems to protect them from infection; however, they do have physiological and biochemical systems that help inhibit infection and spread of pathogens within tissues of the affected plant. Some biocontrol agents are known to trigger these mechanisms, and in the case of induced resistance, host plants are purposely inoculated with this agent in an effort to trigger the resistant response. The microorganism that triggers the response is usually not a severe pathogen of the host. If it were, it would defeat the whole purpose. Induced resistance is not highly understood and is currently a very exciting area of research throughout the scientific community.

Advantages and Disadvantages

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

Advantages.

- * If used properly, they help reduce the use of chemical-based fungicides. This is good for the environment and is one of the most important reasons to consider their use.
- * They help reduce the risk of developing pathogen resistance to traditional chemicals. Due to the overuse of certain chemical fungicides, some common plant pathogens such as *Pythium* sp. and *Botrytis* sp. have become resistant to these fungicides. This is less likely to happen with biocontrol agents because the beneficial organism co-evolves along with the target organism and adapts to the changes. Something a chemical cannot do.
- * In most cases, they are safer to use. Most biocontrol agents have very low or no toxicity to humans and other mammals.
- * They tend to be more stable than chemical pesticides if stored properly. These are living organisms and must be stored as such. If they spoil, they are no longer effective.
- * In most cases, they have lower re-entry interval (R.E.I.) times. This is a significant factor especially when it is necessary to enter the production facility immediately following application.

* In most cases, they are less phytotoxic. Because they are "natural" they are less likely to cause toxic effects on the host plant, especially if mistakes are made and rates are miscalculated.

Disadvantages

* Biocontrol agents tend to be more difficult to implement when compared to chemicals. Since most of these products have to be implemented prior to the onset of disease, greater preparation by the user is necessary. Biologicals work best in greenhouses that routinely scout for diseases and insects and detect problems early.

* In most cases, they have a narrower target range. Most are not broad-spectrum products. Identification of the correct target organism is imperative.

* They may not work as quickly as chemicals. Since their populations need to take time to build up they can take more time to be effective. That is why it is necessary to apply them prior to the onset of severe disease outbreak.

* These products do not eradicate the pathogen or rescue the host from infection. They have to be administered prior to the onset of disease, in most cases at pre-plant.

* They may have a shorter shelf life if not stored properly. Remember, these are living organisms that don't take well to extreme temperatures.

* In most cases, biocontrol products are more expensive to use. This includes both time and money. They may be a bit more expensive to purchase initially, and they take more time to initiate, if used properly.

* They may not be compatible with the use of other chemical fungicides and bactericides. The product label should be checked to see with what chemicals the product is compatible. Many of these beneficials are fungi, and some of the more common greenhouse fungicides have the potential to kill these beneficial microorganisms.