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Texas Cooperative EXTENSION
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Biologically-Based Products for Disease Control and Plant Growth Enhancement

What Are Biologically-Based Products?
Biologically-based products are liquids, powders and/or granules that contain as their main active ingredient any source of beneficial microbes (bacteria, fungi, etc.) that help protect the plant from diseases and/or help to enhance plant growth. These types of products include: biologicals, biopesticides, inoculants, soil conditioners, biostimulants, etc.).

What are Beneficial Microbes?
Beneficial microbes are natural, living organisms (fungi or bacteria) that benefit the host plant by increasing root growth and nutrient uptake, fixing nitrogen, decreasing plant stress and protecting roots from pathogens. This is a natural soil-plant relationship that exists in most soils; however, this activity is greatly reduced in soils that are heavily used by agriculture, or in sterile soils used for greenhouse/nursery production.

What is The Soil-Plant Relationship?
The Soil-Plant relationship is a delicate balance of soil-dwelling beneficial ("the good guys") microorganisms such as actinomycetes, algae, bacteria, cyanobacteria, fungi, protozoa that exist around plant roots and create a healthy environment for improved growth. Hopefully, there is a greater amount of good microbes (beneficials) around the roots than there is bad microbes (diseases). The plant feeds the beneficial microbes allowing them to grow while the microbes feed the plants enzymes, minerals, antibiotics, growth regulators and hormones that allow the plant to protect itself and growth in a healthy manner. A good place to look for background information is the website www.soilfoodweb.com.

What Kinds of Biologicals Are There?

Bacterial-based:

- *Bacillus subtilis (various strains)*
- *Streptomyces lydicus, Streptomyces griseoviridis*
- *Burkholderia cepacia*
- *Rhizobia*
- *Others*

Fungal-based:

- *Coniothyrium minitans*
- *Gliocladium virens*
- *Trichoderma harzianum, Trichoderma spp.*
- *Mycorrhizae spp.*
- *Others*

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How Do Biologicals Work?
There are many ways in which biologicals work, but in general, there are three main widely known methods that these organisms use for controlling diseases and enhancing growth of plants including:

1.) Competition – The good bacteria and fungi block out the bad diseases from attacking the roots by taking up space on the roots where diseases attack and by stealing the food sources around the roots that diseases use to survive.

2.) Antibiotics/enzymes – Just as with humans, bacteria and fungi produce chemicals that kill the diseases.

3.) Mycoparasitism – Some of the biologicals will attack the diseases, wrapping themselves around or producing enzymes that breakdown their cells and then they feed off the dead cells.

What Are the Advantages and Disadvantages of Bacterial-Based Products?
The benefits of bacterial-based products are that they are generally easier to apply, as they may be sold and stored as liquids, and they can potentially last longer in storage (up to 2 years). Unfortunately, bacteria are generally not as long lasting in the soil and chlorinated water may knock down populations, thus multiple applications are generally necessary to see responses.

What Are the Advantages and Disadvantages of Fungal-Based Products?
The benefits to fungal-based products are that they are longer lasting in the soil or on the roots, generally requiring only one application every 3 months. However, storage is not as long as bacteria and inert ingredients are generally made of clay carrier making good agitation necessary. Also, may not do as well for foliar applications.

What Are Some of the Major Biological Products Sold on the Market Today?

Product Name	Active Ingredient	Activity Claimed	EPA-Registered?
Actinovate/Actino-Iron	S. lydicus	Growth enhancement	No
Companion	B. subtilis	Root diseases, growth	No
Compost Teas	Various	Root diseases, growth	No
Contans	C. minitans	Root diseases	Yes
Deny	B. cepacia	Root diseases, growth	Yes
Kodiak	B. subtilis	Root diseases, growth	Yes
Messenger	Harpin protein	Foliar diseases, growth	Yes
Mycorrhizae	Over 150 species	Growth, nutrient uptake	No
MycoStop	S. griseovirides	Root diseases, growth	Yes
RootShield	T. harzianum	Root diseases, growth	Yes
PlantShield	T. harzianum	Root diseases, growth	Yes
SC-27	27 different organisms	Growth enhancement	No
Serenade	B. subtilis	Foliar diseases	Yes
SoilGard	G. virens	Root diseases	Yes
Subtilex	B. subtilis	Root diseases, growth	Yes
T-22 Planter Box	T. harzianum	Root diseases, growth	Yes
USDA Inoculant	Rhizobia	Nitrogen fixation	No

How Are the Biologicals Applied to Crops?
Most biologicals are as spores, conidia, or hyphae (reproductive stages of the beneficials) and are applied in liquids, dry powders or granules. The liquids and dry powders can be applied to soil mixes as a drench after which the spores will germinate and colonize the roots. Liquids and powders can be applied to the leaves for foliar protection as well. Granules are generally incorporated as pre-mixes for germination or plug transplants, or applied as top-dressing to pots.

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When is the Best Time to Apply Biologicals?
The best time to apply biologicals is immediately after planting (or before, in the case of granules). This will allow the roots to be colonized with the biological as soon as they germinate. Most biologicals do not work well if disease is already present. They are better at preventing diseases than they are at curing them.

Can Biologicals Be Mixed With Chemicals?
Yes, surprisingly most biologicals are compatible with chemicals, even certain fungicides. Most companies have listed the compatible chemicals and the best times to use them on their labels. Please always read the label before using a combination of biologicals and chemicals.

Why Are Some Biologicals EPA-Registered and Others Are Not?
A biological must be registered with the EPA to make any claims about disease control. To do so requires testing for disease control, plant, animal and worker safety, toxicity, and many other things. This often requires millions of dollars to achieve. If claims are made without a registration, this is illegal and the manufacturer could be sued and production shut down. As a result of the costs, many companies will instead claim growth promotion and other benefits so that they do not have to be registered with the EPA. The advantage to having an Official EPA Registration is that growers can know that the product is government regulated, it has been tested to verify the claims, and that any claims they make have been reviewed by the same standards as chemical companies.

Are There Any Cautions About Using Biologicals?
Yes, they are not substitutes for good water, soil and fertility management for your crops. There are many claims about reducing diseases and nutrient management requirements by substituting with these products, but more continued research is needed. Every grower should trial all products, including biologically-based ones on a small (e.g. one half greenhouse) and compare it to standard treatments. However, a good grower will integrate the methods he/she uses for disease control and growth enhancement, thus not depending solely on one method to do the job.

Are There Any Organizations That Regulate Biologicals?
Other than the EPA, there is not any organization that protects growers and consumers from fraudulent claims or snake oil salesmen. However, many biological manufacturers have recently organized a group called the BioPesticide Industry Alliance (BPIA), created to self-regulate themselves for quality, accuracy and efforts for EPA registrations.

Some Available Websites:
www.agbio-inc.com
www.agraquest.com
www.agrobiologicals.com
www.bioworksbiocontrol.com
www.edenbioscience.com
www.encoretechllc.com
www.growthproducts.com
www.martinmarietta.com
www.soilfoodweb.com
www.soiltechcorp.com
http://dmoz.org/business/industries/agriculture_and_forestry/biologicals