NM PRO
NURSERY MANAGEMENT & PRODUCTION

Biological FUNGICIDES

Why these products are becoming more common

By Kevin Hattori

Green industry researchers around the world have been exploring the possibilities offered by biological disease controls for years. In the past, a major part of this research was driven in large part by intellectual curiosity.

With an onslaught of government regulations, increased societal concerns about chemical pesticides, increased popularity of organic farming and pest and disease resistance to chemicals, necessity has entered the equation. So, too, has simple mathematics. Plant protection is big business, with the U.S. Environmental Protection Agency estimating the U.S. fungicide market at more than $800 million.

As a result, many companies are joining the race to develop safe, viable and effective alternatives to chemical pesticides. The underlying premise is to use the least chemicals possible, augmented by better fertility practices and organic products. The development fray is comprised mainly of startups and smaller companies.

WHAT THEY ARE

Biological fungicides are microbials, containing naturally occurring, non-genetically engineered microorganisms. For instance, Companion is created from *Bacillus subtilis* GB03, first discovered in Australia in the 1930s. The active ingredient of RootShield is *Trichoderma harzianum* (T-22) and SoilGard is made from *Gliocladium virens* (GL-21).

Some of these microbes have biochemical properties, meaning they produce a byproduct, such as an enzyme, that has further effects on a pathogen. *B. subtilis* GB03, for example, produces antibiotics that are very active against pathogenic fungi, especially *Rhizoctonia, Fusarium* and *Pythium.*

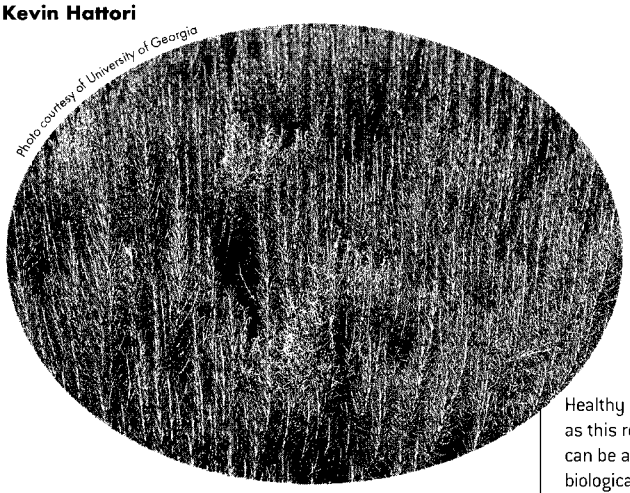

Photo courtesy of University of Georgia

Healthy crops, such as this rosemary, can be achieved with biological fungicides.

Most biofungicides are preventative rather than curative, so it is best to apply them early in the production cycle before pathogen attacks occur. Doing so gives the beneficial microbes in the biofungicide a chance to colonize, providing them with a much better chance to outcompete and/or attack the pathogen. Established colonies of beneficial microbes are far more capable of protecting the plant, giving growers the option of reducing the costs and labor of additional chemical applications.

Biofungicides differ from chemical fungicides in their modes of action. Chemical fungicides generally have two modes. The first of these is contact, in which the chemical must come into direct contact with the pathogen. The second is systemic, where the chemical is absorbed by the plant and affects the pathogen when the plant is under attack.

Biological fungicides have additional modes of

Common biologicals
Page 2

Costly classification
Page 2

Keys to success

To be successful, a biological fungicide must:

- ☑ Control a wide variety of fungal diseases.
- ☑ Be able to survive in a wide variety of growing media.
- ☑ Have good stability.
- ☑ Be easy to handle, use and apply.
- ☑ Be cost-effective.

action including niche occupation, where they grow on or near a plant's roots, stems or foliage, and induced systemic reaction, which causes a reaction in the plant to fight off pathogens. Some biofungicides also produce antibiotics, which have pathogen-fighting properties best classified as contact. Most biological fungicides fall into the contact category.

MAKING THEM WORK

"I believe there are a number of reasons that biological fungicides are taking over the forefront of plant root management," said Mark J. Arena, a researcher with the Clemson University Extension Service. "First, the EPA is slowly but surely removing certain chemical fungicides from the market because of concerns over environmental and human health concerns. Fungicide resistance, re-registration and label restrictions, have also limited the use of many chemical fungicides, particularly on ornamental crops.

"Biofungicides provide a safe and effective alternative to the use of chemicals, and there is a growing body of evidence suggesting that plant survival and root health can be greatly improved by growing plants in mixes fortified with beneficial microorganisms."

Based upon cost analyses, including factors like time and labor costs and application intervals, using biofungicides can offer significant economic savings when compared to chemicals, Arena said.

In response to increasingly stringent government legislation, many larger growers now carry a government lobbyist on staff. The companies are rightfully concerned about the impact such regulations will have on their overall practices, and they must be prepared for whatever the future holds.

This fact is borne out in the ever-increasing emphasis on the implementation of best management practices (BMPs) and integrated pest management programs. The greatest concern of growers is being able to maintain production levels under new regulations and the resultant practices. Time and labor costs are critical considerations. With EPA-registered biological fungicides, restricted-entry interval time is zero.

USE AT MONROVIA

As one of the industry's leading nursery growers, Monrovia, headquartered in Azusa, Calif., illustrates well the growing importance of biological fungicides.

"Monrovia tries to use as few pesticides as possible without compromising the quality of our products," said John Keller, Monrovia director of research. "We are committed to finding biological solutions to plant pest problems, and we have conducted trials on various biological products for many years.

"The current regulatory climate also encourages companies to look for alternative methods of pest control in a framework of IPM. We use biological products whenever we can attain equal or better results with the biological vs. the synthetic product."

Common biologicals

Here are some biological fungicides currently on the market. Each has contact as a mode of action.

Name	Manufacturer	Active ingredient	Form
Actinovate	Natural Industries Inc.	*Streptomyces lydicus* (WYEC 108)	granular
AQ10	Ecogen Inc.	*Ampelomyces quisqualis*	powder
Companion	Growth Products Ltd.	*Bacillus subtilis* (GB03)	liquid
Deny	Market VI	*Pseudomonas cepacia*	aqueous solution
Mycostop	AgBio Inc.	*Streptomyces griseoviridis* (K-61)	powder
Norbac 84C	New BioProducts Inc.	*Agrobacterium radiobacter* (K84)	aqueous suspension
RootShield	BioWorks Inc.	*Trichoderma harzianum* (T-22)	granular & powder
SoilGard	Thermo Trilogy Corp.	*Gliocladium virens* (GL-21)	granular

For a more complete listing of commercially available biocontrol products for use against soilborne crop diseases, visit http://www.barc.usda.gov/psi/bpdl/bpdlprod/bioprod.html.

Classification is costly

To be legally classified as a biological fungicide, a product must be registered with the U.S. Environmental Protection Agency.

This testing process is designed to prove the product's safety to humans, animals and the environment and to prove efficacy. Extremely strict quality control procedures must be followed under this testing, a fact that ensures the product really contains what it promises.

Costs incurred during the registration process are significant, usually $300,000 to $3 million. The process takes two to four years.

In the nursery industry, employees are constantly coming in contact with plants, so products with short REIs are essential, Keller said. Biological products are a nice fit with these Worker Protection Standard requirements and will become even more so as more products become available.

KEY QUALITIES

Phillip Brannen at the University of Georgia is an expert on soil biological controls and their modes of action.

"When looking to create a biological fungicide, it is important to find an organism that is a fast colonizer," Brannen said.

Bacteria (as opposed to fungi) are the best candidates for creating biological fungicides since they can be used in conjunction with chemical fungicides without fear of harming the beneficial organisms, Brannen said. Another important consideration is whether the microbes are gram positive, or spore producing.

"Bacteria that are gram negative are not very good candidates for product development because they are always in an active, live state," he said, "And as a result, they are very sensitive to storage problems and have a very short shelflife."

A successful biological fungicide must be formulated in a way that favors both the activity and survival of the microbes it contains. Most manufacturers have accomplished this through powdered or granular formulations, which require mixing. Many of these products have special handling requirements or considerations, like refrigeration, to keep their microbes alive.

Before purchasing a biological fungicide, growers should know if the product has special storage or mixing requirements, short shelflives or can be used with irrigation equipment and sprayers without clogging.

SEE THE POSSIBILITIES

One of the most common biological control strategies is the application of microbial products to increase the populations and activities of beneficial microbes around a plant. Like a car pulling into a full parking lot, any new pathogen arrivals will be unable to find open spaces.

Another avenue being explored is the use of biological fungicides in combination with reduced rates of chemical fungicides while achieving equal or better results.

With so many factors facilitating its development, the biological fungicide marketplace is an emerging one on the verge of an explosion. Many companies, researchers and growers are conducting work with biologicals. And they are doing so not just because of regulations, but because they actually believe that biologicals have great potential for success.

Kevin Hattori *is director of public relations at Growth Products Ltd., P.O. Box 1252, White Plains, NY 10602; (914) 428-1316; fax (914) 428-2780; e-mail khattori@growthproducts.com;http://growthproducts.com.*