

Biological Control Agent Seed Treatments

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Purpose

This paper is intended as a resource providing general background on the current state of biological seed treatments and their application in the marketplace. It is not intended to provide detailed information or conclusions about any specific product. This paper is not in anyway intended to serve as a legal reference. FIS does not accept any liability for decision taken with reference to this document.

General Background Information

Biological control agents used as seed treatments are microorganisms that protect seeds and seedlings from various pathogens. Pursuit of alternatives to chemical pesticides and an increasing interest in "organic" production methods have stimulated increased scientific development of biological control agents over the past 20 years. Advances have been achieved over this period through a greater understanding of the control mechanisms used by these agents especially in the soil (a).

Cotton has been the first large-scale agronomic crop treated with biological control agents for the suppression of seedling diseases of the rhizosphere. Much of the cotton planted in the USA is treated with one or more biological control agents (b). These products have also been used and tested on numerous other agronomic crops and vegetable crops.

Though some limited progress could be noticed in the technology, formulation difficulties, storage stability, shelf life of products after application to the seed and erratic biological efficacy have slowed the growth and adoption of the technology. In addition, limited understanding of the rhizosphere ecology, the release of some products which did not meet performance expectations, the uncertainty of the size of the commercial opportunity, the strength of patents and the cost of registration have hindered the development of this market (c).

Of the biological control agents patented by early 1999, 84% were bacteria and 16% were fungi. The bacteria included species of *Streptomyces*, *Pseudomonas*, *Bacillus* and *Enterobacter*. Species of *Pseudomonas* and *Bacillus* made up the vast majority of those products. Fungi products consisted of various species of *Phomopsis*, *Ectomycorrhizae*, *Trichoderma*, *Cladosporium* and *Gliocladium* (d).

Modes of Action

There are a number of modes of action employed by these microorganisms that lead to the seed and seedling protection. These can be loosely categorized into the areas of antagonism, antibiosis, competition and mycoparasitism (e). Each of these modes of actions have advantages and disadvantages that affect performance. The key disadvantage is that any single mode of action gives activity against a very narrow spectrum of pathogens. To date the majority of the biological control agent products have focused on one disease. Therefore mixtures of organisms with different modes of action or combinations of chemicals and biological control agents might enhance the spectrum of activity but there is limited knowledge and understanding of interaction of such mixtures.

The use of biological control agents to either reach a particular pathogen not affected by chemical treatments or assist a chemical by improving the overall activity against a particular pathogen appears to be the most effective approach for these products.

Application Issues

When using a biological control agent, one of the key issues is the assurance of proper loading of the appropriate number of cells on each seed. Another issue to consider is the stability and viability of the organism across the environments where the seed may be exposed and the time duration the seed will be stored.

Various carriers and polymers have been used to increase the survival rate of the organism with mixed success. Some of the biological control agents are adversely affected by the combination with some traditional chemical seed protection.

These products come in dry formulations as dusts, dry spores, and gum/talc powders. Many liquid formulations are also available for sprays, dips, fluid drilling gels and solid matrix priming. These may be designed for large-scale application or planter box treatments.

Registration Issues

Most biological control products are regulated not only as pesticides but may also be governed by the regulations concerning the handling and release of microorganisms. Since these products are relatively new and infrequent, many countries do not have a standard process for registration and handle all applications on a case by case basis (c).

There is also limited to no knowledge of the possible ecological consequences of the use of living organisms as seed treatment.

There may be some biological seed treatments that make no specific claims about pest control. They claim to be designed to improve nutrient availability, water and nutrient transport, growth promotion or enhancement, or increased natural plant resistance. Evidence of these claims can be questionable in some cases. In some cases these types of products may not need to be registered at all.

Discard Issues

Laws and regulations regarding the discard of biological control agents and/or the seeds treated with these products vary by country and product. Each applicator should check with the local and national authorities on how to handle disposal of unneeded product.

Some biological products may present an advantage to the seed companies in that treated seed may still be eligible to be released into the normal grain trade as a disposal option.

Conclusions

Biological control agents as seed treatments are being actively developed by a number of companies across many countries. These products may provide a good solution for growers who are working toward organic status of their crop. These products may also provide a partial solution for protection against specific pathogens. It should be stressed that biological efficacy of biological seed treatment is at the current time far from reaching the efficacy of chemical seed treatment, nevertheless biologicals can represent in some occasions an interesting complement of chemical protection. Customers should be fully aware

of the pathogens they are trying to mitigate and the mechanism of control the biological control agent uses against those pathogens.

Growers should also understand the stability of the organism being used to help ensure the proper loading is still on the seed at planting.

Seed companies need to have a complete understanding of the regulatory and registration issues associated with these products. This is not only true for the country in which the application is taking place but also for all potential target markets for the seed.

If the investment in these technologies continues at the current pace, in some specific crops such as vegetables cultivated in controlled environment (greenhouse), these products may have a significant place in the options to protect seed and seedlings.

References

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