BIOLOGICAL CONTROL OF SOILBORNE PLANT PATHOGENS WITH ANTAGONISTS INTRODUCED WITH THE PLANTING MATERIAL

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Historically, biological control of plant pathogens has focused more on diseases caused by soilborne plant pathogens than any other group of diseases. This long-term effort, dating back to the 1920s but with greatest efforts since the mid 1960s, is beginning to pay off. Some progress has been made with microbial biocontrol agents added directly to soil in combination with a carrier-foodbase, but the greatest progress has been made with root-associated microbial biocontrol agents introduced with the planting material.

Some of the reasons to consider this approach as a strategy for control of root diseases of food crops are:

> The array of root-associated microorganisms available for selection and screening seems almost unlimited and is virtually untapped as a biological and genetic resource;
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> Microbial biocontrol agents can be targeted for specific pathogens on specific crops, with few if any significant nontarget effects;
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> Fermentation technology needed to mass produce inoculum of microbial biocontrol agents is well developed and widely available; and
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> Microbial biocontrol agents offer companies opportunities for more rapid product development and registration at a cost much less than for chemical pesticides.

The use of plant-associated microorganism for biological control of plant pathogens, and also certain insects, e.g., with endophytes, is as generic and broadly applicable as the use of genes for resistance to pests and plant diseases or the use of vaccines for control of human and other animal diseases. Just as a different gene or different vaccine is typically needed for each pathogen, and sometimes each strain or biotype of pathogen, so a different microorganism is typically needed for each plant pathogen or plant- host pathogen interaction. On the other hand, strains can be selected for broad-spectrum activity, and the new tools of rDNA technology open the way for development of strains with ability to control more than one component of a pathogen complex and possibly an entire pathogen complex responsible for the root diseases of any given crop.

Transplanted crops are especially good candidates for

protection using microbial biocontrol agents for the simple reason that the microbial biocontrol agent can be thoroughly established on roots of the seedling by any number of methods prior to or at the time of transplanting. A greater challenge, but also of great promise, is the use of microorganisms applied one place, e.g., on the seed at planting, and expected to end up in adequate populations another place, e.g., on roots or root tips several centimeters deep in the soil.

There are at least four basic mechanisms by which a nonpathogenic microorganism can provide biological control of a pathogenic microorganism during coexistence in the rhizosphere--or any other habitat, for that matter. The mechanisms are antibiosis (inhibition by production of a low molecular weight compound, or antibiotic), predation or hyperparasitism (mycoparasitism, in the case of one fungus parasitizing another fungus), competition for resources, and induced resistance. Each of these mechanisms has been shown to be effective against soilborne pathogens. It is also possible to screen for any one or more of these mechanisms in the hunt for effective strains. As part of our presentation, we will discuss methods of screening and testing based on our own experiences in the discovery and development of rhizosphere bacteria (rhizobacteria) for biological control of root pathogens.