

Biological Disease Control and Suppressive Soils

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BIOLOGICAL CONTROL--The use of beneficial microorganisms, such as certain bacteria or fungi, or their gene products, to control plant pathogens and the diseases that they cause.

SUPPRESSIVE SOILS--Defined by the absence of disease development even in the presence of a virulent pathogen and a susceptible plant host.

Agents & Mechanisms of Biological Control

Fungi

Trichoderma spp.--mycoparasitism, antibiosis

Fusarium spp.--competitive exclusion, induced resistance

Pythium spp.--mycoparasitism, competition



Bacteria

Bacillus spp.--antibiosis

Fluorescent *Pseudomonas* spp.--antibiosis, induced host resistance, substrate competition

Streptomyces spp.--antibiosis



Biological Disease Control by Introduced *Pseudomonas* sp.

Control of Take-all
of Wheat



P. fluorescens 2-79



P. aureofaciens 30-84 (=2W5)

Control of Rhizoctonia Root
Rot of Apple



Control *P. putida* 2C8



Some Advantages Relative to Chemical Controls

- ◆ **Narrow range of activity relative to chemical controls; reduced likelihood of negative impacts on plant beneficial microbes (mycorrhizae, etc.)**
- ◆ **Integrate into organic production systems**
- ◆ **Limited quantity of active metabolite(s) released into the environment and produced where needed**
- ◆ **Usually less phytotoxic**
- ◆ **In most cases they are safer to use**



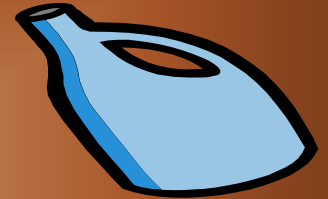
Some Limitations Relative to Chemical Controls

- ◆ **Narrow range of activity relative to chemical controls**
- ◆ **More difficult to implement**
- ◆ **Control is dependent upon survival of the introduced organism in a hostile environment**
- ◆ **Ability of host to sustain the biocontrol organism may not only be species-specific but also cultivar specific**
- ◆ **Environment may not be suitable for expression of genes involved in biocontrol**

Buyer Beware?



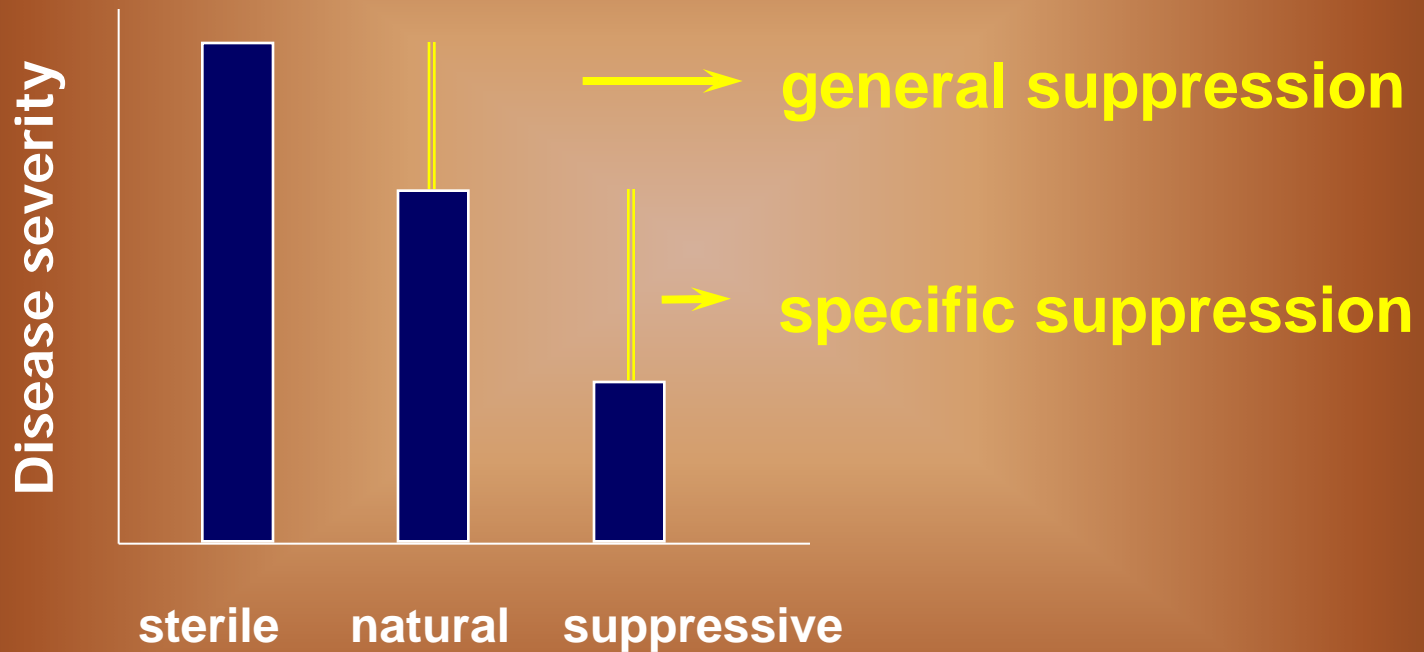
Microbial “Soups” Marketed
as Plant Growth Promoters but
with Declarations of Disease
Control Activity



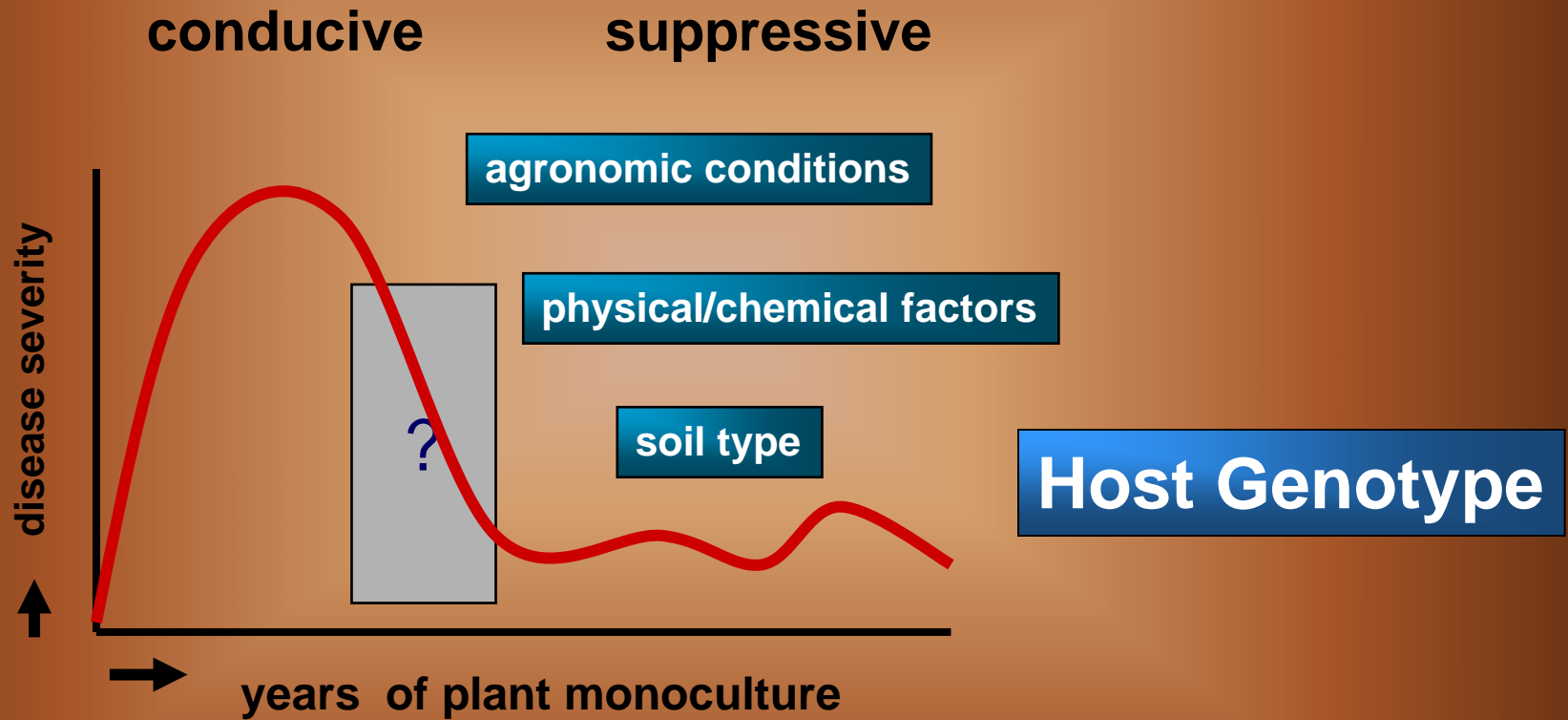
Enhancing the Efficacy of Biological Control

- ↓ Genetic modification to enhance gene expression or rhizosphere colonization
- ↓ Modification of application methods, introduction with novel substrate or as colonized medium
- ↓ Multiple applications, through drip irrigation systems
- ↓ Use in management of disease problems where long term survival is not a prerequisite for disease control
- ↓ Manage resident soil microbial antagonists/induce a disease suppressive soil

Disease Suppressive Soils



Induction of Disease Suppressive Soils



Phyto-management of Microbial Communities to Induce Suppressiveness Toward *Rhizoctonia solani* AG-5



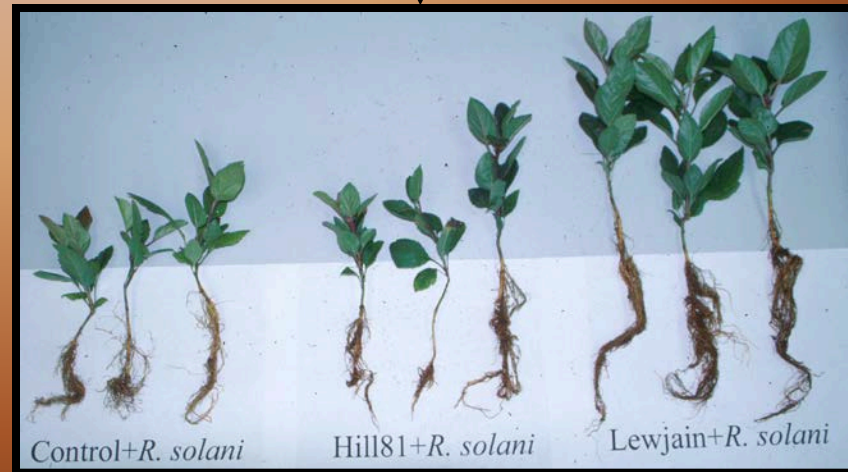
Apple Replant Disease



Wheat Induction of Soil Suppressiveness to *Rhizoctonia solani*?



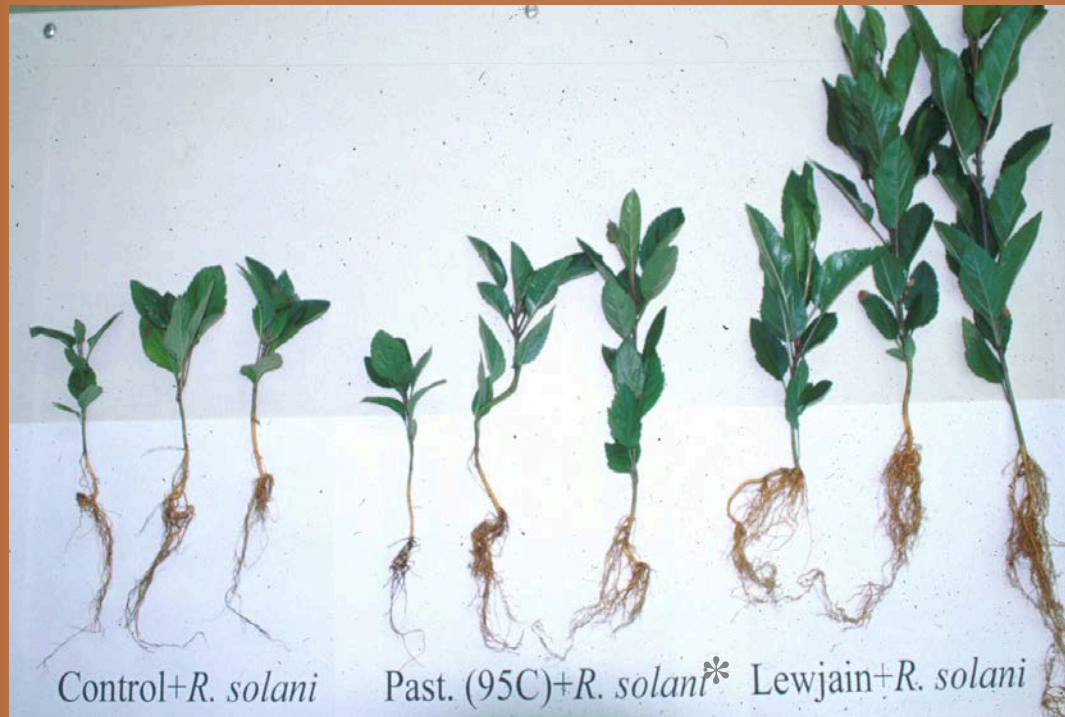
0.1% *R. solani* AG 5
oat bran inoculum



Eltan
Hill81
Lewjain
Madsen
Penawawa

Sunny Slope Orchard

Elimination of Wheat Genotype-Specific Induction of *Rhizoctonia solani* AG5 Suppression via Pasteurization



CV Orchard Soil

*=Pasteurized Lewjain cultivated soil

Wheat genotype-specific induced suppression (% root infection) of *R. solani* AG 5 in artificially infested orchard soils

| Treatment | CV | WVC-A | WVC-SS |
|------------------|--------|-------|--------|
| Control | 26.7bc | 18.2b | 22.6b |
| Pasteurized 95 C | 48.0d | 42.7c | 39.3c |
| Eltan | 24.4bc | 25.8b | 23.3b |
| Hill-81 | 29.3c | 16.7b | 21.4b |
| Lewjain | 1.3a | 3.3a | 7.3a |
| Madsen | 14.0ab | 18.9b | 20.7b |
| Penawawa | 3.3a | 1.4a | 10.0a |

^zValues indicate percent root infection. Means in the same column followed by the same letter are not significantly ($P=0.05$) different.

Relative Antagonistic Activity of Fluorescent *Pseudomonas* spp. Wheat-Cultivated Orchard Soils

| Treatment | Auvil | CV | Sunnyslope |
|-----------------|---------------|---------------|--------------|
| Control | 0.71a | 0.33a | 0.06a |
| Past. 95C | 0.63a | 0.50a | 0.40a |
| Eltan | 0.49a | 0.48a | 1.36b |
| Hill81 | 0.91ab | 0.34a | 0.43a |
| Madsen | 0.60a | 0.37a | 0.25a |
| Lewjain | 2.31c | 0.74ab | 2.23c |
| Penawawa | 1.65bc | 1.20b | 2.29c |



Advantages:

Takes advantage of resident microbial antagonists that are highly adapted to the site.

Can be used as a means to enhance soil OM

Is compatible with organic farming methods

Methods developed to “speed-up” the microbial transformation



Disadvantages:

Time

Cost of land not in production

Cost of raising the crop

