

Evaluation of Biological Control Products for Root Rot Control in Bedding Plants

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Biological control products are being considered more often for control of diseases in greenhouses and nurseries. Biological control relies on the use of antagonistic fungi or bacteria to control plants pathogens and it provides an alternative and environmentally-friendly way of controlling plant diseases without the use of chemical pesticides. Their accessibility to growers has prompted numerous ques-

tions as to whether the products actually work in controlling diseases, primarily root rots caused by the fungi *Pythium* and *Rhizoctonia*.

It is no surprise that the ornamental industry seems to be targeted by biological control products. Biological control, defined as the total or partial destruction of pathogen populations by other organisms, has been used for years. It is a naturally occurring process that humans are attempting to manipulate by introducing organisms known to be antagonists of plant pathogens into soil where they may be lacking. These approaches have worked successfully in laboratories and in greenhouse trials, but often fail under field conditions because the introduced antagonist is unable to compete with existing microorganisms in the soil. Ornamental plants are grown in sterile soilless mixes (a competition-free medium) often under controlled environmental conditions (greenhouses) making the ornamental industry a natural market for biological control.

Several biological control products are currently available including SoilGard®, RootShield™, Bio-Trek®, and Greygold®. In April and May of this year, I tested two products, SoilGard 12G (*Gliocladium virens* GL-21; Thermo Trilogy Corp. 7500 Grace Dr., Columbia MD 21044) and RootShield™ Granules (*Trichoderma harzianum* Rifai strain KRL-AG2; BioWorks Inc., 122 North Genesee Street, Geneva, NY 14456) for control of *Pythium* and *Rhizoctonia* root rots on five bedding plant species.

Both SoilGard® and RootShield™ granular products were incorporated separately into a peat-based soilless growing medium (Premier ProMix) at the rate of 1 pound per cubic yard. Inoculum of *Pythium* sp. and *Rhizoctonia solani* was then incorporated separately into the media containing the biological control products and in non-amended media. Market packs were filled with the soilless media treatments and 12 plugs (#512) of five bedding plant species (impatiens 'Dazzler White', begonia 'Ambassador Scarlet', vinca 'Pacific Red', petunia 'Dreams Mix', and salvia 'Red Hot Sally') were transplanted into each soil treatment. Plants were evaluated 4-5 weeks after transplanting for plant survival. Living plants were measured for average plant height and fresh foliage

weight, dry foliage weight, and dry root weight per plant, tables 1 and 2).

In general, neither of the biological control products tested could be relied on completely for *Pythium* and *Rhizoctonia* root rot control nor did the products provide any benefit to plant growth in the absence of a pathogen. For impatiens, only the fungicide treatment (Cleary's 3336WP drench at the rate of 12 oz/100 gal) was effective at controlling *Rhizoctonia* root rot (Table 1). Poor control of *Rhizoctonia* with the biological control products on impatiens, begonia, and petunia and on other plants where the disease tends to effect the foliage can be explained.

The biological control products tested rely on the use of fungi that colonize the root system of the host plants. They do not move through the plant or move from the soil. The fungi (*Trichoderma* and ® *Gliocladium*) can parasitize the hyphae (fungal thread-like growth) of *Rhizoctonia* and inhibit the growth of *Pythium*. They also compete with the pathogen for infection sites on the root system. The pathogen, *Rhizoctonia*, infects the roots and crown of host plants and under humid, wet conditions causes an aerial blight when the fungus moves from the soil and infects the leaves and stems of plants resulting in their collapse. With the biological control products, no protection is provided to the plant parts above the soil and therefore, adequate control of the disease was not achieved.

The effect of *Thizoctonia* root rot on salvia and vinca was less than in impatiens, begonia and petunia plants. The only significant difference among the soil treatments evaluated for salvia and vinca was in plant height. For salvia, both SoilGard® and RootShield™ provided control of *Rhizoctonia* root rot equal to fungicide treatment (Cleary 3336WP drench) and the non-inoculated control.

Control of *Pythium* root rot with RootShield™ was more promising than control achieved in the *Rhizoctonia* tests. For all plants tested, except impatiens, SoilGard® did not control *Pythium* infection and resulted in significantly lower fresh foliage weights and plant heights than the *Pythium*-inoculated control (Table 2).

Due to the age and size of the plant plugs when planted into the *Pythium*-inoculated soil mixes, no significant plant loss was found. Losses due to *Pythium* infection are primarily due to damping-off in which *Pythium* infects the young, tender roots and stem of host plants, killing them. Older, established roots can often sustain *Pythium* infection without plant death. Infected plants are generally weaker and smaller and can not withstand plant stress.

Both SoilGard® and RootShield™ adequately controlled *Pythium* infection on impatiens equal to fungicide treatment

(Subdue 2E drench at the rate of 1 fl. oz/100 gal) and non-inoculated controls (Table 2). RootShield™ also controlled *Pythium* infection petunia, however, SoilGard® did not. Vinca and salvia plant results were similar. RootShield™ treatment was not significantly different from the inoculated control and, therefore, did not control *Pythium*. Only the fungicide treatment adequately controlled the disease on vinca, salvia, and begonia.

The effectiveness of the biological control products to control root rot diseases was variable on the bedding plants tested which only demonstrates how variable the products can be. Results of other studies have shown that RootShield™ and SoilGard® are effective in reducing root rot diseases. The main point I want to make is that you must try the products on a limited basis in your own production system to truly know whether they will work for you. I would not recommend relying solely on biological control for disease management.

Root rot diseases develop primarily from unsanitary greenhouse conditions that introduce the pathogens into new crops such as plant and soil debris on benches and floor, insect problems, reused pots and unclean tools, and poor environmental conditions that favor disease development including over-watering and high soluble salts. Avoidance of these conditions will reduce root rot diseases.

The biological control fungi I evaluated (*Trichoderma* and *Gliocladium*) are natural soil inhabiting fungi. Their growth is favored by drier soils. If you are over-watering and promotion conditions favoring disease development, you also are providing conditions unfavorable for the biological control fungi which may reduce its effectiveness.

One other consideration when using biological control products is how the products are introduced into the growing medium. I incorporated the products into the soilless mix prior to planting. Some products also have a drench formulation that can be applied after plant establishment. The granular products are convenient because it reduces labor costs and time, but depending upon storage time and conditions the viability of the products may be affected. These products contain living organisms. If they over-heat or freeze or are stored too long prior to use, the biological control fungi may be killed.

If you are interested in trying any biological control product in your greenhouse or nursery, let me know. I am interested in finding out how the products are working for individual growers and I can help design a test that can show you if the products are providing any benefit to you.

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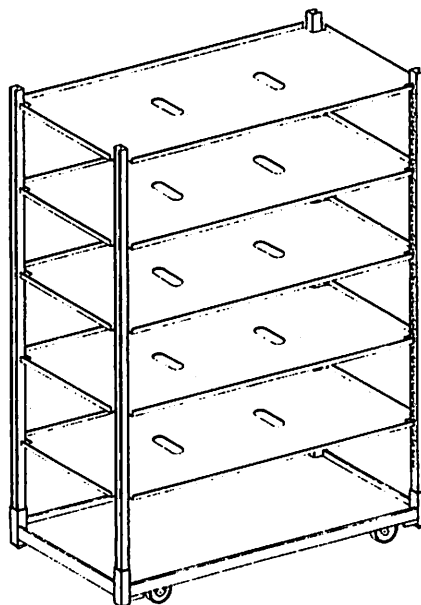


Table 1. Evaluation of RootShield™ and SoilGard biological control products on growth of bedding plants inoculated and non-inoculated with *Rhizoctonia solani*.

IMPATIENS ‘Dazzler White’					
Soil Treatment	Plant Loss (%)	Plant Height (cm)	Fresh Foliage Weight (g)	Dry Foliage Weight (g)	Dry Root Weight (g)
Non-inoculated control	0 a ⁴	13.9 ab	14.5 a	0.7 a	0.3 b
Non-inoculated: SoilGard ¹	0 a	14.0 ab	16.8 a	0.9 a	0.3 b
Non-inoculated: RootShield ²	0 a	15.5 a	15.2 a	0.9 a	0.5 a
Inoculated control	50 b	5.1 c	4.0 b	0.3 bc	0.2 c
Inoculated: SoilGard	75 b	1.8 d	1.1 b	0.1 c	0.0 d
Inoculated: RootShield	83 b	3.4 cd	5.5 b	0.5 b	0.1 cd
Inoculated: Fungicide-treated ³	0 a	12.1 b	13.6 a	0.7 a	0.3 b
BEGONIA ‘Ambassador Scarlet’					
Non-inoculated control	0 a	11.1 a	25.0 a	0.7 a	0.14 ab
Non-inoculated: SoilGard ¹	0 a	10.8 a	24.4 a	0.7 a	0.07 bc
Non-inoculated: RootShield ²	0 a	12.2 a	22.3 ab	0.6 a	0.14 ab
Inoculated control	17 ab	4.5 c	8.2 c	0.3 a	0.04 c
Inoculated: SoilGard	33 b	6.2 b	11.4 bc	0.4 a	0.05 c
Inoculated: RootShield	25 ab	4.3 c	6.9 c	0.3 a	0.07 bc
Inoculated: Fungicide-treated ³	17 ab	5.2 bc	9.8 bc	0.4 a	0.15 a
PETUNIA ‘Dreams Mix’					
Non-inoculated control	0 a	15.1 a	13.1 ab	0.7 a	0.2 a
Non-inoculated: SoilGard ¹	0 a	15.1 a	14.8 ab	0.7 a	0.1 a
Non-inoculated: RootShield ²	0 a	15.3 a	14.9 ab	0.8 a	0.1 a
Inoculated control	17 b	13.1 b	11.1 bc	0.8 a	0.2 a
Inoculated: SoilGard	42 c	9.3 c	8.5 c	0.7 a	0.1 a
Inoculated: RootShield	25 b	10.5 c	9.9 bc	0.8 a	0.1 a
Inoculated: Fungicide-treated ³	25 b	13.9 ab	16.7 a	1.2 a	0.2 a

¹ SoilGard 12G (*Gliocladium virens* GL-21) incorporated at rate of 1LB/cu.yd soil mix prior to planting.

² RootShield Granules (*Trichoderma harzianum* Rifai strain KRL-AG2) incorporated at rate of 1 LB/cu.yd soil mix prior to planting.

³ Plants drenched with Cleary’s 3336WP at the rate of 12 oz/100 gal after planting.

⁴ Numbers followed by the same letter are not significantly different at $p=0.05$.

Table 2. Evaluation of RootShield™ and SoilGard biological control products on growth of bedding plants inoculated and non-inoculated with *Pythium* sp.

IMPATIENS 'Dazzler White'					
Soil Treatment	Plant Loss (%)	Plant Height (cm)	Fresh Foliage Weight (g)	Dry Foliage Weight (g)	Dry Root Weight (g)
Non-inoculated control	0 a ⁴	13.9 a	14.5 ab	0.7 bc	0.3 bc
Non-inoculated: SoilGard ¹	0 a	14.0 a	16.8 a	0.9 a	0.3 bc
Non-inoculated: RootShield ²	0 a	15.5 a	15.2 ab	0.9 a	0.5 a
Inoculated control	0 a	12.7 a	10.9 c	0.5 d	0.2 c
Inoculated: SoilGard	0 a	14.7 a	13.8 b	0.6 c	0.3 bc
Inoculated: RootShield	0 a	14.0 a	14.2 ab	0.7 bc	0.4 ab
Inoculated: Fungicide-treated ³	0 a	13.5 a	14.9 ab	0.8 b	0.4 ab
VINCA 'Pacific Red'					
Non-inoculated control	0 a	12.4 ab	5.0 a	0.5 b	0.21 a
Non-inoculated: SoilGard ¹	8 a	14.0 a	5.6 a	0.6 a	0.16 ab
Non-inoculated: RootShield ²	0 a	13.9 a	4.7 a	0.5 b	0.16 ab
Inoculated control	0 a	8.2 c	2.6 b	0.2 d	0.06 cd
Inoculated: SoilGard	0 a	4.7 d	1.4 c	0.2 d	0.03 d
Inoculated: RootShield	0 a	9.7 bc	3.3 b	0.4 c	0.11 bc
Inoculated: Fungicide-treated ³	0 a	10.7 bc	5.2 a	0.6 ab	0.16 ab
PETUNIA 'Dreams Mix'					
Non-inoculated control	0 a	15.1 a	13.1 ab	0.7 a	0.2 a
Non-inoculated: SoilGard ¹	0 a	15.1 a	14.8 ab	0.7 a	0.1 a
Non-inoculated: RootShield ²	0 a	15.3 a	14.9 a	0.8 a	0.2 a
Inoculated control	0 a	16.6 a	10.5 b	0.4 bc	0.1 a
Inoculated: SoilGard	0 a	8.1 b	5.5 c	0.3 c	0.1 a
Inoculated: RootShield	0 a	15.5 a	13.0 ab	0.7 a	0.1 a
Inoculated: Fungicide-treated ³	0 a	16.0 a	12.1 ab	0.6 ab	0.1 a

¹ SoilGard 12G (*Gliocladium virens* GL-21) incorporated at rate of 1LB/cu.yd soil mix prior to planting.

² RootShield Granules (*Trichoderma harzianum* Rifai strain KRL-AG2) incorporated at rate of 1 LB/cu.yd soil mix prior to planting.

³ Plants drenched with Subdue 2E at the rate of 1/2 fl. oz/100 gal after planting.

⁴ Numbers followed by the same letter are not significantly different at $p=0.05$.