Auburn University
Southern Forest Nursery
Management Cooperative

RESEARCH REPORT 15-03

EVALUATION OF SUMAGROW™ AS A BIOLOGICAL SOIL AMEMDMENT/ INOCULANT FOR THE PRODUCTION OF LOBLOLLY AND SLASH PINE

by
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INTRODUCTION

In recent years there has been an emphasis on conducting business in a "green environment" to attract more environmental-conscience consumers. Companies that market biological pest management or soil amendments/inoculants products are frequently approaching nurseries to sell their products under the green umbrella. These products are marketed to either control the soil microflora, enhance plant growth, or bolster the physical, chemical and nutritional status of the soil environment.

The use of biological soil inoculants (BSI) to protect plants from pathogenic soil micro-organisms is not a new idea but one that continues to appear in the inboxes and mail boxes of many nurseries and the staff at Auburn University. In 2009, a Google® search of the term "soil inoculants" yielded 6,100 hits or Web Pages; in 2015 the same search term yielded 243,000 Web Pages. Microbiologists have known for many decades that organic wastes and animal manures contain their own indigenous populations of microorganisms, which in theory, may be a good idea, but in practice have result in unpredictable and inconsistent results (Parr et.al. 1994). Biological Soil Inoculants act against soil pathogens through several methods; the production of antibiotics; by competing for space and utilization of substances needed for growth, by directly parasitizing the soil pathogen; or by the production of toxins or compounds needed by the microorganism for normal metabolic activity (Baker 1968, Parr et. al. 1994).

Microorganisms present in the root zone can also affect plant development. These organisms can increase the availability of nutrients to the plant, increase the ability of plants to take up nutrients, or produce plant hormones (IAA e.g.) thereby increasing plant growth, (Vondewell et. al. 2001). A commonly known effect is the presences of certain mycorrhizal fungi which make phosphorus more readily available to the plant.

All of these BSI must be added to an 'inert' carrier in order to be applied to the soil or greenhouse containers. Sometimes the carrier is indicated either on the label or the Material Safety Data Sheet (MSDS), many times however the inert carrier is not listed. Oftentimes, a common liquid carrier used in a number of BSI is listed as the generalized term "humic acids". Humic substances are not a singular compound but rather a naturally occurring, heterogeneous organic substance that can be divided into humic acids and fulvic acids. Humic acid is a high molecular weight, long chain molecule, dark brown in color and soluble in an alkaline solution. Fulvic acid is a low molecular weight, short chain molecule, yellow in color and soluble both acid and alkaline solutions. Both humic and fulvic acids alone are known to increase plant growth (Senn and Kingman 1973).

SumaGrow™ is a new BSI compounds. According to the manufacture, SumaGrow™, is a synergistic consortium of native microbes selected for their abilities to increase plant health and growth through soil fertility and promoting early root formation. In addition, SumaGrow™ inhibits plant pathogens and enhances the plant's natural defense mechanisms. The exact ingredients of SumaGrow™ are proprietary but a company reports that it contains 30 different strains of bacteria and fungi that are found in healthy soil including, *Azorhizobium*, *Pseudomonas*, *Enterobacter*, *Stenotrophomonas*, *Bacillus*, *Rhizobium* and *Trichoderma* in a 12% carrier of Humic Acid. The product costs between $40 and $50 USD per gallon/acre.

Prior to the 2014 growing season, a representative from Bio Soil Enhancers in Hattiesburg, MS contacted a Nursery Cooperative member to see if it was possible to test SumaGrow™ in a nursery production system. Previous in-house Bio Soil Enhancer studies had shown positive results in loblolly pine outplanting trial which is why they wanted to test the material in a nursery production system. The nursery contacted the staff at Auburn and we began discussions to develop an experimental design and protocol. Initially, Bio Soil requested an operational experiment where the nursery would reduce total fertilization by 50% in the treatment area as the company felt their product worked best under reduced nutritional conditions. However, since we did not have any first-hand experience with the product, this request to reduce fertilization was declined by the nursery. We explained that a nursery would be more willing to put in a second study if some benefit was seen using the product at normal fertility levels. Thus, the purpose of this study was to determine if there was a seedling response to SumaGrow™ treatments under normal seedling production activities.

METHODOLOGY

Within the nursery, three different units were identified. The first unit, three years from fumigation, was sown with slash pine; and two other adjacent units, two years from fumigation, were sown to loblolly pine (Table 1).

Two applications of SumaGrow™ were made to a randomized block design. The first application of 0.5 gallon/acre was made on May 2, 2104 and the second and final application of 0.5 gallon/acre on June 2, 2014. Each plot was 60' x 120' and the SumaGrow™ was applied with a nursery 9-bed sprayer. The control plots did not receive any SumaGrow™. The study was replicated in the loblolly pine seven times and three times in the slash pine. All plots within the units were managed under normal nursery protocols including nutrition and pest management.

Following the first and second application of SumaGrow™ in June (Table 1), seedling counts were made from the treated areas using 3 sq ft counting frame and seedlings were collected for quality evaluation throughout the season from either beds 2, 4, 6 or 8 within each unit near the midpoint of each treated plot.

All data were analyzed in SAS 9.2 using analysis of variance (ANOVA). Treatment means with Pr > F less than or equal to 0.05 indicates statistically significant differences.

RESULTS AND DISCUSSION

Loblolly pine: The application of SumaGrow™ during the growing season on loblolly pine had no effect on seedling numbers (Table 2) or seedling characteristics (Table 3 and 4) when compared to the non-treated control seedlings at the end of the growing season in November 2014.

Slash Pine: Unlike loblolly pine, the application of SumaGrow™ on slash pine over the growing season increased seedling densities (Table 2) and seedling growth (Table 3 and 4) over the non-treated control seedlings at the end of the growing season. However, the magnitude of the difference does not support a significant biological difference between SumaGrow™ and the nontreated control. However, there were several observations that indicate SumaGrow™ may be beneficial on either slash pine or seedlings growing on third year land. The seedling counts for slash pine were more consistent over time for the SumaGrow™ treatment compared to the control (Table 2) and numerically greater for four of the five sampling periods (Figure 1). The higher seedling densities resulted in smaller seedlings in the SumaGrow™ treatment. This effect of smaller seedlings being associated with greater seedling densities has frequently been observed in other Nursery Cooperative research. A benefit of soil amendments/inoculants such as SumaGrow™is that the organisms included in the product may improve plant health by protecting the seedlings from pathogenic organisms. Since the slash pine in this study were grown on third year land, it is possible that the non-treated control seedlings were negatively affected by pathogenic organisms associated with third year land.

MANAGEMENT IMPLICATIONS

These products are safe when applied as directed, however, a nursery manager must decide if any benefit (such as, increased seedling numbers or quality) from applying BSI outweigh the treatment costs. Based upon the significant increase in the market availability of BSI products in the past several years one fact that is certain, you will be contacted by a BSI salesmen. Be aware of the following points:

1. Salesmen make a living selling their product. Expect to be contacted at some time.
2. For some BSIs, we know the composition (ex. Plant Shield®, Root Shield®). However, for others, the active ingredients are either proprietary (as with SumaGrow™) or presented in such a general description that it is of no practical use. For example: "This product contains 5 beneficial, synergistic soil fungi." The question I have learned to ask is "What is the composition of the inert ingredients?" I was told by a salesman of biologicals that companies include "inert" ingredients in their products that just by themselves are known to elicit positive plant response (i.e. fertilizers).
3. Inquire if the reported response is due to the active or inert ingredient? It is entirely possible that the combination of organisms causes a synergetic effect (greater that the individual alone). However, it may also be true that one ingredient (active or inert) may cause most if not all of the response. Previous Nursery Cooperative research (Research

Report 09-05) has shown that humic acid (which is a common BSI carrier) can increase seedling quality when compared to fertilizer alone. Humic acid has been shown to increase the uptake of nutrients in plants, especially nitrogen, phosphorus iron and zinc (Hopkins and Stark 2003, Senn and Kingman 1973, Tan and Nopamornbodi 1979, Rauthan and Schnitzer 1981, Mackowiak et. al. 2001). A liquid humic acid is generally used in conjunction with the application of a liquid fertilizer. The cost of humic acid is approximately $15/gallon/acre. The decision should be made as to whether using your normal fertilization program supplemented with humic acid or buy a BSI for a higher cost per acre and adjusting fertilization use works best for your nursery.

4. Some products are well documented on the web others are not. It goes without saying that just because a company has an impressive web site; it does not validate the efficacy of the product. But, in this internet savvy world, I would question a product that cannot be found on the web.
5. Salesman will drop names of "well-know" people or institutions that have verified or back their product. Recently, a salesman told me that a professor at Auburn tested his particular product, later when I contacted this professor at Auburn University, his memory was that he had tested the product over 15 years ago but the product was sold under a different name.
6. Some products have a history of name changing. Old name/product didn't sell? Try changing the name and marketing approach.
7. Biological Soil Inoculants are here to stay; we will probably have the opportunity to further test these products in the future, hoping to find one to wholeheartedly recommend to the Nursery Cooperative.

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Table 1. SumaGrow™ treatment and seedling evaluation dates, Shellman, GA 2014.

Loblolly Pine Sown	4/17/2014
Slash Pine Sown	4/21/2014
First application of SumaGrow™ on loblolly & slash pine	5/5/2014
Loblolly and Slash pine seedling counts	5/9/2014
Seedling counts	5/29/2014
Second application of SumaGrow™ on loblolly & slash pine	6/3/2014
Loblolly and slash pine seedling counts	6/10/2014
Loblolly and slash pine seedling counts	6/25/2014
First Seedling Quality evaluation	7/8/2014
Final seedling –Counts and Seedling Quality Evaluation	11/14/2014

Table 2. Seedling counts per square foot over the growing season for Loblolly and Slash pine seedlings treated with SumaGrow™, Shellman, GA 2014.

Species	Treatment	5/9/14	5/29/14	6/10/14	6/25/14	11/14/14
Loblolly	Control	26.9	28.8	27.6	26.8	26.3
Loblolly	SumaGrow™	26.0	28.3	27.6	27.7	27.0
	Pr>F	**0.12**	**0.65**	**0.98**	**0.45**	**0.54**
Slash	Control	24.9	28.7	26.7	26.5	22.8
Slash	SumaGrow™	26.7	27.7	28.2*	27.0	27.2
	Pr>F	**0.30**	**0.54**	**0.03**	**0.49**	**0.14**

Means followed by an *within a column row for a species indicate they are significantly different at alpha = 0.05.

Table 3. Seedling characteristics for Loblolly and Slash pine seedlings treated with SumaGrow™ July 2014, Shellman, GA.

				Dry Weight (gm)	
Species	**Treatment**	**RCD (mm)**	**Height (cm)**	**Root**	**Shoot**
Loblolly	Control	1.4	10.1	0.04	0.27
Loblolly	SumaGrow™	1.4	10.1	0.04	0.28
	Pr>F	**0.25**	**0.82**	**0.85**	**0.5**
Slash	Control	1.7	10.9	0.07	0.37
Slash	SumaGrow™	1.8*	10.9	0.07	0.39
	Pr>F	**0.02**	**0.72**	**0.82**	**0.61**

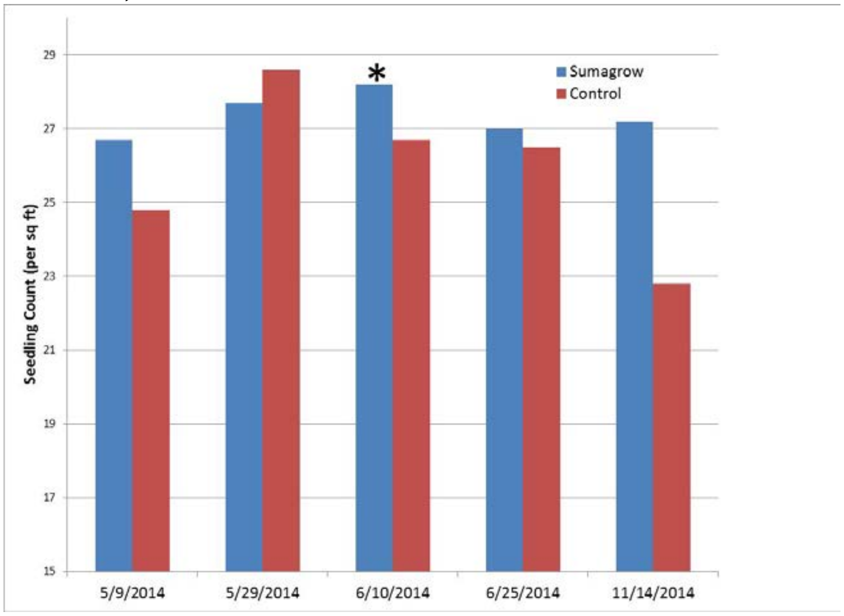
Means followed by an *within a column row for a species indicate they are significantly different at alpha = 0.05.

Table 4. Loblolly and slash pine seedling characteristics treated with SumaGrow™, Shellman, GA, November 2014.

				Dry Weight (gm)		
Species	**Treatment**	**RCD (mm)**	**Height (cm)**	**Root**	**Shoot**	**Root Weight Ratio (%)**
Loblolly	Control	5.0	30.0	0.77	3.7	17
Loblolly	SumaGrow™	4.9	29.9	0.76	3.6	17
	Pr>F	**0.23**	**0.72**	**0.83**	**0.71**	**0.79**
Slash	Control	4.6*	28.7	0.66	3.7	15
Slash	SumaGrow™	4.3	27.1	0.57	3.4	15
	Pr>F	**0.02**	**0.45**	**0.08**	**0.68**	**0.87**

Means followed by an *within a column row for a species indicate they are significantly different at alpha = 0.05.

Figure 1. Slash pine seedling counts treated with SumaGrow™ over the growing season, Shellman, GA 2014.



Column bars with an * within a date indicate they are significantly different at alpha = 0.05.