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RESEARCH REPORT 01-6

THE AFFECTS OF BIOGROW™ MYCORRHIZAL INOCULUM ON THE GROWTH OF HARDWOOD AND PINE SEEDLINGS AT THE JOSHUA TIMBERLANDS NURSERY

by
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INTRODUCTION

The symbiotic relationship between forest trees and their mycorrhizal fungi provide benefits to the tree host. Mycorrhizae are especially important in phosphorus nutrition when this element is sub-optimally available. Although a great deal of research indicates other benefits from mycorrhizae, such as increased water absorption and protection from some soil pathogens, these effects often differ from site to site. Even though specific mycorrhizae have been quantitatively more beneficial than others in some specific environments it may not be cost affective to supplant otherwise adequate, natural, mycorrhizal inoculum for seedlings to be planted on typical sites

Two mycorrhizal inoculum preparations (BioGROW™) from Mycorrhizal Applications Inc. were evaluated at the Joshua Timberlands Nursery near Elberta, Alabama during the 2000 growing season. Four species of oak were inoculated with a preparation designated for hardwoods and two species of pine were inoculated with the other preparation to determine if this commercially available inoculum would improve seedling quality.

METHODOLOGY

Two preparation of BioGROW™ mycorrhizal inoculum were purchased from Mycorrhizal Applications Inc. One preparation was for pines and one for hardwoods. Both contained fungus spores along with not described ingredients purported to increase colonization efficiency. These inocula were applied according to the directions provided by the producer. The initial volume of each preparation (1 L) was reported to contain sufficient spores to treat 100,000 seedlings at a rate of 100,000 spores per seedling. Therefore, for hardwoods at approximately 10/ft^2 there was inoculum for 2,000 linear feet of bed and this was applied to a 480 ft long bed of each of four oak species. The species treated were: water oak (Quercus nigra), shumard oak (Q. shumardii), nuttall oak (Q. nuttallii), and willow oak (Q. phellos). The litter of inoculum was shaken throughly and mixed with

6.5 gal of water and sprayed at rate of 20 gallons per acre over oak seedlings one month after sowing on May 16, 2000. Most of the oak seedlings were putting on their first true leaves when inoculated. The inoculum for pines was prepared and sprayed at the same rate as that for hardwoods even though there were more seedlings/ft^2 in the pine beds. Two beds of slash pine (*Pinus elliottii*) and two of longleaf pine (*P. palustris*) were also sprayed on May 16, using the inoculum preparation designated for pines.

After inoculation, treated seedlings were maintained like others of the same species within the nursery. On November 27, 2000 (186 days after inoculation) two samples from each inoculated bed and two from an adjoining but not treated bed were collected. In each inoculated bed, all seedlings within a 4ft^2 counting frame were harvested across from the second riser (approximately 80 ft from the bed end) and at the fourth riser in each inoculated bed and in the not inoculated bed that was up-wind during inoculation. The soil was loosened by inserting the whole blade of a shovel (11"deep) and pulling back until the seedlings with as many roots as possible could pulled from the ground. All seedlings within the counting frame were collected.

Seedlings were dried and measured in Auburn. The hardwood samples were divided into stems, large roots and fine roots and oven dried. The number of plantables and culls were determined (respectively, stems > than or < 1/4"RCD) and the mass of the components was recorded. Five randomly selected pine seedlings from each sample were root scanned (Hewlett Packard®6004C Scanner and WinRHIZO® software) to determine total root length and total fine root lengths, and separate subsamples were used to determine root and shoot weights and average RCD's.

Four hardwoods samples within each bed were combined and analyzed for differences attributable to species (N=4) and inoculation (N=2). Pines were analyzed for differences between species (N=2), bed (N=2) and inoculation (N=2). For both hardwoods and pines the null hypothesis was no difference between inoculated and not-inoculated seedlings.

RESULTS

Weight differences among oak species and for mycorrhizal inoculation are presented in Table 1. Growth differences between oak species were predictable, based on inherent germination energy for each species, and are presented as part of the replication scheme evaluating the affects of the mycorrhizal inoculum. However, the statistical significance of growth increases due inoculation (for rejection of H_0) became moot due to the greater mean biomass of not-inoculated seedlings. Differences between slash and longleaf pines and for mycorrhizal inoculation of these species is presented in Table 2. Similarly to the oaks, not inoculated pines were insignificantly larger. Also, root scan measurements indicative of more fibrous root systems (more total length and more fine root length) were greater among seedlings from not inoculated beds.

Despite more care than would typically be given during regular harvest, and good tilth of the nursery beds, we preserved little (almost none) fibrous root system on most lifted oaks. Although, this may be typical for large bareroot hardwoods, it reduces the importance (if any) of the transfer of mycorrhizae to the planting site. This probably restricts the beneficial affects of inoculating hardwoods (at least with ectomycorrhizae) mostly to growth in the nursery. The transfer of mycorrhizae from the nursery to the planting site can enhance the growth of pine seedlings outplanted to some harsh sites. However, even for pines most published evidence for increased growth after outplanting is confounded with size differences at nursery harvest.

Table 1. Seedling numbers and biomass for four oak species in beds treated or not treated with BioGROW™ mycorrhizal inoculum at Joshua Timberlands Nursery near Elberta, AL in 2000.

Variable	Cull† $4ft^2$	Plants $4ft^2$	Shoot $gm/4ft^2$	Large Root $gm/4ft^2$	Small Root $gm/4ft^2$	Root Shoot
Shumard	14	23	214	380	35	1.97
Willow	24	22	125	225	31	2.06
Nuttall	1	16	272	252	49	1.11
Water	3	12	132	121	15	1.06
Lsd	*10*	*11*	*62*	*58*	*15*	*0.43*
BioGROW	9.2	17.1	180	229	32	1.48
No BioGROW	11.5	19.3	192	260	34	1.61
Lsd	*6.9*	*7.9*	*44*	*41*	*10*	*0.30*

† Variables Cull and Plants are the number of seedlings/$4ft^2$, respectively, < or > 1/4" RCD

Table 2. Mass, RCD, and root lengths by diameter class for two species of pine in beds treated or not treated with BioGROW™ mycorrhizal inoculum at Joshua Timberlands Nursery in 2000.

Variable	RCD† (mm)	Root Weight (gms)	Shoot Weight (gms)	Root Tips	Root Length (cm)	Root <0.5 mm dia in cm
Longleaf	11.5	3.38	11.5	632.5	232.6	131.95
Slash	6.5	1.36	5.3	904.6	279.3	103.01
Lsd	*1.0*	*0.48*	*2.0*	*604.3*	*146.8*	*77.4*
BioGROW	8.75	2.26	8.58	409.9	236.1	109.9
No BioGROW	9.04	2.48	8.21	450.4	275.9	125.9
Lsd	*1.05*	*0.48*	*2.26*	*260.1*	*147.5*	*82.7*

† RCD, and root and shoot weights are means for 25 randomly picked seedlings per plot sample. Root tips, root lengths and the length of roots < 0.5mm in diameter are means for five root scanned seedlings per sample plot.

MANAGEMENT IMPLICATIONS

Innoculation with BioGROW™ did not affect hardwood or pine seedling quality, however, the products probably perform differently in different soils and with different species of trees. Like any treatment, it is important to evaluate new product (chemical or biological) in limited areas and to compare the cost to the response.