# Auburn University Southern Forest Nursery Management Cooperative

## RESEARCH REPORT 98-6

PLANT GROWTH-PROMOTING RHIZOBACTERIA AS A SEEDLING ROOT-DIP TREATMENT AT OUTPLANTING

by
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**INTRODUCTION**

Research with plant growth-promoting rhizobacteria (PGPR) on agricultural crops has been ongoing for nearly 15 years. However, the effects of bacteria as inoculants on forest trees has just entered a new phase of research. The potential benefits to the forest resource community of using PGPR as a disease control treatment, maximize growth promotion or to increase stand survival is enormous. While, the ability of PGPR to induce resistance and promote growth in such agronomic crops as cotton, cucumber, and peanut does not necessarily imply that they will work for forest tree species, there is no reason to suggest that PGPR isolates would not be effective against plant pathogens in either forest nurseries or plantations. Indeed, the same fungi that have been examined on other agricultural crops are common to both nursery and field settings. These include *Fusarium* sp., *Phytophthora* sp., *Pythium* sp., and *Rhizoctonia* sp.

While a number of PGPR strains used in agriculture have been identified that could be useful in reforestation programs, there are a few bacterial isolates have been examined more closely in Canada. For example the use of *Bacillus polymyxa* resulted in a significant increase in the biomass of lodgepole pine (*Pinus contorta*) and white spruce *(Picea glauca)* seedlings 8 weeks after sowing. Another PGPR isolate, *Burkholderia cepacia*, used in containerized nurseries in British Columbia resulted in a significant decrease in the amount of *Fusarium oxysporium* on Douglas-fir roots (*Psuedostuga menzesii*), increased seedling biomass and increased seedling stand survival for up to two years after outplanting. These examples strongly suggest that the beneficial effects of using specific PGPR are not limited to agronomic crops and would be highly beneficial in all areas of forestry. These studies were conducted to determine if currently available bacterial strains are effective at increasing seedling survival and growth after outplanting in the southeast United States.

## METHODOLOGY

In February 1996, two outplanting trials were conducted to examine the effects of using *Burkerholdia cepecia* as a root dip prior to planting. This bacterial strain was recovered from cotton roots near Auburn, Alabama and has been shown to be effective in controlling *Fusarium* root rot and increasing seedling biomass, and survival after outplanting of containerized lodgepole pine seedlings. In this trial, 400 bareroot loblolly and 400 longleaf pine seedlings were lifted from the Rock Creek Nursery in Brewton Alabama and hand planted at the Solon Dixon Forestry Education Center maintained by the School of Forestry at Auburn University. The site was a converted orchard and the planting site was banded with Oust® and Velpar® in the spring of 1996 and again in 1997.

Prior to planting, seedlings were soaked for 15 minutes in a five-gallon pail that contained 1000 mL of either water or water in which a 100 mL of concentrated bacteria were added. Seedlings were planted in rows of 20 seedlings with 10 rows per treatment. Loblolly pine seedlings were measured for height and root collar diameter after planting, and longleaf seedlings were measured for root collar diameter. Seedlings were monitored for survival as well as growth (loblolly) and emergence from grass stage (longleaf) at 6, 12 and 24 months after planting. If the bacterial treatment was to be effective, then treated seedlings should have greater survival and growth over non-treated seedlings.

## RESULTS

Pre-treating seedling roots with the bacteria had no affect on either seedling growth or survival at any of the three measurement periods for loblolly pine. Seedling growth over two growing seasons was approximately 1.6 m (5 ft) for both the treated and untreated seedlings with seedling survival at 91%. Only 6 cm (2 in) separate the two treatments with respect to seedling height (Table 1).

**Table 1. Loblolly pine seedling characteristics outplanted near Andalusia, Alabama.**

| Treatment | Height @ Planting | Height@ 24 months | Growth | Survival |
|---|---|---|---|---|
| Control | 20.2 cm | 196.8 cm | 176.6 cm | 91.0 % |
| Bacteria Root Dip | 21.9 cm | 190.2 cm | 168.3 cm | 91.0 % |

Treating seedling roots with the bacteria had no affect on either longleaf survival or emergence from grass stage at any of the three measurement periods. Seedling growth over two growing seasons was approximately 17 cm ( 7 in) for both the treated and untreated seedlings with seedling survival at 62%. Only 2.7 cm (1 in) separate the two treatments with respect to seedling height (Table 2).

**Table 2. Longleaf pine seedling characteristics outplanted near Andalusia Alabama.**

| Treatment | Height @ Planting | Height @ 24 months | Emergence from Grass Stage | Survival |
|---|---|---|---|---|
| Control | NA* | 18.9 cm | 62 % | 62 % |
| Bacteria Root Dip | NA | 16.2 cm | 60 % | 62 % |

## MANAGEMENT IMPLICATIONS

This particular PGPR strain did not increase either survival or growth over the non-treated loblolly or longleaf pine seedlings in outplanting trials. The lack of response was unfortunate as this particular strain had shown significant increases in lodgepole pine and Douglas-Fir in British Columbia. Thus, while *Burkerholdia cepecia* has been shown to be effective on other conifer species, we were not able to duplicate this effectiveness. Plans are to continue to monitor the outplanting trials for another two years for potential long-term affects, however, we have no further plans to pursue research with this product and do not recommend its use in outplanting to increase seedling survival or growth.