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RESEARCH REPORT 02-1

ROOT-DIPPING SEEDLINGS WITH RHIZOBACTERIA AMENDED VITERA DID NOT REDUCE RUST INFECTION AFTER OUTPLANTING

by
Scott Enebak and Bill Carey
&
Doug Sharp - Plum Creek Timber Company

INTRODUCTION

In two greenhouse trials, plant growth-promoting rhizobacteria (PGPR) induced systemic resistance (ISR) in loblolly pine to fusiform rust (Plant Dis. 84:306-308). Induce resistance is not unusual with respect to PGPR. Both foliar and root disease, as well as some insects are reported to be controlled in agronomic crop literature (Phytopathology 86:221-224). The duration of affects on plants has been examined and once induced, plants are as resistant as genetically resistant cultivars to a pathogen for at least through a growing season. With respect to forest tree seedlings, small reductions early in the rotation in the amount of fusiform rust could have a large impact in the volume of fiber produced. There is no reason to suspect that PGPR would not reduce filed infection as had been observed in the greenhouse. We addressed two questions, 1) How long will the "induced" resistance last? and 2) how much will infection be reduced? To test these two hypotheses, we examined the effects of treating loblolly and slash pine with PGPR prior to outplanting.

MATERIALS & METHODS

Seedlings

Two-thousand seedlings, in each of 4 half-sib families were lifted from the Jesup Nursery on February 5, 1999 and put in cold storage. Two families were slash pine (15X and 5X) and 2 families

were loblolly pine (52B and 504) and represented a high and low rust resistance value for each species.

Treatment

Pine seedlings were treated February 8, 1999 with one of three bacterial suspensions or a control. Seedlings from each family were removed from the cooler, counted and tied into 8 bundles of 60 seedlings each. Roots of seedlings in each bundle were dipped into 6 L of either Vitera alone or Vitera + Bacteria suspension. The Vitera mixture consisted of 1 gallon Vitera mix to 300 gallons of water and was taken off of the packing line. Vitera + Bacteria treatments were 6 L of Vitera to which 25 mL of one of three bacteria concentrates (1.0×10^{10} cfu mL) were added. The bacteria used in these trials were SE34 (#285), T4 (#286) and INR7 (#287). After treatment the 8 bundles of 60 seedlings were randomly divided into two piles of 4 each and placed into two bags for outplanting at either Jesup, GA or Hazelhurst, MS. Seedling bags were strapped and placed into cold storage.

Planting

Seedlings were planted at Jesup Georgia on February 9, 1999 on a site recently harvested, wind-rowed, chisel-plowed and double bedded. Within a family, seedling Vitera treatments were planted in a 4 x 4 factorial design - 16 blocks per family. Each seedling block was replicated 4 times and used a 10' x 5' spacing, (5 rows of 10 seedlings) for a 50 seedling plot. 800 seedlings were planted per family for a total of 3200 seedlings planted. Pearl River was planted on February 16, 1999 on a site recently disked and plowed. The design was a complete randomized block with 4 blocks of 51 seedlings each planted on a 10 x 6 spacing of 3 rows of 17 seedlings.

Measurements

One year after planting survival, growth and rust infection was determined by family and treatment. Data was collected for 1-, 2-Yr post planting at Jesup GA, and 1- and 3-Yr post planting at Hazelhurst, MS site.

RESULTS

At the end of the first field season, bacteria-amended Vitera at planting had not affected seedling survival, RCD, tree height or rust infection for any pine family at the Jesup GA planting site (Tables 1 & 2). Survival ranged from 54-79% for loblolly pine and one slash pine family had 2-6% survival depending upon the treatment. This survival could not be attributed to neither planting site, date of planting, treatment nor "planter". Data was collected at the Jesup GA planting site Year 2 post planting, however, as for Year-1 data, there was no treatment affect on survival, RCD or growth (data not shown). Rust infection was too low (10 galls on 1445 remaining trees) for treatment affects to be analyzed. Significantly more rust infection occurred at the MS site than the Jesup site. One bacterial treatment (LS286) resulted in smaller RCD's and lower survival compared to non-treated controls at Year 1 for loblolly pine family 504 (9.0 mm and 55.8% survival) (Table 3). Unfortunately, treatment with bacteria at the time of planting did not increase survival, seedling

growth or decrease rust infection over the non-treated controls (Tables 3 & 4). Considerable seedling mortality of the same slash pine family (16% survival) occurred in MS (Table 4), but one strain, LS285 increased survival of 15X with 77% survival vs 43% for the Check (Table 4).

MANAGEMENT IMPLICATIONS

Data collected from these trials did not suggest that rhizobacteria induced resistance to fusiform rust or increased survival and seedling growth across all families.

REFERENCES

Enebak, S.A. and Carey, W. A. 2000. Evidence for induced systemic protection to fusiform rust in loblolly pine by plant growth-promoting rhizobacteria. Plant Disease 84:306-308.

Wei, G., Kloepper, J.W., and Tuzun, S. 1996. Induced systemic resistance to cucumber diseases and increased plant growth by plant growth-promoting rhizobacteria under field conditions. Phytopathology 86:221-224.

Table 1. Seedling characteristics by species and family treated with PGPR and planted at Jesup, GA 1999.

	Loblolly Pine					
	Family 504			Family 52B		
Treatment	Survival %	Height (cm)	RCD (mm)	Survival%	Height(cm)	RCD(mm)
		70.4	19.3		62.9	
		68.5	18.2		60.9	
		68.3	18.6		60.1	
		70.7	19.0		57.5	

Table 2. Seedling characteristics by species and family treated with PGPR and planted at Jesup, GA 1999.

	Slash Pine					
	Family 5X			Family 15X		
Treatment	Survival (%)	Height (cm)	RCD (mm)	Survival (%)	Height (cm)	RCD (mm)
	6.0	56.6	19.2	44.0	58.6	21.2
	2.0	43.0	13.4	47.0	56.1	21.3
	1.5	74.0	23.8	39.5	56.1	20.5
	6.5	56.0	17.6	45.5	56.4	19.9

Table 3. Loblolly pine growth, survival and fusiform rust galls present 1 & 3 years post treatment with three PGPR strains at the time of planting for two families, Pearl River, MS 2002.

		First Year				2nd Yr Total		Third Year		
Family	Trmt	Hgt (cm)	RCD (mm)	Surv (%)	Galls[f]	Galls[f]	Galls[f]	[f] Hgt (cm)	Surv (%)	Growth (cm)
			11.7			0.10	0.17	342	89.7	286
			9.1			0.12	0.22	304	62.7	258
			9.0*			0.21	0.29	271	51.9	222
			10.4			0.13	0.36	300	76.4	246
52B	Check	54.3	12.0	72.0	0.30	0.20	0.50	308	72.0	253
	LS285	41.5	9.4	62.7	0.94	0.10	1.04	266	60.2	224
	LS286	53.9	10.5	54.4	0.28	0.37	0.66	285	54.9	231
	LS287	51.7	9.6	65.8	0.30	0.14	0.45	292	57.6	240

[f] Number of fusiform rust galls per tree

*Indicates that PGPR different from control, P=0.05.

Table 4. Slash pine growth, survival and fusiform rust galls present 1 & 3 years post treatment with three PGPR strains at the time of planting for two families, Hazelhurst, MS 2002.

		First Year				2nd Yr Total		Third Year		
Family	Trmt	Hgt (cm)	RCD (mm)	Surv (%)	Galls [f]	Galls [f]	Galls [f]	Hgt (cm)	Surv (%)	Growth (cm)
		42.4	17.9			0.44	1.12	241	20.5	199
		40.7	11.6			0.14	1.19	247	11.7	207
		45.9	11.6			0.34	0.86	261	12.2	215
		35.2	9.0			0.23	0.52	216	16.6	181
15X		38.2	11.2			0.78	1.99	215	41.6	176
		44.0	12.9			0.51	1.76	282	74.5*	238
		40.0	12.5			0.59	1.67	223	57.3	183
		41.3	14.3			0.64	2.00	279	59.8	238*

[f] Number of fusiform rust galls per tree

*Indicates PGPR different from control, P=0.05.