Effect of a Soil Bacterium (*Agrobacterium rhizogenes*) on Root Development and Drought Avoidance of Interior Douglas-fir Bareroot Planting Stock

**INTRODUCTION**

Douglas-fir is frequently planted in warm, droughty sites in the interior of British Columbia, where unsatisfactory survival is associated with low soil moisture during the summer. One hypothesis, tested in this study, was that treatments which could result in greater seedling root growth, and therefore perhaps greater ability by the seedling to use soil moisture, would increase survival. Strobel and Nachmias (1985) have shown that the soil bacterium *Agrobacterium rhizogenes* is associated with increased production of roots on bareroot almond (*Prunus amygdalus*) seedlings grown under field conditions in Israel. A very limited trial with Douglas-fir showed that the bacterium was associated with increased survival of treated seedlings. However, the small populations of the trial (15 seedlings per treatment) and the lack of evidence that the bacterium actually infected seedlings suggested the need for further research to establish the validity of these results.

**THE PROJECT**

Two-year-old bareroot Douglas-fir seedlings were grown from an interior seed source. Strain 232 of *A. rhizogenes*, employed in the foregoing experiment by Professor Strobel and kindly supplied by him, was used to treat the seedlings.

The bacterium was grown on liquid YM medium until a vigorous population was established. The medium was then divided into two fractions. In one, the bacterial population was allowed to remain intact; in the second, the bacteria was filtered out, but the medium constituents and any products of the bacterium were allowed to remain.

The roots of random populations of Douglas-fir seedlings were soaked for 0, 6, 12, or 24 hours in each of the containers of thoroughly aerated medium. In addition, a sub-set of randomly selected seedlings received a root abrasion treatment before soaking for 24 hours in the bacterial solution. This treatment was included in the experiment because it was believed that wounds in the root system might facilitate infection of the roots by the bacterium. Immediately after treatment in mid-May 1986, the seedlings were: 1) potted in 10-L containers of a sandy clay loam and then placed in a greenhouse; 2) planted in a prepared nursery bed; or 3) shipped to Kamloops for outplanting in a prepared field site. Twenty-five seedlings for each of the above treatments, together with 25 untreated (control) seedlings, were potted and arranged in a random design in the greenhouse where they were maintained with adequate irrigation during the summer and fall. Fifty seedlings which had been soaked for 24 hours in the bacterial solution and 50 seedlings which had been soaked for 24 hours in the medium and 50 control seedlings were planted in a random design in a nursery bed. One half of each population was exposed to rain and received irrigation; the second half was protected from precipitation and not irrigated.

A third set of seedlings, 100 for each 24-hour soak treatment except the root abrasion, and 100 control, were outplanted in a fenced enclosure near Savona. This field plantations was at an elevation of 1250 m in the IDP’s subzone. The ecosystem association is IIF; the surface soil is a loam; the subsurface is a clay loam. The area was harvested in 1982; site prepared and planted in 1984, though the resultant plantation was unsuccessful; and site prepared again in 1986 before establishment of the plantation. This last site preparation included ripping followed by scarification with a “shark-fin” barrel. The high soil water content at the time of site preparation largely obviated the intent of the scarification, which was to mix the organic material into the soil. The 100 seedlings of each population were divided into four groups of 25 plants each; the outplanting experimental design consisted of 12 randomly selected rows spaced 2 m apart, with seedlings spaced 1 m apart within the rows.

**RESULTS**

Potted seedlings which had received the root abrasion treatment either demonstrated extreme planting check or died. Obviously, the damage to the root system, although minor, overrode completely any possible effect of the bacterium. The remaining treatments had no effect on seedling phenology and no significant effect on seedling growth. The only measurable effect on either diameter or height growth was a slight reduction in growth with increased period of soaking in either solution. Similarly, treatment had no significant effect on either seedling phenology or seedling growth for the plants in the nursery bed.

The growth of seedlings in the field plantation was similar to that of the potted seedlings. Neither treatment tested produced a significant effect. The same trend of reduced growth with increased period of soaking also occurred, regardless of the presence of bacteria. However, seedling mortality was affected by treatment. Thirteen of the seedlings whose roots had been soaked in the bacterial suspension died; one of the seedlings whose roots had been soaked in the filtered medium died. None of the control seedlings died.
CONCLUSIONS

The inoculation of Douglas-fir seedlings with A. rhizogenes did not, in this study, produce superior survival or growth. An examination of the root systems of the potted seedlings also showed no superficial difference between the roots of inoculated and control seedlings. Either bacterial infection was not successfully established in the seedling roots, or the bacterium did not stimulate root proliferation. The results confirm a similar response of Douglas-fir germinants treated with several strains of A. rhizogenes in a concurrent study at the University of British Columbia. Failure to establish successful infections of seedling roots has also been reported by Diner and Karnosky (1987), who reported that they were able to establish A. rhizogenes infections of calli and seedlings of European larch (Larix decidua Mill.) but not of jack pine (Pinus banksiana Lamb.).

REFERENCES


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