Wetting Agent in the Planting Hole Reduced the Effect of Seasonal Drought on Douglas-Fir Container Stock

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The use of a wetting agent in the planting hole with Douglas-fir 1+0 plugs provided significant relief of moisture stress and reduced mortality compared to control seedlings during an 8-week drying cycle. A cost-effective means of application remains the major operational limiting factor.

Many Douglas-fir plantation failures on the east side of Vancouver Island, BC, result from seedlings being ill prepared for their first season of drought. Improved stock quality, handling, and timing of planting are needed. In the interim, use of a slow-release water source in or near the planting hole could alleviate some of these plantation failures. A wetting agent may provide sufficient slow-release water to pull many seedlings through their first critical season.

The objective of this trial was to test three levels of a wetting agent known as Aquakeep (Mitzuta Ind., Vancouver, BC), a polyacrylamide powder that can absorb up to 400 times its weight in water and release it more slowly than water bound to surrounding soil particles.

Methods

This experiment was designed as a completely randomized block with 3 replicates of 4 treatments and 25 seedlings per treatment. The four treatments consisted of four levels of Aquakeep in the planting hole (0, 0.125, 1.0, and 3.0 grams). The seedlings, 1+0 Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) containerized seedlings from a single seed source and nursery, were dibble planted into 15- centimeter-diameter pots. The potting medium consisted of 2 parts peat/1 part perlite/1 part coarse sand. The Aquakeep treatments were applied in powder form at the time of planting into the dibble hole. All seedlings were maintained at field capacity until 90 percent budburst had been achieved. At that point water was withdrawn.

The growing environment was a heated and vented glass greenhouse set to provide a 22 °C (±5 °C) day/night environment with a 16-hour photoperiod at approximately 500 microeinsteins. An additional subset of seedlings (40 seedlings per treatment) was used to assess predawn plant moisture stress (PMS) during the drying cycle (five seedlings per treatment per week).

All seedlings were assessed for survival weekly. Trees were a *priori* defined as dead if greater than 50 percent of their foliage was brown.

Results and Discussion

The results indicate that the presence of a wetting agent in the planting hole significantly decreased plant moisture stress and significantly delayed the onset of mortality (table 1, Figs. 1 and 2). In general, the more wetting agent present, the greater the delay in moisture stress and mortality. However, two important observations were made regarding optimum quantities of Aquakeep. It was evident during the destructive sampling that the wetting agent was acting as a water source while it remained wet. However, once it dried, it appeared to begin to act as a dessicant and may have begun to draw moisture from the seedling root system. This type of effect may explain the discontinuities in the PMS curves (figs. 1 and 2) for both the 0.125-gram and 1.0-gram treatments.

Table 1—*Analysis of variance significance table for treatment (Aquakeep) effects on plant moisture stress and survival for 8 weeks*

Factor	1	2	3	4	5	6	7	8
Plant moisture stress	**	***	***	NS	NS	**	NS	NS
Survival	NS	NS	NS	NS	NS	NS	**	*

*Significant at P = 0.1. ***Significant at P = 0.001.
**Significant at P = 0.05. NS - not significant.

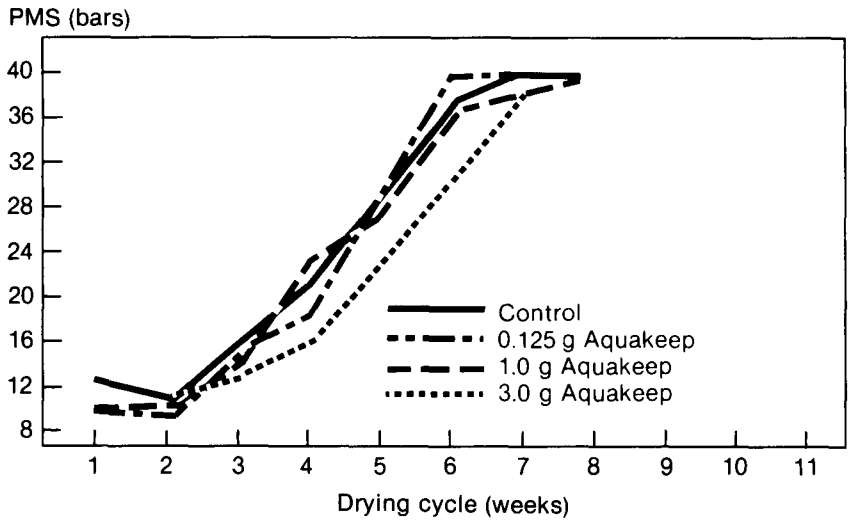

Figure 1—*Weekly mean moisture stress for Douglas-fir container seedlings treated with Aquakeep during an 8-week drying cycle*

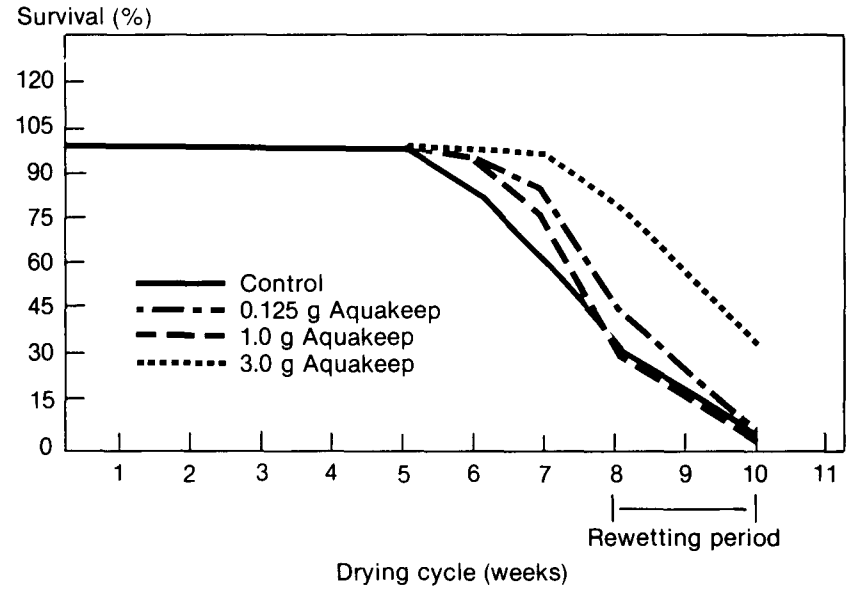

Figure 2—*Weekly mean survival for Douglas-fir container seedlings treated with Aquakeep during an 8-week drying cycle*

The 3.0-gram treatment exhibited a much smoother moisture stress and survival response curve. This may be attributed to the fact that this was the only treatment in which the wetting agent remained wet for the duration of the drying cycle. The major problem with the 3.0-gram treatment was a physical limitation. Apparently, for our potting mix and planting stock, this quantity of wetting agent was excessive. Expansion of the wetting agent as it absorbed water resulted in the plugs being pushed from the planting medium. Plugs were reinserted and the excess wetting agent remained on the surface of the planting medium. Plugs did not come out after reinsertion.

Although the treatments resulted in differential mortalities, the seedlings were responding to moisture stress consistently within treatments (fig. 3). The closeness of the fit in this mortality function suggests a strong link between accumulated moisture stress and seedling mortality. Unfortunately, due to the limitations of our pressure bomb (i.e., maximum 40 bars), we were unable to develop a "moisture stress day" relationship with mortality. Our results indicate this would be a fruitful avenue of future research.

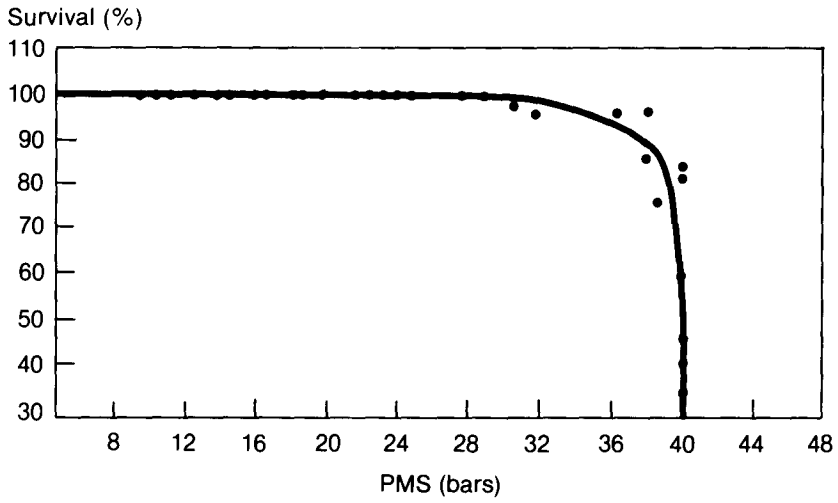

Figure 3—*Relationship of moisture stress and survival for Douglas-fir container seedlings*

Conclusions

The results of this experiment indicate that use of a wetting agent (*Aquakeep*) can provide significant relief of moisture stress and reduce mortality for Douglas-fir plug planting stock during prolonged periods of drought. Up to 3.0 grams of wetting agent per seedling can be effective. However, levels need to be field tested to determine acceptable upper limits. Operational field tests will be necessary to determine the most cost-effective means of delivery and the types of sites most likely to benefit.