Research Reports

Mist Irrigation Reduces Post-transplant Desiccation of Bare-root Trees[1]

Rick M. Bates and Alex X. Niemiera[2]
Department of Horticulture
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061-0327

Abstract

Desiccation during storage and reestablishment is a major factor contributing to poor regrowth of transplanted bare-root trees. The effect of overhead mist irrigation on reducing post transplant water stress in Norway maple (*Acer platanoides* L. 'Emerald Lustre') and Yoshino cherry (*Prunus* x *yedoensis*) was examined. Bare-root Norway maple (desiccation tolerant) and Yoshino cherry (desiccation sensitive) trees were transplanted into pine bark-filled containers and subjected to mist or non-mist treatments. Stem xylem water potential, relative water content, and survivability were determined. Xylem water potential increased (became less negative) for misted maple and cherry trees. Water potential increased for non-misted maple and decreased for non-misted cherry trees. Twenty-seven percent of non-misted cherries were evaluated as nonmarketable due to stem dieback compared to 0% for misted trees. Results of this study indicate that mist irrigation effectively reduces desiccation damage for desiccation sensitive species such as cherries and hawthorns.

Index words: *Acer platanoides*, *Prunus* x *yedoensis*, water stress, water potential, relative water content, survivability.

Significance to the Nursery Industry

Desiccation (water loss) of bare-root trees during lifting, storage, and after transplanting can reduce survivability and hence marketability. This is especially true for species that are typically sensitive to desiccation such as cherry and hawthorn. Results of this study showed that misting bare-root Yoshino cherry after transplanting and before bud break reduced water stress and increased marketability. Yoshino cherry pre-bud break water potential and relative water content values of < −2.2 MPa and 70%, respectively, signaled significant plant water stress. These values may be used to screen shipped bare-root trees of this species to determine post-transplant establishment potential. In this study there was no advantage to misting desiccation-tolerant Norway maple trees.

[1]Received for publication July 12, 1993; in revised form October 18, 1993.
[2]Graduate Student and Assistant Professor, resp.

Introduction

Water stress research on bare-root nursery stock has primarily focused on lift date, length of storage (3) and exposure to dry conditions during processing (1). Water loss from stem tissue, however, can continue after transplanting (7). Stem desiccation after transplanting and before new root growth during periods of high vapor pressure deficit can contribute to stem dieback and poor regrowth in certain species (4). Species such as *Crataegus phaenopyrum* L. is desiccation sensitive whereas *Acer platanoides* L. is desiccation tolerant (6). Several species of *Prunus* have shown poor regrowth following transplanting (personal observation). Some nurseries suggest "sweating" (wrapping liners with

The *Journal of Environmental Horticulture* (USPS Publication No. 698-330) is published quarterly in March, June, September, and December by the Horticultural Research Institute. Subscription rate is $60.00 per year in USA; $85.00 per year for others. Second-class postage paid at Washington, D.C. and at additional mailing office. Send address changes to HRI, 1250 I Street, N.W., Suite 500, Washington, D.C. 20005.

plastic under warm, humid conditions) difficult-to-transplant species as a means of increasing survivability. There are, however, no reports on the use of irrigation to reduce post-transplant desiccation of bare-root stock. The objective of this study was to investigate the effect of mist irrigation to reduce post-transplant stress in a desiccation sensitive (Yoshino cherry) and desiccation tolerant (Norway maple) species.

Materials and Methods

Two-year-old branched bare-root liners of 'Emerald Lustre' Norway maple and Yoshino cherry (30 per species) were shipped from Oregon to Virginia in February 1992. Xylem water potential was measured before initiation of treatments (February 17) using a portable pressure chamber (Model 3005, SoilMoisture Equipment Corp., Santa Barbara, CA) on a 10.2 cm (4 in) stem section excised from each tree. A second piece of internodal shoot tissue, 4 cm (1.5 in), was collected from each tree and fresh weight (FW) was immediately measured for relative water content (RWC) determinations. Stem sections were then placed on water-saturated cotton in airtight beakers for 48 h and reweighed to determine turgid weight (TW). Dry weight (DW) was determined after oven drying stem sections to a constant weight in a 62°C (143°F) oven for at least 72 h. Relative water content was calculated using the formula: RWC = (FW – DW)/(TW – DW) × 100. Trees were transplanted into 100% pine bark-filled 18.9 l (5 gal) plastic containers and dolomitic limestone was surface applied at 2.9 kg/m^3 (4.9 lb/yd^3). Containers were thoroughly irrigated by hand. Aluminum foil covers were fitted around tree stems and over container sides to prevent water (from mist) entering containers while allowing adequate oxygen exchange. The study was conducted in a greenhouse vented at 24°C (75°F) during the day and heated to a night minimum of 18°C (64°F). Beginning on February 17, half of the maple and cherry trees received overhead mist irrigation, 25 sec every 15 min, and the remaining trees received no mist irrigation. Xylem water potential and RWC measurements of stem sections were made between 1200 and 1400 HR for each tree 3, 6, and 9 days after initiation of irrigation treatments.

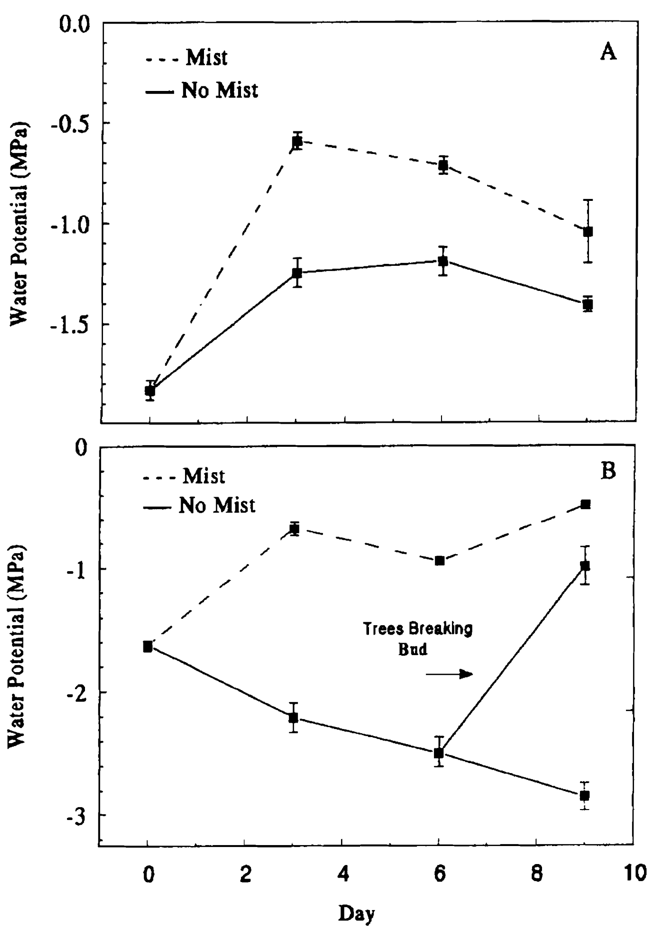

Fig. 1. Xylem water potential of Norway maple (A) and Yoshino cherry (B) as influenced by mist irrigation after transplanting. Each point is a mean of 15 measurements. Bars represent SE of means.

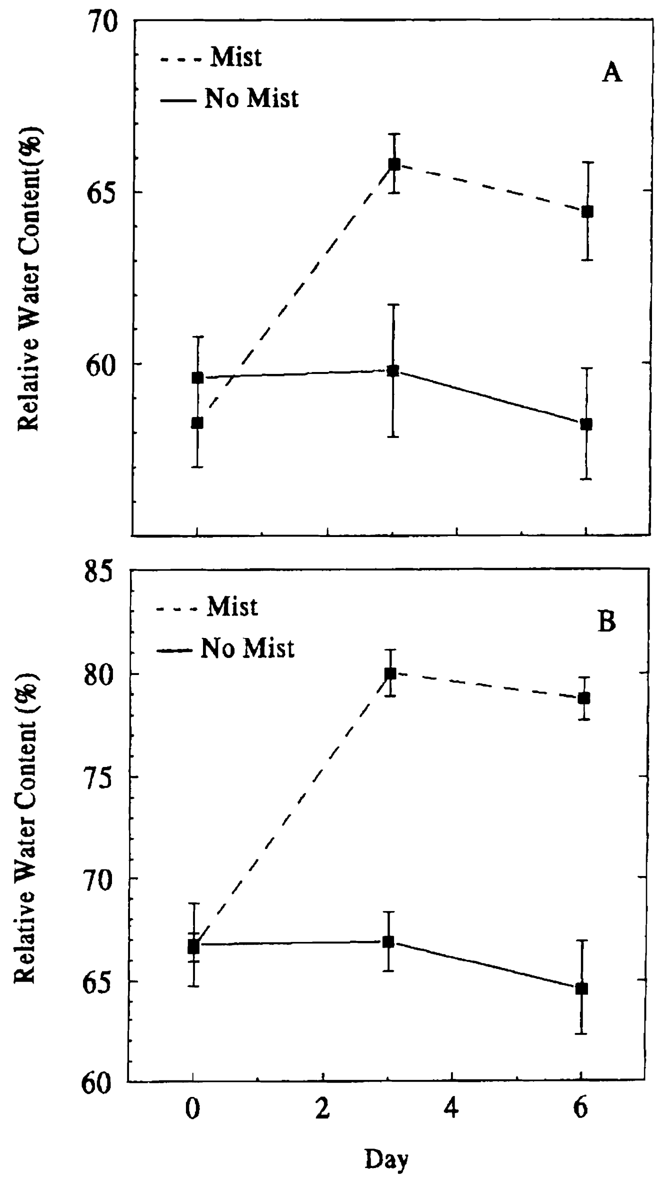

Fig. 2. Relative water content of Norway maple (A) and Yoshino cherry (B) as influenced by mist irrigation after transplanting. Each point is a mean of 15 measurements. Bars represent SE of means.

Plants were greenhouse-grown until May, at which time they were moved to an outdoor nursery. Sixty days after the termination of treatments, plants were graded as marketable or unmarketable. Marketable plants exhibited less than 10% shoot dieback whereas unmarketable plants had > 50% shoot death. There were no intermediate categories of shoot dieback. Data were subjected to analysis of variance procedures. Treatments (species, irrigation, time) were in factorial combination with 15 single plant replications using a completely randomized design.

Results and Discussion

For misted cherry and maple, stem xylem water potential increased (became less negative) during the first three days of the experiment (day 0 to day 3), (Fig. 1); after day 3, there were relatively small changes in water potential for either species. Water potential for all non-misted cherry trees decreased 1.2 MPa from day 0 until day 6 (Fig. 1). Thereafter, water potential increased for trees that exhibited bud break but continued to decrease for those not breaking bud. Water potential of non-misted maples increased 0.6 MPa from day 0 to day 9 (Fig. 1) indicating that transplanting bare-root maples into a moist medium relieved a portion of pre-transplant water stress and prevented further desiccation. In support of this contention, Johnson et al. (5) showed that one-year-old suberized *Pinus* roots were capable of absorbing water in the absence of young unsuberized roots. In contrast to maple, transplanting bare-root cherry trees into a moist medium without mist did not increase water potential. An exception to this occurred when eight of the 15 non-irrigated cherry trees broke bud after day 6 and water potential increased from −2.5 to −1.1 MPa (Fig. 1). This increase may have been related to new root initiation since regenerated roots generally exhibit greater hydraulic conductivity (5) which may have been responsible for the change in water potential. Although not monitored in this study, new root initiation for some species has been shown to occur concurrently with bud break (8).

The increase in RWC from day 0 to day 3 for misted cherry and maple was 12% and 7%, respectively (Fig. 2); after day 3, RWC remained relatively constant for both species. Relative water content of cherry was not measured beyond day 6 because bud break for non-misted cherries occurred about that time. The RWC for misted and non-misted maple (both 100% marketability) was generally less than non-misted cherry (73% marketability) which reflects the desiccation tolerant nature of *Acer platanoides* (6). In general, the magnitude of RWC differences between misted and non-misted trees of each species was similar to the magnitude in water potential differences for the respective treatments, indicating that xylem water potential and RWC are both reliable indicators of bare-root transplant water status.

Sixty days after treatment termination, 100% of misted cherries and maples and 100% of non-misted maples were evaluated as marketable (< 10% stem dieback). In contrast, only 73% of non-misted cherries were deemed marketable. The shoot dieback and unmarketable status of non-misted cherries is most likely due to desiccation following transplanting. These results indicate that pre-bud break stem water potential and RWC values < −2.2 MPa and 70%, respectively, for *Prunus* x *yedoensis* signal a stressful plant water status. These values may be used to indicate the necessity to mist shipped bare-root trees of this species.

In summary, overhead irrigation of transplanted bare-root trees before bud break increased the survival and plant quality of the desiccation intolerant *Prunus* x *yedoensis*. Other measures such as planting at a time when less stressful climatic conditions prevail, coating trees with film-forming compounds (2), and forcing plants out of dormancy may also increase survival.

Literature Cited

1. Coutts, M.P. 1981. Effects of root or shoot exposure before planting on the water relations, growth and survival of Sitka spruce. Can. J. For. Res. 11:703–709.

2. Englert, J.M., K. Warren, L. Fuchigami, and T. Chen. 1993. Antidesiccant compounds improve the survival of bare-root deciduous trees. J. Amer. Soc. Hort. Sci. 118:228–235.

3. Hermann, R.K. 1964. Effects of prolonged exposure of roots on survival of 2–0 douglas-fir seedlings. J. For. 62:401–403.

4. Insley, H. 1981. Some effects of plant handling on the dehydration and survival of broadleaved seedlings. *In*: Proc. Conf. Characterization of Plant Material, International Union of Forest Research Organizations Working Group 31. 05–04, Freiburg, Walbau, 180–91.

5. Johnson, K.H., S.P. McConnell, J.C. Regelbrugge, and J.R. Seiler. 1988. Hydraulic conductance of roots present at the time of lifting and newly regenerated roots of 2 + 0 eastern white pine seedlings. Tree Planters' Notes 39:5–8.

6. Murakami, P., T.H. Chen and L.H. Fuchigami. 1990. Desiccation tolerance of deciduous plants during postharvest handling. J. Environ. Hort. 8:22–25.

7. Schoneer, J. and H. Ziegler. 1980. Water permeability of Betula periderm. Planta 147:345–354.

8. Wilcox, H. 1955. Regeneration of injured root systems in noble fir. Bot. Gaz. 116:221–234.