EFFECTS OF DEFOLIATION AND ANTITRANSPIRANT TREATMENTS ON TRANSPLANT RESPONSE OF SCARLET OAK, GREEN ASH AND TURKISH HAZELNUT

by J. Roger Harris and Nina L. Bassuk

Abstract. *Combinations of defoliation and Moisturin®, a film antitranspirant, were applied to recently transplanted Quercus coccinea (scarlet oak) trees in August and to Fraxinus pennsylvanica (green ash) and Corylus colurna (Turkish hazelnut) trees in the late summer and fall of 1992. For scarlet oak trees, survival was poor for all treatments. Moisturin® treatments aided survival and spring shoot extension for green ash trees transplanted in late summer, but showed no effect on later dates. Defoliation was detrimental to survival of green ash trees at all transplanting dates. Root regeneration did not occur on transplanted green ash or Turkish hazelnut before spring bud break.*

In the past, it has been claimed that the primary cause of death of transplanted trees is water stress (8). Water stress can be indirectly imposed by failure of the much reduced root system to provide water to the rest of the tree (5,6) or directly imposed by improper handling, especially on trees moved in a bare-root condition (16). The above-ground symptoms of water stressed trees include scorched leaves, twig die back and lack of vigor (15). These symptoms, and the accompanying slow post-transplant growth, are known as manifestations of transplant shock. Transplant shock often reduces shoot extension for several years after transplanting (14). Since growth processes are physiologically the most sensitive to drought (7), post-transplant root extension may be severely restricted by water stress at transplanting, curtailing establishment.

Evaporative demands, and the resulting potential for water stress, increase as late spring and summer temperatures increase, leaves develop, and transpiration increases. However, these warmer temperatures and photosynthesizing leaves promote root growth (9). The capacity for plant establishment, if favorable water balance is maintained, may therefore be greater than when the plant is dormant. With this in mind, antitranspirants have often been applied in an attempt to prevent water stress (4,11). The blocking of stomates by antitranspirants, however, has been shown to curtail photosynthesis for extended periods (3). Antitranspirants, may therefore hinder the development of new roots by reducing the production of current photosynthates, which are important for new root growth (13).

Data on transplant response of pruned, non-dormant broad leaved plants are limited, but removal of leaves at transplanting has been shown to decrease post-transplant water stress in some instances. For example, Randolph and Wiest (10) found that Ilex crenata was less water stressed when shoots were pruned at transplanting, and Castle (2) found that citrus trees were less water stressed with increasing amounts of shoot pruning at transplanting.

The objective of this research was to test the hypothesis that transplant response of scarlet oak, green ash and Turkish hazelnut transplanted bare-root out of the traditional spring season, can be enhanced by partial defoliation or the use of an antitranspirant. Two experiments, summer transplanting of scarlet oak, and fall transplanting of green ash and Turkish hazelnut were initiated.

Materials and Methods

Summer Transplanting of Scarlet Oak. Moisture conserving treatments were applied to scarlet oak trees on August 16, 1992. Five treatments were randomly applied to four replicates (20 total trees). Treatments were: 1) no leaf removal (full leaf), 2) every other leaf removed (50% of leaves

removed), 3) 100% of leaves removed, 4) antitranspirant (Moisturin®, a latex emulsion film antitranspirant, Burke's Protective Coatings, Washougal, Wash.) at 1:6 (Moisturin®:water, v:v) solution applied to all shoots and leaves and 5) a 1:12 (Moisturin®:water, v:v) solution, applied to all shoots and leaves. Tree height and caliper (s.e. mean in parenthesis) 15 cm above the soil line at the time of treatment application were 2.34(0.07) m and 3.7(0.1) cm, respectively. Trees were harvested bare-root according to American Association of Nurserymen standards (1) 24 hours after application of treatments. All soil was washed from the root-balls immediately after harvesting, and trees were then transplanted into a completely random design. All trees were handled quickly and irrigated within an hour after digging. Trees were scored for survival (alive or dead) in July, 1993, and survival percentage was then calculated. Trees were considered alive if new shoot growth originated in the upper 50% of the tree.

Fall Transplanting of Green Ash and Turkish Hazelnut. Two hundred bare-root green ash seedlings were obtained from Schichtel's Nursery, and two hundred Turkish hazelnut seedlings were obtained from Watson's Nursery, both in Orchard Park, New York, on November 15, 1990. All trees were held in cold storage (5°C) until April, 1991 and then placed into 3-liter (trade 1-gal.) containers in equal parts topsoil:perlite:peat (v:v:v:) potting soil and grown outside. On August 26, 1992, 32 trees were chosen at random for treatment. Four treatments were randomly applied (8 replicates for each treatment): 1) a control; 2) all leaves and stems sprayed with a 1:12 (Moisturin®:water) mixture; 3) all leaves removed (defoliated); and 4) defoliated + a 1:12 (Moisturin®:water) mixture. After each treatment was applied, the potting soil was washed from the roots. All roots with diameters smaller than 3 mm were removed from green ash, and all roots smaller than 1 mm in diameter were removed from Turkish hazelnut to simulate the usual loss of small diameter roots when larger field-grown trees are transplanted bare-root.

All trees were then stored in cold storage(5°C) for one week, after which trees were transplanted into the ground outside and backfilled with native soil (Tioga silt loam) in a completely random design. This procedure was repeated on September 18, October 5, October 22 and November 10. Mean height caliper (s. e. of the mean in parentheses) just prior to treatment were 92.5(1.5) cm and 1.3(0.03) cm for green ash and 33.2(1.2) cm and 0.7(0.03) cm for Turkish hazelnut. Plants treated on October 22 and November 10 were considered defoliated because of natural fall leaf drop and therefore received only treatments 3 and 4.

Two replicates of each species from each harvest date were randomly selected for determination of root regrowth on May 6, 1993. This date coincided with general spring budbreak. All other green ash trees were harvested on July 13-16, 1993, and the number of regenerated roots (counted at junction with old tissue) and the total length of all new shoots were determined for each plant. Due to late winter herbivory no further measurements were made on Turkish hazelnuts. Shoot extension and root regeneration data from green ash were subjected to analysis of variance. Trees were considered alive if new shoot growth originated in the upper 50% of the tree.

Results and Discussion

Summer Transplanting of Scarlet Oak. Moisture conserving treatments were imposed on scarlet oak on August 16, and trees were transplanted the next day. This was at the time of bud set on the second flush of growth. Survival was poor for all treatments (Fig. 1). Control trees in full leaf transplanted with equal or better success than any treatment, but survival was only 50%. Scarlet oak is reported to be a difficult-to-transplant species (12) and apparently does not transplant well in the summer, regardless of rapid handling or treatment. Unlike the findings of Englert et al. (4), no benefit from treatment with Moisturin® was evident. However, Moisturin® concentrations were considerably greater (undiluted, 1:1 and 1:3, Moisturin®:water) in that study, and plants were dormant and leafless.

Fall Transplanting of Green Ash and Turkish Hazelnut. No root regeneration was found on trees of either species when harvested at budbreak on May 6. Transplanting dates began just after final bud set (Aug. 26) and continued through the

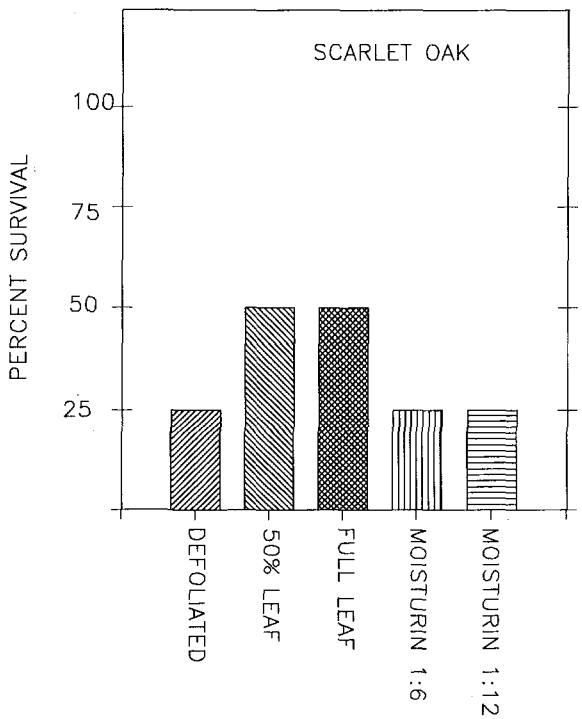

Figure 1. Percent survival of scarlet oak trees transplanted in the summer of 1992 with various Moisturin® and defoliation treatments, n = 4.

root growth period of established trees (data not shown). The capacity for root regrowth on the transplanted trees was therefore present. The period after final bud set has the most potential for plant establishment before spring budbeak since shoot tissues are well developed and able to resist water loss, and a long period with warm soil is available. However, root regeneration on early fall transplants was probably curtailed by transplant shock, despite favorable potential for root regrowth, and the time required for acclimation to transplanting may have left insufficient time for root regeneration because of decreasing soil temperatures.

Although overall treatment effects on shoot extension of green ash were not statistically significant at conventional levels (p = 0.11), a beneficial treatment effect probably occurred for Moisturin® treated plants on August 26 (Fig. 2A). However, no treatment effect trend was evident on the number of new roots (Fig. 2B). Further evidence that Moisturin® was beneficial on this

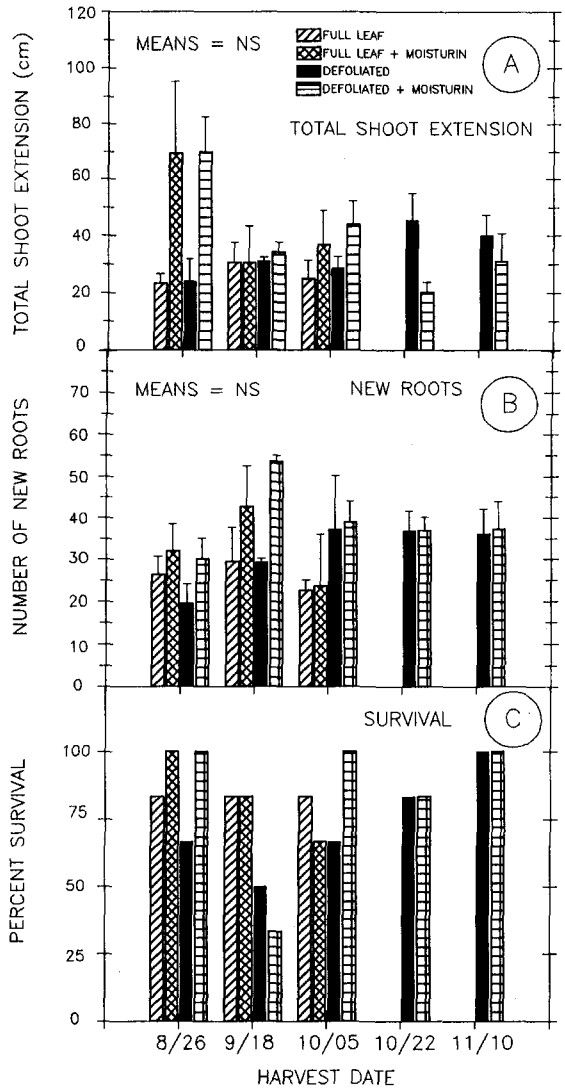

Figure 2. Total spring post-transplant shoot extension (A), number of new roots formed (B) and survival percentage (C) for green ash seedlings transplanted with combinations of Moisturin® and defoliation treatments throughout the fall of 1992. Bars represent standard errors of the means. n = 6.

date is that survival was 100% for both Moisturin® treatments (Fig. 2C), while survival was lower for the other two treatments. Moisturin® had no apparent beneficial effect on measured responses on other transplant dates, and the data suggest that a negative effect on shoot extension (p = 0.06) may have been present on the October 22

transplant date. Defoliation of trees in full leaf proved detrimental for survival, except for those trees treated with Moisturin® on August 26. If early fall transplanting is to be very beneficial, methods which decrease transplant shock sufficiently to allow for root regeneration before the onset of winter are needed. The data from this study indicate that scarlet oak probably cannot be successfully transplanted bare-root in the summer, regardless of treatments imposed. The effects of Moisturin® were marginal on green ash under the conditions of this study. However, green ash is considered an easy-to-transplant species, and response to treatments on a difficult-to-transplant species (e.g. Turkish hazelnut) may yield different results.

Literature Cited

1. American Association of Nurserymen. 1990. American Standard for Nursery Stock. American Association of Nurserymen, Inc. Washington, DC.
2. Castle, W.S. 1983. *Antitranspirant and root and canopy pruning effects on mechanically transplanted eight-year-old 'Murcott' citrus trees.* J. Amer. Soc. Hort. Sci. 108: 981-985.
3. Davies, W., and T. Kozolwski. 1974. *Short- and long-term effects of antitranspirants on water relations and photosynthesis of woody plants.* J. Amer. Soc. Hort. Sci. 99: 297-304.
4. Englert, J.M., K. Warren, L.H. Fuchigami, and T.H.H. Chen. 1993. *Antidesiccant compounds improve the survival of bare-root deciduous nursery trees.* J. Amer. Soc. Hort. Sci. 118: 228-235.
5. Geisler, D., and D. Ferree. 1984. *The influence of root pruning on water relations, net photosynthesis, and growth of young 'Golden Delicious' apple trees.* J. Amer. Soc. Hort. Sci. 109: 827-831.
6. Harris, J.R., and E.F. Gilman. 1993. *Production method affects growth and post-transplant establishment of 'East Palatka' holly.* J. Amer. Soc. Hort. Sci. 118: 194-200.
7. Hsiao, T.C. 1973. *Plant response to water stress.* Ann. Rev. Plant Physiol 24: 519-570.
8. Kozlowski, T.T., and W.J. Davies. 1975. *Control of water balance in transplanted trees.* J. Arboric. 1: 1-10.
9. Lee, C.I., and W.P. Hackett. 1976. *Root regeneration of transplanted Pistacia chinensis Bunge seedlings at different growth stages.* J. Amer. Soc. Hort. Sci. 101: 236-240.
10. Randolf, W.S., and S.C. Wiest. 1981. *Relative importance of tractable factors effecting the establishment of transplanted holly.* J. Amer. Soc. Hort. Sci. 106: 207-210.
11. Ranney, T.G., N.L. Bassuk, and T.H. Whitlow. 1989. *Effect of transplanting practices on growth and water relations of 'Colt' cherry trees during reestablishment.* J. Environ. Hort. 7:
12. Struve, D.K., and B.C. Moser. 1984. *Root system and root regeneration characteristics of pin and scarlet oak.* HortScience 19: 123-125.
13. Thompson, B. 1992. *Patterns of gas exchange, photosynthate allocation, and growth during a root growth capacity test.* Can. J. For. Res. 22: 248-254.
14. Watson, G.W., E.B. Himelick, and E. Smiley. 1986. *Twig growth of eight species of shade trees following transplanting.* J. Arboric. 12: 241-245.
15. Watson, G.W., and E.B. Himelick. 1983. *Root regeneration of shade trees following transplanting.* J. Environ. Hort. 1: 50-52.
16. Witherspoon, W., and G. Lumis. 1986. *Root regeneration of Tilia cordata cultivars after transplanting in response to root exposure and soil moisture levels.* J. Arboric. 12: 165-168.

Department of Horticulture
Virginia Tech
Blacksburg, Va 24061
and
Urban Horticulture Institute
20 Plant Science
Cornell University
Ithaca, NY 14853

Résumé. Des combinaisons de traitement impliquant défoliation et application de Moisturin (un film antitranspirant) ont été appliquées sur des *Quercus coccinea* en août et sur des *Fraxinus pennsylvanica* et des *Corylus colurna* durant la fin de l'été et l'automne de 1992. Pour le *Quercus*, le taux de survie était faible, peu importe le traitement. Les traitements au Moisturin ont contribué positivement au taux de survie et à l'élongation printannière des rameaux pour les *Fraxinus* transplantés à la fin de l'été, mais ne montrèrent aucun effet pour les arbres transplantés en automne. La défoliation a été néfaste à la survie des *Fraxinus*, peu importe la date où les arbres ont été transplantés. La régénération des racines ne se produisait pas avant l'éclosion printannière des bourgeons pour les *Fraxinus* et les *Corylus*.

Zusammenfassung. Die Kombinationen von Entlaubungsmittel und Moisturin®, einem antitranspirationsfilm, wurden im August an Quercus coccinea Bäumen und während des Spätsommer und Herbstes 1992 an Fraxinus pennsylvanica und Corylus colurna Bäumen ausprobiert. Bei Quercus war das Überleben bei allen Versuchen nur schwach. Moisturin-Behandlungen förderten das Überleben und den Ausbruch der Frühjahrsknospen bei Fraxinus, die im späten Sommer verpflanzt wurden, zeigten aber keinen Effekt zu späteren Zeitpunkten. Entlaubungsmittel waren zu allen Pflanzzeitpunkten schädlich. Die Wurzelregeneration bei verpflanzten Fraxinus und Corylus setzte nicht vor dem Ausbruch der Knospen im Frühjahr ein.