TRANSPLANTING SEEDLINGS

When the seedlings reach approximately 2.5 cm (1 inch) in height, they can be transplanted into individual grow cells. This initial transplanting usually occurs in late May or June of the following year after seeds were sown. I like to use the standard 72-cell-size trays for the initial planting. I transplant all seedlings of each cross at this stage and continue to weekly fertilize with half-strength liquid fertilizer until the seedlings have rooted into the soil. I apply a light application of granular nursery fertilizer, following recommendations as needed. As the plants grow larger, the more vigorous and healthy seedlings are transplanted into 10-cm (4-inch) containers and fertilized.

At each transplanting stage, the less vigorous seedlings will be discarded. Later the seedlings in the 10-cm (4-inch) containers will then be transplanted into 15-cm (6-inch) containers and grown to flowering. This is the most exciting and rewarding phase of the seedling growing process for most azaleas breeders. Not only are plants mature enough to evaluate growth habits and many other characteristics, but also plants are mature enough to give an explosion of color when in bloom.

SUGGESTED REFERENCES

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Plant-Water Relationships for Woody Ornamental Crops©

Eric Johnson
Southern Sun Biosystems, 116 Whispering Springs, Hodges, South Carolina 29653

INTRODUCTION

The management of plant-water relationships has a tremendous bearing on the development of adventitious roots and the subsequent development of a healthy root system. Plant-water relationships and their specific impact on rooting of cuttings have been studied for over a hundred years with contributions that have greatly changed the way we propagate plants today. With the development of intermittent mist systems and more sophisticated environmental controls, plant propagators are realizing higher levels of rooting success leading to the development and introduction of many new plant cultivars, formerly considered impossible or economically unviable to propagate. Proper management of plant-water relationships entails maintaining a proper balance between air and water in the propagation media, on the leaf surface, and in the environment surrounding the cutting. Of course, the physiology is much more complex, but for the purposes of this study, we will look at the direct impact of soil moisture and misting frequencies on the rooting of five selected woody ornamental plants.

MATERIALS AND METHODS

The design of the trial was to look at a range of woody ornamental species with rooting potentials from easy to difficult. The species were propagated in different media with varied moisture retention properties. These test groups were then placed in the greenhouse in ten discreet groups with ten differing mist schedules. The plants

selected for the trials were: styrax (*Styrax japonicus*), red maple (*Acer rubrum* 'October Glory'), river birch (*Betula nigra* 'Cully', Heritage™ river birch), Chinese elm (*Ulmus parvifolia* 'Burgundy'), and zelkova (*Zelkova serrata* 'Green Vase').

All cuttings were harvested from the same location where the irrigation and fertilization practices were uniform from group to group and overall plant health was optimal. All cuttings within a given species were harvested from the same field on the same day and all groups of plants were harvested and prepared in 3 days. Cuttings were harvested between 21 to 23 June, between the hours of 7:00 AM to 11:00 AM. Softwood cuttings were used with medium-firm stems. Each species was treated with the same auxin for all trial groups, although from species to species, auxin concentrations varied depending on the requirement of a given species. All cuttings were stuck in Growing Systems 38 Groove Tube trays with a soil volume of 158 cc per cell. Trays were filled with nine different media supplied by Sun Grow Horticulture. The media trade names were: LC1, NCM-6, NCM-7 NCM-5, Rooting mix, NCM-2, NCM compost, and PX3.

Media. The various media were supplied courtesy of Joe Williamson, Sun Grow Horticulture, and consisted of:

- **LC1**: 75% to 85% peat and the balance in perlite, lime, gypsum, and a fertilizer starter charge.
- **NCM-6**: 5% to 15% peat, 5% to 15% perlite, 75% to 85% mini nuggets, soil conditioner, lime, gypsum, and a starter fertilizer with minors.
- **NCM-7**: 5% to 15% peat, 25% to 35% composted pine, 50% to 60% mini nuggets, soil conditioner, lime, gypsum, and a starter fertilizer with minors.
- **NCM-5**: 6% to 14% peat, 30% to 40% composted peanut hulls, 55% to 65% composted bark, soil conditioner, lime, gypsum, and a starter fertilizer with minors.
- **Rooting mix**: 65% to 75% composted pine bark and 23% to 35% perlite.
- **NCM-2**: 60% to 70% composted pine bark, 5% to 15% sand, mini nuggets, lime, gypsum, and a starter fertilizer with minors.
- **NCM compost**: 100% composted bark.
- **PX3**: 10% to 20% peat, 40% to 50% composted pine bark, 40% to 50% composted peanut hulls, lime, gypsum, and a starter fertilizer with micros.

The media analyses were done courtesy of Ron Walden, Sun Grow Horticulture, and results were from mixes in standard 15-cm (6-inch) azalea pots. Media analyses were:

Media	Total porosity (%)	Air (%)	Water (%)
LC1	91.0	21.3	69.7
NCM-6	80.6	33.8	46.8
NCM-7	78.7	36.0	42.7
NCM-5	77.2	31.8	45.4
Rooting mix	79.4	39.7	39.7
NCM-2	67.3	22.5	44.8
NCM comp.	79.2	33.4	45.8
PX3	78.7	28.6	50.1

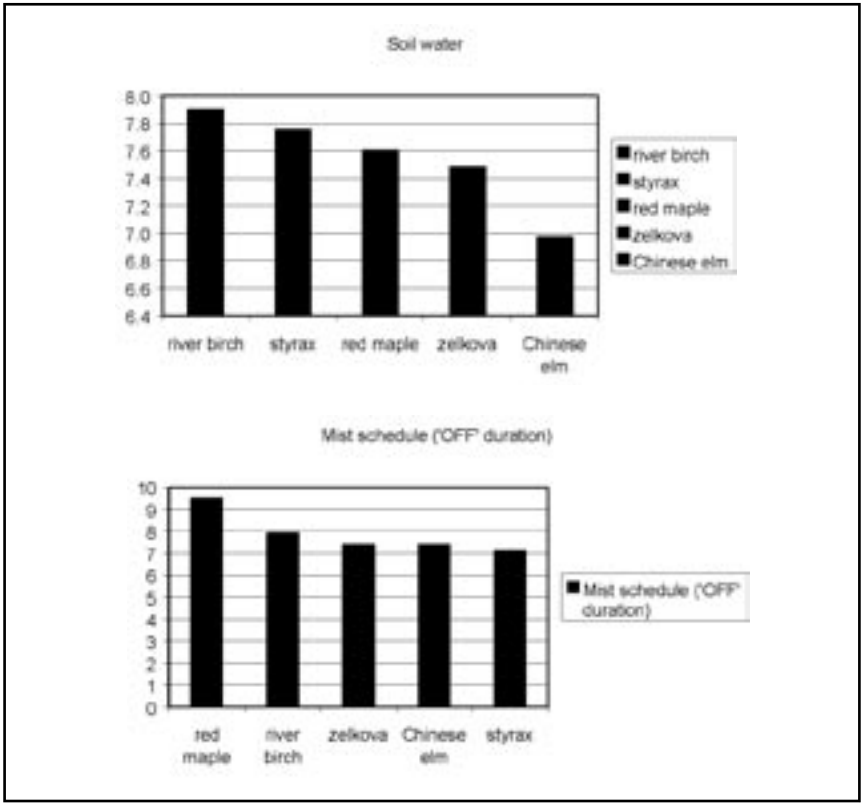

Figure 1. Overall (a) soil water and (b) mist schedules of five woody plant species.

Table 1. Effect of media and water on rooting of Chinese elm (*Ulmus parvifolia* 'Burgundy').

Mist 'off' duration (min)	Media	Soil wetness rating	Rooted (no.)	Rooting (%)	Root quality	Overall rooting index
8	PX 3	7.2	36	100	8	288
12	NCM 7	6.1	36	100	8	288
6	NCM 7	6.1	36	100	7	252
4	Compost	6.6	36	100	7	252
4	LC 1	10.0	36	100	4	144
6	Compost	6.6	34	94	7	238
10	PX 3	7.2	34	94	6	204
12	PX 3	7.2	34	94	4	136
4	NCM 7	6.1	32	89	8	256
8	Compost	6.6	32	89	8	256

Table 2. Effect of media and water on rooting of red maple (*Acer rubrum* 'October Glory').

Mist 'off' duration (min)	Media	Soil wetness rating	Rooted (no.)	Rooting (%)	Root quality	Overall rooting index
11	Rooting mix	5.7	36	100	10	360
11	PX 3	7.2	36	100	10	360
11	Mix 1	10.0	36	100	9	324
11	Compost	6.6	36	100	8	288
7	PX 3	7.2	34	94	10	340
11	LC 1	10.0	34	94	10	340
4	Compost	6.6	34	94	10	340
11	Regular	6.5	34	94	8	272
11	NCM 2	6.4	34	94	7	238
7	LC 1	10.0	32	89	10	320

Each medium was assigned a "soil moisture" rating between 1 to 10, with ten ranked wettest, based on percent water in the medium. Hence a rating of five was 50% less wet than ten.

Each trial group contained five flats of each medium, one flat for each of the five species.

The mist schedule was set daily to begin at 9:00 HR and turn-off at 18:00 HR. The "ON" duration for each group was a constant 7-sec, which was the time necessary to completely wet the leaf surface with minimal run-off. The "OFF" duration for the 10 trial groups ranged from 3 to 12 min. The mist treatment groups were randomly arranged in the greenhouse and sectioned off with clear polyethylene to prevent over-spray from adjacent groups. Total applied water was expressed in liters, and was as follows:

Cycle "off" duration (min)	**Cycles per day**	**Total daily water (L)**	**Total maximum water (%)**
3	180	149.6	100
4	135	112.2	75
5	108	89.8	60
6	90	74.8	50
7	77	64.1	43
8	67	56.0	37
9	60	49.9	33
10	54	44.9	30
11	49	40.8	27
12	45	37.4	25

Table 3. Effect of media and water on rooting of styrex (*Styrax japonicus*).

Mist 'off' duration (min)	Media	Soil wetness rating	Rooted (no.)	Rooting (%)	Root quality	Overall rooting index
7	LC 1	10.0	36	100	10	360
12	LC 1	10.0	36	100	10	360
10	LC 1	10.0	36	100	10	360
4	NCM 5	6.5	36	100	9	324
4	NCM 2	6.4	36	100	9	324
8	LC 1	10.0	36	100	9	324
4	SPM	6.7	36	100	8	288
4	Rooting mix	5.7	36	100	8	288
12	Rooting mix	5.7	36	100	8	288

Table 4. Effect of media and water on rooting of river birch (*Betula nigra* 'Heritage').

Mist 'off' duration (min)	Media	Soil wetness rating	Rooted (no.)	Rooting (%)	Root quality	Overall rooting index
9	LC 1	10.0	34	94	9	306
7	NCM 5	6.5	32	89	2	64
7	LC 1	10.0	30	83	9	270
10	PX3	7.2	30	83	5	150
11	LC 1	10.0	28	78	4	112
10	LC 1	10.0	28	78	4	112
11	NCM 2	6.4	26	72	6	156
5	Compost	6.6	26	72	4	104
5	Rooting mix	5.7	26	72	2	52
4	NCM 6	6.7	24	67	8	192

Table 5. Effect of media and water on rooting of Zelkova (*Zelkova serrata* 'Green Vase').

Mist 'off' duration (min)	Media	Soil wetness rating	Rooted (no.)	Rooting (%)	Root quality	Overall rooting index
12	NCM 7	6.1	36	100	10	360
5	NCM 5	6.5	34	94	9	306
5	LC 1	10.0	34	94	4	136
4	LC 1	10.0	30	83	3	90
7	LC 1	10.0	30	83	2	60
7	NCM 2	6.4	28	78	3	84
7	NCM 7	6.1	26	72	4	104
11	NCM 6	6.7	26	72	3	78
5	Compost	6.6	24	67	9	216
11	NCM 2	6.4	24	67	7	168

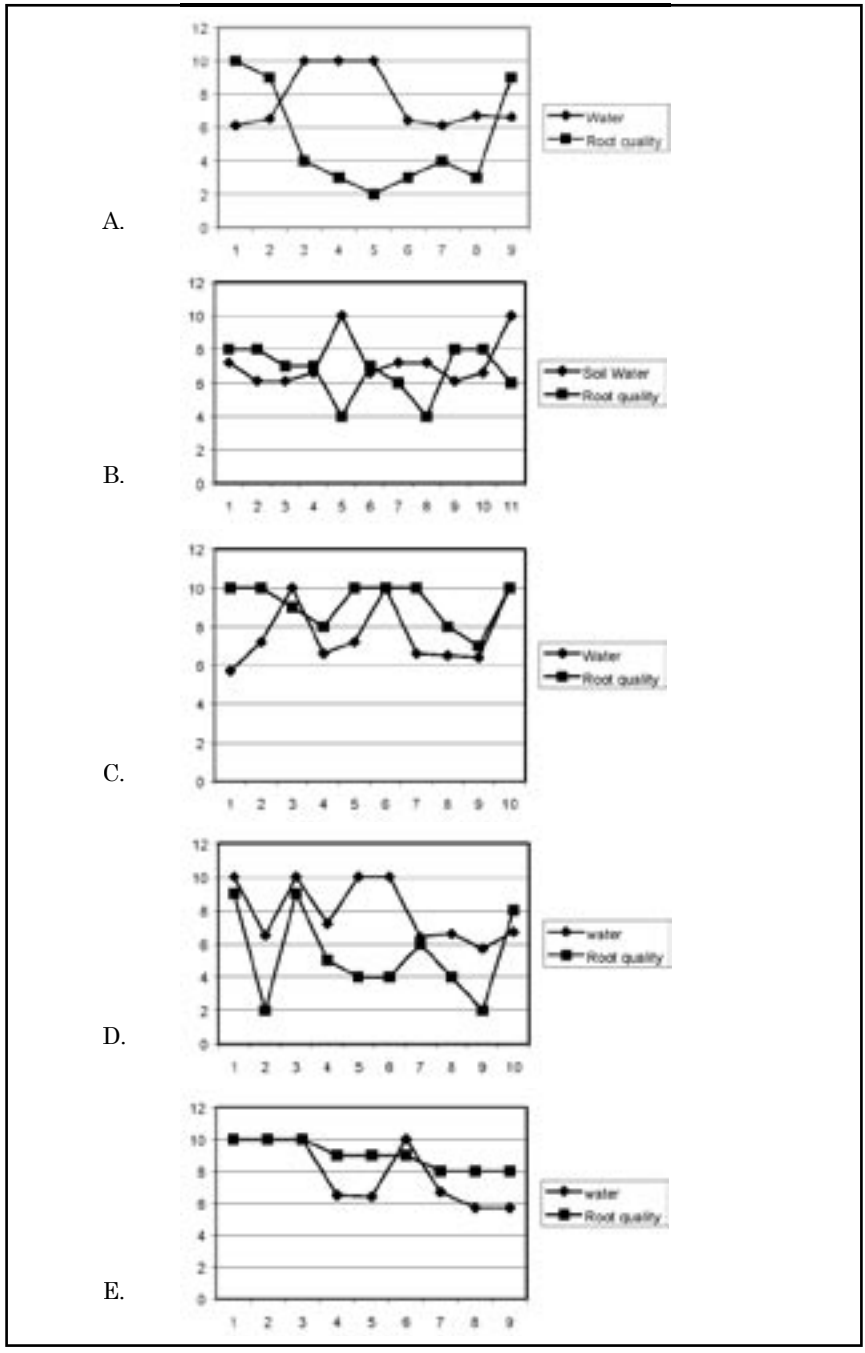

Figure 2. Relationship between media wetness and root quality among five woody plant species: (A) *Zelkova serrata* 'Green Vase', (B) *Ulmus parvifolia* 'Burgundy', (C) *Acer rubrum* 'October Glory', (D) *Betula nigra* 'Heritage', (E) *Styrax japonicus*.

Cuttings were harvested after 21 days and evaluated for rooting percentage as well as root quality. Root quality was assessed by measuring the average length of the roots in a given trial group and rated on a scale of 1–10, with each increment corresponding to approximately 1 cm (0.4 inch) of root growth.

Since the quality of the root system is as an important as the rooting percentage, the root quality was multiplied by the total number of rooted cuttings to give an overall root index value; this combined rooting percentage and root quality.

RESULTS

After evaluating more than 15,000 cuttings, it became apparent that the success or failure of a given group could only be interpreted in terms of the combination of media and mist schedule. There did not emerge a clear winner or loser among the individual media or the individual mist schedules. Rather, certain combinations of the two main treatment effects yielded superior or inferior results. In some cases, as with Chinese elm (Table 1), there was a strong correlation between the amount of overhead mist, rooting percentages, and root quality. High frequency mist cycles tended to produce crops with a higher rooting percentage, whereas low frequency mist cycles produced crops with much higher root quality.

This relationship did not occur with red maple, styrax, or river birch (Tables 2, 3, and 4). These three consistently rooted better under moderate mist schedules with fairly heavy media, while zelkova (Table 5) and Chinese elm (Table 1) did better with lighter media and lower mist frequency. Interestingly, the rooting preferences of these species corresponded closely with their water consumption in field or larger container tree production, suggesting that the optimal mist schedule and media for a given species is correlated to the parent plants water usage or requirement (Figs. 1 and 2).