Propagation of Juvenile Scots Pine Cuttings Under a 24-Hour Photoperiod

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Successful rooting of juvenile Scots pine cuttings was achieved with continuous lighting. Under a 24-hour photoperiod, 83 percent of all cuttings had rooted in 8 weeks with minimal Botrytis losses.

Vegetative propagation of Scots pine (*Pinus sylvestris* L.) by cuttings is possible for juvenile (*2*), 5-year-old (*3*), and 10-year-old (*1*) plants. According to these references, the biggest problem in rooting Scots pine is fungal attack by Botrytis spp. To prevent Botrytis infection, relatively dry conditions are required; however, Scots pine cuttings need a lot of water during the propagation process.

Since Scots pine is a relatively light-intolerant species, we decided to try adding light to the cuttings during the propagation period. The additional light would increase the transpiration and photosynthetic rate. We hoped that th is would reduce excess moisture around the cuttings, thereby decreasing the potential for Botrytis infection, and reduce the calluising and rooting time.

The objective of this article is to report on rooting success obtained with Scots pine cuttings rooted under supplemental lighting.

Scots pine cuttings were successfully rooted under a 24-hour photoperiod light regime with minimal losses to Botrytis spp. As light intensity increased, the cuttings rooted faster and produced greater root mass.

Methods

Scots pine seedlings were grown for 15 weeks (October 19, 1981, to February 1,1982) in Leach Super Cell[1] containers in a greenhouse under a 24-hour photoperiod of 5,000 to 6,000 lux supplied by high-pressure sodium lamps. On February 1, seedlings averaged 14.5 centimeters in height and 3.5 millimeters in diameter. At this time, the plants had ceased height growth and had set bud (presumably because the container restricted further growth). Cuttings were excised from the top 5 centimeters of the leader and planted in a 1:1 mixture of peat and vermiculite. Before planting, cuttings were treated as follows:

1. Control, no treatment.
2. Five-second dip in 4,000 parts per million indolebutyric acid (IBA). The source of IBA was STIM-ROOT.[2]
3. Wounding + IBA. Wounding consisted of 3 or 4 vertical cuts with a razor blade, each about 0.5 centimeter in length on the basal stem extending from the outer bark to the outer xylem.
4. Wounding.
5. Untreated cuttings planted in the same peat and vermiculite mixture except one-sixth of the vermiculite was inoculated with MycoRhiz[3] (*Pisolithus tinctorius*), a mycorrhizal fungus inoculum.
6. Wounding + IBA + MycoRhiz-inoculated medium as in treatment 5.

There were eight cuttings per treatment and two replications under each of three light conditions (288 cuttings total). The three light conditions were maintained for 24 hours per day and were as follows:

1. A minimum 5,000- to 6,000 lux light intensity. On cloudy days and at night, this was achieved with high-pressure sodium lamps.
2. In a bright portion of the greenhouse with natural sunlight during the day and a minimum 500- to 600-lux light intensity at night maintained with fluorescent lamps.
3. In a less illuminated portion of the greenhouse with approximately 60 percent of the daytime light intensity of 2 and a minimum 500 to 600 lux at night maintained by fluorescent lamps.

[1]Registered trade name of Ray Leach Cone-Tainer Nursery.

[2]Registered trade name of Plant Products Co., Ltd.

[3]Registered trade name of Abbott Laboratories.

Cuttings were planted in Leach Fir Cell[4] containers and placed under plastic supported by a light wooden frame (fig. 1). In general, the cuttings were not shaded. There were a few very bright, sunny days when the temperature under the plastic was excessive. On those occasions, shade cloth was placed over the cuttings of light treatments 1 and 2 for 4 to 5 hours during the day. Cuttings were misted with a fog nozzle and hose as required (at least once per day), and fungicides were applied twice per week. After 8 weeks, the cuttings were excavated and examined for roots. Root mass was not quantified at sampling time.

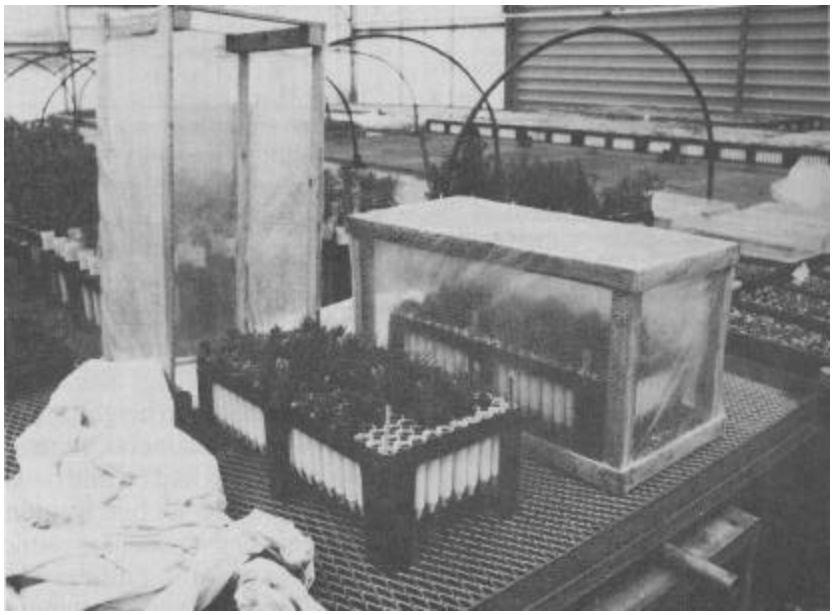

Figure 1.—*Plastic and supporting frame under which Scots pine was rooted.*

Results and Discussion

Most of the cuttings under a minimum 5,000- to 6,000-lux light intensity had callused 2 weeks after they were planted, and the first roots were noticed in the third week. Under light conditions 2 and 3, it took 3 and 4 weeks, respectively, to develop callus tissue, and rooting occurred in the following weeks. Cuttings produced roots in all treatments. After 8 weeks, 83 percent of all cuttings had rooted. Callusing and rooting occurred most rapidly under the highest light intensity treatment; and after 8 weeks, these cuttings had accumulated the greatest root mass (figs. 2 and 3).

All preplanting cutting treatments were successful in inducing root formation (table 1). Treatment differences within and between each light condition were statistically nonsignificant. An average of two to three roots were produced at the base of all rooted cuttings. Untreated cuttings (control) also produced roots, but on fewer cuttings (65 percent on the average), and their root mass was small compared to other treatments. Cuttings treated with IBA, wounding, and wounding + IBA had produced slightly heavier root systems after 8 weeks. Under all light conditions, cuttings with the greatest root mass were those planted in peat and vermiculite inoculated with MycoRhiz. It appeared that the MycoRhiz did not promote faster root production on cuttings, nor did it increase the number of roots at the base of the cuttings. Rather, MycoRhiz increased the branchiness and growth of the roots once they were initiated.

Cuttings rooted under light conditions 1 and 2 did not appear to be infected by *Botrytis* spp. Cuttings that did not root under light conditions 1 and 2 suffered from drought and many of them had desiccated before the end of the 8-week propagation period. These cuttings were located at the edge of the tray where the rooting media dried faster than in the

[4]Registered trade name of Ray Leach Cone-Tainer Nursery.

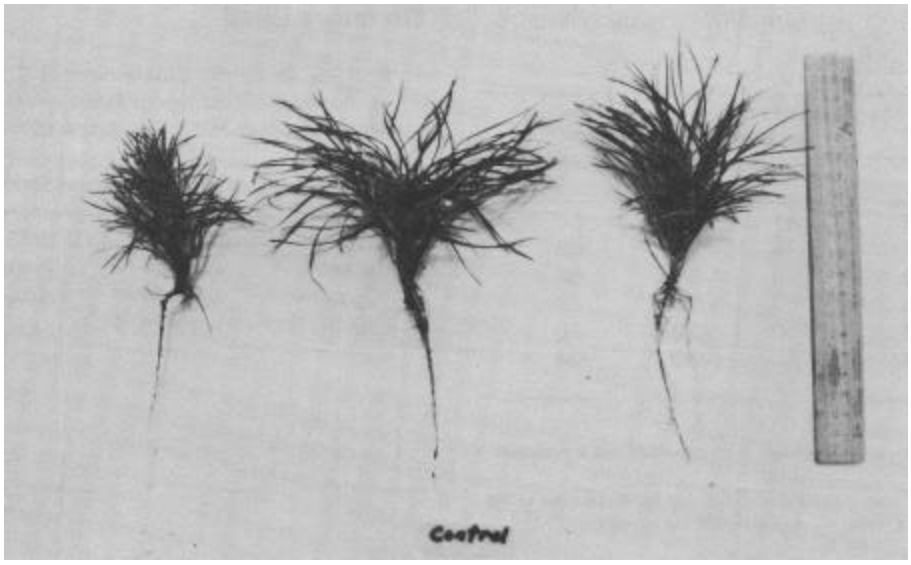

Figure 2.—*Typical untreated (control treatment) Scots pine cuttings from light condition 1 (right), light condition 2 (center), and light condition 3 (left).*

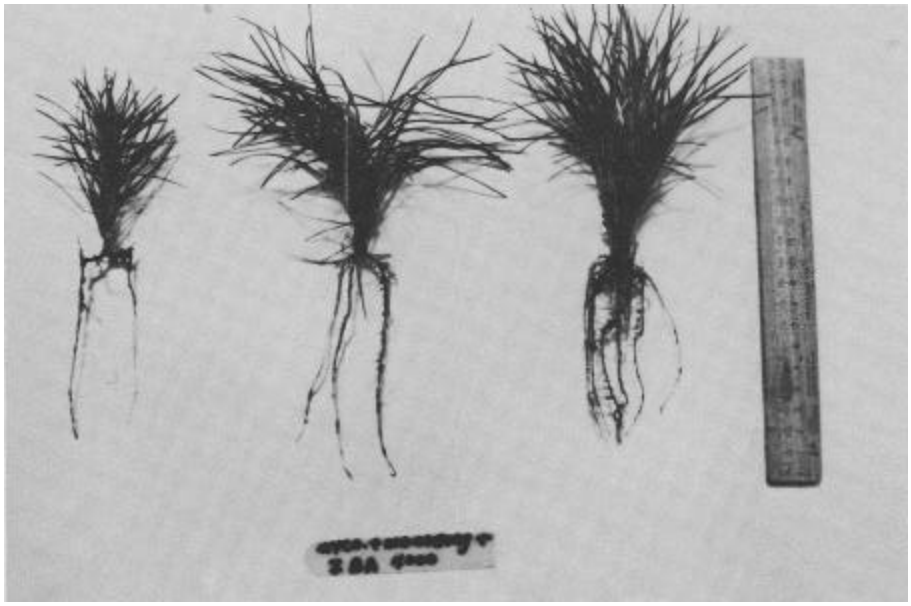

Figure 3.—*Typical cuttings treated with wounding + I8A + planted in MycoRhiz-inoculated medium from light condition 1 (right), light condition 2 (center), and light condition 3 (left).*

center of the tray. Because each tray stood separately in its rooting environment, we presume that a greater proportion of the cuttings would root when more trays were added on a production scale. Under light condition 3, many of the cuttings that did not root had been infected by *Botrytis* when sampled after 8 weeks; it appeared that none were lost to drought.

Conclusion

The experiment did not measure actual light intensity because it is very difficult to quantify in a greenhouse environment. Nevertheless, the work did demonstrate that: (1) Under a 24-hour photoperiod with sufficient light intensity, Scots pine cuttings can be rooted with minimal *Botrytis* losses; and (2) With increasing light intensity, Scots pine cuttings root faster and produce more root mass.

Table 1.—*Rooting percentages obtained with juvenile Pinus sylvestris cuttings under three light intensity regimes*

Treatment	Percentage of cuttings rooted under light conditions:[1]			
	1	2	3	X
Control	50	81	63	65
IBA	88	94	81	88
Wounding + IBA	88	94	81	88
Wounding	88	69	75	77
MycoRhiz	94	100	63	86
Wounding + IBA + MycoRhiz	94	100	88	94

[1]Light condition 1 = minimum of 5,000 to 6,000lux.
2 = bright portion of greenhouse with natural sunlight during the day and a minimum of 500 to 600 lux at night.
3 = a less illuminated portion of the greenhouse with approximately 60 percent of the daytime light intensity of 2 and a minimum of 500 to 600 1ux at night.

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