ROOT AND SHOOT GROWTH OF SWEETGUM ROOTED CUTTINGS

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Abstract. Sweetgum *(Liquidambar styraciflua* L.) is one of the most widely adapted hardwood species in the southeastern U.S.. The productivity and value of sweetgum plantations may be increased by using genetically superior, rooted cuttings. Previously, methods have been developed to produce rooted cuttings of sweetgum and now the objectives are to fine tune the techniques and increase the size of the rooted cuttings for field planting. Five levels of nitrogen (0, 25, 50, 100, and 200 ppm N) with either ambient photoperiod or a 3-hour night interruption (with incandescent light) were imposed on four clones over five replications. The night interruption stimulated shoot growth, while nitrogen levels affected root and shoot growth differently. The same four clones were tested in five different potting media combinations (1:2:2 peat : perlite : vermiculite, 1:1 peat : perlite, 1:1 peat : sand, 1:1 peat : bark, 1:1 bark : sand by volume) over five replications. Even though there was poor survival in the media study (<50%), differences in root morphology existed. Some sprouts of two clones were chilled at 4°C for an additional month and then set and placed under intermittent mist. Root and shoot growth on these rooted cuttings were greater than those not exposed to additional chilling. Clonal differences existed in all the studies. Future studies can build on these results to produce high-quality sweetgum rooted cuttings for operational plantation establishment.

Keywords: *Liquidambar styraciflua,* stem cuttings, vegetative propagation, nitrogen. photoperiod, media, chilling.

INTRODUCTION

Sweetgum *(Liquidambar styraciflua* L.) is widely adapted to many different soils and sites in the southeastern United States. Approximately 2500 acres of sweetgum are planted annually in this region. It is an important raw material for forest products, such as pulp, veneer and lumber. Due to the increasing demand for hardwoods. it would be desirable to increase productivity using plantation forestry. One way of accomplishing this is by planting superior genotypes using vegetative propagation. Vegetative propagation in forestry is becoming a widely used method of reproduction. Large genetic gains can be made by establishing clonal plantations using rooted cuttings (Zobel and Talbert, 1984). Sweetgum is a species that roots well from cuttings, making it a good candidate for clonal forestry.

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Even though sweetgum cuttings root well, limitations currently exist to the production of sweetgum by rooted cuttings. To date, most rooted cuttings produced have not been as large as first year seedlings. Therefore, our first objective was to produce larger rooted cuttings.

It has been reported that dormant sweetgum shoots do not root well (Land and Cunningham, 1993). Previous research (Cunningham, 1989), showed cuttings collected in May and July rooted at higher frequencies than those collected in February and September. However, cuttings collected in July did not grow as large as May collected cuttings. It would be advantageous and more cost effective to obtain additional crops per year for production. We collected sprouts in both May and July to determine if larger cuttings can be produced by altering certain environmental conditions. Another objective was to amend or eliminate the time consuming and labor intensive procedures associated with propagation. We conducted a study to test the necessity of trimming versus not trimming the leaves. Another study involved a cold-storage treatment.

METHODS

Sweetgum sprouts were collected on May 17, and July 18, 1994 from the Union Camp Corporation cutting orchard in Bellville, Georgia. The cuttings were rooted and grown at the North Carolina State University Plant Science Research Greenhouses in Raleigh, North Carolina. Sprouts were prepared for setting by pinching back all the new growth, both terminal and lateral. Then, they were cut into two six-inch (15 cm) cuttings; apical = 1st 6" cutting, basal = 2nd 6" cutting. All leaves were trimmed back to approximately one-half the leaf surface area (except those cuttings used in the leaf surface area study). At least two leaves remained on each cutting. The bases of all prepared cuttings were treated with Hormodin 2 (0.3% IBA).

The cuttings were grown in Ray Leach™ tubes (Stuewe and Sons, Corvallis. Oregon) and set on benches in a greenhouse bay equipped with an intermittent mist system. The mist nozzles delivered 8 1/2 gallons (70 liters) of water per hour. A misting regime of 6 seconds every 20 minutes was used after an initial period of daily observations and adjustments. The cuttings remained in the mist house for 10 weeks. During the ninth and tenth weeks in the mist house, the misting frequency was gradually reduced before the cuttings were transferred to another greenhouse bay.

Four experiments were conducted in 1994. Four clones were used throughout the studies except for a cold-storage study in which only two clones were used. The first and largest of the four studies was the Nitrogen/Photoperiod Study. It was a split-plot design with 5 replications. There were 5 nitrogen levels (0, 25, 50, 100, and 200 ppm) and 2 light treatments (ambient photoperiod or a 3-hour night interruption with incandescent lights). These treatments were imposed on the cuttings the week following transfer to the non-mist greenhouse bay (11 weeks after the cuttings were stuck). The second study tested different rooting and growing media in a randomized complete block design with five replications. Five different media compositions (1:2:2 peat : perlite : vermiculite, 1:1 peat : perlite. 1:1 peat : sand, 1:1 peat : bark, 1:1 bark : sand by volume) were used to determine their effect on root (and shoot) growth. A third study investigated the effects of different leaf surface areas using a split-plot design with five replications. Leaves on cuttings were either trimmed (leaves cut to approximately 1/2 leaf surface area) or left intact. The last study involved a cold-storage treatment of one month. Although there was no replication of chilling treatments, cold-stored cuttings were compared with cuttings treated in an otherwise identical manner (the 1 peat : 1 perlite composition of the media study). The sprouts for the cold-stored cuttings remained in a 4°C cooler for one additional month before preparing and setting.

All studies were terminated in December, 1994. Roots and new shoot growth were collected and their dry weights [dried at 70°C (150°F) for 48 hr.] obtained. Other variables measured included root collar diameters (mm), number of main roots counted, and shoot lengths (cm). Survival and rooting percentages were calculated for the treatments.

RESULTS AND DISCUSSION

The following results are preliminary and based on mean statistics. Analyses of variance are underway. Only the results of the May studies are reported in this paper as cuttings set in July rooted poorly. The rooting percentage for May, across all studies, was greater than 80%, while for July, the percentage was less than 40%.

Clonal differences were evident in all four studies. Clone 1 had the greatest root and shoot growth, as well as survival, except in the Nitrogen/Photoperiod study, where survival of this clone was the lowest. Clonal differences in rooting and short-term shoot growth may contribute to successful plantation establishment. These characteristics could be important for early assessment of potential clones for field planting.

In the Nitrogen/Photoperiod study, shoot growth increased as the level of nitrogen increased. Root growth, however, peaked at 25 ppm N. The optimal nitrogen level for a particular application will depend on the ideal root:shoot ratio. An intermediate range of 50 to 100 ppm N resulted in a fairly large and well-balanced rooted cutting. The night interruption promoted shoot growth, but root growth was unaffected by photoperiod. The larger shoots from the night interruption probably resulted from delayed budset.

Different media compositions resulted in differing root morphologies. Media did not, however, affect survival, which was generally poor for this study. This limits the conclusions that can be drawn from this study.

In the leaf surface area study, root growth was greater on cuttings with non-trimmed leaves, while shoot growth was greater on cuttings with trimmed leaves. Trimming the leaves did not increase rooting percentages. However, this study was too small to see the effects of these treatments as if they were to take place on an entire greenhouse bench. Overlapping leaves could restrict water from reaching the media and reduce air movement, which could potentially cause uneven moisture and fungal problems in a large-scale operation.

Cold-storing sprouts for one month resulted in an increase in both root and shoot growth. The control cuttings were those in the 1 peat : 1 perlite composition of the media study. It appears that a chilling treatment is beneficial, but further studies need to be done. The greater growth in chilled cuttings may be the result of the conditions in the greenhouse at the time of setting. Cold-storing sprouts prior to setting has potential, but needs further investigation.

Finally, across all studies, there were differences in performance between apical and basal cuttings. The basal cuttings had slightly greater root and shoot growth compared to the apical cuttings.

CONCLUSIONS

- Clonal differences exist in sweetgum cutting root and shoot growth characteristics.
- Higher N levels produce larger shoots. Lower N levels produce larger roots; a reasonable range is 50-100 ppm N.
- A 3-hour night interruption with incandescent lights promotes shoot growth.
- Leaf trimming does not affect rooting percentages, but needs to be investigated on a larger scale.
- Cold-storage of sprouts before setting cuttings appears to have potential, but needs further investigation.
- Basal cuttings produce larger rooted cuttings than apical cuttings.
- Cuttings collected in May perform better than those collected in July.

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