

**EFFECT OF MOISTURE AND FERTILIZERS
ON SUGAR MAPLE SEEDLING GROWTH**

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Two ways to help satisfy the need for more high-quality sugar maple trees (Acer

Table 1. Approximate Amount of Mineral Elements in Kilograms per Hectare Equivalent to One Liter of Hoagland Solution per Pot

Elementa	Kilograms per hectare
N	69.1
P	10.2
K	77.3
Ca	52.7
Mg	16.1
S	21.1
Fe	1.7

All other mineral elements less than 0.25 kilogram per hectare for each.

Three soil moisture levels were maintained to simulate different soil moisture stress conditions. Moisture retention values for the different treatments, as determined by laboratory analysis, were: (1) low moisture, 8 to 18 percent by weight, which approximated the range of soil moisture content between the permanent wilting point (15 atmospheres tension) and 1 atmosphere tension; (2) medium moisture, 18 to 28 percent by weight, the approximate range in soil moisture content between 1 and 1/3 atmosphere tension; and (3) high moisture, 28 to 38 percent by weight, the approximate range in soil moisture content between 1/3 and 1/10 atmosphere tension. The highest value (38 percent) is the average B-horizon moisture content found by Curtis and Post (unpublished data) in their soil-site study of northern hardwoods.

The three ranges of soil moisture content were maintained by first determining the amount of water necessary to bring each pot to its maximum assigned moisture percentage. This weight of water was then added to the containers of soil. Pots were rewatered when the soil moisture content approached the lower moisture limit.

We know that by watering in this manner we did not get uniform moisture distribution throughout the pot. For the low and medium moisture levels, particularly, the upper portions of the soil in the pots probably approached field capacity, while the lower portions were relatively dry. Kramer discussed this problem (4). But our figures refer to the average moisture content in the pots. Water for this study was obtained untreated from a deep well.

To compensate for increases in system weight due to seedling growth, we computed regression on green weight as a function of seedling height and diameter. These data were obtained from other 2-year-old seedlings that had received the same water and nutrient treatments. The regression was then used to estimate the green weights of seedlings in the study pots, which allowed us to maintain soil moisture content at the designated level.

At the end of the third growing season, the following measurements were recorded: (1) shoot height, (2) shoot diameter, measured 1 inch above the root collar, (3) shoot dry weight, and (4) root dry weight. Shoot height was also recorded at the ends of the first and second growing seasons.

RESULTS

Effect of watering treatment--Watering significantly increased all recorded aspects of growth (root dry weight, shoot dry weight, shoot height, and shoot diameter) (Table 2). Relative differences were greatest for shoot weight (minimum value less than one-third the maximum value) and smallest for shoot diameter (minimum value almost two-thirds the maximum value). Because shoot weight is proportional to shoot volume, and shoot volume tends to be proportional to the square of shoot diameter, it is not surprising that shoot weight increased more than shoot diameter.

Table 2. Sugar Maple Seedling Growth--Effects of Watering Levels After Third Growing Season

Effect of nutrient treatments--None of the recorded aspects of seed-ling growth were significantly stimulated by fertilization (Table 3), nor were there any statistically significant interactions between watering levels and nutrient levels.

Table 3. Sugar Maple Seedling Growth--Effects of Nutrient Levels After dany statisticall

Steinbeck (6), who fertilized sycamore seedlings weekly with 0.1-, 0.5-, 1-, and 3-normal Hoagland solution, found that growth increased with fertilizer concentration; but total dry weight was greater with the 1-normal than with the 3-normal solution. His results are not really comparable with those of our study because he had more soil (builder's sand) in his containers, and he flushed the soil weekly with distilled water to prevent buildup of salt. Our high dosage of nutrients may have been slightly toxic, possibly due to the manner in which nutrients were applied. In long fertilization studies it would probably be better to add the nutrients in several small doses than to add the entire amount at the start of the experiment.

SUMMARY

Growth of 3-year-old potted sugar maple seedlings was significantly affected by watering levels. Shoot growth responded more than root growth to additional water; thus high levels of soil moisture result in a relatively low seedling root:shoot ratio, and this may retard establishment of outplanted sugar maple seedlings. For the old-field soil used in this experiment, added nutrients did not significantly affect growth.

LITERATURE CITED

1. Black, C. A. 1968. Soil-Plant Relationships. Ed. 2. New York: John Wiley and Sons.