MASS TESTING OF SUGAR MAPLE (ACER SACCHARUM MARSH.) SEEDLINGS FOR SUGAR CONTENT IN SAP

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Sugar content of sap is one of the attributes now under investigation in our study of 32 rangewide sugar maple provenances. In this study we wanted to determine sap sugar concentrations for 1,900 seedlings whose stem diameters, measured 1 inch above the groundline, range from 0.1 to 0.9 centimeters.

We had two problems: (1) weather and (2) a method for getting sap from trees so small. Under ideal climatic conditions -- a warm day with little or no wind preceded by a freezing night -- sap can be obtained from small seedlings.2/ However, seedlings are highly sensitive to slight changes in air temperature and wind movement; andforsustained periods of mass testing, seedlings must be protected from these elements. So in spring 1967 we erected apolyethylene greenhouse large enough to cover two seedbeds, which had been heavily mulched the previous fall. The Quonset-hut type greenhouse consisted of 15 modules, each 5 feet long, coupled to one another by bolts.

Temperatures in the unheated greenhouse dropped many nights to far below freezing; however, on sunny days, they often rose to above 50 F., even though the temperature outside was freezing (fig. 1).

Koelling2/ reported that No.22 Huber-point hypodermic needles may be used successfully to get sap samples from 2-year-old potted sugar maple seedlings growing in a greenhouse, or lined out in a nursery bed. But, he found that sap would not flow from the seedlings in a nursery unless the soil around their roots had thawed.

In 1967 we tried a No. 20 hypodermic needle to extract sap from the stems of the small seedlings. However, we learned that as we forced the needle into the stem, some phloem and xylem tissue was forced into the needle, which seemed to restrict sap flow. So in 1968 we drilled lead holes in each sapling with a No. 70 drill bit mounted in a battery-power electric drill, and then inserted the needle. This eliminated clogging. As a drop of sap appeared at the end of the needle (fig.2), it was collected on the plate of a refractometer and the sugar percentage was read and recorded.

Although sap appeared easier to get in 1968, still only about 23 percent of the tapped seedlings produced enough sap for a sugar determination. We concluded that environmental factors, as well as individual genetic differences, play very important roles in influencing the sap-flow mechanism, and that methods to obtain sap samples need to be improved.

Testing small seedlings is complicated by the size of our provenance study. Readings have to be obtained from over 1,900 seedlings. To do this job during the short sap season, testing has to be done throughout the few periods when environmental conditions appear suitable. It is possible under greenhouse conditions that during any given day these 2-year-old seedlings lose their flow potential rapidly. Koelling2/ said that,"after a seedling is moved into a warm environment, its flow potential is sustained for only a short time -- usually no longer than 30 minutes."

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2/ Koelling, Melvin R. 1968. Determining sap sweetness in small sugar maple trees. U.S.D.A. Forest Service, NE. Forest Expt. Sta. Res. Note NE-76. 4 pp., illus.

Figure 1. -- Interior of greenhouse showing two seedbeds that represent two replicates in the experimental design.

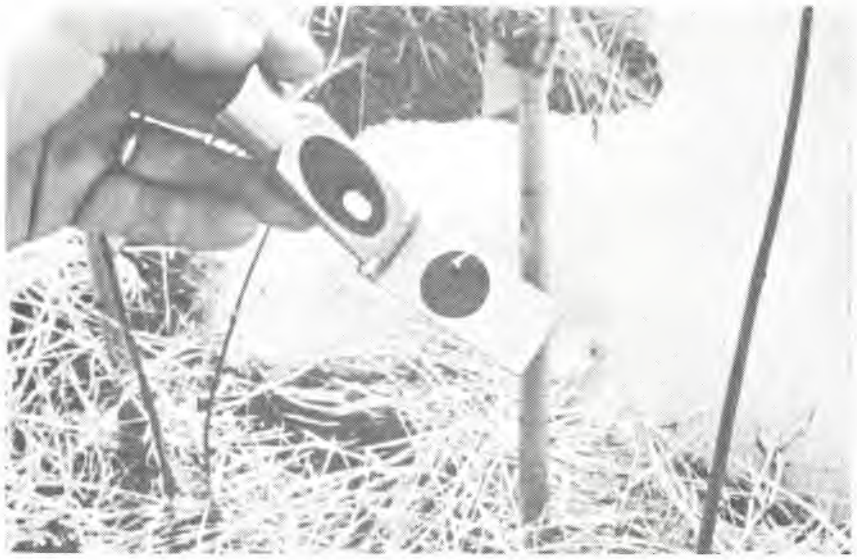

Figure 2. -- To determine the sugar content, a drop of sap at the end of a hypodermic needle is collected on a refractometer plate.

Sap sugar determinations of older planted stock indicate that the sap flow mechanism may also be controlled in part by age or size of the individuals tested. In 1968 we determined sap sugar content on selected sugar maple progenies that were outplanted in 1960 at Underhill Center, Vermont, and Williamstown, Massachusetts. Diameters of the trees, 1 inch above the groundline, ranged from 0.6 to 8.5 centimeters. Sap samples were obtained from 94 percent of the 396 trees in the Underhill Center outplanting and from 98.5 percent of the 624 trees in the Williamstown outplanting. No artificial environmental controls were employed at either location during the test periods.

It appears from our experience that a number of unknown factors influence sap flow in small seedlings. Although our results are encouraging, we need to learn more about these factors before mass testing of young nursery stock will be completely successful.