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## COMPARISON OF VACUUM AND GRAVITY SAP FLOWS FROM PAIRED SUGAR MAPLE TREES

*Abstract.*—Paired sugar maple trees with single tapholes were used to compare sap yields from vacuum-pumping with sap yields from gravity flow. Results indicated that vacuum yields were approximately twice as great as gravity flows. These results support previous findings from studies in which vacuum and gravity were compared with two tapholes on the same tree.

At the Forest Service sap production research project at Burlington, Vermont, we have been studying the vacuum-pumping technique for the past four sugaring seasons. Our previous work indicated that, when two tapholes were drilled in each tree, and sap was collected from one taphole with vacuum-pumping and from the other taphole by gravity flow, total sap yields could be increased nearly four times with vacuum-pumping (*Blum and Koelling 1968*).

Although dye and vacuum studies from the two-taphole trees revealed that sap moved only from above and below the taphole (*Blum and Koelling 1968*), there was some question about the independence of taphole yields when one taphole was vacuum-pumped and the other was not.

During the 1968 sap season we compared vacuum-pumping with gravity flow on an individual-tree yield basis. The results supported our earlier findings that the use of a vacuum pump can increase sap volume yields appreciably.

### The Study

Two sets of 15 trees each were paired on the basis of similar sap volume yields measured during the 1967 season. Earlier research had indicated that pairing on the basis of previous yields is a valid procedure (*Blum and Gibbs 1968*). Each tree was tapped once, to a wood depth of

3 inches excluding bark; and all tapholes received a paraformaldehyde sanitation pellet.

Vacuum-pumping was assigned at random to one tree in each pair. The trees were pumped at controlled levels of 5 and 10 inches of mercury. At 5 inches of vacuum the trees were pumped for 16 hours; at 10 inches for 42 hours. The sap yields were collected through unvented plastic tubing into 55-gallon drums (fig. 1).

From the other tree in each pair, sap yield was collected in buckets, by gravity flow.

Sap volumes and sap-sugar percentages were measured on all trees and were recorded periodically throughout the sap season from 1 March to 15 April. Data were totaled for the sap season and were subjected to a "t" test for paired replicates.

Figure 1.—Sap yields from vacuum-pumped tapholes were collected in 55-gallon drums. The bucket in left background was used to collect sap flowing from a taphole by gravity.



## Results and Conclusion

Study results indicated that trees pumped at 5 inches of mercury yielded twice (200 percent) as much sap as trees from which sap was collected by gravity flow (table 1). At the higher vacuum—10 inches of mercury—we found that the sap yields from the pumped trees were  $2\frac{1}{2}$  times (250 percent) greater than the sap yields from the other trees. Sap yield differences at both levels of vacuum were significant at the 5-percent level.

Sugar readings were recorded on the vacuum-pumped trees before and after pumping (6 sets of readings for 6 days of pumping). There was no significant difference in daily sap sweetness before or after pumping. This confirms results obtained in all our vacuum experiments in past years. Therefore, vacuum-pumping at 5 and 10 inches of mercury did not result in any change in sap-sugar concentration.

Results support our recent research findings that vacuum-pumping increases sap volume yields of sugar maple. This previous vacuum work was based on paired tapholes on the same trees. The paired one-taphole tree comparisons have strengthened the validity of taphole independence. We also observed that the sap-yield differences between vacuum-pumped and gravity-flow tapholes were greater at higher vacuum levels (table 1). Additional research is being done on the sap yield-vacuum level relationship.

Table 1.—*Sap yields collected from one-taphole trees paired for comparing vacuum-pumping and gravity flows*

| Method of<br>sap collection | Vacuum<br>level                 | Sap<br>yield            |
|-----------------------------|---------------------------------|-------------------------|
|                             | <i>Inches of mercury</i>        | <i>Gallons per hour</i> |
| Vacuum-pumping              | 5                               | 1.4                     |
| Gravity flow                | 0                               | 0.7                     |
|                             | <i>(Difference—200 percent)</i> |                         |
| Vacuum-pumping              | 10                              | 3.0                     |
| Gravity flow                | 0                               | 1.2                     |
|                             | <i>(Difference—250 percent)</i> |                         |

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