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Stemflow in a multi-storied Aspen community

J.R. Clements

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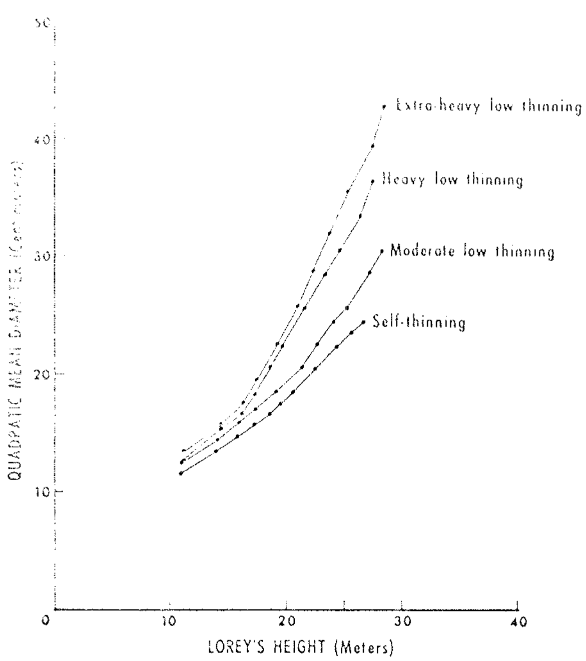

FIGURE 1. The relationship between the quadratic mean diameter and the mean height by thinning grades.

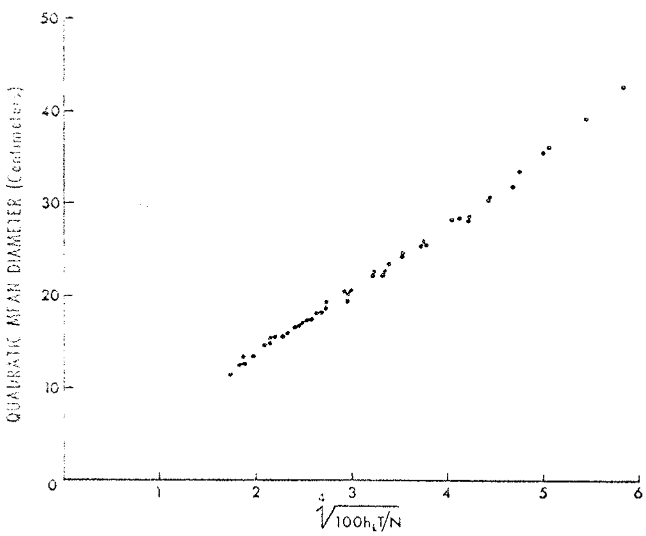

FIGURE 2. The relationship between the quadratic mean diameter and the height/age/spacing expression.

The equation was tested on data from permanent sample-plot records for thinned stands of Norway spruce from Norway (Eide and Langsaeter, Meddelelser fra det Norske Skogforsoksvesen. Bind VII, hefte 24-26, 355-500, 1941). The test data satisfied two conditions: (1) height over age data were nearly identical to Carbonnier's data, and (2) for a given age, the number of trees per hectare was within the range of his data.

The results of this test are shown in Table 1. The errors in predicting the diameters with the equation range from an underestimate of 0.8 to an overestimate of 2.9 cm; the errors in predicting the diameter increment range from an underestimate of 0.5 to an overestimate of 1.4 cm.

These results are very promising and may well justify further studies of the use of current stand characteristics for growth prediction purposes. The form of the regression equation may even be more useful than its direct predictive potential because, while the constants and regression coefficients would change for different species and sites, the form of the independent variable $\sqrt[4]{h_L T/N}$ could have general application in much the same way as d^2h as often used in tree volume equations. F. Evert, Forest Management Institute, Ottawa, Ont.

SILVICULTURE

Stemflow In A Young Stand of Aspen Suckers.—This report presents results of a stemflow study in a 5-year-old, dense, sucker stand of largetooth aspen [*Populus grandidentata* Michx.]. The purposes of this study were to determine the relation of stemflow volume per tree to gross rain per storm, to determine the proportion of gross rain reaching the ground as stemflow, and to derive an equation to predict rain equivalent of stemflow from gross rain for use in other studies of water relations of this sucker stand.

The sucker stand, at Petawawa Forest Experiment Station, developed after a fire in May 1964. In October 1968, there was an average of 28,900 stems per ha, ranging in diameter at breast height from 1 to 5 cm. Average basal area was 13.1 m^2 per ha. Average tree height was 4.6 m and average depth of the leafy canopy was 2.0 m. The site was a gently rolling plain about 150 m above sea level. Soils were non-calcareous fine sand (about 22 cm deep) of deltaic origin re-worked by wind, overlying silt. Regional climate is continental, local mean annual precipitation is 78.8 cm and local mean annual temperature is 4.2 C.

Nine trees were selected for study, one from each diameter class of 0.6 cm. Stemflow channels were attached to the stem about 25 cm above ground surface, and connected to plastic containers. Channels were about 1 cm wider than the stems. Gross rain was measured in three M.S.C. rain gauges in a clearing about 45 m from the selected trees. Diameter of the clearing was about 13.8 m. The orifices of the gauges were 64.5 cm^2 in area and were 76 cm above ground surface (i.e. above splash height).

Stemflow and gross rain measurements, made only while the trees were in leaf, began 4 Aug. and ended 28 Oct. 1968. Measurements of stemflow and gross rain were made after each storm. A storm was defined as any rainy period separated from any other rainy period by at least 6 hours and storm size was the amount of gross rain measured from a storm. During the study there were 18 storms ranging in size from 1.0 to 18.9 mm (total 178.8 mm), and stemflow volumes ranged from a trace to 1.3 l per tree per storm.

The relation between stemflow volume per storm and gross rain per storm was expressed for each tree separately by the general rectilinear equation

$$S_t = a + b\,P \quad \text{liters per storm} \qquad (1)$$

where S_t = stemflow per storm in liters; P = gross rain per storm in mm; and a, b are equation coefficients.

There was no evidence of curvilinearity on graphs of plotted data. Values of r^2 for the separate equations for each tree ranged from 0.51 to 0.94, and were significant at $P = 0.005$. Values of standard errors of estimated stemflows per storm for mean storm size, expressed as percentage of mean stemflow per storm, ranged from 4.4–21.6%.

A single equation was calculated to interpolate between measured storm sizes and measured tree basal areas. To do this the a and b coefficients computed after question (1) for each tree were separately expressed as statistical functions of basal area per tree according to the equations

$$a = c\,BA \quad \text{liters per storm} \qquad (2)$$

$$b = d\,BA \quad \text{liters stemflow per mm gross rain} \qquad (3)$$

where a, b are the regression coefficients from equation (1), BA = basal area per tree in cm^2 and c, d are equation coefficients.

For equation (2), $c = -0.0044$, $r^2 = 0.69$, standard error of $c = 0.0005$, and $n = 9$. For equation (3), $d = 0.0038$, $r^2 = 0.86$, standard error of $d = 0.0005$, and $n = 9$.

Then the functions for *a* and *b* were substituted in equation (1) and the general stemflow equation for the sucker aspens is

$$S_t = BA(-0.0044 + 0.0038\ P) \text{ liters per tree per storm} \qquad (4)$$

where the symbols are as before.

Total volume of stemflow per hectare was easily computed for each storm size using equation (4) and the average number of stems per hectare in each diameter class. Then, total volume for each storm size was converted to mm equivalent rain. Computed values of stemflow in mm rain equivalent, were plotted over gross rain per storm and the equation representing this relationship is

$$S = -0.058 + 0.050\ P \quad \text{mm per storm} \qquad (5)$$

where S = stemflow per storm in mm per storm and
P = gross rain per storm in mm.

With this equation, rain equivalent of stemflow in the sucker stand can be computed for any amount of gross rainfall.

From the coefficients in equation (5), it is apparent that stemflow in terms of rain equivalent is nearly 5% of gross rain. This percentage is higher than that for mature largetooth aspen in a nearby forest reported by Clements (Can. J. Forest Res. 1:20-31, 1971). In the mature forest, stemflow amounted to 1.5 to 2.2% of total June-to-September gross rainfall.

Although it is a small proportion of gross rain, stemflow may play a significant role in the sucker trees' water and nutrient cycles. Carlisle *et al.* (J. Ecol. *55*:615-627, 1967) found that stemflow had a high nutrient concentration. If stemflow from the aspen suckers in this study also have a high nutrient concentration, then nutrients and stemflow would be readily available to fine feeding roots which arise adventitiously on aspen suckers at the stem base or near the stem base on the parent root (Maini, *In* Growth and Utilization of Poplars in Canada. Dep. Forest. Rural Dev., Dep. Publ. No. 1205, pp. 20-69, 1968).

Availability of stemflow to feeding roots may be further demonstrated: 5% of gross rain enters the ground at the base of trees whose combined basal area is 13.1 m^2/ha or about 0.13% of ground surface area. This method of water entry into the soil represents a substantial funneling of rain to the feeding roots.—John R. Clements, Petawawa Forest Experiment Station, Chalk River, Ont.

(*Continued from back cover*)

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