CANADA

Timber Talks

Department of Fisheries and Forestry

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Can You Predict Forest Growth and Yield? No. 68

Most forest-management practices are directed toward increasing the allowable cut or to a reduction in rotation age. To evaluate such practices, future wood volumes must be predictable. This may be accomplished by measurement of permanent sample plots or by the use of empirical yield tables. These methods either take too long before results become available or are not too reliable. A method has been devised whereby tree and stand growth is simulated on a computer so that estimates of growth and yield can be obtained quickly and the results of stand treatments tested and demonstrated rapidly.

A mathematical model (group of related equations) was developed to simulate the growth of stands in terms of the crown expansion of individual trees. A particular plot for which growth predictions are to be made is simulated in a computer by a "map", showing the location and crown size of each tree. As trees grow the spread of their crowns is limited by the size and location of competing trees. The growth and resulting asymmetrical development of the tree crown is simulated by a scanning program which directs the computer to search out growing space available to each tree. Diameter and volume of the bole are estimated from the height and crown size of each tree at the end of the prediction period. The individual tree is the basic unit in the simulation, and the influence of environment on its growth is described in terms of the crown development. Variables included in the model are age, site, quality, spacial distribution of trees, competition, cultural practices (thinnings) and unexplained sources of variation attributable to genetics, microsite, root grafting, etc. Data were collected from even-aged stands of white spruce near Prince George, B.C.

Equations were evolved to describe relationships between the various components of the tree growth and environmental factors. The mathematical model was based on the following determined relationships for which equations had been developed:

a) Cumulative height-growth of trees describes the extensional growth of the branches within the growing space limitations imposed by competing trees.

b) Height-growth of a tree is a function of the height-growth of dominant trees and the width of the crown relative to maximum crown width of comparable open-grown trees.

c) There is a 50 per cent possibility that a tree will be suppressed if the natural logarithm of the ratio between crown width and maximum crown width falls below - 1.75.

d) Tree height and crown width provide accurate estimates of diameter and volume of the bole.

Suitable and adequate data from British Columbia were not available to test the reliability of the model; consequently, limited permanent sample plot data from Ontario were used. Testing revealed that simulated and actual values for number of trees per plot, crown width, average diameter of the bole and volume per acre were in reasonable agreement. Simulated values were usually slightly low for stand height and a little high for rate of basal area growth at age 45 (1967) when dominants were 50-60 ft tall. Certain limitations to the model are recognized but can be overcome.

The model provides estimates of the growth and yield of different sizes of stands of white spruce. From the computerized simulation of the growth of the stands, estimates of time for crown closure, diameter distribution and total volume by diameter classes can be obtained. This information will permit comparisons of the results of initial spacing before seedlings are planted and provide reliable predictions of the results from various thinning and harvesting regimes.

REPORT: Simulation of the Growth of Even-Aged Stands of White Spruce. Kenneth J. Mitchell. Forest Research Laboratory, Victoria, B.C.