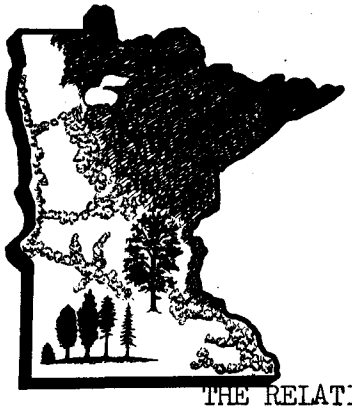

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THE RELATION OF SOIL HORIZON TEXTURE AND ACIDITY TO THE SITE INDEX OF ASPEN IN NORTHERN MINNESOTA 1/

Daniel Meyer 2/

Forest site prediction based on soil horizon texture has been the subject of much research recently, particularly with the southern coniferous species. Experience has shown that site evaluation schemes based solely on a few soil properties have value only in limited areas where biotic and climatic factors can be considered constant. However, it still would be helpful to know what sort of relationship does exist between certain soil properties and aspen site quality for future site studies.

Summary of Correlation Studies

Variables Studied			Results
Site Index	Silt+Clay	B Horizon	r=.576 **
Site Index	Silt+Clay	C Horizon	r=.523 **
Site Index	Clay	B Horizon	r=.425 *
Site Index	pH	C Horizon	r=.510 **
pH C Horizon	Silt+Clay	C Horizon	r=.572 **
Site Index	Silt+Clay	A_1 Horizon	n.s.
Site Index	Silt+Clay	A_2 Horizon	n.s.
Site Index	Clay	A_1 Horizon	n.s.
Site Index	Clay	A_2 Horizon	n.s.
Site Index	Clay	C Horizon	n.s.
Site Index	pH	A_0 Horizon	n.s.
Site Index	pH	A_1 Horizon	n.s.
Site Index	pH	A_2 Horizon	n.s.
Site Index	pH	B Horizon	n.s.

** Significance exceeds 1% level.
* Significance exceeds 5% level.
n.s. Not significant at the 5% level.

Thirty-six of the eighty permanent aspen plots established in connection with the forest tent caterpillar investigations 3/ were used in the study. The basis of selection was the site index value of the plot. The plots having the highest values, lowest values, and those having values nearest the mean site index were selected. The topography and drainage among the plots ranged from flat swamplands to excessively drained ridges. The plots were distributed over fifteen counties in northern Minnesota, and occurred on both glacial outwash and till deposits. Precipitation and other climatic factors vary considerably among plots.

A soil profile pit was dug in the center of each plot. The percent sand, silt, and clay of the horizons was determined by the Bouyoucos hydrometer method. A glass electrode pH meter was used to measure soil acidity. Site index was determined by the age and average height of two dominant trees.

In order to determine if there was a regression of site index on horizon texture and acidity, several correlation studies were made. A summary of the results is presented in the table.

1/ This study was made possible through a cooperative grant from the Office of Iron Range Resources and Rehabilitation.
2/ Graduate student, University of Minnesota School of Forestry.
3/ Batzer, H. O., A. C. Hodson, A. E. Schneider. 1954. Preliminary Results of an Inquiry into the Effects of Defoliation of Aspen Trees by the Forest Tent Caterpillar. Minnesota Forestry Notes No. 31.

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Despite the variations which could be, and probably are, induced by the differences in drainage conditions, climate, and topography, there still exists a highly significant correlation between site index and the texture and acidity of certain soil horizons.

To show these relationships graphically, the silt+clay content of the B horizon was classified into six textural classes. The site index of the plots within each textural class was averaged and plotted against the mid-value of the textural class (Fig. 1). The relationship between site index and the silt+clay content of the C horizon (only 26 plots sampled) is shown in Figure 2. A test of curvilinearity indicated that, within the limits of the data studied, these relationships are linear.

Analyses of variance applied to the data revealed highly significant differences between the poor and good, and the medium and good site classes with regard to soil texture. However, in no case was a significant difference noted between the soil textures of the poor and medium site classes.

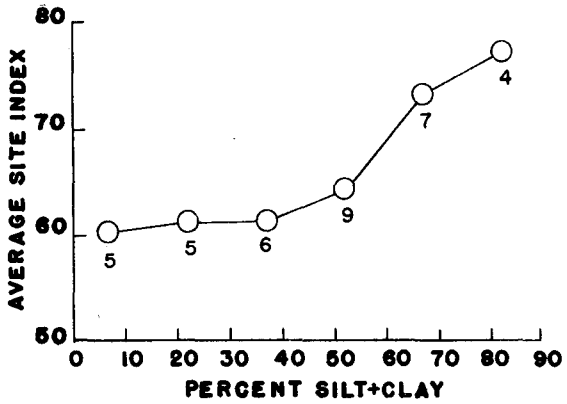

Fig. 1. Relationship of Site Index to the Silt+Clay Content of the B Horizon.

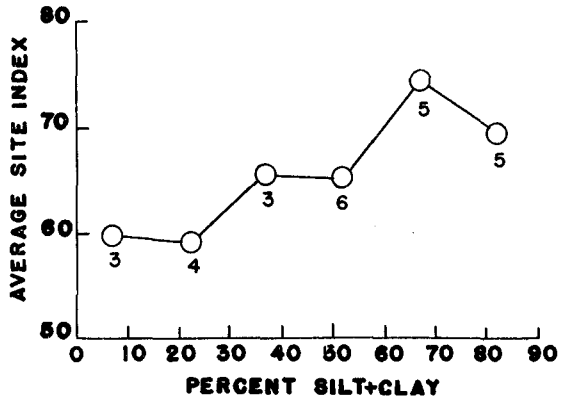

Fig. 2. Relationship of Site Index to the Silt+Clay Content of the C Horizon.

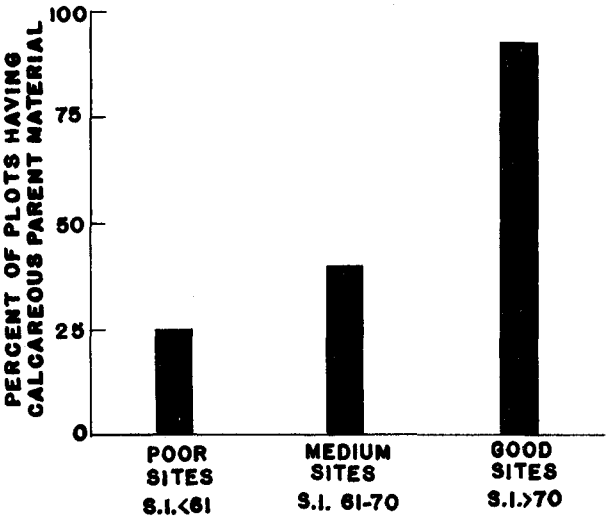

Fig. 3. Percent of Plots Having Calcareous Parent Materials by Site Classes.

The pH of the C horizon, as well as the silt+clay content of this horizon was found to be correlated with site index. It would be difficult to ascertain which of these elements is more important to aspen growth. Though free lime ($CaCO_3$) was found in the parent material (C horizon) in some of the poor and medium sites, a very high percentage of the good sites exhibited this profile characteristic (Fig. 3).

On a relatively small number of plots distributed over a large and heterogeneous area, one might expect relationships between soil texture and/or acidity and site index to be masked by other differences among the plots. However, since both horizon texture and acidity were found to be significantly correlated with site index, the importance of these properties to the growth of northern Minnesota aspen has been demonstrated. Since only one quarter to one third of the variability has been accounted for by soil texture or by pH, prediction on the basis of these qualities must be made with extreme caution.

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