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GROWTH OF GREEN ASH SEEDLINGS IN RELATION TO SOIL ORGANIC-MINERAL COMPONENTS IN A TRIANGULAR COORDINATE SYSTEM

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In a greenhouse study of Green ash (*Fraxinus pennsylvanica* Marsh.) seedlings were grown in upland forest soils<sup>2/</sup>. Soil samples were collected from 30 upland forest stands in the Central Minnesota Pine Section, representing a wide range of moisture and nutrient conditions (Minn. For. Notes No. 119<sup>3/</sup>). The samples were taken from individual horizons and from the top soil of eight subplots in each sampling area.

Seedlings grown for four weeks in quartz sand were planted in clay pots (10 per pot) containing the soil samples. During the growing season the foliage shed was collected. Dormant seedlings were harvested after six months of growth. Roots were washed and the plants air-dried. Dry-weights of stem, roots, and foliage of seedlings were determined.

Triangular coordinates<sup>4/</sup> were used for relating growth characteristics to soil factors. Figures 1 to 3 show triangular coordinate systems based on soil organic-mineral components, i.e., silt-clay, organic matter, and sand-gravel as coordinate axes. Plots were combined in groups of three to simplify the drawing of contour lines. Computed averages are identified by a circle (Fig. 1-3). Reference numbers of plots in the coordinate system are shown in Figure 1-4. This coordinate system was used only for the evaluation of seedling growth in soil samples of the top soil.

The total seedling weight (Fig. 3-6) shows that maximum growth occurred under balanced silt-clay, organic matter, and sand-gravel conditions. Plots 11, 14, and 24 are characterized by deeper humus layers and higher nitrogen levels than the other plots. Comparing total weight with data from Fig. 2, the increase in seedling weight is apparently related to an increase in potassium and, to a certain level, nitrogen. Phosphorus values show little association with changes in seedling weight. Seedling weight tends to increase with increasing values of water holding capacity, pH of humus layer, and pH of the mineral top soil up to a certain level and then decreases.

Shoot weight (without leaves), root weight, and weight of foliage follow a similar pattern as the total weight of seedlings. Foliage is retained longer by plants in soils with relatively low percentages of silt-clay (Fig. 3-4). Low shoot-root ratios are associated with maximum seedling weights (Fig. 3-5, 6); and maximum shoot-root ratios are associated with maximum percentages of silt-clay, organic matter, and sand-gravel (Fig. 3-5).

Standard deviations of total weight of seedlings were computed for each group of three plots. Plots with increased percentage of silt-clay show the largest variation in seedling growth (Fig. 3-7). The results of Duncan's multiple range test correspond to the sloping pattern of the contour lines (Fig. 3-8).

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<sup>2/</sup> Kurmis, V. 1963. Growth of green ash seedlings in upland forest soils. M.S. thesis, unpubl. Univ. Minnesota. 71 pp.

<sup>3/</sup> Bakuzis, E.V., H.L. Hansen, and V. Kurmis. 1962. Weighted site indices in relation to some characteristics of the edaphic field of the Central Pine Section of Minnesota forests. Minn. For. Notes No. 119. 2 pp.

<sup>4/</sup> Bakuzis, E.V. and R.M. Brown. 1962. Elements of model construction and the use of triangular models in forestry research. For. Sci. 8: 119-131.

The triangular models permit the study of seedling growth characteristics in relation to the three soil factors of the coordinate axes; and also permit simultaneous consideration of other soil factors so that comparisons of different soil factors and growth characteristics may be made.

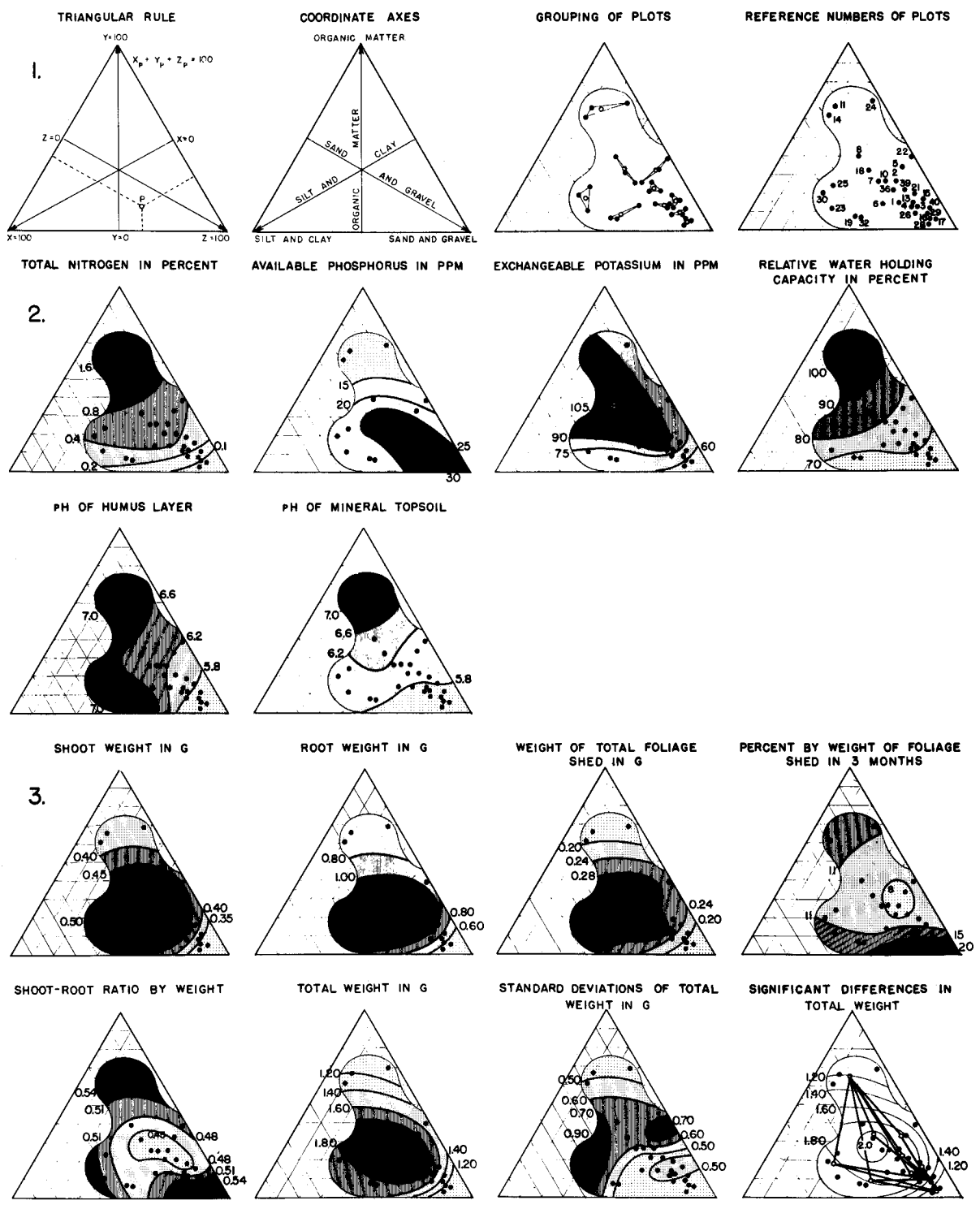


Figure 1. The soil organic-mineral triangular coordinate system.  
 Figure 2. Additional soil factors of the top soil in this system.  
 Figure 3. Growth characteristics of green ash seedlings in the coordinate system. Standard deviations of total weight of seedlings and significant differences (5% level) in total weight of seedlings between groups of plots are indicated by connecting lines in the last two diagrams. The data on shoot, root, foliage, and total weight of seedlings refer to 10 seedlings.