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YEAR END REPORT OF THE RESEARCH PROJECT
ON
POST-FIRE SUCCESSION AND TREE SPECIES REPRODUCTION
ON ISLE ROYALE NATIONAL PARK

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By

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One of the main objectives of this study is to determine what successional trends exist following fire in the upland boreal type forests of Isle Royale National Park. In particular, trends which affect the inflammability of the forest are being sought. Another objective is to study relationships between tree seedling and sprout establishment and various environmental factors.

METHODS

During the summers of 1975 and 1976, 258 sampling points were established along transects running at right angles to the main topographic features of the park. At each point tree counts and breast-height diameters were sampled in 8 meter radius circular plots. Tree seedlings and sapling counts, light estimates, soil litter depth measurements and determinations of slope, aspect, and topographic position were made in 4 meter radius circular plots concentric with the tree plots. Soil surface microhabitat (rotted wood, moss, leaf litter, etc.) cover was determined by a line-intercept method within the 4 meter plots. The age of the stand in which each plot lies was determined by aging four of the larger trees in the stand with an increment borer. The presence of seed sources in the surrounding area for each of the major tree species was also noted.

RESULTS

The stands ranged in age from 40 years (corresponding to a catastrophic fire in 1936) to about 225 years. They were divided into 5 age groups each representing a cluster of more or less similar ages. Several parameters were then averaged for each age group and plotted against the average age of the group in order to detect successional trends.

Relative densities of balsam fir (Abies balsamea) and white spruce (Picea glauca) both tend to increase with increasing stand age (Figure 1 and 2). These tendencies reflect the shade-tolerant nature of these two species. The shade-intolerant white birch (Betula papyrifera), on the other hand, tends to decrease in relative density as stand age increases (Figure 3). The decreasing trend for the shade-intolerant quaking aspen (Populus tremuloides) is not as clear-cut (Figure 4). Since this species is less ubiquitous than the other three major species, it is possible that factors other than stand age may be important in explaining the relative density of this species.

A plot of the relative density of all shade-tolerant species is shown in Figure 5. In addition to balsam fir and white spruce, this includes black spruce (Picea mariana) and northern white cedar (Thuja occidentalis). This quantity increases with stand age but the rate of increase tends to decrease. A similar graph for shade-intolerant species is shown in Figure 6. In addition to white birch and quaking aspen this includes jack pine (Pinus banksiana). These tend to decrease with age, while the rate of decrease becomes less. It appears that the older stands sampled in this study (200 - 225 years old) may be approaching a steady state.

One of the major factors in determining the inflammability of a forest is the basal area of coniferous tree species. Our data indicate that this quantity increases as the forest increases in maturity (Figure 7). Two quantities sampled in this study are measures of the amount of fuel on the forest floor. These are (1) the percentage of the ground covered by wood and (2) the depth of the A_0 soil litter layer. The total amount

of wood cover is made up of decayed wood (D), moss on decayed wood (MD) and undecayed wood (W). The plots of $D + MD + W$ and A_0 versus stand age (Figure 8 and Figure 9) show that both of these quantities increase with time.

Another method of detecting successional trends in the abundance of various tree species is by examining the size structure of each species in stands of similar age. This was done for stands in the age group 85 - 112 years. This age group was chosen because it represents stands of intermediate maturity and because the number of plots in it are relatively large. In each species, each tree was placed in a 5 cm. diameter class. The logarithm of the density of trees in each age class was then plotted against the average diameter of that class. For white spruce the resulting curve was close to a straight line indicating a logarithmic relationship of density versus diameter (Figure 10). For balsam fir, densities also increase toward smaller diameter class (Figure 11) but in the smaller size classes there is a slight departure from the straight line type relationship found in white spruce. This is probably the result of moose browsing on fir over the past 70 years. For both the birch and aspen, densities fall off markedly in the lower age classes (Figure 12 and Figure 13). These four diagrams suggest that birch and aspen will decline in importance in the future, while spruce and fir will increase.

Analysis of seedling and sprout establishment versus various fire-related parameters is still in progress. The more important parameters involved are (1) soil litter depth (2) amount of decayed wood on the forest floor (3) amount of light at ground level (4) amount of seed source available and (5) topographic soil moisture regimes. Computer analysis

using multiple regression and other similar techniques is being employed. Meanwhile, during the present summer we are collecting data on ground cover plants in the boreal forest type using the same plots that were established for the study described above. Emphasis will be on the composition and diversity of ground cover species as related to various stages of post-fire succession.

FIGURE 1.

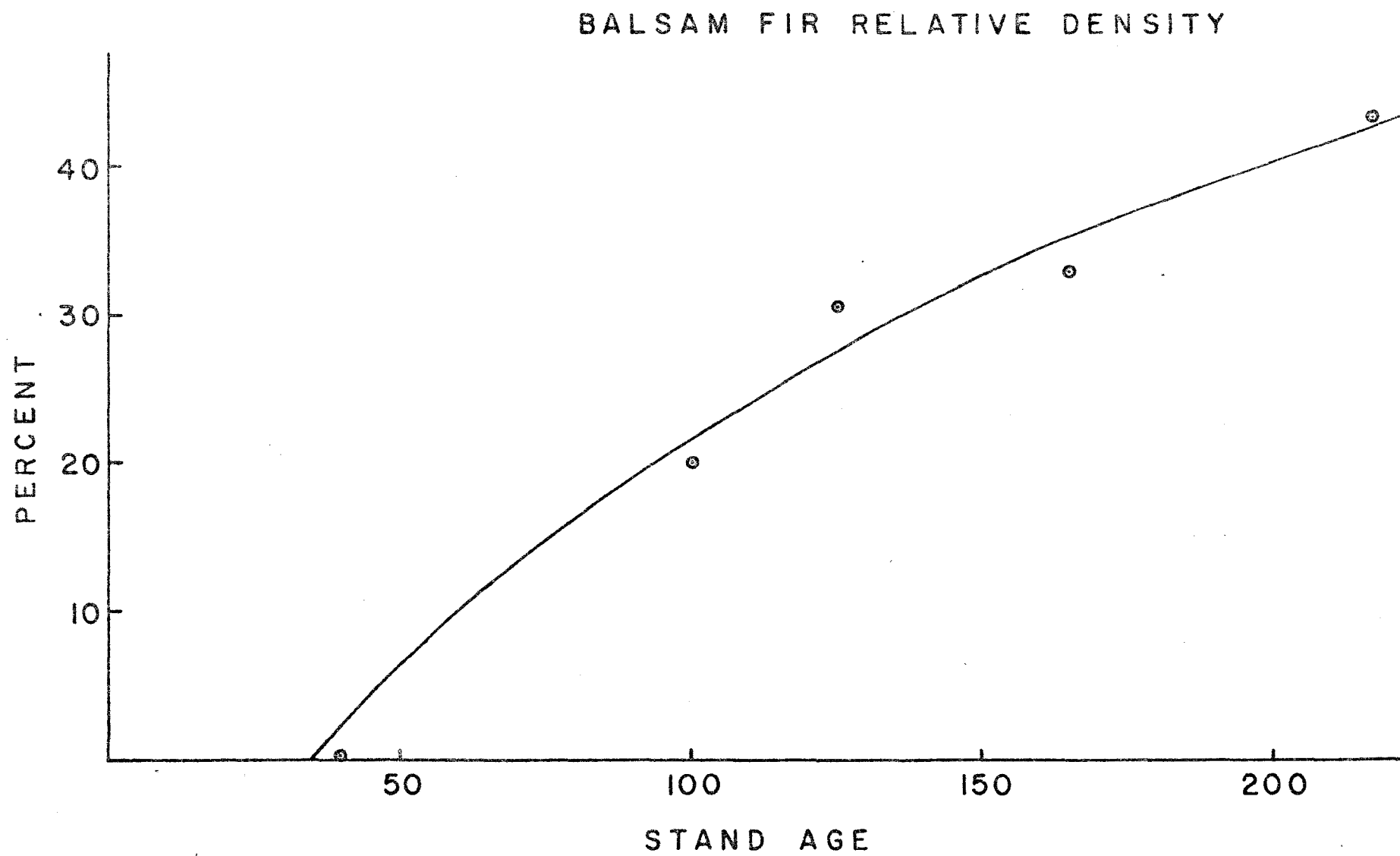


FIGURE 2.

W. SPRUCE RELATIVE DENSITY

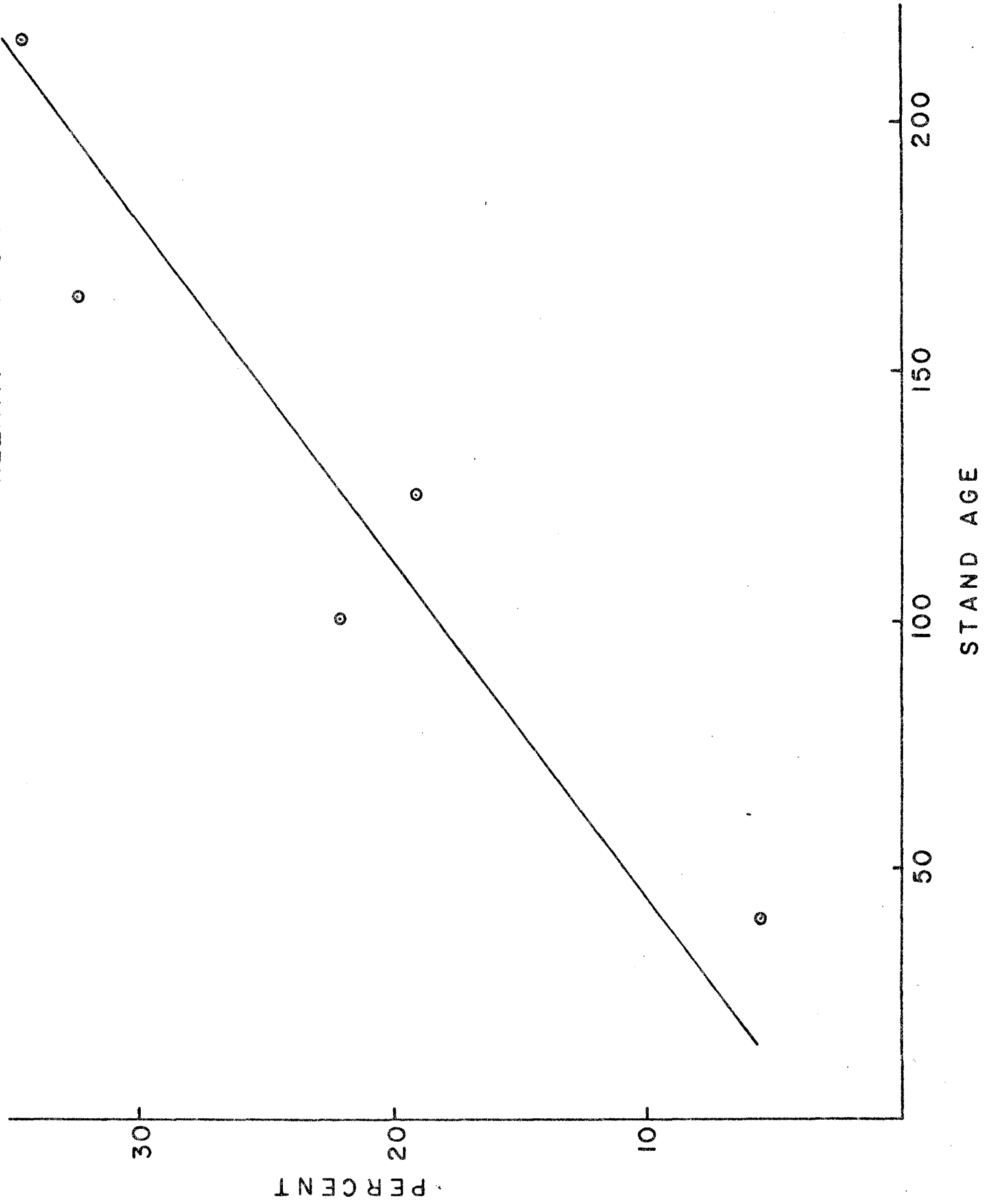


FIGURE 3.

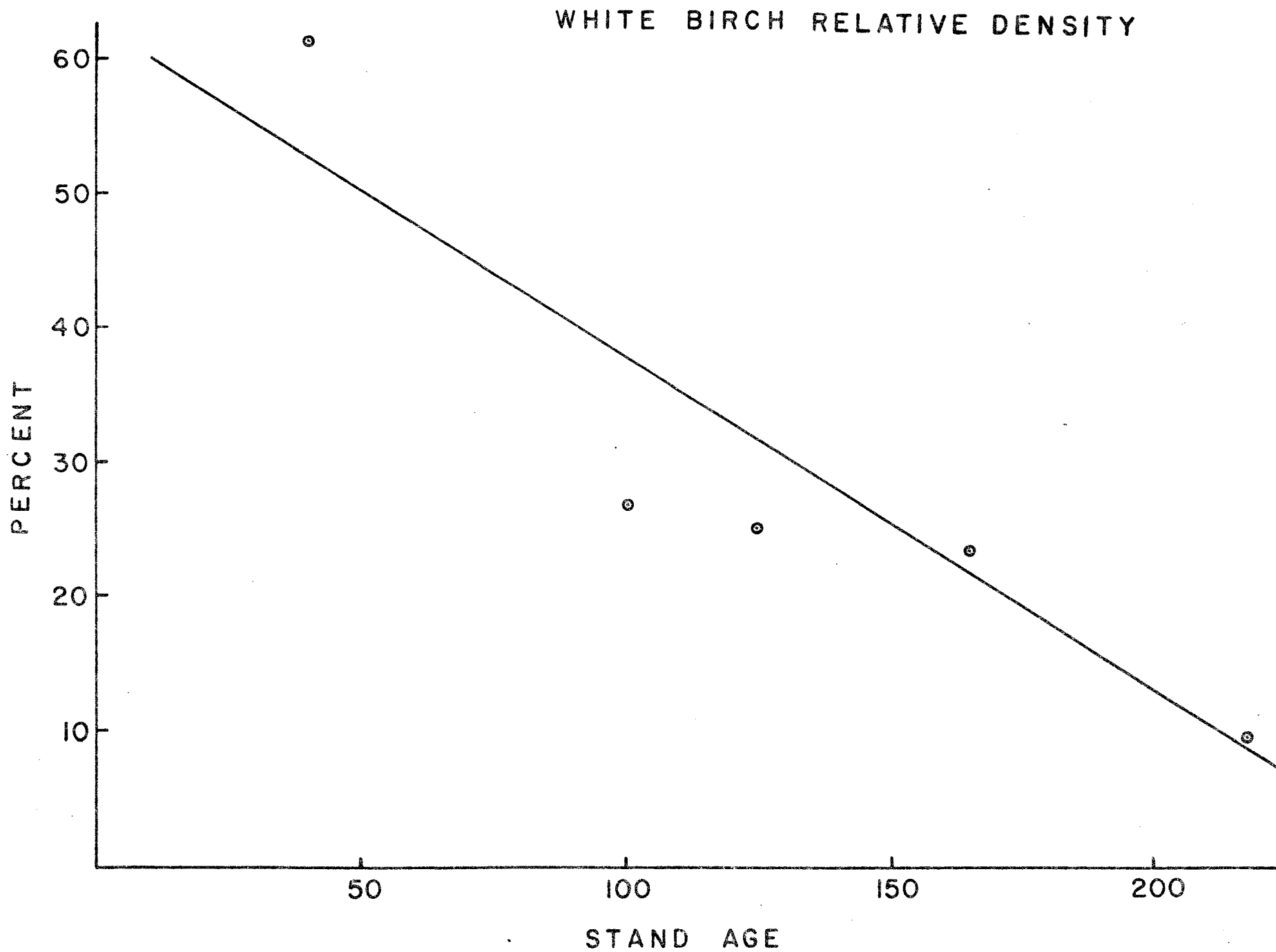


FIGURE 4.

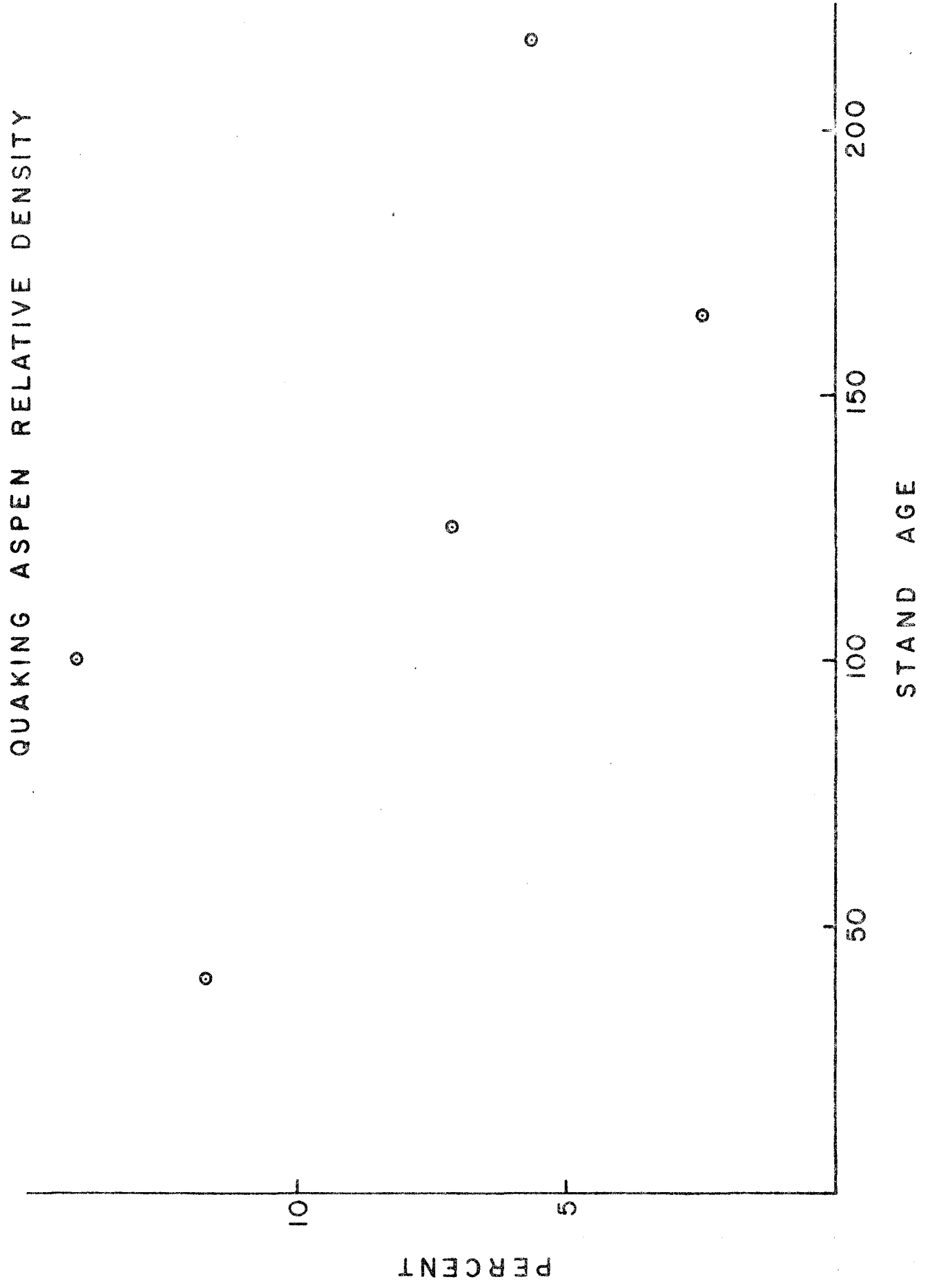


FIGURE 5.

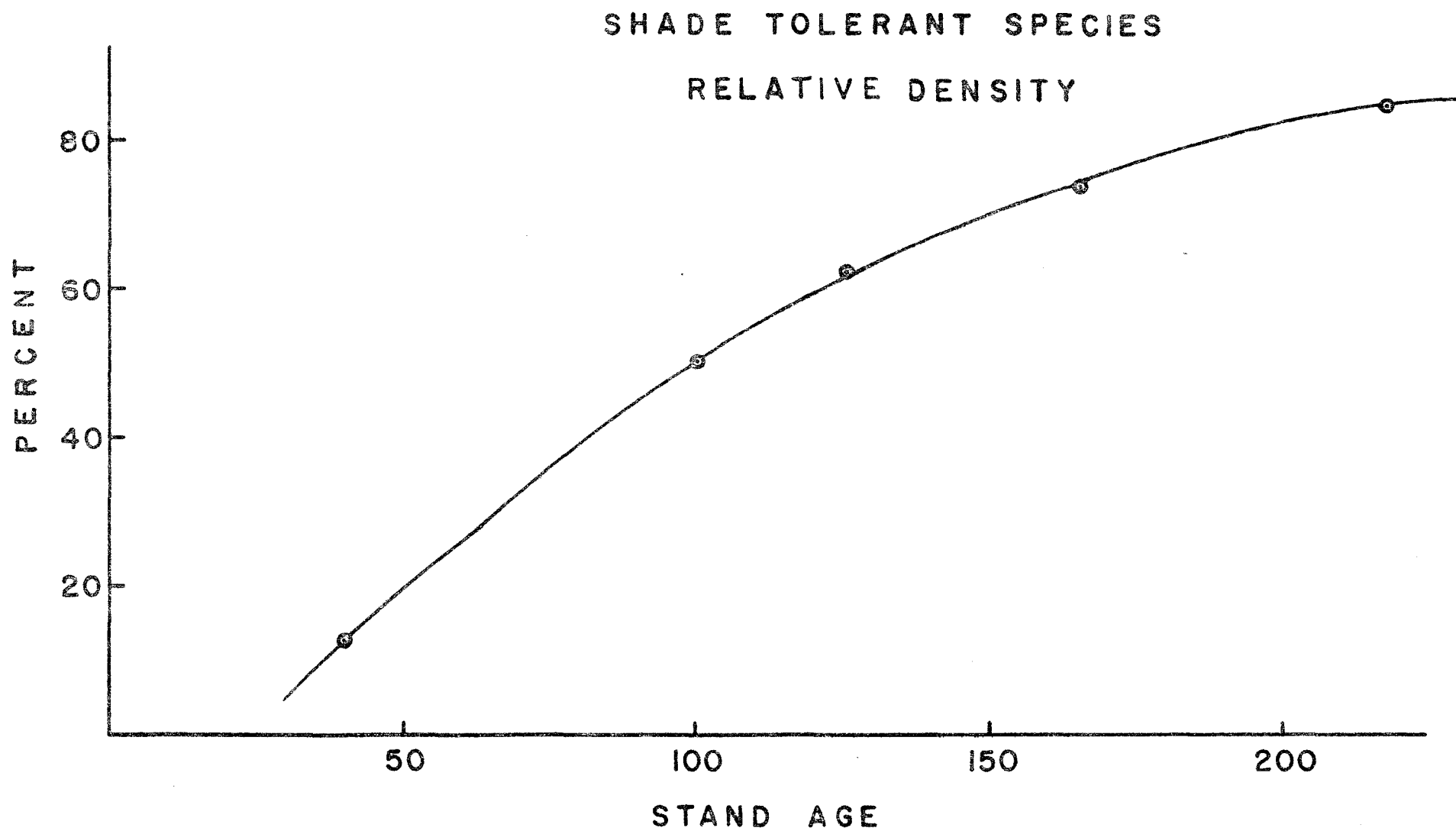


FIGURE 6.

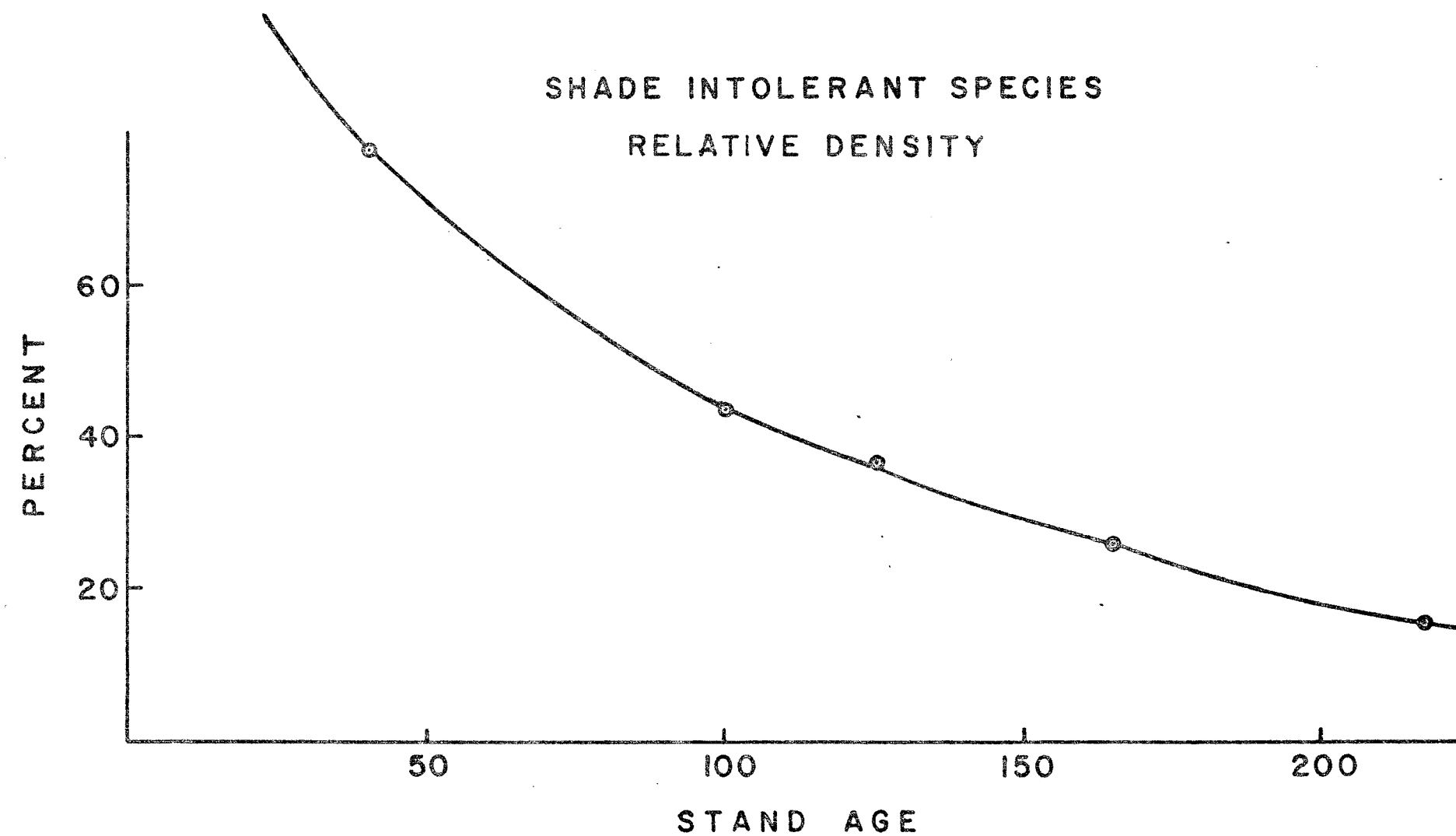


FIGURE 7.

CONIFER BASAL AREA .

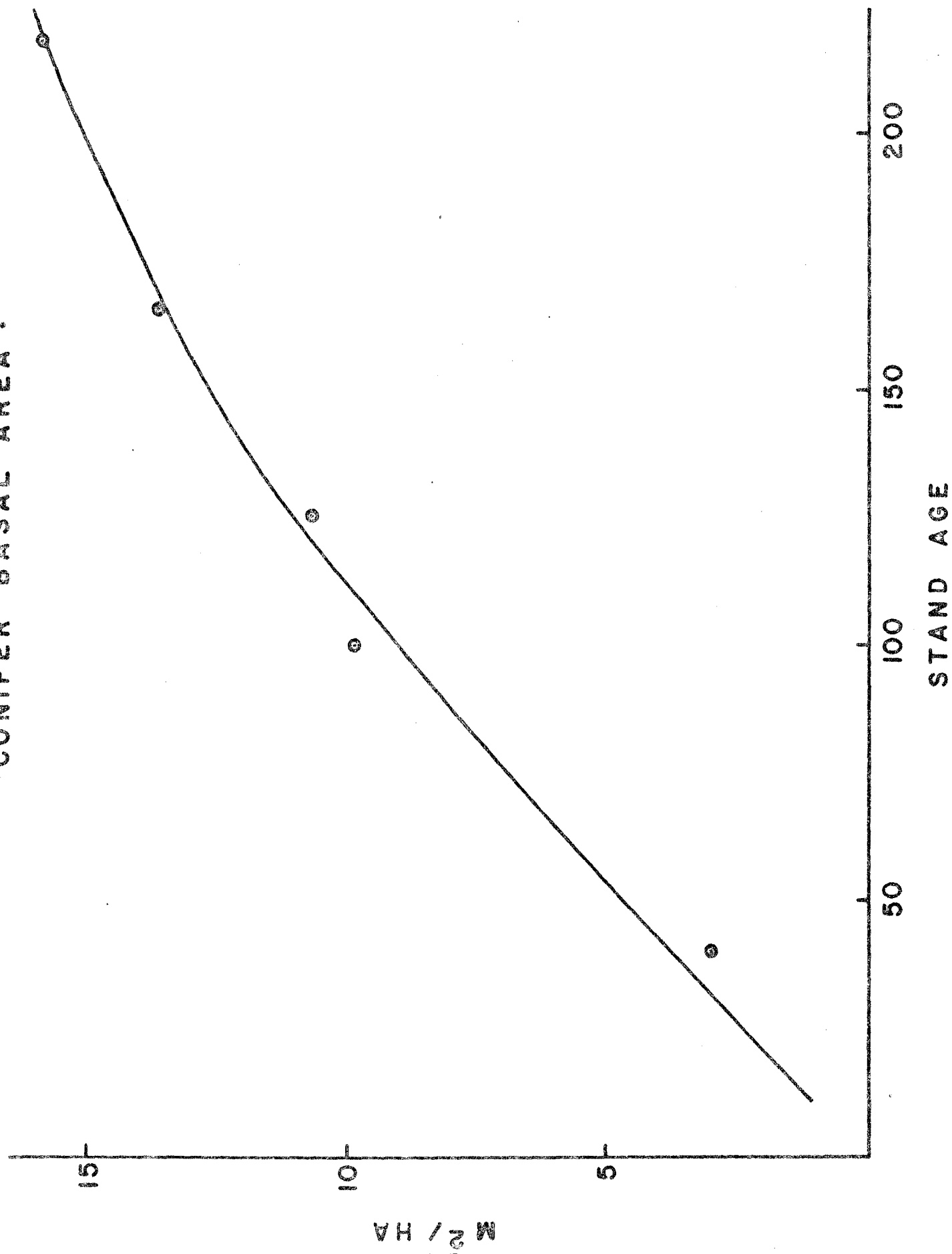


FIGURE 8.

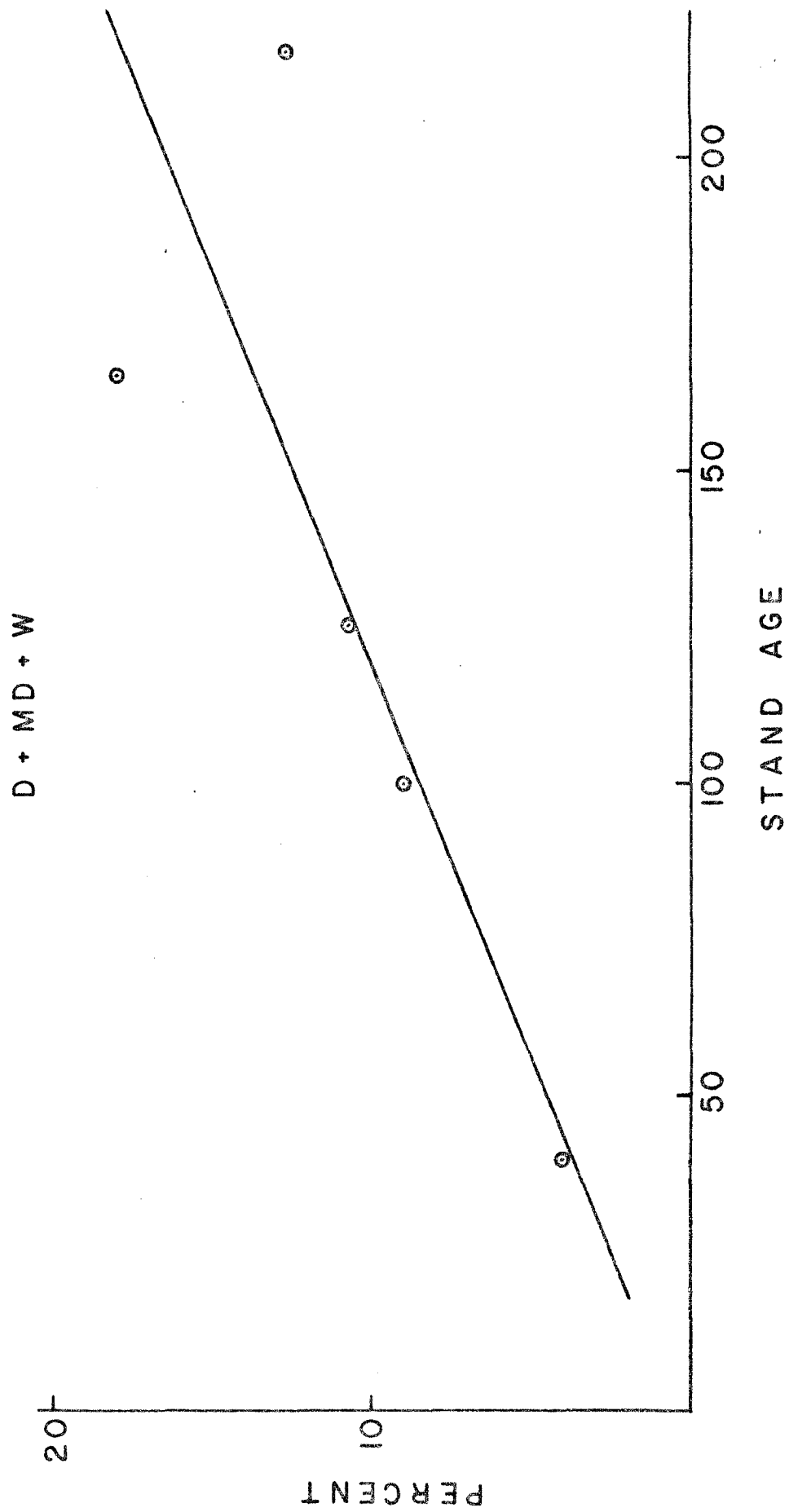


FIGURE 9.

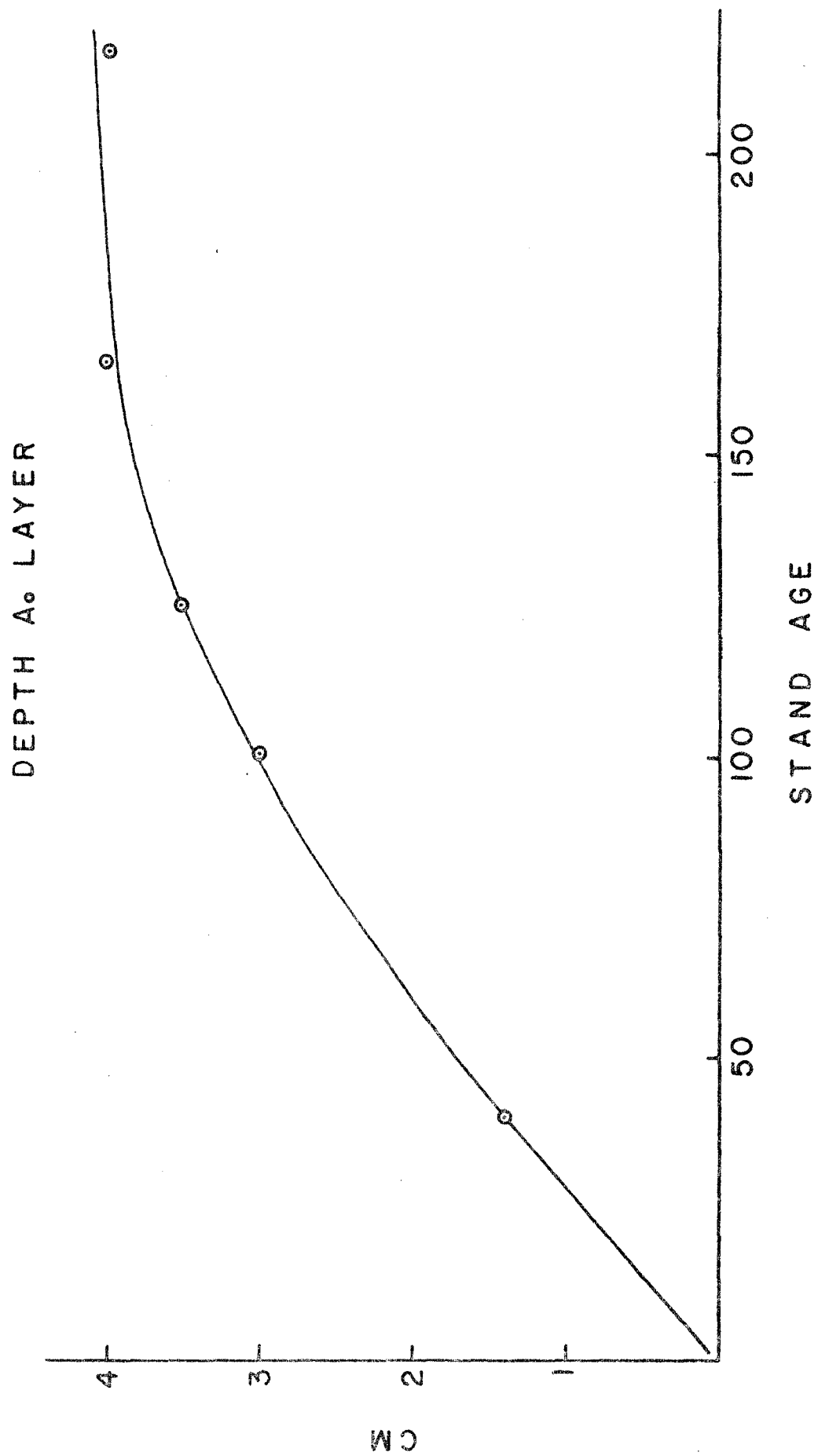


FIGURE 10.

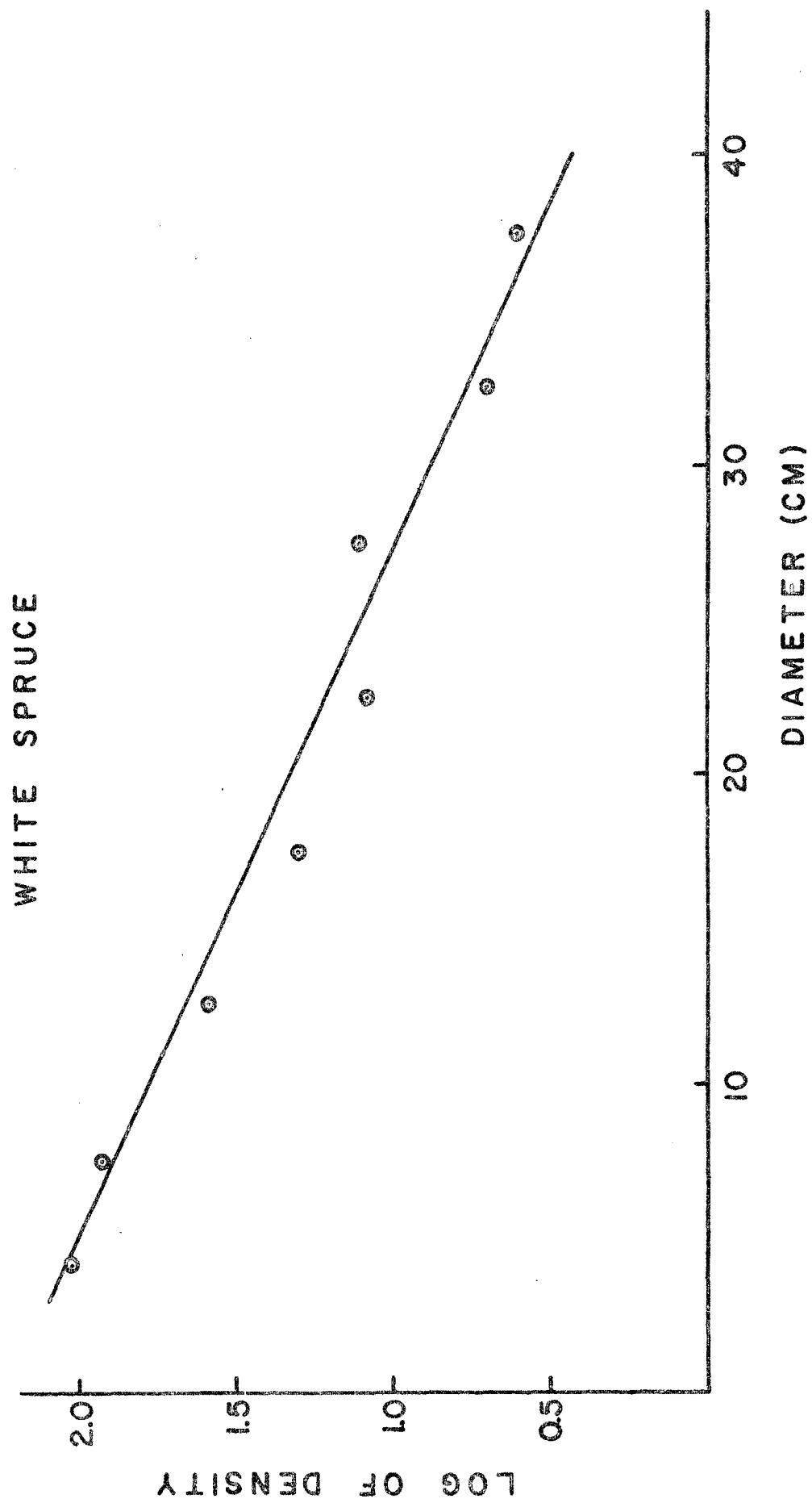


FIGURE 11.

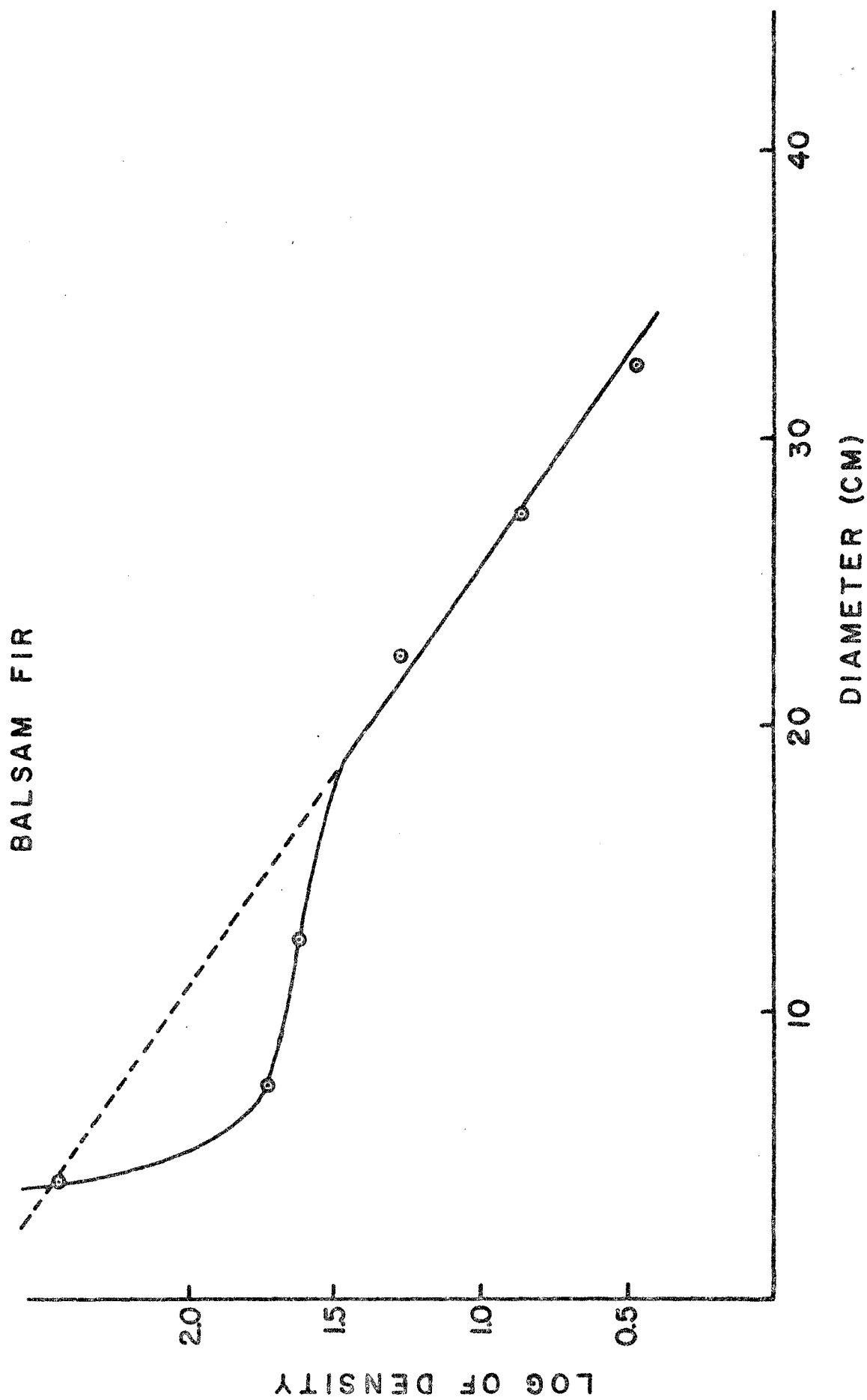


FIGURE 12.

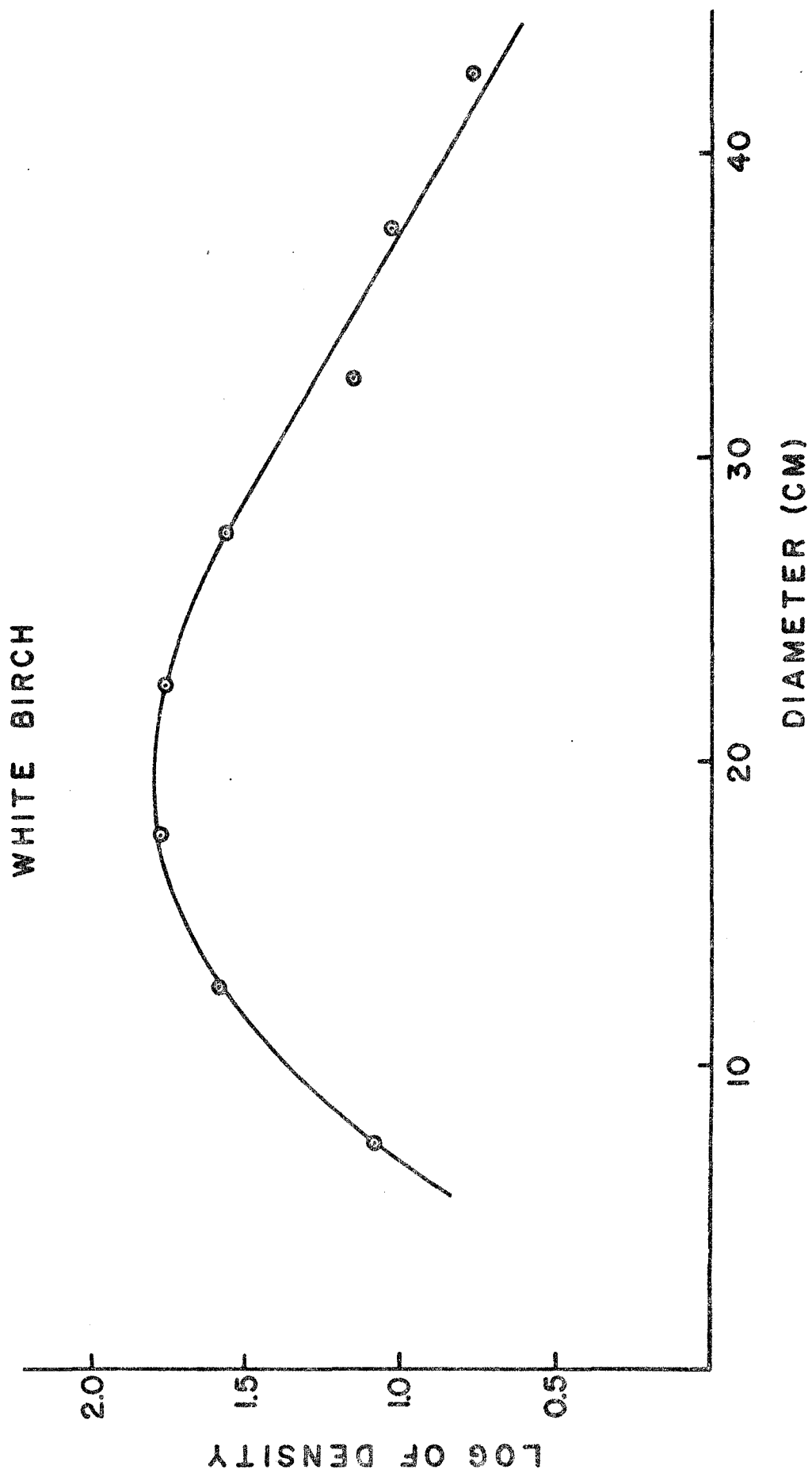


FIGURE 13.

