North Central Forest Experiment Station 5.07

CENTRAL HARDWOOD NOTES

Estimating Black Walnut Plantation Growth And Yield

Growth and yield of plantation grown black walnut depends upon the site productivity and management practices such as vegetation control and thinning. Growth and yield information for all the various combinations of sites and management practices is not available; however, there is some information from unmanaged plantations which provides reasonable estimates. The following graphs relate directly to plantations established with site preparation and weed control the first 2 or 3 years, but no additional management.

Site Index

The first step in estimating growth and/or yield is to determine site productivity. For existing plantations, the age and the average height of the dominant/codominant trees are used to estimate site index (fig. 1). Site index (SI) is expressed as the height in feet at 50 years. For example, the SI for a 25-year-old plantation with an average dominant/codominant tree height of 50 feet is equal to 70. For areas without trees, available information on the soil profile and on tree growth in adjacent areas can help you make a general estimate of relative productivity from low (SI 40) to high (SI 80).

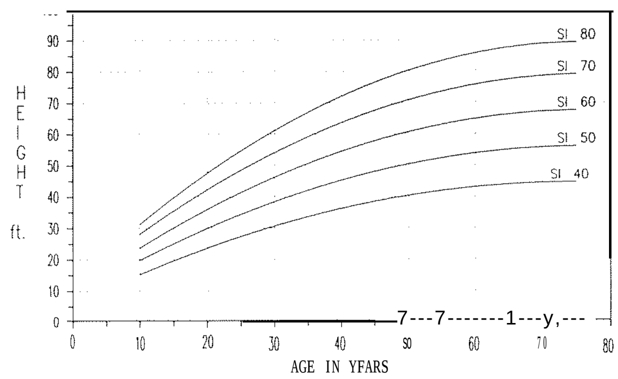

Figure 1 .-Site index determination for black walnut plantations.

Growth and yield estimates on a per acre basis can be obtained directly from a series of graphs for plantations established at an original spacing equivalent to 10 by 10 feet, and indirectly for other spacings as described. While number of trees (fig. 2) decline through natural mortality over time, the yield estimates apply strictly to stands without silvicultural thinning.

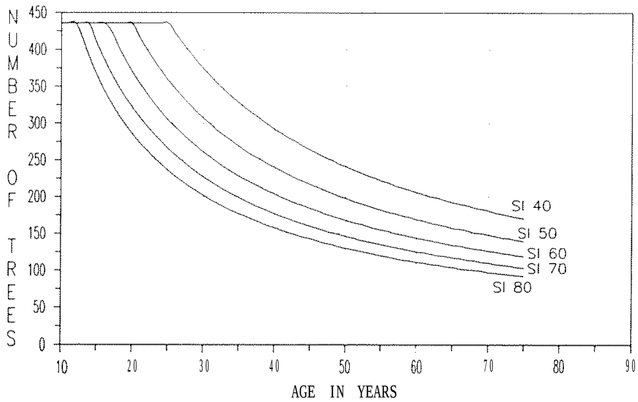

Figure P.-Numbers of trees per acre by age and site index.

Basal Area Growth and Volume Growth

You can use figure 3 to estimate basal area growth by site index for different time periods. For example, the basal area growth of all trees for a plantation with an SI = 60 is estimated to be about 11 square feet between the ages of 30 and 40 years. This estimate is obtained by subtracting the total basal area at age 30 (about 81 square feet) from the total basal area at age 40 (about 92 square feet). You can use figure 4 to estimate volume for different sites at various ages. By age 75, the Doyle rule board foot volume for the same stand above is about 7,300 board feet per acre for trees at least 11 inches in d.b.h.

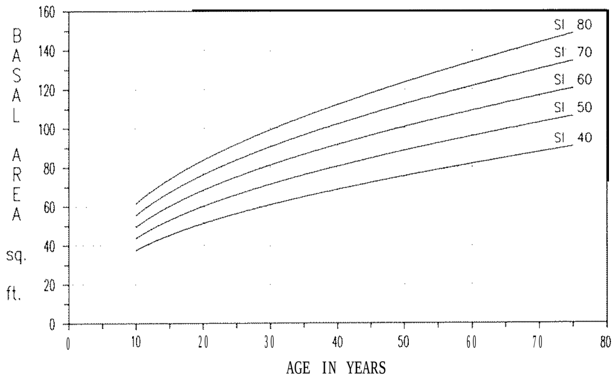

Figure 3.-Basal area per acre by age and site index.

Additional management activities, especially thinning, will change the growth and yields from those shown in the graphs. The primary effects of additional management beyond the establishment period are to reduce the time to obtain a given yield, or to redistribute the yield from many, small trees to fewer, large trees. Although you cannot use the graphs directly in these cases, they can be used in conjunction with other information to develop growth and yield estimates.

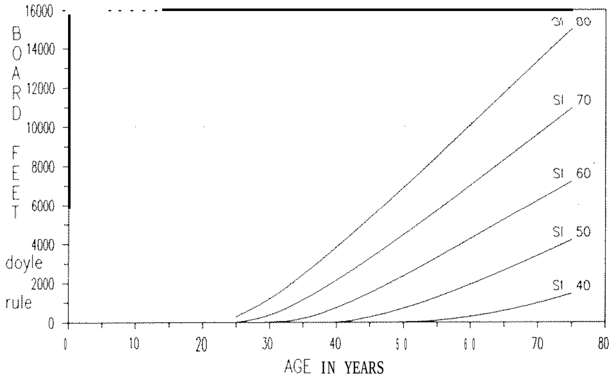

Figure 4.-Board foot volumes, Doyle Rule, per acre by age and site index.

For example, if past management such as weed and understory control or fertilization has increased the growth rate, and the measured basal area is 81 square feet at age 25 for a plantation with an SI = 60, the trees have grown 20 percent faster than without management. This conclusion is drawn by noting from figure 3 that an unmanaged plantation on SI = 60 would have a basal area of 81 square feet at age 30, and that the age difference of 5 years is 20 percent of the actual age (30 years - 25 years/25 years = 20 percent).

If continued management keeps the trees growing 20 percent faster for the rest of the rotation, then you can expect to produce 7,300 board feet on SI = 60 sooner than age 75 (fig. 4). Obtain the actual age by solving the following equation: 25 years/30 years = X years/75 years. In this example, 7,300 board feet can be produced in 63 years.

The management activity that affects individual tree growth most is periodic thinning. Although total yield per acre at final harvest is usually less in thinned stands, the value yields can often be increased by accumulating the growth on fewer, but larger trees. The levels of stocking for the unthinned stands used to develop the graphs were considerably higher than desirable for rapid individual tree growth.

Crown Competition Factor

Crown competition factor (CCF) can be used to determine the level of stocking (fig. 5). At CCF = 100, the plantation fully occupies the site, and each tree can grow at about its maximum rate. As the stocking level rises above CCF = 100, individual tree growth will be progressively less. In general, the diameter growth will be reduced about 4 percent for each 10 CCF units above 100 (see Note 6.05 Silvicultural Treatments in Immature Stands for additional discussion of stocking).

For example, the average tree size in unthinned stands on site index 60 increased from 10.5 inches to 11.8 inches between ages 50 and 60 (fig. 6), while the CCF was about 200 (fig. 5) as determined from the number of trees (fig. 2) and basal

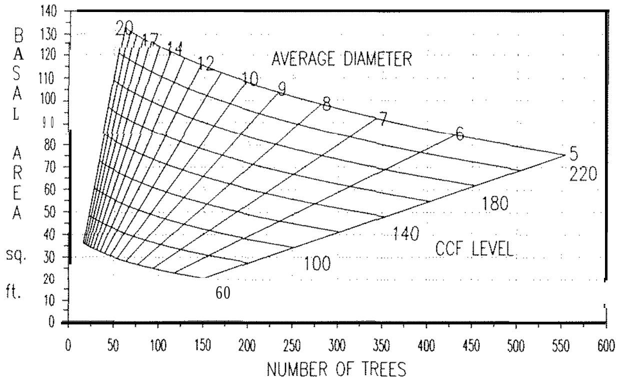

Figure 5.—Black walnut stocking chart.

area (fig. 3) S I= 60. If a stocking level of CCF = 100 had been maintained through periodic thinnings, the average tree size would have increased by 2.2 inches, rather than 1.3, during the same period. This conclusion is drawn by noting that at a stocking level of CCF = 200, growth would be about 40 percent less than at CCF = 100. Thus, growth from figure 6: 1.3 inches/l - 0.40 = 2.2 inches.

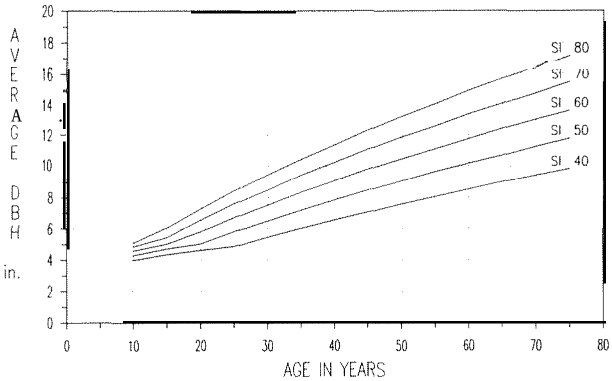

Figure 6.-Average diameter by age and site index.

Black walnut trees are very responsive and the growth and yield can be altered significantly by management. Although the graphs are derived from generally unmanaged plantations, they can provide reasonable estimates for managed plantations if adjustments are made for effects of treatments as shown in the preceding examples. As is true of all such growth and yield estimates, when periodic measurements are available they should be compared with the tabular values and the appropriate adjustments made to customize the graphic value to local conditions.

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