The Ocular LAI Comparator©
for Loblolly Pine
Version 4.1

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Introduction

The role of leaf area in determining light interception and, subsequently, forest productivity has been well established. Both the amount and the seasonal patterns of foliage production and abscission determine the amount of leaf area that is displayed at any time during the year. Recent work has shown that the availability of site resources (nutrients and water), climatic factors (temperature and precipitation), biotic factors (insects and diseases), and anthropogenic elements (*e.g.,* ozone) affect foliage production and abscission. Of these factors, nutrient availability has been shown to be the most important factor contributing to the variation in leaf area and productivity of loblolly pine stands across the southeastern United States. For a given site, soil water holding capacity is generally thought to be fixed and, therefore, not manipulatable after site preparation has been completed. Climatic factors, although variable, are also not manipulatable. Fortunately, nutrient availability is highly manageable, and dynamic over an entire rotation.

Based on the factors that can be managed, we propose that a site's maximum potential leaf area (in the absence of nutrient limitations) will be a function of available soil water holding capacity and climatic influences. A stand's current leaf area can then be compared to its potential leaf area to determine its potential responsiveness to fertilization or other silvicultural treatments. Additionally, current stand growth can be more accurately predicted by leaf area than currently used measures such as basal area and site index. In the future, incorporation of leaf area into growth and yield models may improve our ability to predict future growth.

Loblolly pine typically exhibits a stable yearly minimum leaf area in late winter and early spring after needlefall has slowed and before new foliage production begins (Figure 1).

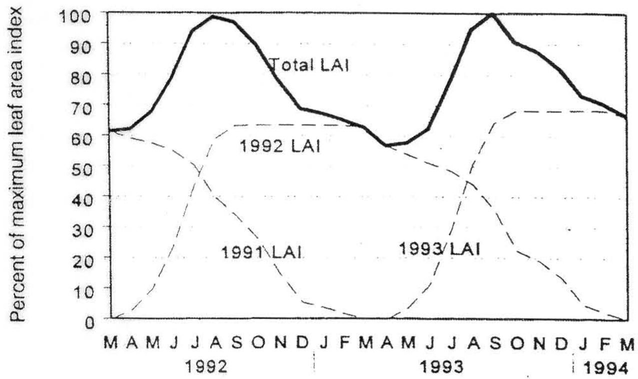


Figure 1. Seasonal dynamics of loblolly pine leaf area index (LAI) in North Carolina. Total LAI reflects seasonal foliage production and abscission.

Peak leaf area is reached in late August or September following completion of elongation of current year foliage. Peak leaf area is often twice that of the winter low, and only lasts for a brief period before maximum needlefall occurs.

Stand density has little effect on leaf area in fully stocked loblolly pine stands (basal area threshold 80 ft^2/acre (18 m^2/ha)). Under fully stocked conditions, the canopy structure is available to support the level of leaf area that can be produced and retained given the availability of resources. At basal areas less than the threshold, leaf area will be reduced.

LAI Comparator© Description

Effective use of leaf area as a diagnostic tool to aid in site-specific silvicultural prescriptions has been limited by our ability to easily and accurately assess leaf area. The LAI Comparator© provides the forest managers with a tool to assist in the accurate estimation of leaf area index (LAI). The LAI Comparator© presents two series

of pictorials representing a range in LAI for two typical combinations of canopy structures and densities.

Each circular view represents nine crowns and an area approximately 30 feet (10 m) in diameter reflecting a typical plantation spacing of 8 x 10 feet (2.4 x 3.0 meters). The images represent a random approximation of foliar distribution as observed when looking from below. Each small black square, or pixel is 4 inches (10 cm) on a side, approximating the foliage on a single shoot or a clump of needles on a branch. On opposing pages, within rows of the same LAI, views portray foliage more (left) or less (right) spread out from the main stem of the tree.

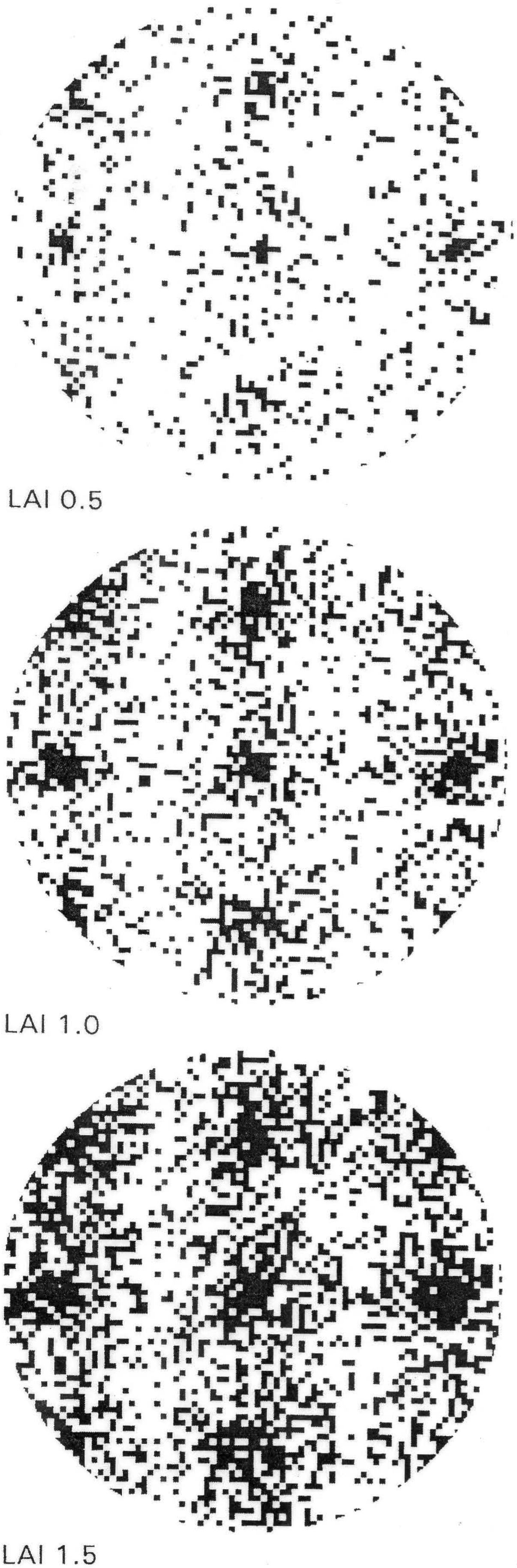
LAI should be determined during the period of maximum leaf area. Leaf area can be determined during the stable winter period but with less sensitivity because leaf area is low. We suggest that a linear adjustment be made in understocked stands to get a true per-acre estimate of LAI.

$$\text{Adjusted LAI} = \frac{\text{basal area}}{\text{full stocking threshold}} \times \text{comparator estimate}$$

It is also possible to use the LAI Comparator© to estimate ***relative*** crown density in understocked or recently thinned stands and, therefore, relative response to treatment.

Instructions

1) Walk around the stand to get a sense of overall stand variability in canopy LAI. Make an estimate of LAI by determining which view(s) most closely approximate(s) the appearance of the canopy. You should estimate LAI at several points throughout the stand. *...Continued on page 12.*



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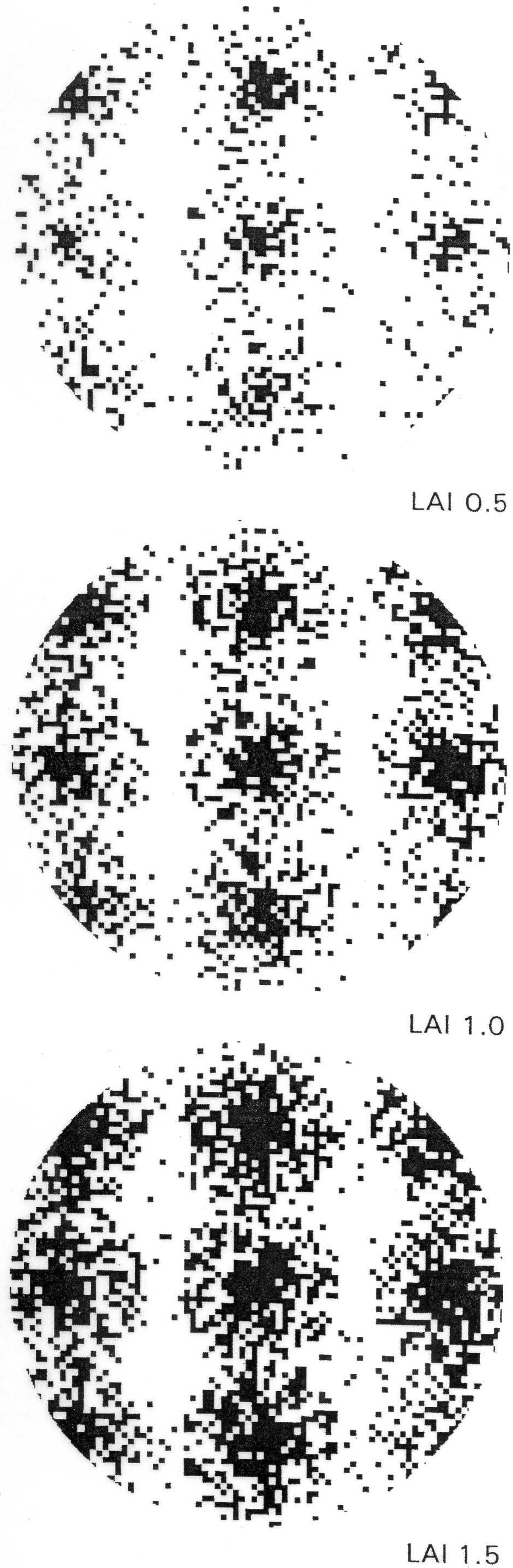

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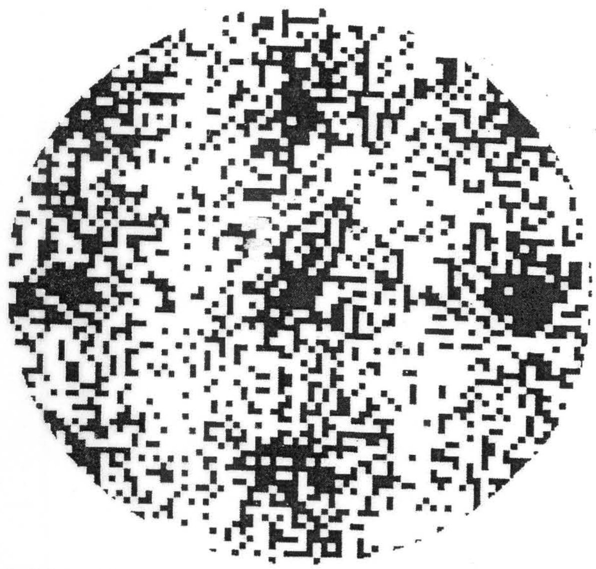
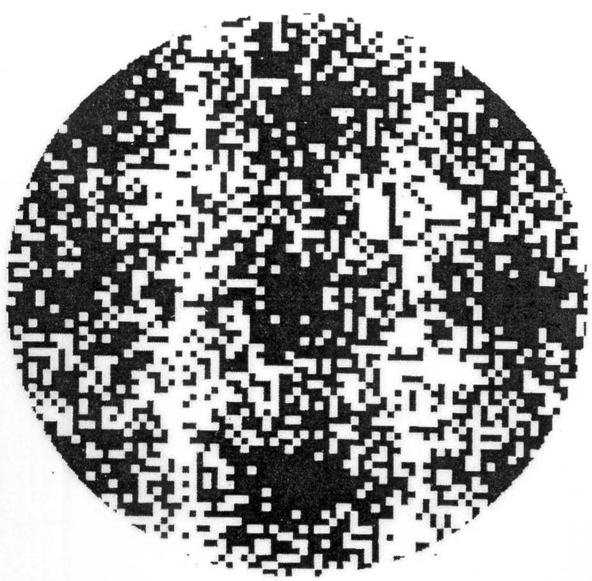


LAI 1.5

LAI 2.0



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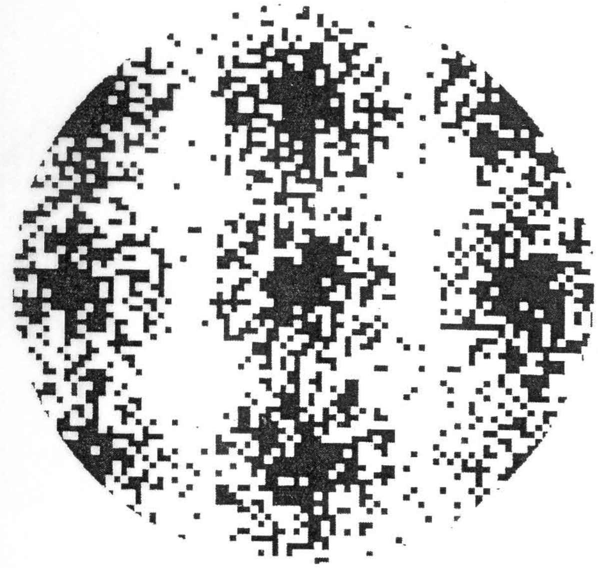

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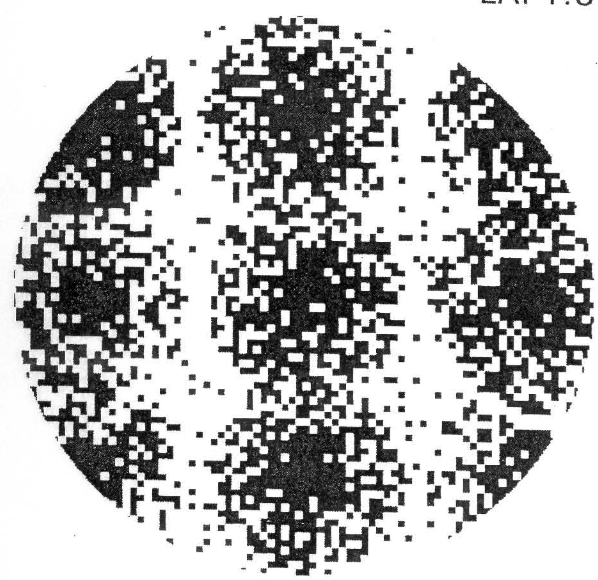

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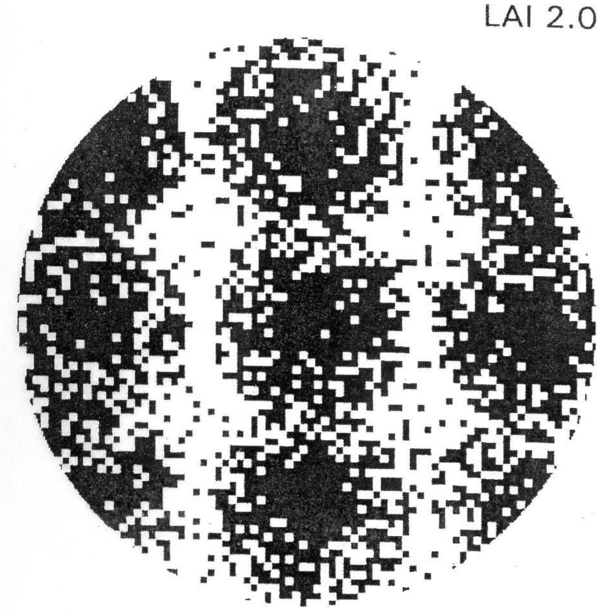

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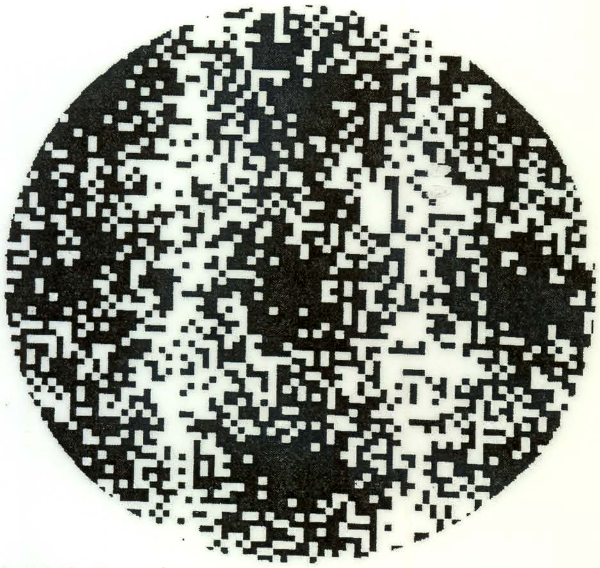

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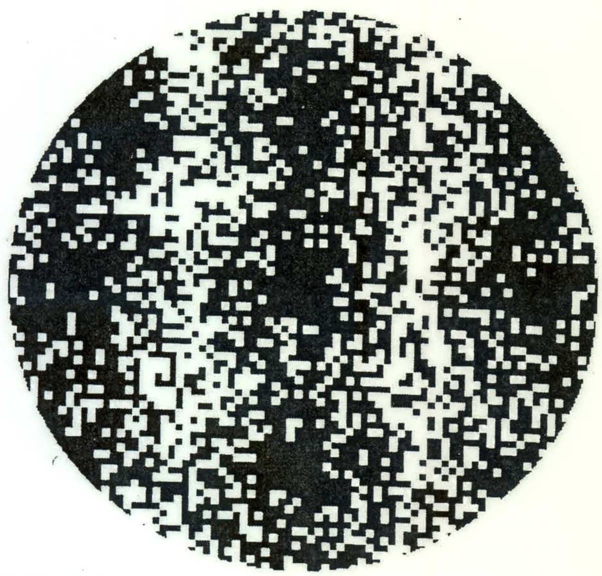

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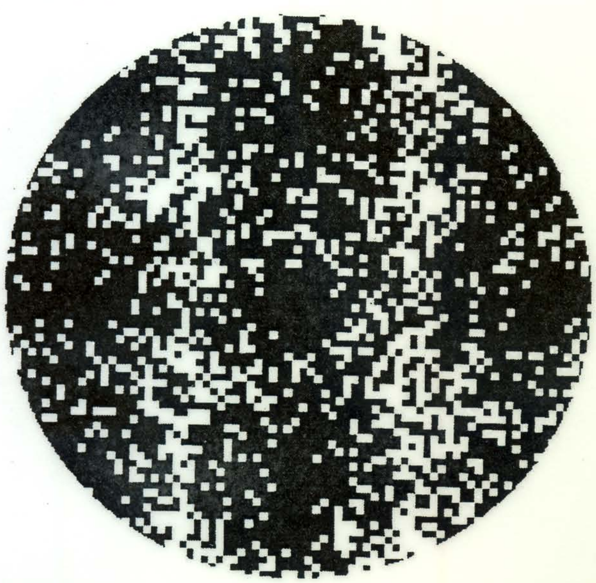

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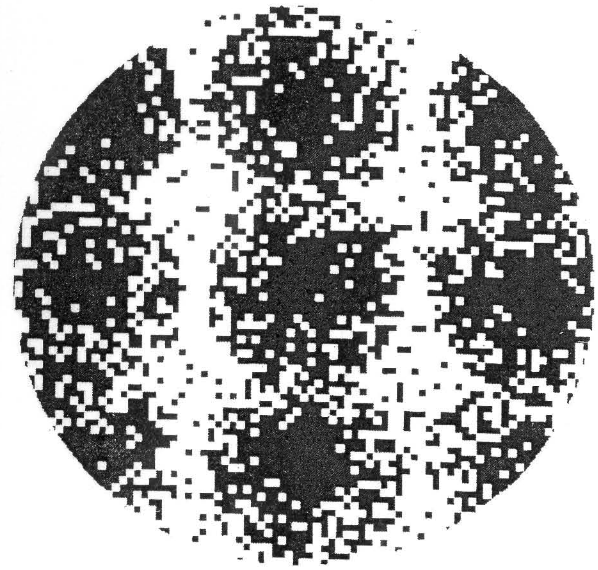

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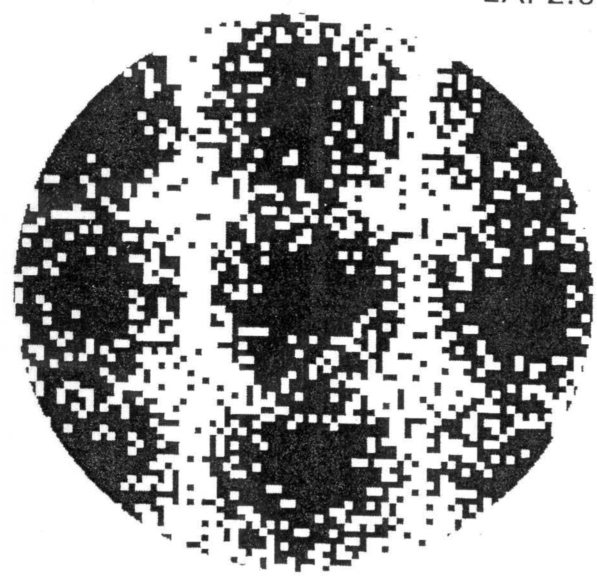

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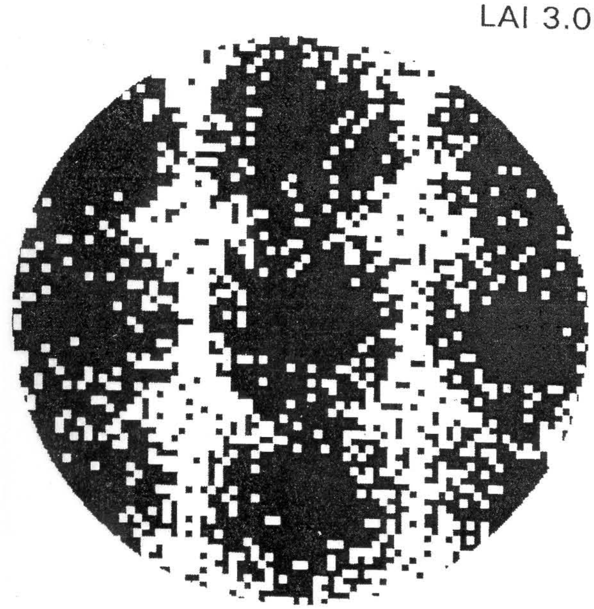

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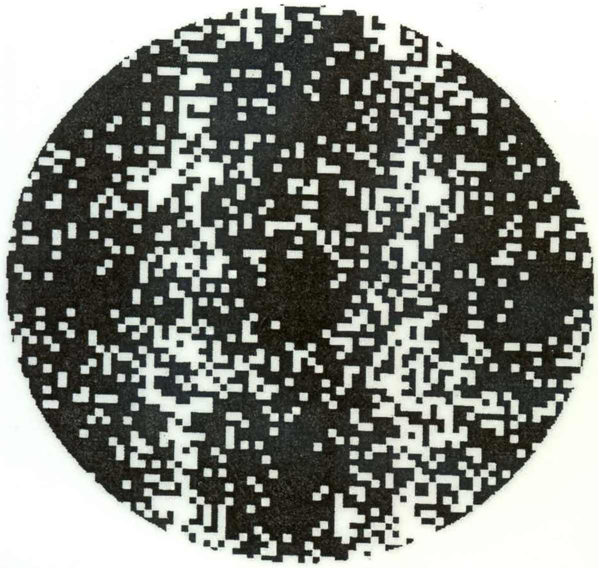

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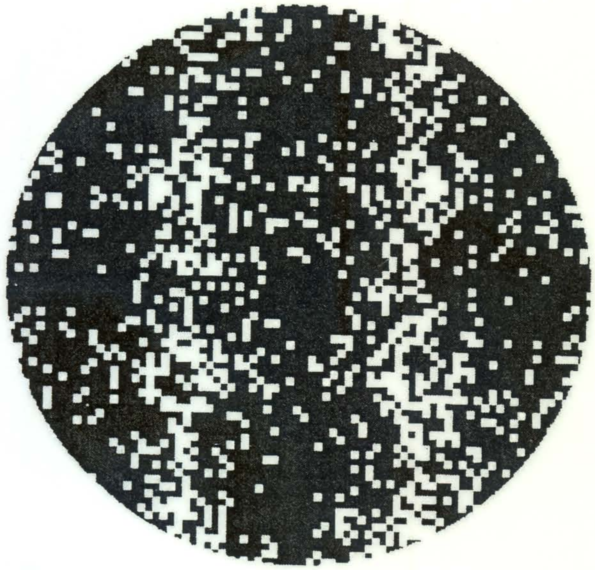
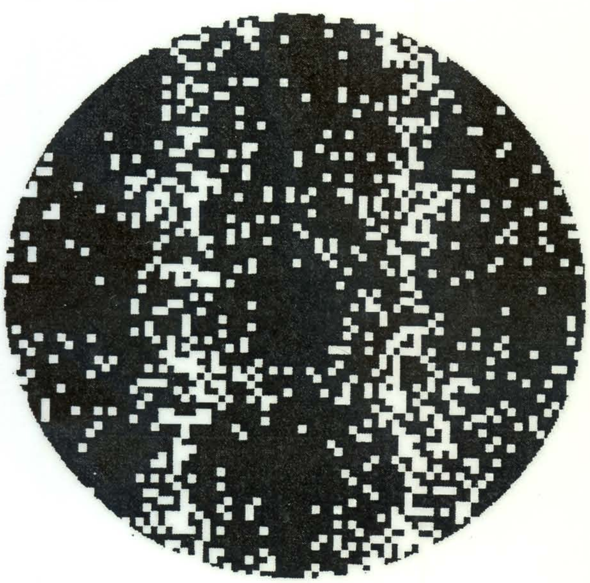


LAI 4.0



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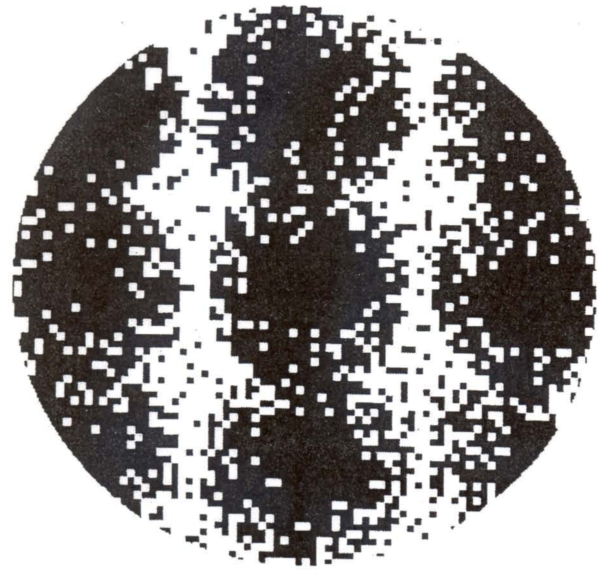

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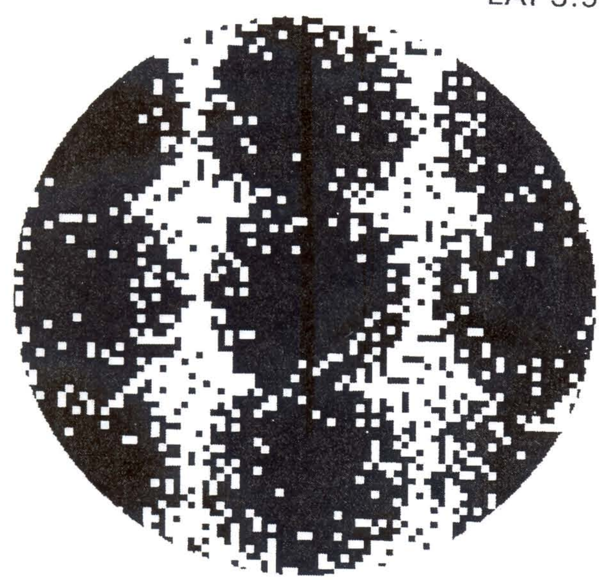

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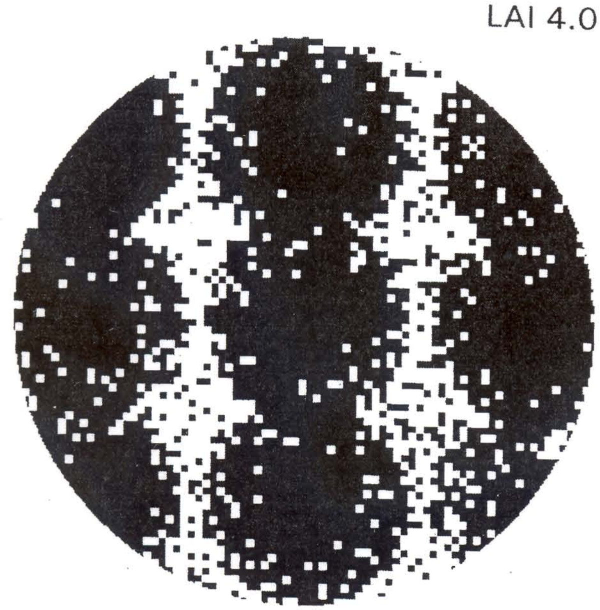

LAI 4.5

Compare the general density and distribution of foliage silhouetted against the sky. Best results are obtained under a bright, overcast sky. Pay close attention to the amount of sky seen between adjacent crowns, and within crowns. The bole and branches you see in the crown should be ignored.

2) Calibrate your eye by comparing the canopy illustrated in Figure 2 with the images on page eight. Note that there are differences in the degree of shading of foliage elements in Figure 2 while the comparator images are all of the same black tone. Therefore, each pixel in a comparator image approximates a foliage element in the canopy, regardless of the degree of shading.

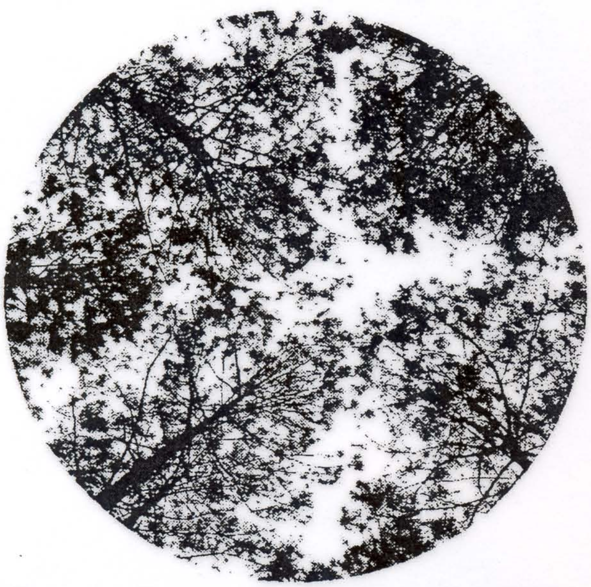

Figure 2. Photograph of a loblolly pine canopy looking skyward. This stand has an LAI of 3.2 (projected) based on needlefall collections.

3) Select the one view that provides the best overall match to observed conditions. Start with an approximate selection on the comparator, then refine it by moving up or down to adjust LAI, or between the left or right pages to adjust for crown spread. Interpolation between images will refine your LAI estimate.

If you have any questions or suggestions regarding the use or interpretation of this comparator, please direct them to Director, Forest Nutrition Cooperative, Box 8008, Department of Forestry, North Carolina State University, Raleigh, NC 27695.