

GUIDES FOR THE SELECTION OF TOUGH HICKORY

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The true hickories supply most of the wood possessing a high degree of shock resistance. Ability to select hickory that satisfactorily meets the requirements, particularly toughness, of handles for all kinds of striking tools, for picker sticks in textile machinery, and for many other exacting uses, usually is attained through long experience with these species and the application of certain rule-of-thumb methods. More reliable guides to selection are needed today, since logging and manufacturing costs are high and manufacturers can ill afford to manufacture items that are discarded or degraded in subsequent inspections. Studies at the Forest Products Laboratory have shown that the selection of hickory for rigorous service can be done at various points from the standing tree to the final product.

Selection in the Forest

Points to consider when cutting hickory trees for manufacture of items of high toughness include: (1) the character of the stand, whether old-growth or second-growth; (2) the history of the stand with respect to previous cutting that would affect subsequent growth of remaining trees; (3) the quality of the site; and (4) the appearance of individual trees.

Stand Character

Wood from old-growth hickory is frequently much more variable in strength characteristics than that from second-growth. Forest Products Laboratory investigations of the wood of virgin-growth hickory trees grown in the Appalachian region revealed great extremes of toughness within a single cross section of a log. Visible evidence of low strength was most apparent in the ring-width pattern of a tree as seen in a cross section, such as the end of a log or a smoothed core of an increment boring. In general, the ring width of old-growth hickory trees decreased markedly toward the bark. Trees showing such decline in ring width contained in the corresponding portion, wood much weaker than that of wider growth rings formed earlier in the same tree. These differences have led to rings-per-inch requirements in specifications for handle grades.

Selection on the basis of rings per inch is a rule of thumb rather than an exact specification for the quality of hickory. All hickory wood of the same rings-per-inch count is not equally tough. It may vary in different parts of the same tree or from tree to tree.

In the forest, trees or logs can be classified with respect to their growth history as having a sustained, an accelerated, or a declining ring-width pattern, or combinations of these patterns. Hickory trees with a sustained or accelerated ring-width pattern have been found to produce wood of uniformly high quality from pith to bark. Narrow growth rings during the early years of a tree contain strong, heavy wood. With well-sustained or accelerated growth, the quality of the wood usually remains high. Thus, if examination of ring width from the pith to the bark reveals such a well-sustained growth pattern, the high quality of the wood from that tree is assured. This condition results in a maximum width of sapwood (white hickory) of high quality and may be responsible for the rule-of-thumb specification frequently used by buyers of hickory logs and bolts that "heartwood shall not exceed one-third of the diameter of a log or bolt."

The width of the rings of the outer portion of the tree is important primarily as compared to that of the rings produced earlier in the tree. A reduction of ring width in the later growth of a tree results in decreased strength and toughness. A growth pattern of that design is a warning of inferior quality in the narrower rings. The degree of inferiority is likely to increase as the circumstances causing it persist.

In second-growth stands, conditions causing reduction of ring width usually have not existed for a very long time, and thus present second-growth trees are less likely to contain wood deficient in strength from this cause. If such stands later on become crowded, slower growth and poorer wood may result.

Stand History

A normal sequence of ring width in many old-growth hickory trees is first a period of rather narrow ring development, next a gradual increase in ring width, and sooner or later a final period of declining width of rings. This sequence of behavior may be changed or interrupted by accidents of nature or by action of man.

The most common change is that brought about by cutting, or accidental removal, of some of the trees in a stand. If this occurs after the remaining trees have undergone a long period of decelerated growth, they will be stimulated to grow more rapidly, with resultant increase in ring width and toughness. Under such circumstances, it frequently happens that a zone of wood of poor quality may be followed by a zone of wood of exceedingly high quality.

Measurements of increment cores from 87 hickory trees in old-growth stands gave an average of 31 rings in the first radial inch of wood next to the bark, 25 rings in the second inch from the bark, and 21 rings in the third inch. Thus the outer 3 inches, or 6 inches of the diameter (averaging 19 inches for the 87 trees) would not meet AA grade handle specifications of 17 rings or less on a rings-per-inch basis. In another stand, hickory trees left standing in logging operations 13 years before they were measured averaged only 12 rings in the inch of wood next the bark. In the preceding inch of growth, acquired before the stand was logged, there were 24 rings. Radial growth thus

was doubled after the stand was logged. Sapwood width measured 2.9 inches in these trees in comparison with an average width of 1.9 inches in other old-growth stands.

If advantage is to be taken of the wood of accelerated growth (or of high-quality wood found earlier in the same tree) great care must be exercised in segregation during manufacture to avoid a combination of wood of good and poor quality in the same piece. It is highly desirable that trees making accelerated growth in diameter after a stand is partially cut (or thinned) be allowed to grow for a sufficient length of time to supply an outer zone thick enough to furnish the material of sizes required in the products to be manufactured.

Silviculturally, the best time for partial cutting (or thinning) would be when trees begin to appreciably reduce ring width due to crowding. This would prevent development of alternate zones of narrow and wide rings. The value of trees showing such alternate zones of growth would be determined largely by the proportion of the tree in the inferior zone or zones and the possibility of avoiding it in the final product.

Site Quality

On the poorest sites, hickory trees suffer more from stunted growth and lack of suitable sizes and clearness of manufactured products than from actual deficiency in the quality of the clear wood. The scrubby hickory trees of poor sites will not supply suitable amounts of defect-free material for high-class products. Limby trees produce locally cross-grained wood. The less thrifty trees of poor sites are more liable to bird peck and insect damage than are the more thrifty trees grown in better locations.

Appearance of Individual Trees

The expert woodsman often exhibits a high degree of skill in spotting individual standing hickory trees of high quality. No record is available of the facts or features used in selecting trees on this basis. To the woodsman it is a sixth sense developed through practice that doubtless combines age, form, vigor, and appearance of the tree. For example, a large tree in a stand must show evidence of continued active growth by a well-formed crown tapering upward (not flat-topped or stag-headed). A small tree in comparison with other trees of the stand should be relatively younger and occupy a situation where it has had opportunity to grow without crowding and exhibit certain characteristics of youth, such as smoother or less ridged bark and thrifty growth indicated by the annual lengthening of top branches.

The bark of trees may offer a good clue to one who becomes familiar with its behavior. On slowly growing trees, light-colored streaks at the bottom of bark furrows are not readily apparent. These streaks, when conspicuous, are evidence of expansion of the bark due to rapid increase in the diameter of the woody trunk. Bark characteristics that may be observed will vary with

species of hickory. Instead of light streaks between ridges, a shagbark hickory tree will manifest more copious shedding of bark while growing thriftily than while stagnating.

Selection at the Cut-up Plant

Assuming a supply of green or partly air-dry hickory lumber from which some product -- for example, picker sticks -- is to be produced, the selection of material of adequate strength and toughness for this purpose presents a difficult problem. With lumber, examination of ring width on the ends of boards or planks can be helpful if considered in the same way as cross-sections of trees. This involves the determination of the inner and outer portions of the boards with respect to their position in the cross section of the tree and the sequence of wide and narrow growth rings.

In judging the quality of blanks, squares, or other items not completely dry, ring-width study is also helpful. The degree of curvature of rings in any piece will indicate nearness to the pith. Narrow rings from near the center of trees need not be excluded, but narrow rings having a low degree of curvature in either heartwood or sapwood indicate material of lower strength than that of wider rings preceding it. On this basis, pieces containing wood of low toughness may be eliminated.

When the inspector is so fortunate as to deal with kiln-dried or thoroughly air-dried material, the comparative weight of pieces of the same size is a good index of quality, the heavier pieces supplying the best material.

It is especially desirable to channel unsuitable material to less exacting uses before manufacture has proceeded to a point where the wood is no longer suitable for other uses. Pieces culled after final manufacture represent a maximum loss.

Some Numerical Guides

Specifications for handles of striking tools limit the best grades to less than 17 rings per inch. In addition, a weight requirement of 55 pounds per cubic foot at 12 percent moisture content may be added. If the weight requirement is enforced, the rings-per-inch limit is unnecessary, since narrow-ringed wood of the required weight will supply satisfactory material. With green or partly dry material, the actual weight of which is difficult to judge, selection on the basis of rings per inch may be most feasible. More efficient use of good material will result, however, if only wood from the outer growth zones of a tree is judged on this basis.

Tests for Quality

Some rather easy tests for judging the quality of wood on a basis of specific gravity have been published by the Forest Products Laboratory recently. A test applicable to use with standing timber provides for determination of the specific gravity of an increment core or of auger chips that can be obtained from standing trees, logs, or timbers. The method is described in detail in Forest Products Laboratory Report No. 1587, "A Field Method of Determining Specific Gravity by Use of Increment Cores or Auger Chips," available free on request. A sensitive helical spring is employed, calibrated to a chart giving specific gravity values for increment cores of specified diameters and lengths. The diameter of core on which the chart is based is obtained from calibration of the cutting edge of the increment borer used. The procedure consists of extracting cores from trees, measuring their length while green, or cutting them to an exact length. Cores are dried in an oven to a moisture-free condition and then suspended from the spring on a thread falling opposite the appropriate core length on the chart. The specific gravity is read directly from the chart as shown by an indicator.

A method requiring less initial preparation can be used with dry lumber of known moisture content or with oven-dry samples. This method consists of floating elongated pieces of suitable dimensions -- for example, 1 by 1 by 10 inches -- on end in a cylindrical container of water and measuring the immersed portion. The immersed length divided by the total length of the piece equals its specific gravity in the condition tested. This method is suitable for comparing partly dry pieces of the same moisture content and for determining specific gravity of moisture-free samples. It cannot be used with green material. The method is described more fully in Forest Products Laboratory Report No. 1398, "The Flotation Method of Determining the Specific Gravity of Wood."

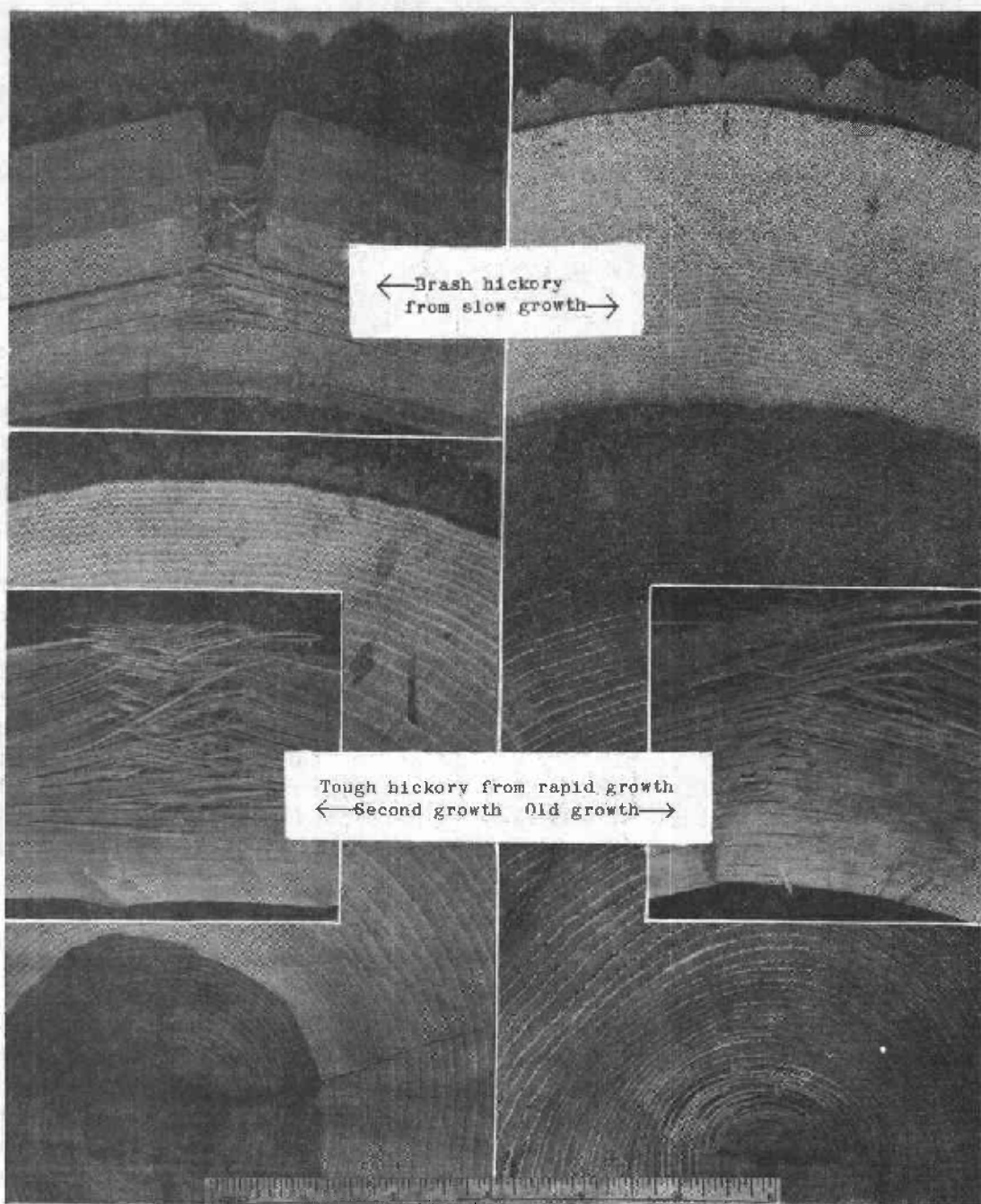


Figure 1.--Ring-width patterns as seen in cross sections of old-growth and second-growth trees and typical failures that show the relationship of growth to wood quality.

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