SOME WOOD GROWTH CHARACTERISTICS AND DEFECTS OF INTEREST TO WOOD TURNERS

presented to Glendale Woodturners Guild
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I. Normal Growth Patterns:

Planes of reference: cross-section = end grain
radial = cut boards show vertical grain (quarter-sawn)
tangential = cut boards show flat grain

wood characteristics	description	wood working characteristics
Cross-section	End grain showing growth rings on turned objects.	Softwoods: variation in smoothness between annual rings. Hardwoods: little or no variation
Radial (quarter-sawn)	Vertical grain with ray tissue crossing at right angles	Softwoods: generally uniform vertical grain Hardwood: often showing flecks or ray tissue streaks; vessel cells pits (pores) evident
Tangential	Flat grain showing annual ring variation and pattern	Softwoods: normal flat grain pattern Hardwoods: same with pits evident

A. Sapwood - living (xylem) wood tissue which moves water and nutrients up the stem
- general uniform color across all species
- high moisture content thus creating more problems with checks and splits
- wide range of stains or other treatments possible

B. Heartwood – former living wood tissue now plugged with resins, minerals, lignin, and other extractives characteristic of each individual species; gives strength and stiffness to tree
- heartwood color unique to each tree species giving the associated grain, color, patterns, etc.
- less capable of color change modification during finishing

C. Annual Rings – wood tissue formed during each year of growth
- composed of springwood [thin cell walls and large lumens (pores)] for water movement
- composed of summerwood (thick walls smaller pores) which creates visual grain pattern
- springwood accepts stain better than summerwood
- prominent in temperate species; much less so in tropical wood species -enviro. conditons

D. Anisotropy (shrinkage and unequal dimensional changes) – for woodturners mostly a problem of cracks and splits during wet wood (log) drying period and in turning wet wood

E. Conifer Wood Cells – long and fiberous thus providing more flexibility in tree
- during turning and sanding more 'fuzzy' surface noted

F. Hardwood Wood Cells – shorter and of two types: the vessel cells create the pits or pores apparent in certain species
- thicker wall create more density, thus 'hard' wood

1. Diffuse Porous Wood – vessel cells smaller and scattered throughout the annual ring
   - sycamore, alder, beech, maple, sweetgum, madrone, cherry, birch

2. Ring Porous Wood - vessel cells large, concentrated in spring wood
   - oak, elm, hickory, ash, walnut, locust

G. Ray Tissue - vascular tissue which radiates outward from tree pith (center)
   - produces visible and unique patterns in quarter-sawn hardwoods, esp. oak
   - present in softwoods but fine and inconspicuous

H. Resin Canals – characteristic of conifers (softwood) especially pine, redwood, Douglas-fir, spruce, etc.
   - in turned legs, newels, posts, etc., may exhibit leakage of sap onto finished surface

I. Lignin and Extractives – compounds which bind cells together, contribute strength properties, or provide unique colors or other wood properties
   - denser than normal wood cells, they will absorb much less stain or other finish thus providing visual contrast with more absorbent wood tissues

J. Wood Qualities

1. Color
2. Luster
3. Odor and Taste
4. Grain and Texture
   a. Spiral Grain
   b. Interlocked Grain
5. Wood Characteristics
   a. Weight
   b. Hardness
   c. Figure
      i. Annual Growth Rings
      ii. Grain Orientation
         - Ribbon or Stripe
         - Curly or Wavy
         - Broken Stripe
         - Blister or Quilted
         - Bird's-Eye or Dimpled
         - Crotch or Stump
         - Burl
   d. Color Distribution

II. Growth Related Defects

A. Spiral Grain – helical orientation of grain giving a twisted appearance
   - widespread in softwoods and hardwoods
   - softwoods tend to be left spiraled
   - hardwoods tend to be right spiraled
   - probably genetic and affected by the environment
   - when severe, will affect lumber dimensional stability

B. Interlocked Grain – a regular reversal of right - left spirality
- produces alternating rougher and smoother surfaces
- common in tropical hardwoods
- seen in American elm, sycamore, and black tupelo
- in radial surfaces (quarter-sawn) produces ribbon-stripe

C. Knots – the base of a branch embedded in the tree trunk which grows in diameter each year
- if annual ring continuity is maintained the knot will be solid
- if the branch dies then trunk diameter growth will encase the bark and a loose knot results
- fiber density and orientation increase likelihood that knots will star-check or crack when drying

D. Growth Stresses – normal in the growing tree as a result of environmental conditions and age
- trees react to these stresses with wood structured to counter-act the effects

1. Reaction Wood - greatly affects dimensional stability as wood dries

a. Compression Wood (conifers) – produced on the underside of an eccentric branch in order to "push" the branch back against the pull of gravity
b. Tension Wood (hardwoods) - produced on the upper side to "pull" the branch back - up
- noted as a "woolly" surface in green lumber

E. Pitch Defects - various conditions found in softwood species having resin canals

1. Pitch Streaks – excessive amounts of resin in localized areas of wood

2. Pitch Pockets – cavities in growth rings filled with liquid or crystallized sap

III. Seasoning and Machining Defects (mostly a problems with finished lumber)

A. Seasoning Checks – typical problem with green wood (log) drying and wet wood turnings

B. Planer Burn – found on boards but not a problem in wood turning

IV. Wood Deterioration by Fungus and Stains

A. Fungus – a living organism which extracts nourishment from living wood cells
- breakdown wood cells to extract nutrients
- ultimately the wood is destroyed as a useful product; it won't burn either
- arresting this process by cutting and drying the wood might produce some useful, interesting patterns if done before wood is destroyed
- sapwood is most susceptible and generally becomes unusable; heartwood more durable

1. Brown Rot (conifers) – due to speed of attack and more severe damage probably of little interest to wood turners

2. White Rot (hardwoods) – as fungus interacts with heartwood a wider variety of colors may result
- spalt (spalting) (black lines representing forward progress of fungus) is a well known result in maple, etc.

B. Sapwood Stains – discolorations found solely in sapwood (living cells)

1. Blue Stain - common stain found in pines

B. Mineral Stain – caused by crystalline substances in wood cells which include various minerals picked up by the tree
- normally olive to greenish black stained areas
- common in maple

D. Oxidation Stain – color changes in surface organic compounds
- contact with air or sunlight

V. Human Health and Skin Allergy Issues - many important and well known examples for the turner to be aware of
- good topic for another presentation

BIBLIOGRAPHY

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