



CTPA Arboriculture 101

Tree Identification

*Introduction, Conifers and
Part I Broadleaf Trees*

by Douglas J. Pistawka

Photos by Doug Pistawka, Oscar Stone,

University of Georgia at www.forestryimages.org, UCONN Plant Database and Vanderbilt bio images

Objectives

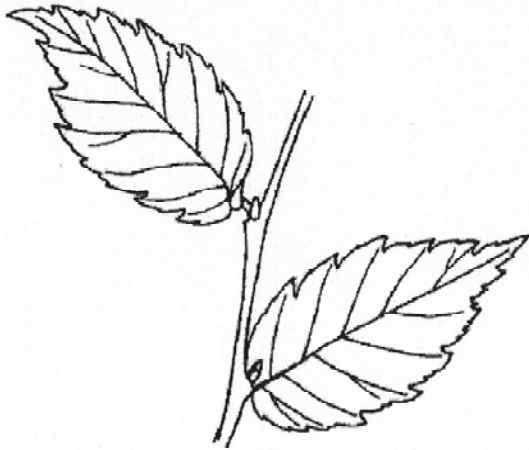
as stated in “DEP Info for Applicants for an Arborist License”

- “Identify all common trees found in the region in their summer and winter condition, including but not limited to” those listed.
 - Any tree on CAES grounds may be on the exam
 - Common names only
- “Know the healthy form of each tree, and its appearance and rate of growth” as well as their strength characteristics
- “Know the suitability of trees to different sites” for soil, moisture and sunlight

Objectives cont.

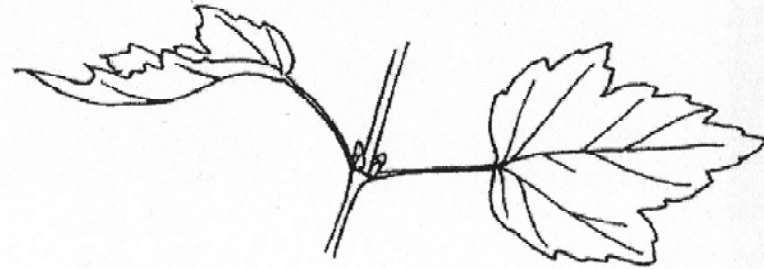
- ID trees using **buds and twigs**, leaves, bark, silhouette, flowers and fruit
- Use common insect damage, disease and physiological disorders to help ID trees
- Learn how to use a key
- Expand your vocabulary to help describe and ID trees

Leaf and Bud Arrangement



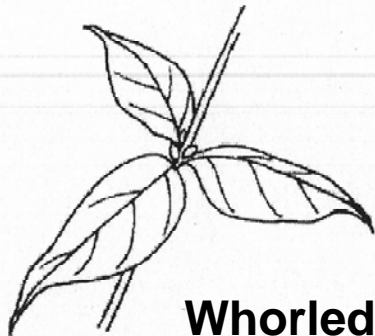
Alternate

Leaves and buds arranged in alternating sides of stem
elm, oak, beech, birch



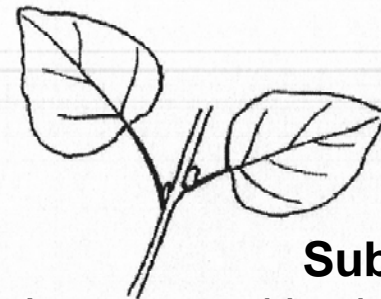
Opposite

Leaves and buds directly across from each other on stem
maple, ash



Whorled

3 or more buds and leaves at a node
catalpa, paulownia



Subopposite

Leaves and buds slightly offset from each other on stem
katsura, buckthorn

“MAD CAP HORSE”

Mnemonic device to help remember

Trees with opposite branches:

- [M]aple, [A]sh, [D]ogwood
- [Cap]rifoliaceae Family - honeysuckle, lilac and viburnums
- [Horse] chestnut/buckeye
- Also, catalpa and paulownia which may be opposite or whorled.

Leaf Types - Broadleaf Trees

Simple Leaf

Bud is located at the base of a single leaf and the stem

Sinus space between two lobes

Lobe – projected part of leaf

Margin – outer edge

Base – bottom

Stipules – leaf-like organ at base of leaf
i.e. sycamore, tulip polar

Midrib – central vein

Vein – conductive vessels

Blade – broad flat portion of leaf

Petiole – leaf stalk

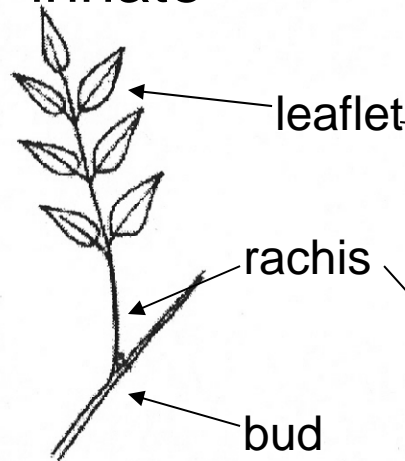
Bud – undeveloped leaf, flower or shoot



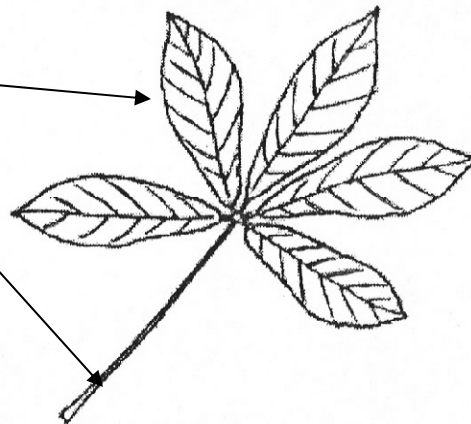
Compound Leaf

Bud is located at the base of a structure with more than one leaflet

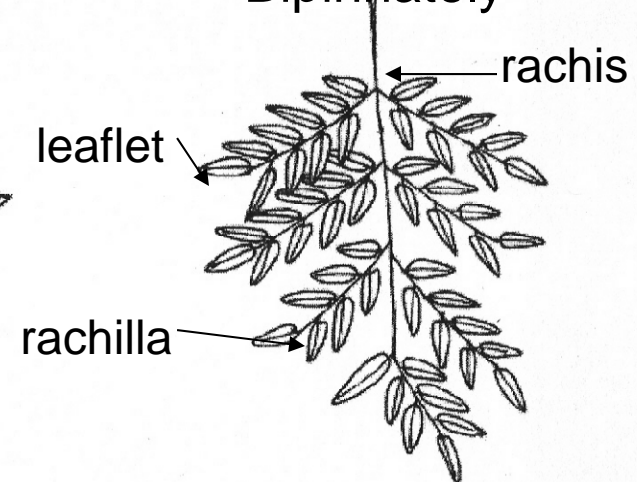
Pinnate



Palmate



Bipinnately



Leaflets attached along a single stem (rachis); most common

i.e. ash, hickory, walnut, ailanthus

Leaflets all attached to a common point like the spokes of a wheel

i.e. Horse chestnut, buckeyes

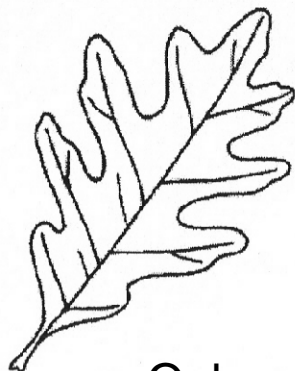
Leaflets are - attached to multiple stems (rachilla)

i.e. silk tree, honey locust, devils walking stick, Kentucky coffee tree

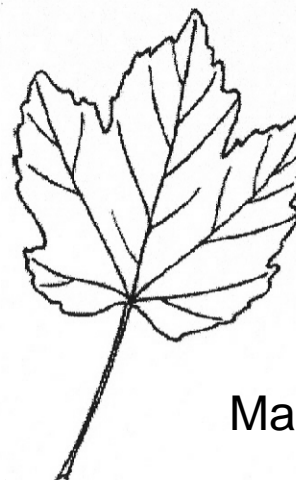
Leaf Venation



Elm



Oak



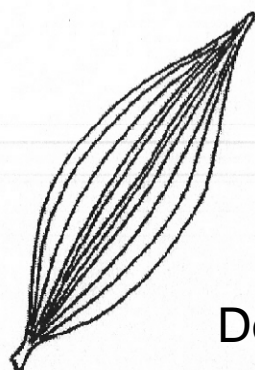
Maple

Pinnate

Central vein from base to tip like a fishbone

Palmate

Several veins of similar size from base to tip, all attached to a common point



Dogwoods



Ginkgo

Parallel

Veins run parallel from base to tip

Dichotomous

Veins run in a "Y" pattern

MARGINS



Entire

Smooth



Sinuate

Wavy



Serrate

Saw-like



Dentate

Toothed



Lobed

Rounded



Cleft

Split

TIPS



Acuminate

Sharply pointed



Acute

Pointed



Obtuse

Blunt



Rounded

Circular



Truncate

Cut tip



Emarginate

Notched

BASES



Cuneate

Wedge



Acute

Pointed



Obtuse

Blunt



Rounded

Circular



Truncate

Cut tip



Auriculate

Lobed

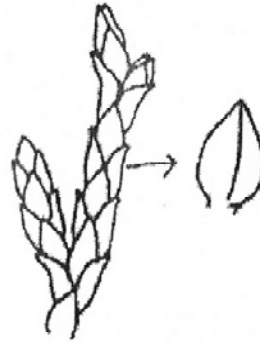
Leaf Types - Conifers



Needle-like

Needles may be arranged in:

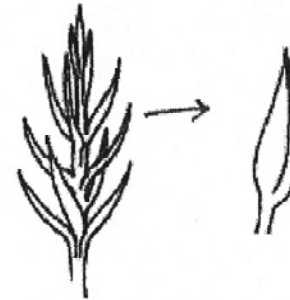
- Bundle of 2, 3 or 5 (Pines)
- Single on stem (Fir, Spruce and Hemlock)
- Clusters on stem (Larch, Blue Atlas Cedar)



Scale-like

Scales overlap like scales on a fish

- Cedars
- Juniper

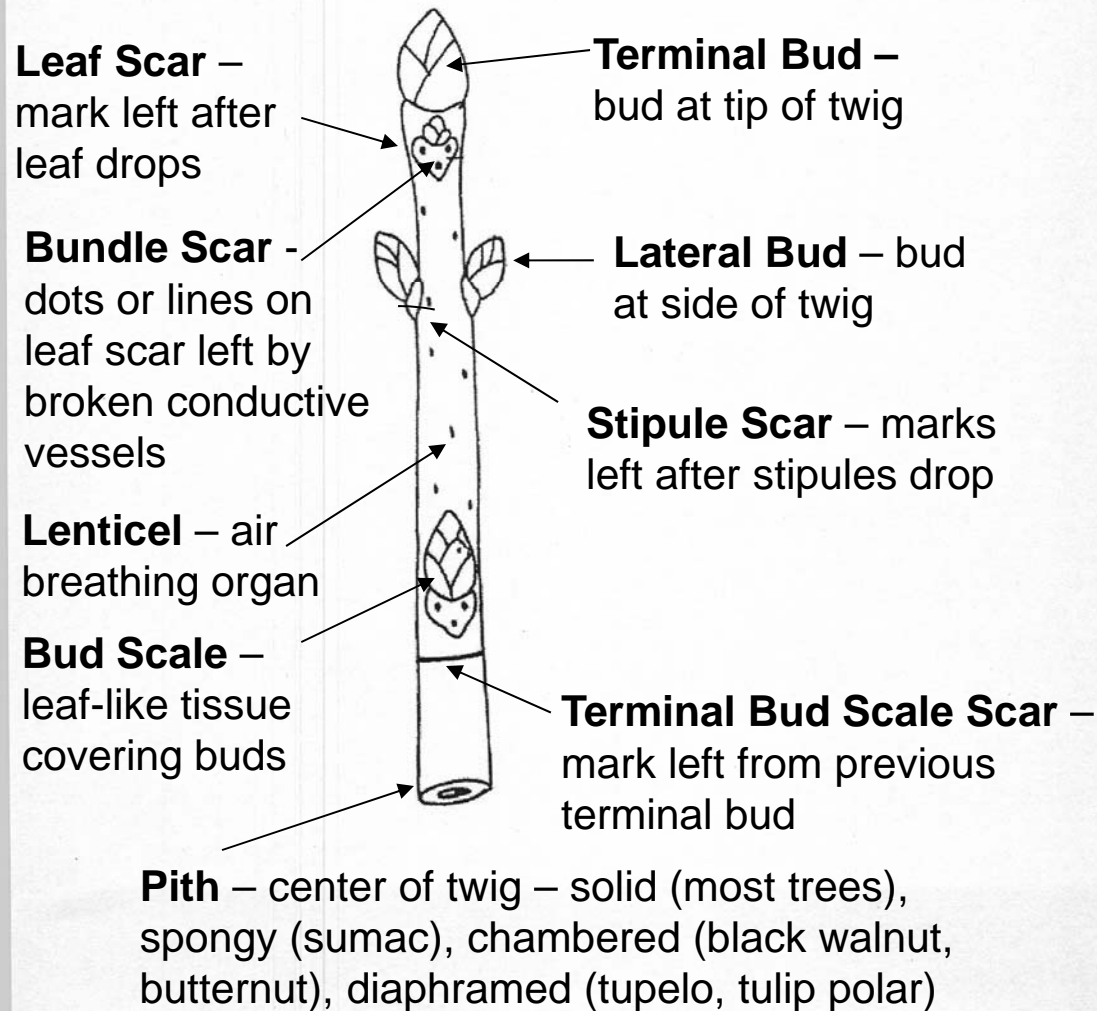


Awl-like

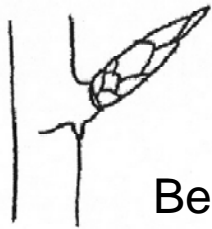
Needles sharp to the touch

Eastern Red Cedar has both scale-like and awl-like foliage

Stem and Bud Morphology



Bud Types



Beech

Conical shape

Imbricate (overlapping scales)



White Ash

Rounded



Chestnut

Ovoid "egg shape"



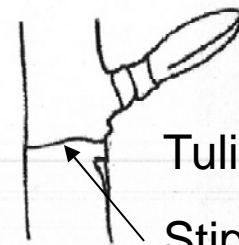
Willow

One-scale



Walnut

Superposed



Tulip Poplar

Stipule scar

Valvate (two-scales not overlapping like praying hands)

Tree Shapes

Conical - Arborvitae

Columnar – Lombardy Poplar

Pyramidal – Blue Spruce

Fountain - Palm

Oval – Shagbark Hickory

Multi-stem - Birch

Spreading - Cottonwood

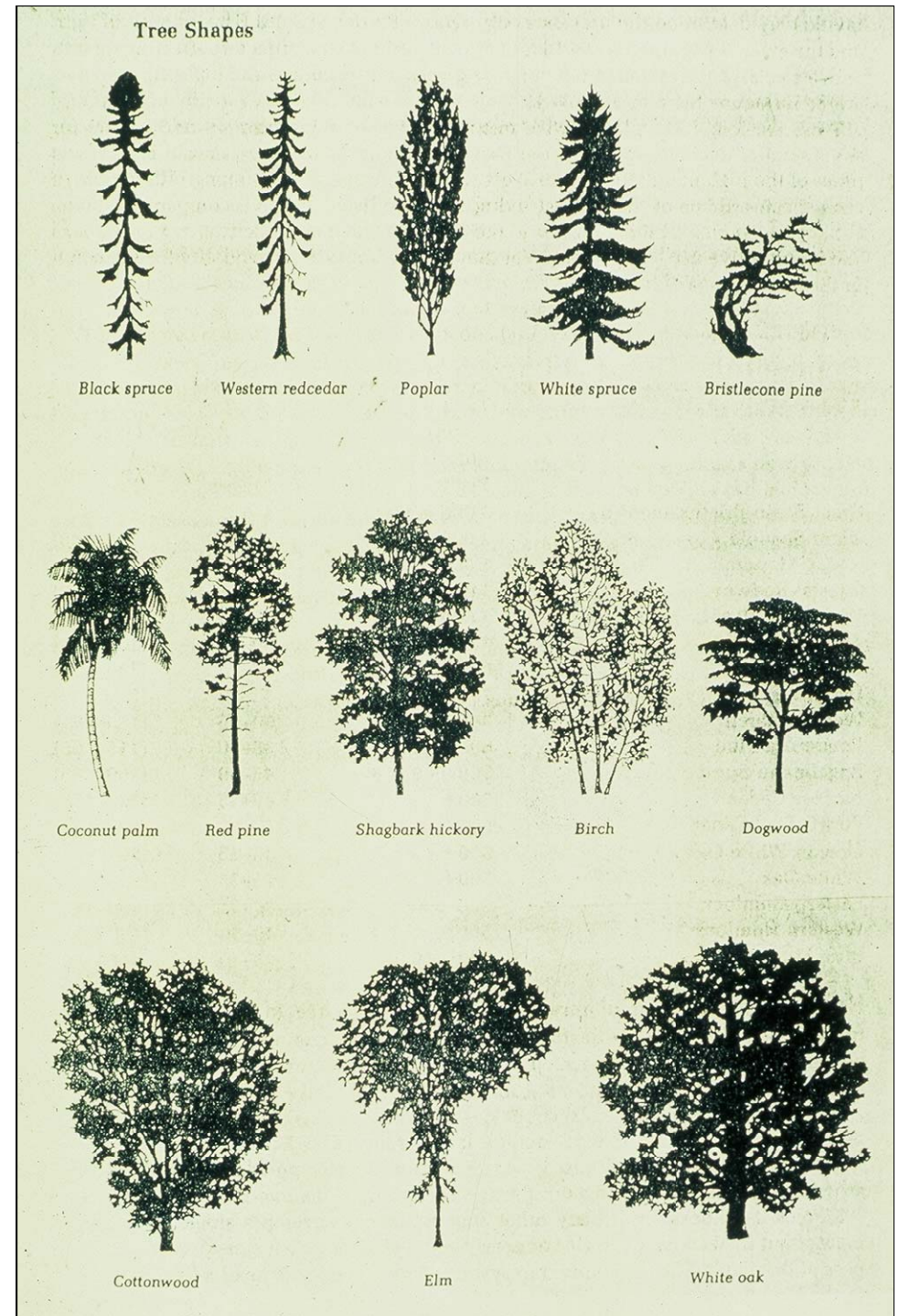
Vase-shaped - Elm

Rounded – White Oak

Growth Habit

Excurrent – Single main stem i.e. pine, spruce, pin oak

Decurrent – Spreading habit i.e. cottonwood, white oak, elm



Conifers


Photos are organized following Peterson's Field Guide into five categories

- Needles in Clusters
- Needles on Woody Pegs
- Flat Needles
- Scale or Awl-like Needles
- Fan-shaped Leaves
- Pines, Larch, [Blue Atlas Cedar, Umbrella Pine]
- Spruces
- Firs, Hemlocks, [Dawn Redwood], Bald Cypress
- Cedars, Junipers
- [Gingko]

Those in [] not in Peterson's,
see Smithsonian guide

Conifers

Gymnosperms vs Angiosperms

- **Conifers** are Gymnosperms which means “naked seeds”. They do not have flowers in the common sense of the word. Instead of producing seeds in an ovary, they produce seeds usually on the scale of a cone.
 - **Broadleaved Trees** are Angiosperms meaning “hidden seeds”. These are true flowering plants which produce seeds in an ovary.
- 

***Conifers with Needles
in Clusters - White Pine***



- Tall trunk with horizontal spreading limbs
- Delicate spray-like foliage

White Pine

- Five needles per bundle
- Soft needles 2 to 4 inches in length
- Pointed orange buds





White Pine cone

Long (3" – 6") tapering cones
without prickles



White Pine

- Dark bark becoming deeply furrowed with age.
- Not scaly like red or Scotch pines
- Prized by British navy for ship masts during Colonial days


Witches Broom White Pine

Dr. Sidney Waxman Collection
Bartlett Arboretum – UCONN Prof of
Plant Sciences named and introduced
34 cultivars of semi-dwarf conifers

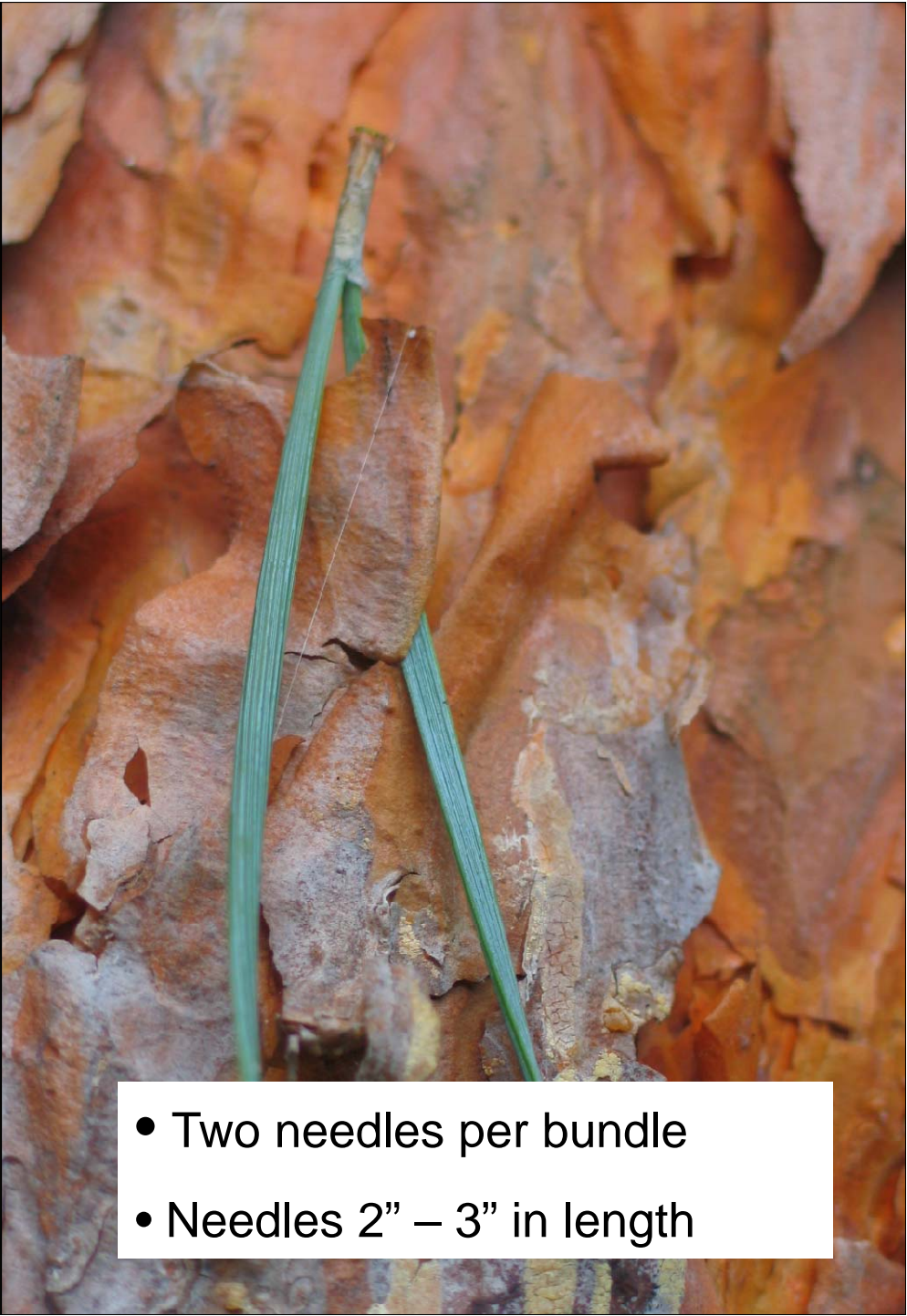


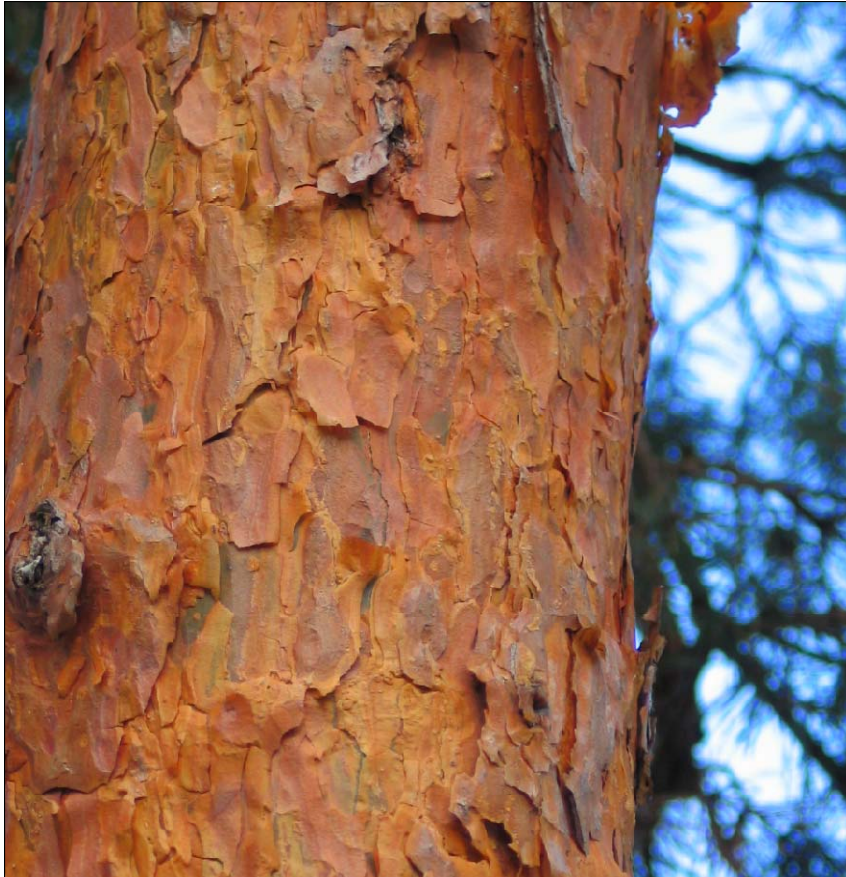
Scotch Pine

- Native of Scottish Highlands
- Bright orange bark on upper trunk and branches



Cones 1 ½" – 2 ½"
without prickles

- 
- Two needles per bundle
 - Needles 2" – 3" in length

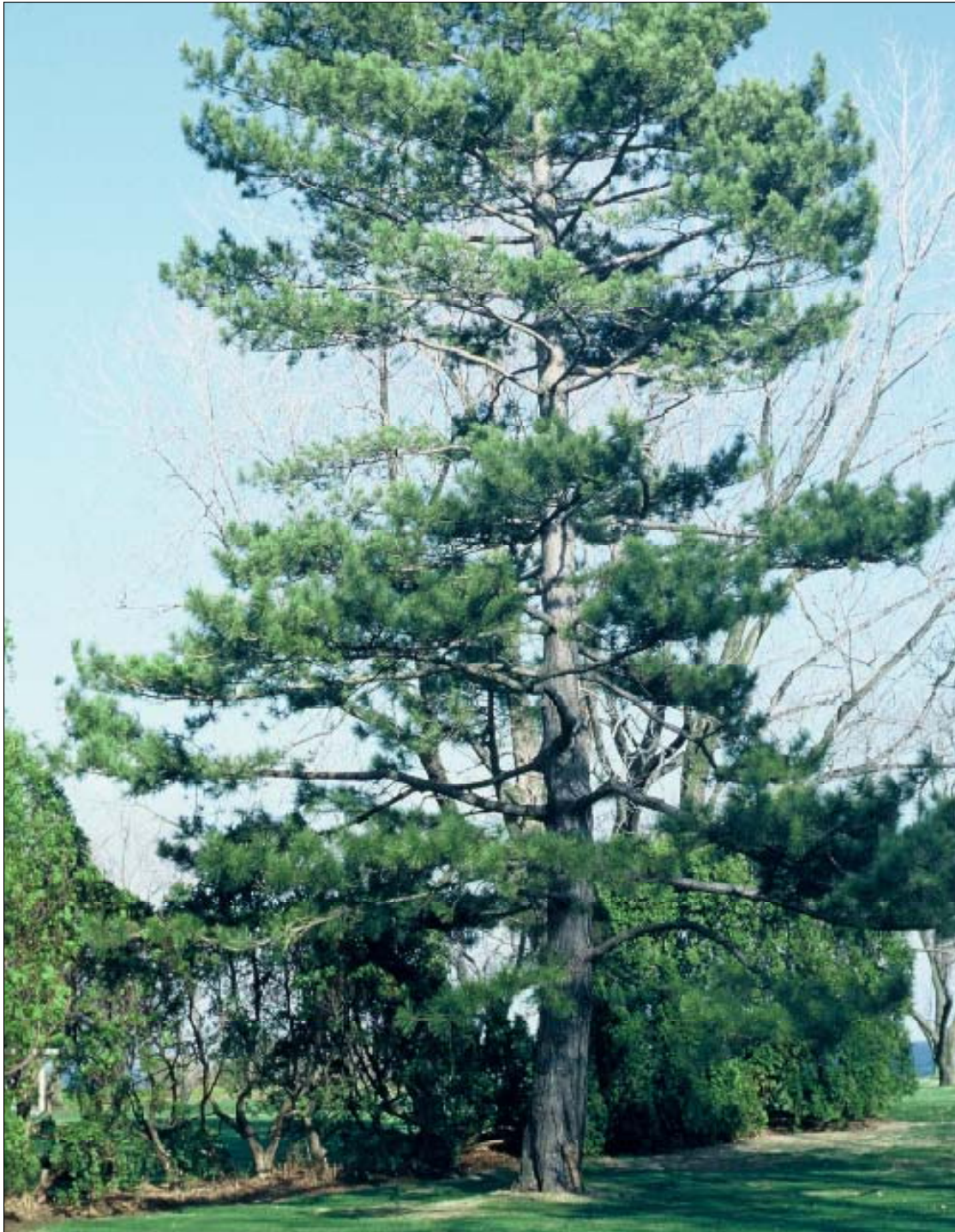


Crown often irregular or scraggly



Scotch Pine

- Orange flaky bark, not checkered like mature red or Austrian pine
- Most widely distributed pine in the world and most important European timber tree



Austrian Pine

- Commonly planted in landscapes and along Connecticut highways
- Tolerant of dry soil, dust and city smoke
- Mature bark with distinctive vertical gray-yellow plates



Austrian Pine

- Two needles per bundle
- Dark green stiff 3" – 6" needles
- Large white resinous buds
- 2" to 3" cone with faint brown border and sharp prickle

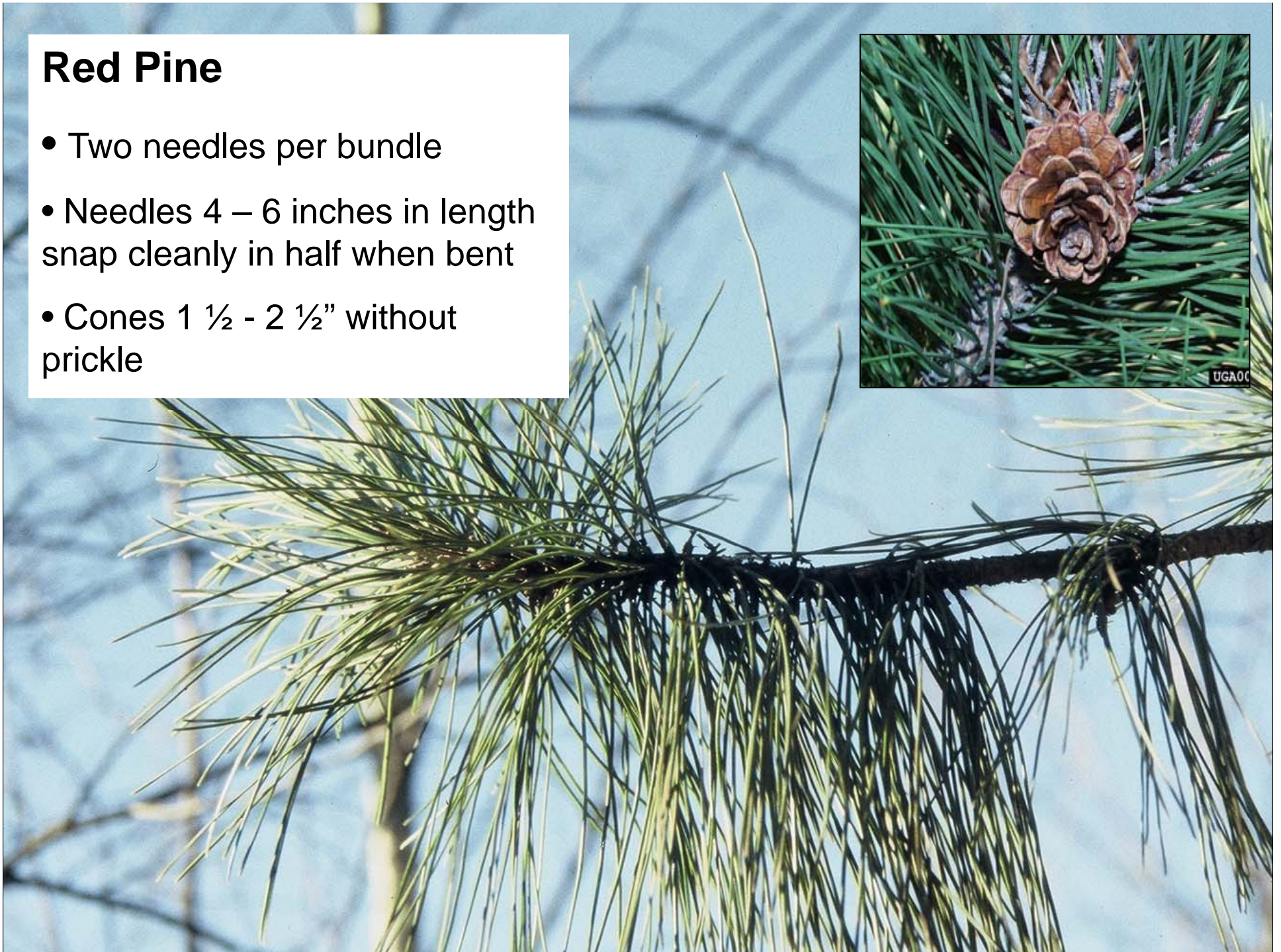


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Red Pine

- Two needles per bundle
- Needles 4 – 6 inches in length snap cleanly in half when bent
- Cones 1 ½ - 2 ½” without prickle





Red Pine

- Reddish scaly bark when young becoming platy with age
- Tall straight trunk with stout right-angle branches and symmetrical crown

- Used for poles, pilings and log cabins

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Conifers with Clusters of Needles on Spurs

- American Larch short 3 sided needles ($\frac{3}{4}$ - 1") shown here
- European Larch longer flat needles of unequal length (1" to 1 $\frac{1}{2}$ ") and often twisted



European Larch (left)

- Cones 7/8" to 1 1/2" long
- Mostly an upland species

American Larch (right)

- Cones 1/2" to 7/8" long
- Tree of northern wet soils
- Indians used roots to sew birch bark into canoes

American Larch



Gold colored deciduous needles
American Larch has upright
branchlets, European Larch droop

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Dark bark flaking off in
small scales



Blue Atlas Cedar

Clusters of sharp steel blue needles arising from spurs with upright female cones

Blue Atlas Cedar

- Native of the Blue Atlas Mts. of Morocco and Algeria
- Pyramidal when young, spreads to a magnificent open crown



Japanese Umbrella Pine

Unusual and attractive umbrella shaped whorls of 3" – 5" long needles at nodes along branches





Japanese Umbrella Pine

- Not a true pine but related to the redwoods
- Hardy and slow growing with dense green foliage
- Pyramidal in form





Needles on Woody Pegs - Spruces

- Evergreen tree with pointed buds and sharp, stiff needles attached singly to twigs
- Pendent cones (hang down from the branches)

Norway Spruce

Strongly drooping lateral branches and long cones



White Spruce

- Blue-green needles with short drooping cones
- Needles are square in cross section with skunk-like odor



Blue Spruce



White Spruce (top) short cones 1" – 2" in length

Norway Spruce (bottom) long cones 4" – 6" in length



White Spruce



Susceptible to cytospora, foremost pulpwood tree, most important commercial tree in Canada

UGA1218029

Blue Spruce



Pyramidal form upper branches ascending, lower branches nearly horizontal



Conifers with Flat Needles

Balsam Fir

- Round buds
- Needles attached singly to twigs with a round needle scar

Balsam Fir

- Upright purple-green cones (1"-3")
- Cones fall apart in late autumn leaving upright central core





Balsam Fir

- “Pitch pockets” - resin blisters on gray bark
- Conical form, branches ascending



Douglas Fir (not a true fir)

- Pointed buds
- Flat needles on a short petiole (base of needle is constricted)
- Rows of white stoma on bottom of needle

Douglas Fir

- Cones hang down (unlike upright cones of true firs)
- 3-pointed bracts stick out from cone like a snakes tongue



Douglas Fir



Conical crown with drooping
lower side branches
Smooth gray bark on young trees

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Mature bark is thick and furrowed
Grows 8' in diameter and 250' tall
along the moist Pacific Coast.

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What is the Largest Tree?

- **Largest Volume**
Giant Sequoia, General Sherman 28.5' dia, 274' tall
- **Tallest**
Coastal Redwood, Hyperion 379' tall
- **Largest Diameter**
Montezuma Cypress – 52' diameter
- **CT's Largest**
Pinchot Sycamore – 9' dia, 95' tall and 146.5' spread in Simsbury
- **Oldest**
 - Bristlecone Pine – Methuselah - 4,800 years old





Eastern Hemlock

- Flat round tip needles on slender stalks
- White stoma on bottom of needles
- Small cones $\frac{1}{2}$ " – $\frac{3}{4}$ " long
- Cone bracts round in shape



Carolina Hemlock

- Notched tip needles
- Longer cones ($\frac{3}{4}$ " – 1 $\frac{3}{8}$ " in length), bracts oblong in shape
- Sprays of needles more three dimensional than Eastern Hemlock

Eastern Hemlock

- Loose, irregular and feathery crown
- Branch tips hang down
- Dark rough outer bark with red/purple inner bark
- Susceptible to hemlock woolly adelgid



Dawn Redwood

- A living fossil, present for the past 50 million years
- One of the most important arboreal discoveries of the 20th century. Was thought to be extinct until found in China in 1941
- Now widely planted in landscapes over 100' tall in U.S. and over 160' tall in China
- Deciduous tree with opposite pairs of needles and buds
- Ball shaped cones 1" in diameter



Dawn Redwood



- Reddish-brown fibrous bark and buttressing trunk
- Fast growing tree with conical shape and soft, lacey appearance





Bald Cypress

- Soft, feathery needles (like Dawn Redwood) but twigs are alternate.
- Native to Southeastern U.S. wetlands but adaptable to both wet and dry sites.

Bald Cypress

- Deciduous conifer with sage green needles changing to orange brown in autumn.
- Red-brown fibrous bark and buttress trunk (similar to Dawn Redwood)



A photograph showing a row of tall, conical Northern White-Cedar trees planted in a residential yard. The trees are densely packed and have a vibrant green color. In the background, there is a white house with several windows and a large green lawn. The sky is blue with some light clouds.

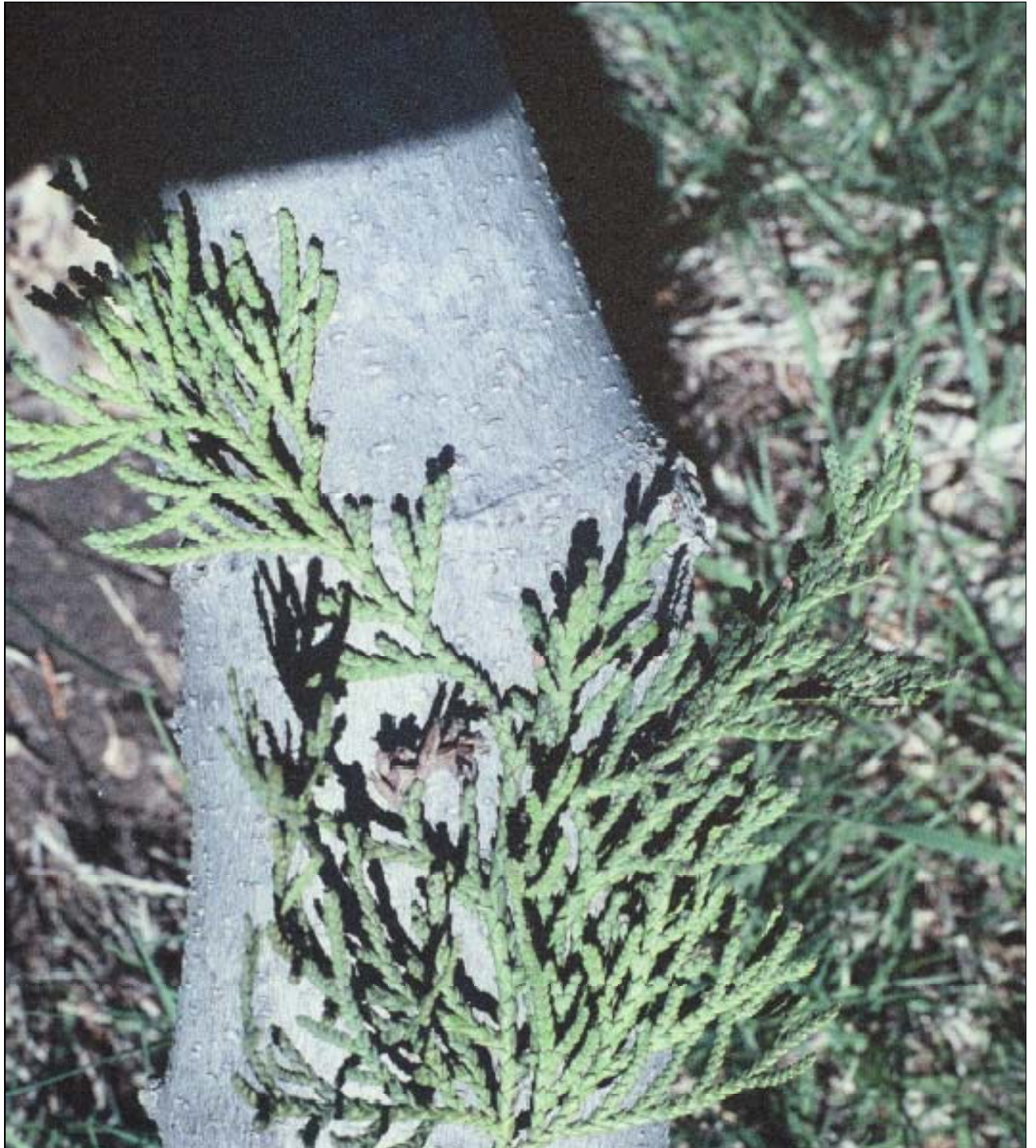
Scale or Awl-Like Needles

Northern White-Cedar (Arborvitae)

- Dense conical form branched to the base
- Native of northern swamps
- Dark American and Emerald Green are a cross with Oriental Arborvitae planted as an ornamental
- Used for poles, posts and lumber

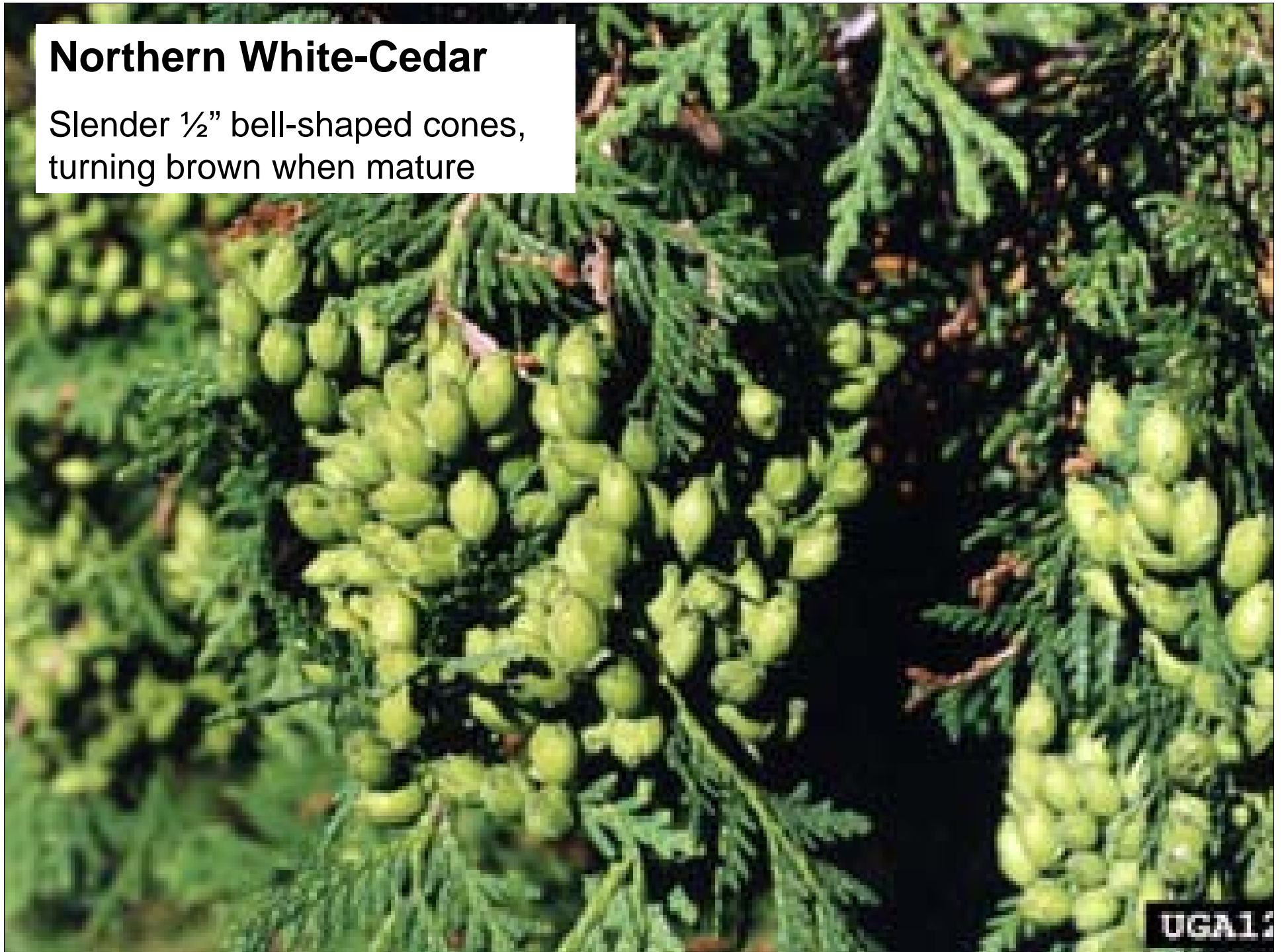
Northern White Cedar

- Flattened sprays of needles
- Zipper or scale-like foliage (similar to overlapping scales on a fish)
- Leaves and bark high in Vitamin C



Northern White-Cedar

Slender ½" bell-shaped cones,
turning brown when mature



Atlantic White-Cedar (*Chamaecyparis*)

- Similar to Northern White Cedar but bottom of leaves have white stoma
- Leaves tend to be narrower and less flattened than Northern White Cedar
- Small ¼" cones turn blue when mature
- Aromatic foliage when crushed



Atlantic White-Cedar

- Found near coastal swamps
- Decay resistant wood used for shingles and lumber
- Many varieties of this tree and its relatives are planted ornamentally i.e. Hinoki, threadleaf, Sawara, Alaskan weeping



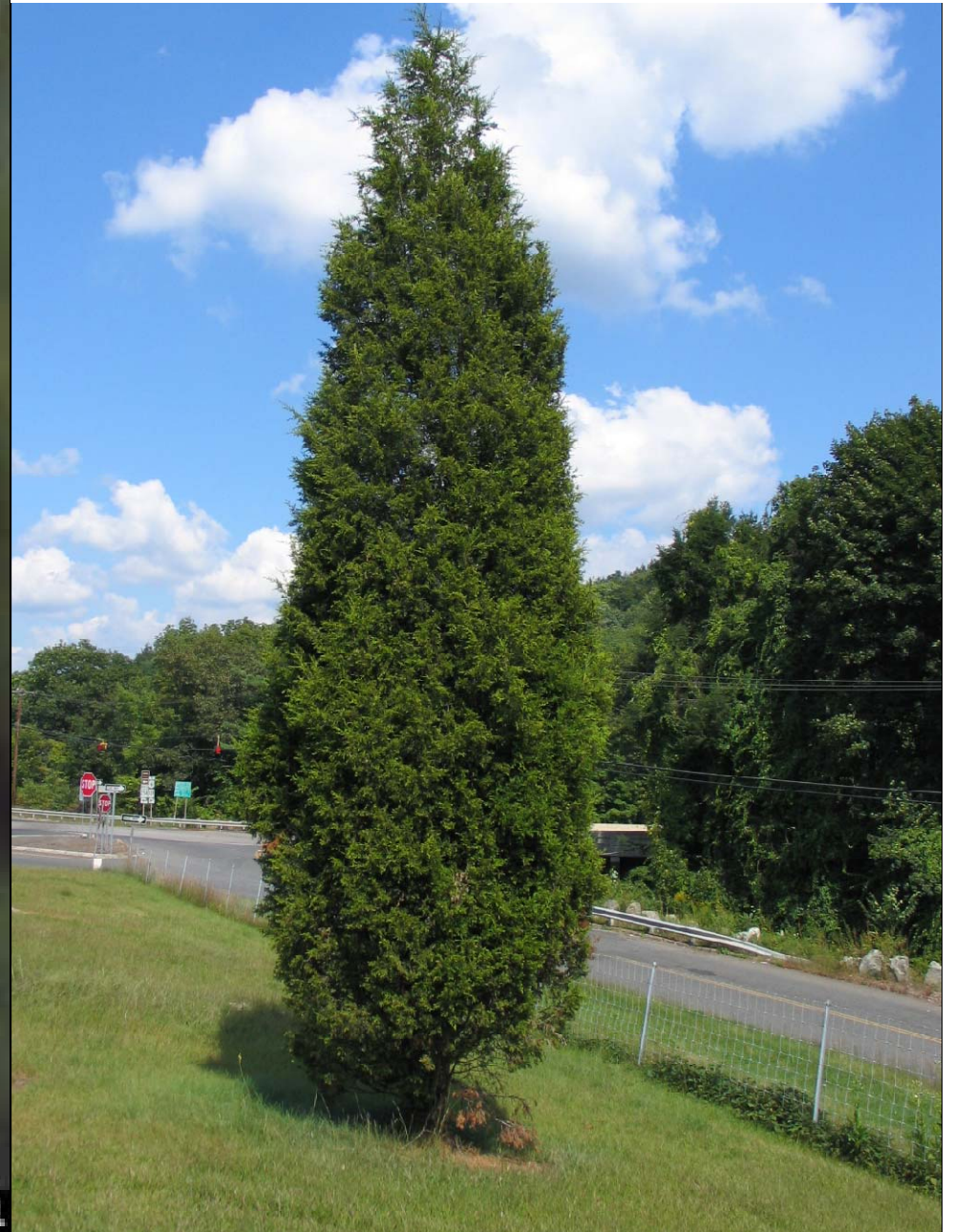
Eastern Red Cedar

Both scale-like and awl-like needles with $\frac{1}{4}$ " blue berries used to flavor gin and sauerkraut

Conical head becoming wider with age, often without branches near the base



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Eastern Red Cedar

- Brown, dry bark shredding in vertical strips
- Most widely distributed conifer in the Eastern 37 states of U.S.
- Found in old fields, dry sites and along Connecticut Highways
- Red, decay resistant heartwood used for furniture and fence posts



Fan-shaped leaves

Ginkgo

- Tree of Chinese descent. The most ancient broad-leaved species
- Tree may live over 1,000 years
- Veins form “Y” shaped pattern in leaf



Ginkgo

- Buds on woody spurs
- Brown corky bark
- Twigs peel in silky fibers



- Upright crown with spreading branches
- Tolerant of urban conditions, beautiful golden fall foliage

Broad-leaved Trees

Peterson organizes broad-leaved trees into four groups:

- **Opposite Compound Leaves** – Horsechestnut, Ash, Boxelder and Paperbark Maple
- **Opposite Simple Leaves** – Catalpa, Maples and Dogwood
- **Alternate Compound Leaves** – Locust, Walnut, Ailanthus, Hickories and Silktree
- **Alternate Simple Leaves** – Part II

Opposite Compound Leaves

Horsechestnut

- Large “U” shaped leaf scars
- Bundle traces along edge of leaf scar
- White and pink flowers



Horsechestnut

- Sticky buds, large terminal bud and spiny fruit
- Ohio Buckeye similar but with less spiny fruit





Horsechestnut

Palmately compound leaf - leaflets arranged like the spokes of a wheel

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Green Ash Top of leaf scar is straight

White Ash Top of leaf scar is U shaped on white ash

White Ash
Crescent shaped leaf scar and bundle traces form a line

UGA13



White Ash

- Compound leaf with 5 – 9 stalked leaflets
- Green ash also has stalked leaflets, black ash does not

Single winged samaras

- White ash (shown below) and green ash are winged $\frac{1}{2}$ way up seed
- Black ash is winged along the entire seed



White Ash

- Round to oval shaped crown
- Diamond shaped bark with interwoven pattern of shallow ridges and furrows, soft and corky texture
- Emerald Ash Borer in CT
- Wood splits easily. “Splints” woven into baskets and chair bottoms



UGA0008156





Box Elder

- Purplish-white twigs with bloom that rubs off
- Opposite compound leaf with 3 to 5 leaflets
- Crescent-shaped leaf scars with 3 bundle scars



Paperbark Maple

- Slow growing ornamental maple maturing to 25-35 feet in height.
- Native to China, with distinctive cinnamon-brown peeling bark
- Trifoliate (3-leaflets) compound leaves which turn red in fall.





Opposite Simple Leaves - Catalpa

- Large heart shaped leaves and cigar shaped seed pods
- Round leaf scar and bundle scars
- Buds may be opposite or whorled
- Clusters of white flowers with yellow and purple spots at end of twigs

The image shows three maple twigs against a solid blue background. The top twig is brown and has a single pointed bud. The middle twig is reddish-brown and has several small, round buds clustered together. The bottom twig is reddish-brown and has several larger, round buds, some of which are green and have a keel-like shape.

Maples

Sugar Maple

Pointed buds and brown twigs
Crescent shaped leaf scar with 3 bundle scars

Red Maple

Round buds (often clustered) and red twigs

Norway Maple – Red and green “keeled” buds

Maple Bark



Red Maple

Young - smooth, gray

Mature – Broken, dark

Circular “bullseye”



Silver Maple

Young - smooth, gray

Mature – Vertical strips



Norway Maple Gray/brown with shallow grooves, ash-like in appearance

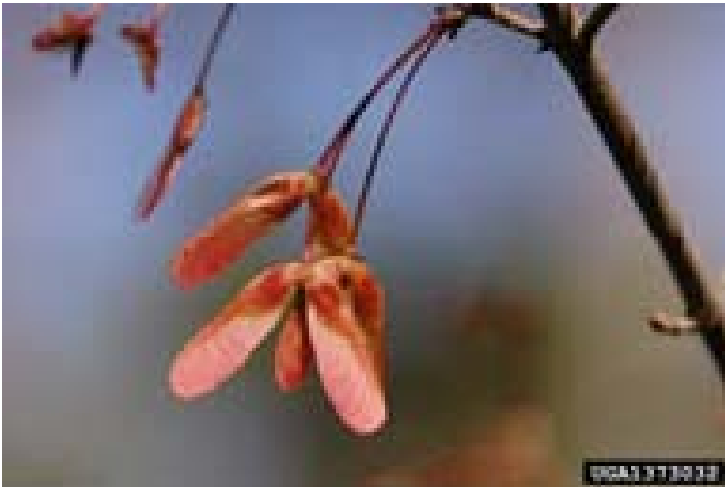


Sugar Maple Gray/brown with vertical grooves and loose edge plates

Maple Samaras



Sugar Maple – “U” shaped



Red Maple – “V” shaped



Silver Maple - “V” Shaped

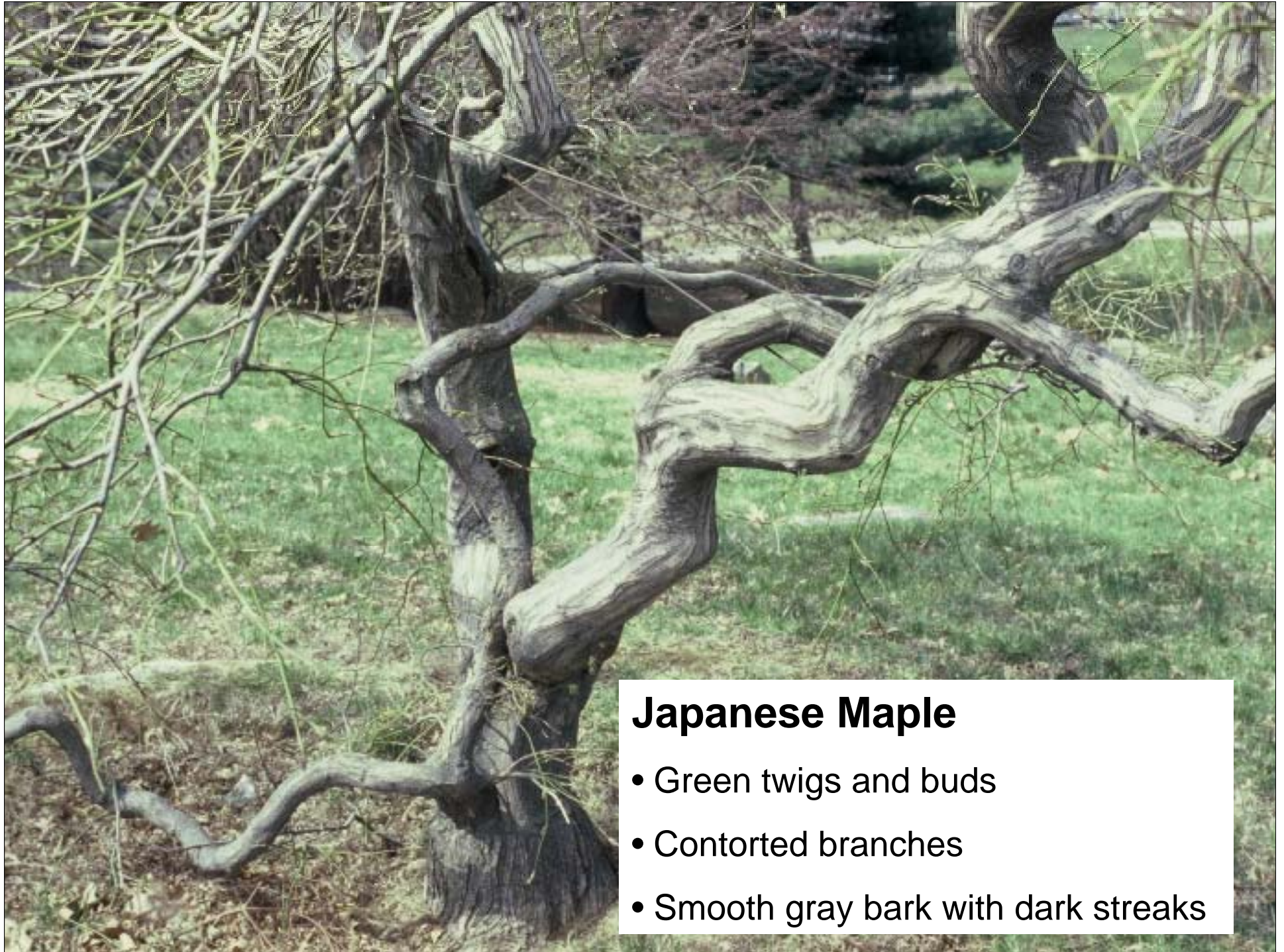


Norway Maple - Straight



Crimson King Maple

- Relatively fast growing Norway maple, tolerant of urban conditions and often planted as an ornamental.
- Weak branch crotches make Norways susceptible to storm damage
- “Plant the Right Tree in the Right Place”



Japanese Maple

- Green twigs and buds
- Contorted branches
- Smooth gray bark with dark streaks



Japanese Maple

- Threadleaf (left) - lacey, threadlike leaves
- Palmatum (right) – cannabis like leaves
- Red twigs with opposite buds



Striped Maple

Three lobed leaf in the shape of a goose's footprint



- Stalked, valvate buds
- Green/red bark with white stripes

Maple Leaves

Norway Maple: 5-7 lobes, shallow "U" sinuses, milky sap at base of petiole

Sugar Maple: 5-7 lobes, shallow "U" sinuses, center lobe often longer



Red Maple: 3 large lobes with "V" sinuses

Japanese Maple: 5-9 narrow pointed lobes, deep "V" sinuses

Silver Maple: Deep "U" sinuses, back of leaf white



Flowering Dogwood

- Showy white or pink flowers with 4 bracts
- Blooms prior to leafout, onion shaped flower buds



Pink Flowering Dogwood

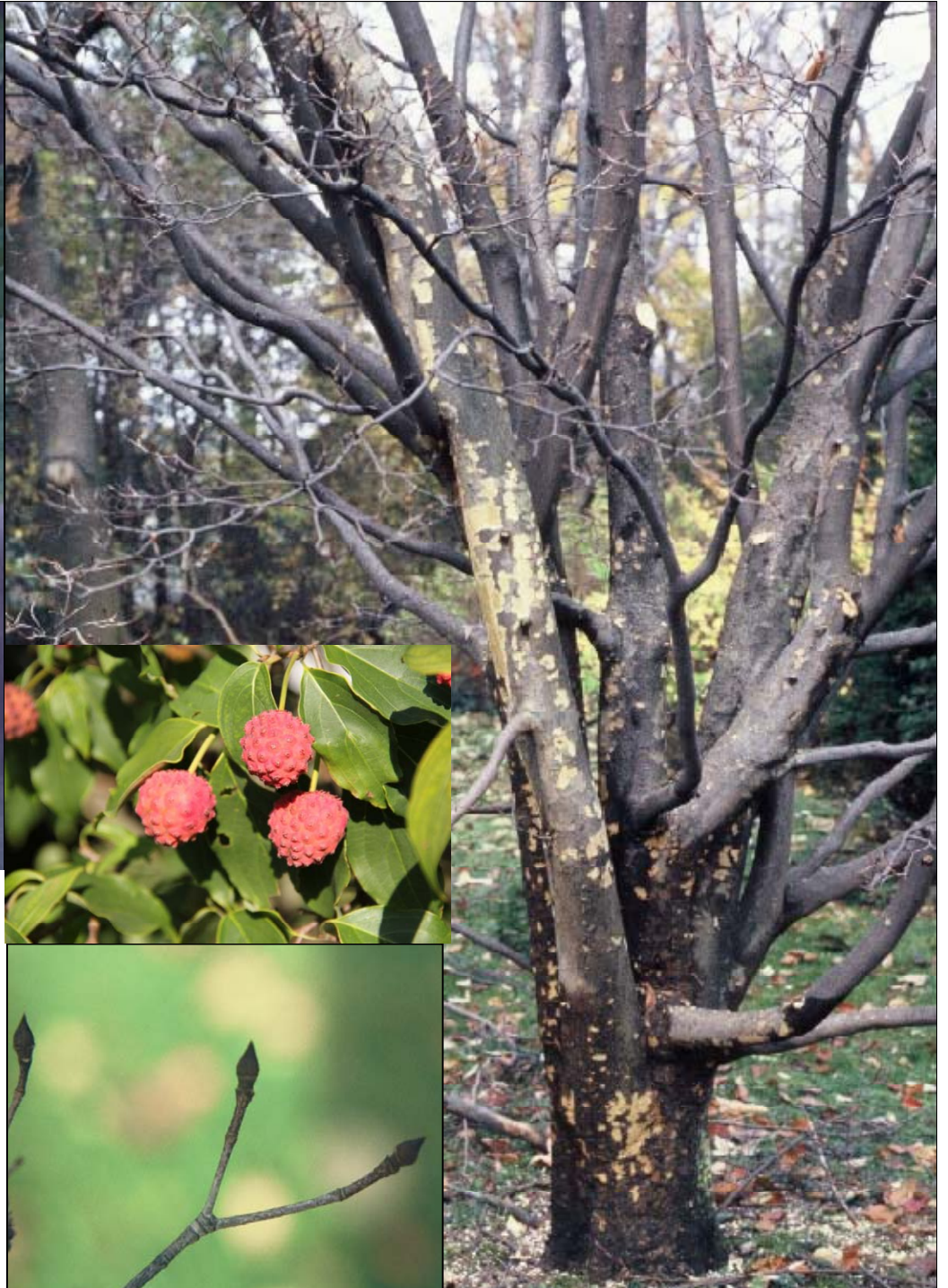
- Grafted onto White Flowering Dogwood rootstock
- Dogwoods prefer understory of surrounding trees
- Blocky checkerboard shaped bark pattern



Flowering Dogwood

Clusters of ½" egg-shaped fruit
turning red when mature





Kousa Dogwood

- 4 bract flower, blooms after leafout
- “Crunchberry” like fruit, pointed opposite buds, exfoliating bark
- Constellation and Century - cross of Kousa and Native Flowering dogwood

Broad-leaved Trees

➤ Alternate
Compound Leaves

➤ Locust

➤ Walnut

➤ Ailanthus

➤ Mountain Ash

➤ Hickories

➤ Silktree



Alternate Compound Leaves

Honey Locust

- Trunk and branches with many stout thorns, several inches long
- Bark dark and somewhat scaly



Thornless Honeylocust

i.e. Shademaster and Sunburst

- Pinnate or bipinnately compound leaves
- Bean pods 6" – 16"



- Minute buds
- Zig-zaged shaped twigs

Black Locust

- Small pairs of thorns
- Deeply ridged bark with cross-hatching
- Dense and durable wood though brittle



Black Locust

- Clusters of white flowers
- Pinnately compound leaves



Black Locust (left) short bean pods
(2" - 6")

Honey Locust (right) long bean
pods (6" - 16")



Butternut

- Yellow/brown twig
- Elongated terminal bud
- “U” shaped bundle traces
- Superposed bud above lateral bud
- Velvet eyebrow above leaf scar



Black Walnut

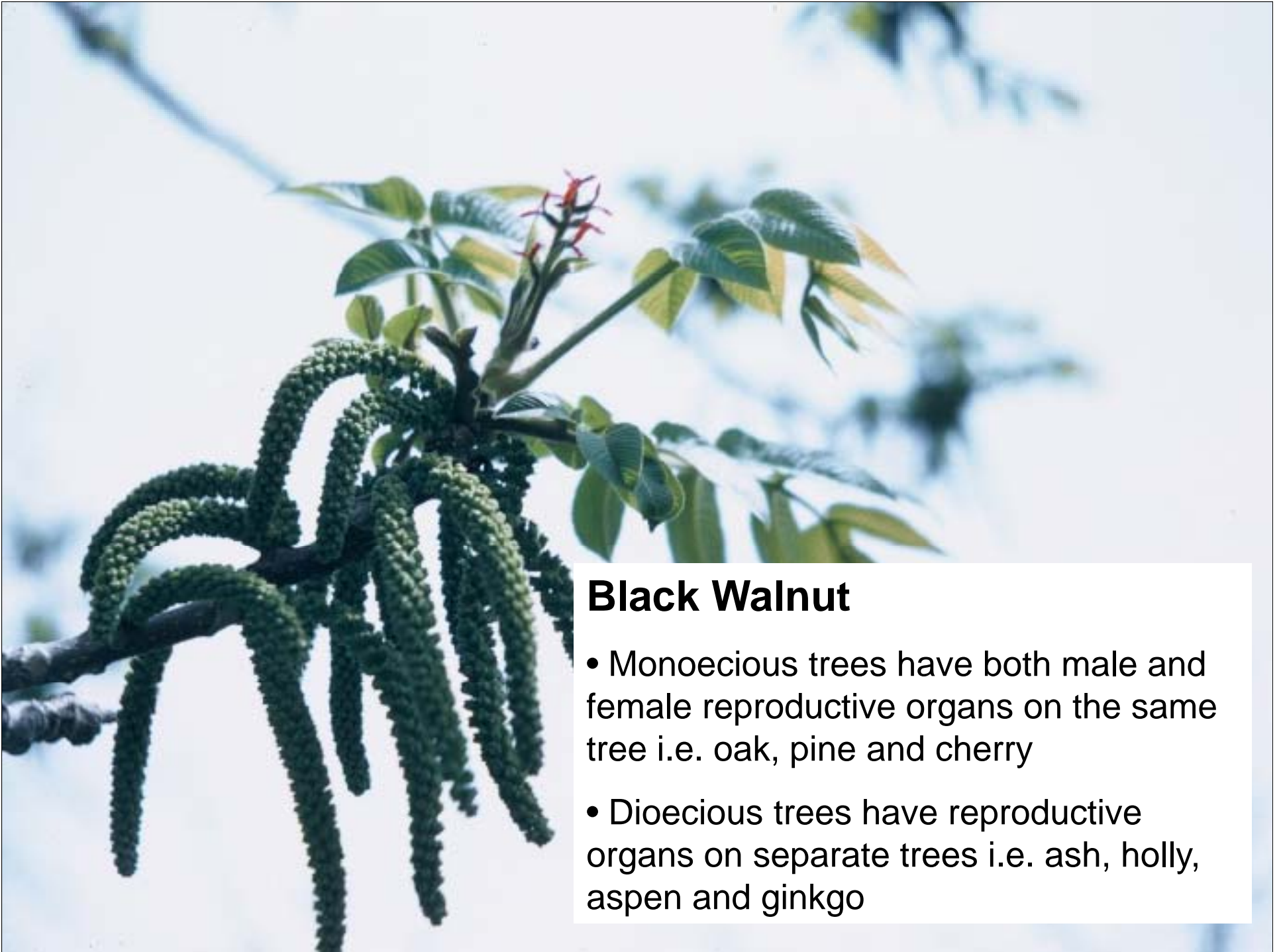
- Dull gray twig
- Blunt terminal bud
- “U” shape bundle traces
- Superposed bud above lateral bud

**Black Walnut (shown here)
and Butternut**

Chambered pith:

Tan colored in black walnut,
chocolate brown in butternut





Black Walnut

- Monoecious trees have both male and female reproductive organs on the same tree i.e. oak, pine and cherry
- Dioecious trees have reproductive organs on separate trees i.e. ash, holly, aspen and ginkgo



Black Walnut (left)

Compound leaf, end leaflet often lacking with round 2" delicious nuts

Butternut (right) with oblong nuts



Black Walnut

- Dark, deeply grooved bark
- One of the most valuable and beautiful grained woods



Butternut

Wide bark ridges are smooth topped making a shiny interlaced network



Ailanthus

- Weak wooded weed tree
- Invasive and will grow in extremely adverse conditions.
- Clusters of small yellow and red blossoms with foul odor
- Fast growing (8' – 12' per year from stump sprouts)



Ailanthus

- Thick twig with brown spongy pith
- Brown woolly buds
- Large leaf scar with many bundle scars
- False end bud (end bud is shed and a lateral bud acts as the end bud)



Occasionally growing into large mature street trees



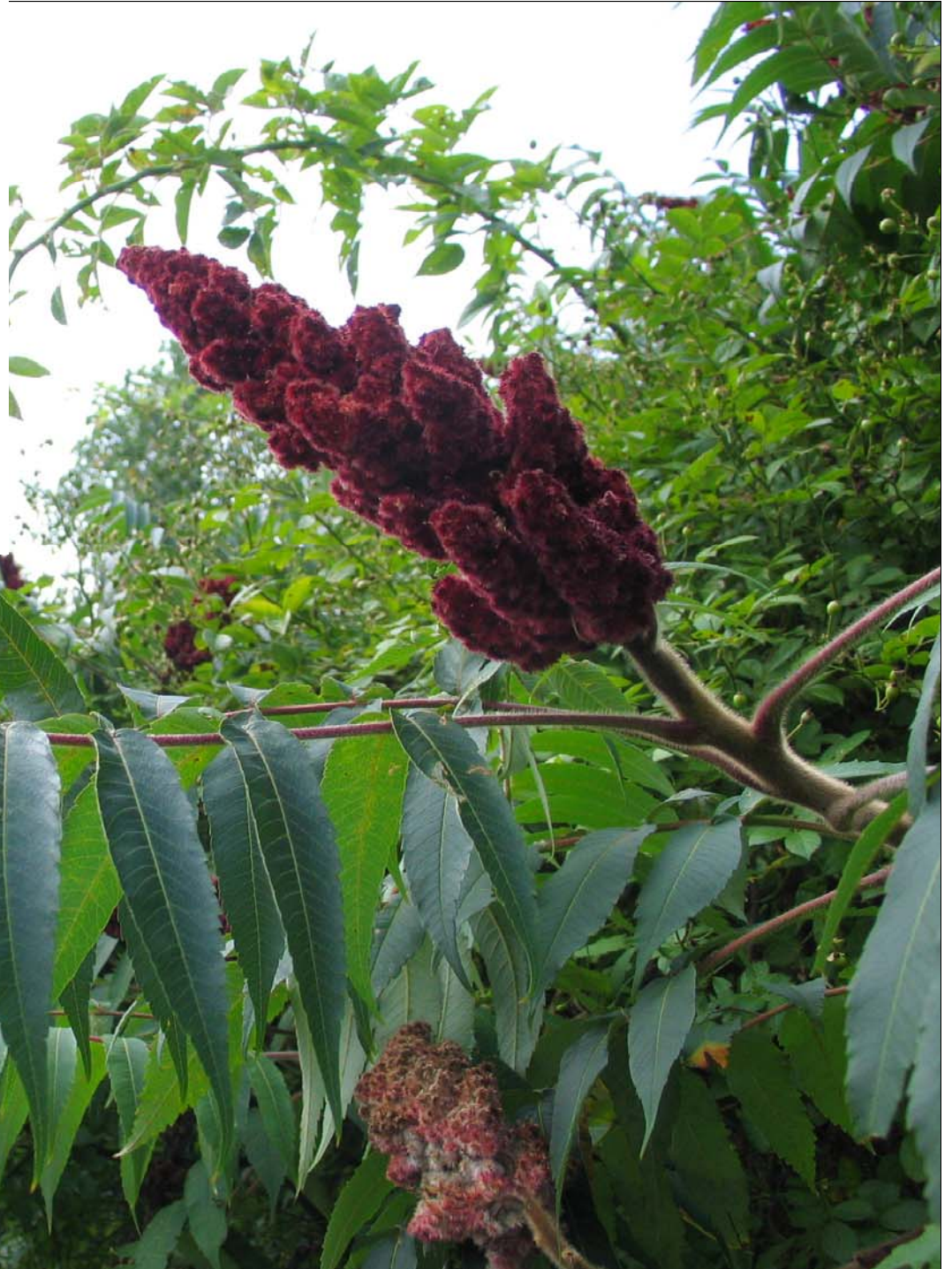
Ailanthus



- Smooth gray bark with light colored grooves
- Clusters of dry winged, single-seeded fruit

Staghorn Sumac

- Thick woolly twig with brown spongy pith
- Clusters of red berries
- Smooth sumac has hairless twigs
- Dwarf sumac has wings along the rachis





Silktree (Mimosa)

- Feather-like bipinnately compound leaves
- Powderbrush-like pink flowers
- Long slender beanlike pods



Silktree

- Light brown smooth bark
- Native to Asia but widely planted and naturalized in eastern U.S.



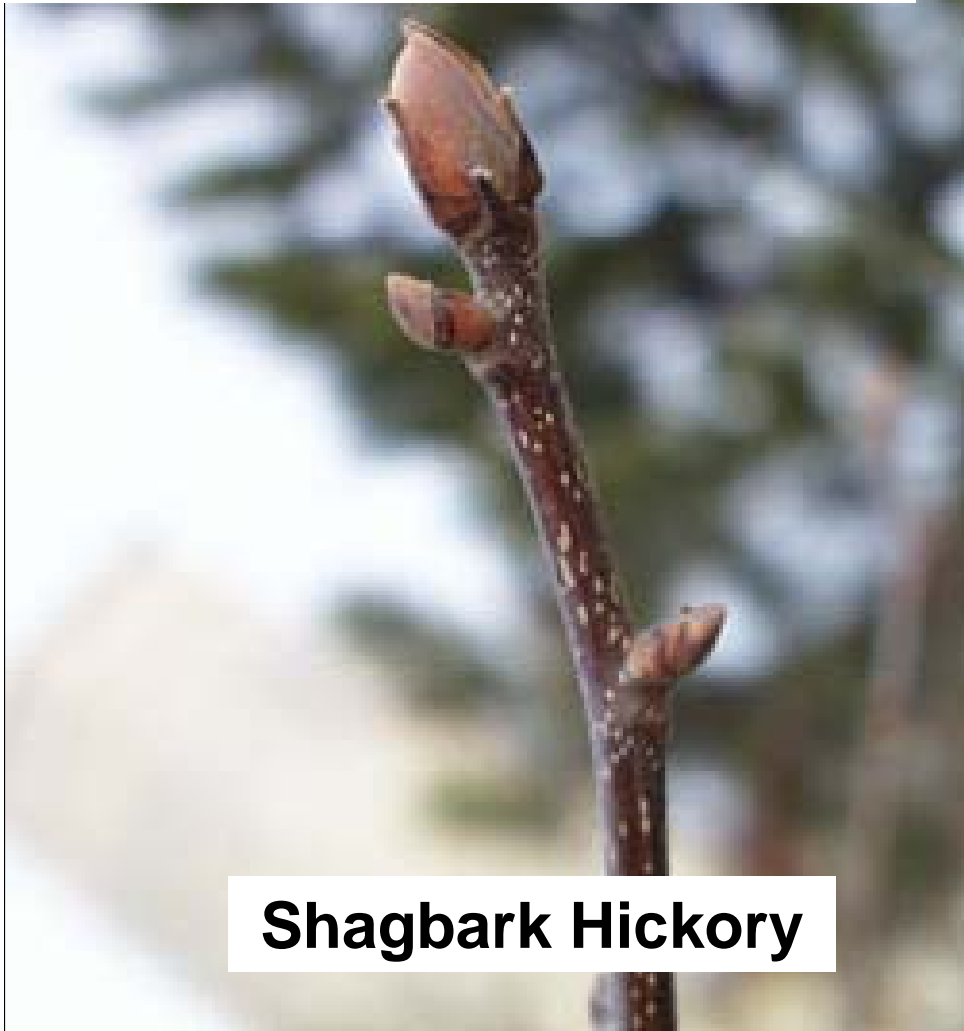
Shagbark Hickory

- Very shaggy bark with long thin strips
- Oblong crown
- Hickories have very strong, heavy and elastic wood

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- Large end bud (>1/2") with loose overlapping scales
- May be slightly hairy
- Red-brown twig with light colored lenticels

- Large end buds, outer scales drop in fall
- Woolly twigs and foliage
- Red-brown twig with light colored lenticels



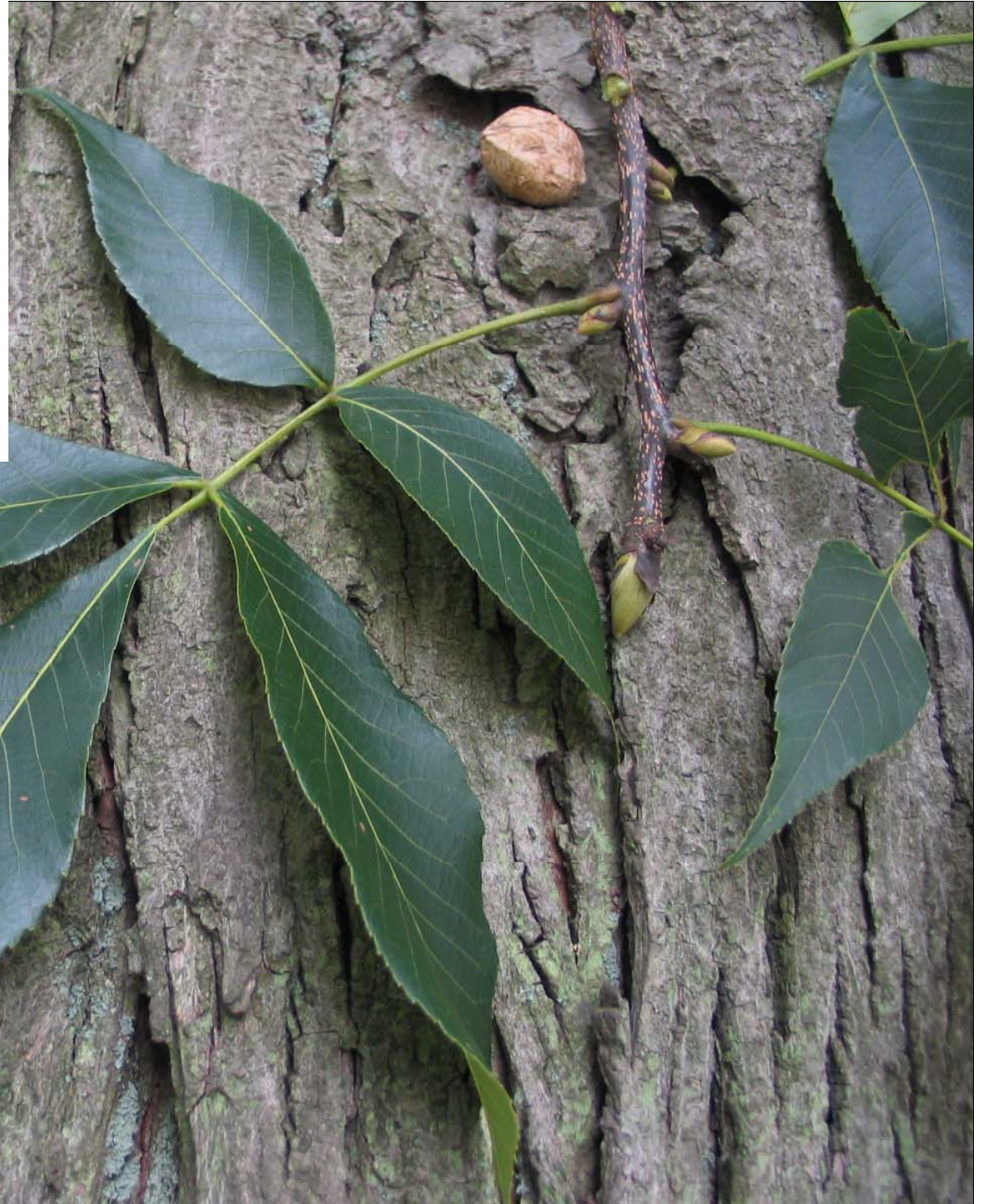
Shagbark Hickory



Mockernut Hickory

Shagbark Hickory

- Hickories have pinnately compound leaves with stalks only on the terminal leaflet
- Shagbark hickory usually has 5 (sometimes 7), hairless leaflets





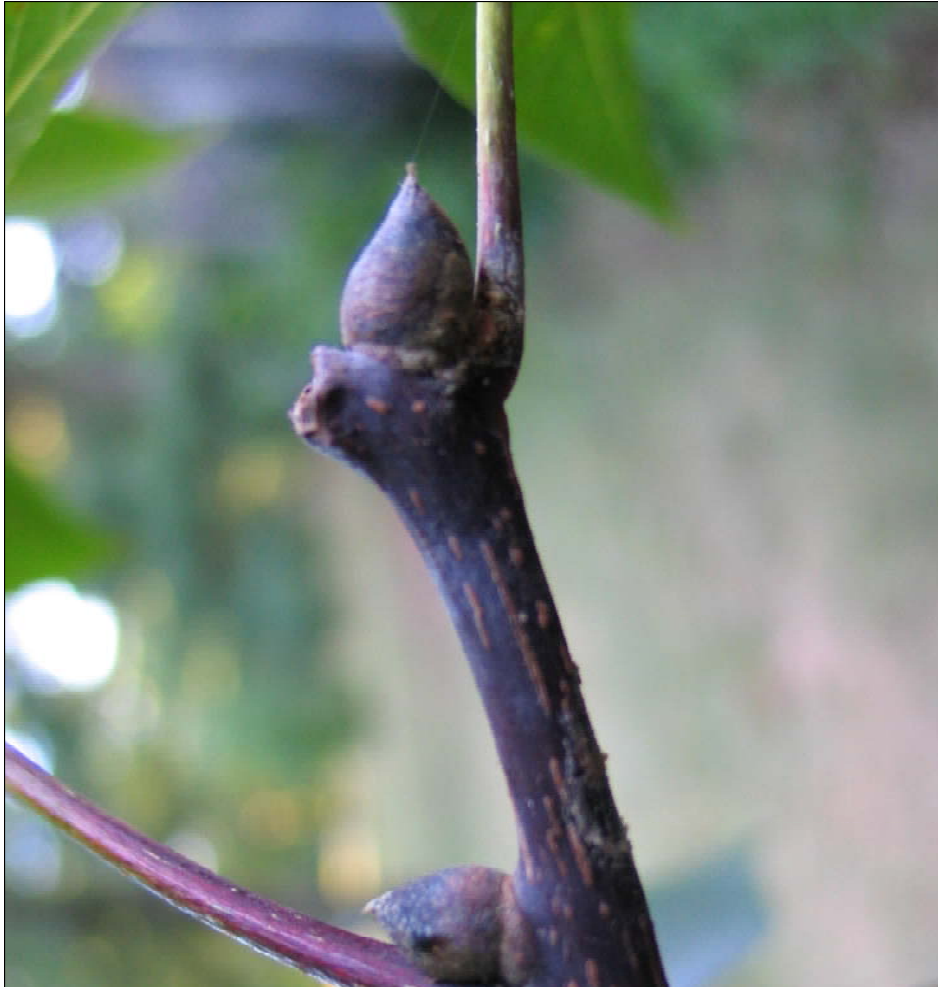
Shagbark Hickory

- Thick husk with 4 ribs
- Edible white nut
- Egg shaped nut, rounded at base



Mockernut Hickory

- Usually 7 (sometimes 9), leaflets per leaf
- Pubescent underside of leaf
- Mature bark mostly tight netted with smooth ridges and shallow furrows



- 5 to 7 hairless leaflets per leaf
- Tight and smooth ridged bark

Pignut Hickory

- Small (less than 1/2") egg shaped buds
- Outer bud scales drop in autumn
- Smooth red-brown twigs



Pignut Hickory

- Brown nut
- Thin husk nut, not winged
- Husk splits into 4, usually not to the base



Mockernut Hickory

- Thick husk
- 4 angled tan/brown nut

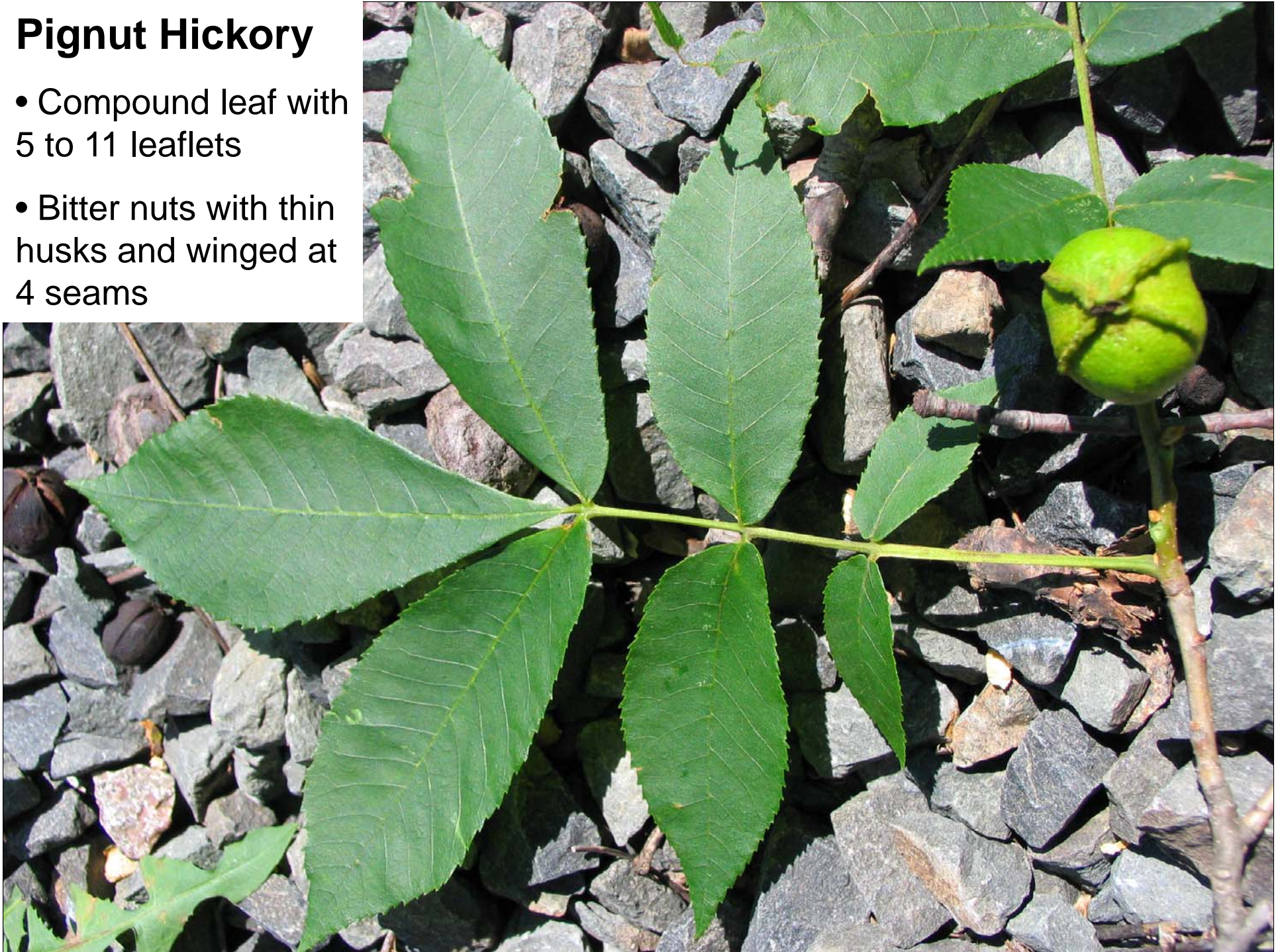
Bitternut Hickory

- Bright mustard yellow paired buds (valvate)
- Twigs mostly hairless



Pignut Hickory

- Compound leaf with 5 to 11 leaflets
- Bitter nuts with thin husks and winged at 4 seams



Key to the Common Hickories

1. Bud scales paired, valvate; buds often appearing naked ----- 2
1. Bud scales imbricate, usually more than 2 visible ----- 3

2. Buds bright yellow. Bitternut Hickory *Carya cordiformis* (Wangenh.) K. Koch. 1
2. Buds brownish. Pecan Hickory *Carya illinoensis* (Wang.) K. Koch. 2

3. Terminal buds short and stout; somewhat globose, usually glabrous. Pignut Hickory *Carya glabra* (Mill.) Sweet; and Red Hickory *Carya ovalis* (Wang.) Sarg. 3
The 1953 "Checklist" considers *C. ovalis* a synonym for *C. glabra*.
3. Terminal buds larger, more ellipsoidal, more or less hairy ----- 4

4. Outer scales soon deciduous, showing the lighter colored ones beneath; twigs often hairy, and quite fragrant when bruised. Mockernut Hickory *Carya tomentosa* Nutt. 4
4. Outer scales persistent, twigs less hairy, or glabrous ----- 5

5. Twigs orange-brown, or buff colored, lenticels orange colored. Shellbark Hickory *Carya laciniosa* (Michx. f.) Loud.
5. Twigs dark reddish brown. Shagbark Hickory *Carya ovata* (Mill.) K. Koch. 5



1

2



3



4



5

Dichotomous key "continuously forks in 2"

William H. Harlow Fruit Key and Twig Key to Trees and Shrubs

