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*Identifying Juvenile Seedlings  
In Southern Hardwood Forests*

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# *Identifying Juvenile Seedlings In Southern Hardwood Forests*

Louis C. Maisenhelder<sup>1</sup>

The purpose of this paper is to aid foresters, landowners, and naturalists in identifying first-year seedlings of some important trees and a few shrubs in the lower Mississippi River Valley and similar environments of the South. Ability to identify the young seedlings is especially important in forecasting the kinds of useful or weed vegetation that may develop as silviculture is applied.

The species described include 16 found only in alluvial bottom lands, 32 found only in loess bluffs and other uplands, and 20 common in both locations. Several nontree species, such as poison-ivy and snowbell, are included because the seedlings are easily confused with those of commercial trees.

Form and color of cotyledons, leaves, stems, and buds are described and illustrated. Cotyledons never resemble mature leaves, though their form is often useful in identifying the plant during the first few weeks after germination. The first true leaves may not be typical of mature leaves, but by the end of the first year leaf or leaflet shapes tend to resemble closely those of the older trees. Twig and bud characters are shown because they help to identify the plant in the dormant season.

Tables that compare leaves, stems, and buds are included for ashes, elms, hickories, and red and white oaks, because seedlings within each of these genera are often difficult to separate.

Latin and common names follow Little's *Check List of Native and Naturalized Trees of the United States*. Publications that were consulted are listed on page 77, but are not otherwise cited.

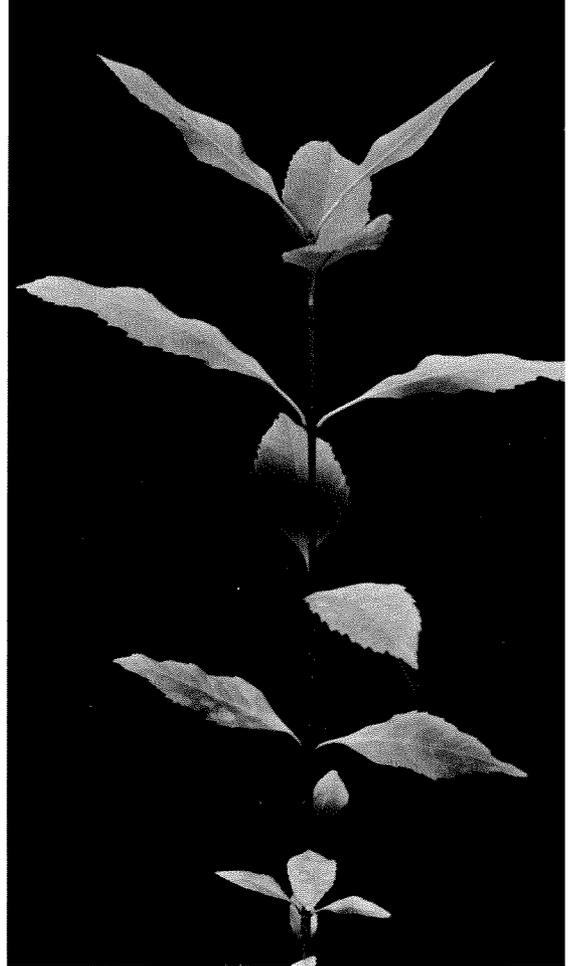
<sup>1</sup> Silviculturist at the Southern Hardwoods Laboratory, which is maintained at Stoneville, Miss., by the Southern Forest Experiment Station in cooperation with the Mississippi Agricultural Experiment Station and the Southern Hardwood Forest Research Group.

Green Ash  
*Fraxinus pennsylvanica* Marsh.  
 Family Oleaceae

Bright green leaflets are opposite on light green stem. They resemble those of mature trees. Species is found in low flats, sloughs, and shallow swamps.

*Cotyledons*.—Medium green with prominent midrib, growing to 1 inch long and 1/8 inch wide 3 days after germination. Lanceolate with blunt, rounded apices. Persist for several weeks. Difficult to distinguish from American sycamore in cotyledon stage, but usually larger.

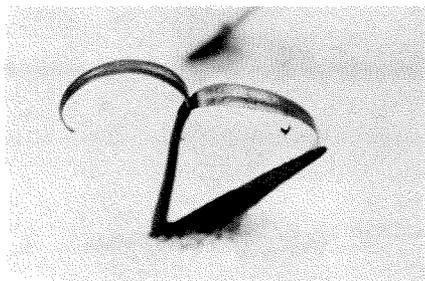
*Leaves*.—First true leaves appear a week after germination as opposite leaflets on elongating stem. Simple, elliptical to ovate with short, dull-pointed apices and wedge-shaped bases, 1 1/2 to 3 inches long by 1/2 inch wide; smooth; bright green above, paler below; margins serrate. Closely resemble leaflets of mature compound leaves, which do not develop until last half of first growing season.



At 3 months seedling still has no compound leaves. X

Table 1.—Seedling characteristics of green, pumpkin, and white ash

Species	Leaves		Stem traits	Buds	
	Color	Margin		Pubescence	Color
Green ash	Bright green above, slightly paler below	Serrate	Olive-green or gray at base. Leaf scars straight or slightly notched at top.	Covered with brown woolly hairs	Brown
Pumpkin ash	Upper surface medium green, slightly paler below	Entire to undulate or finely serrate	Light green at first, becoming dark-green with olive-green streaks at 2 1/2 months. Later brown to gray, still streaked.	Slightly hairy	Brown
White ash	Light green above, slightly paler below	Nearly entire, or with small rounded teeth	Dark purple, becoming brown at maturity. Leaf scars V-notched at top.	Terminal buds: moderate and red-brown. Axillary buds: moderate and brown.	Terminal buds dark brown to black. Axilla buds: brown.



Cotyledons 1 day after germination; seed wing protrudes from soil after planting. X 1½

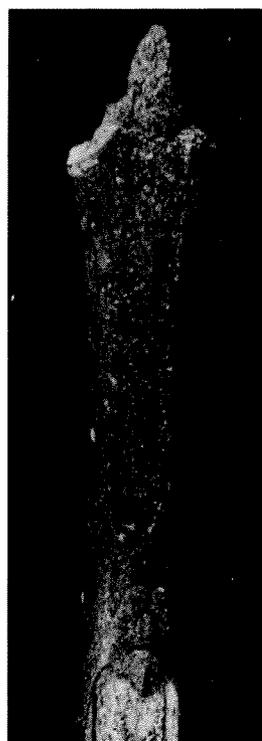
At 2 weeks, persistent cotyledons resemble those of sycamore but are larger. X 1



*Stem.*—Bright green at terminus, shading to olive green or gray at base; smooth with a few pale lenticels and round in cross section throughout.

*Buds.*—Blunt, ovoid, 1/16 to 1/8 inch long. Terminal buds slightly longer and sharper pointed than laterals. All buds densely hairy.

Terminal bud at 1 year; lenticels common on stem. X 4

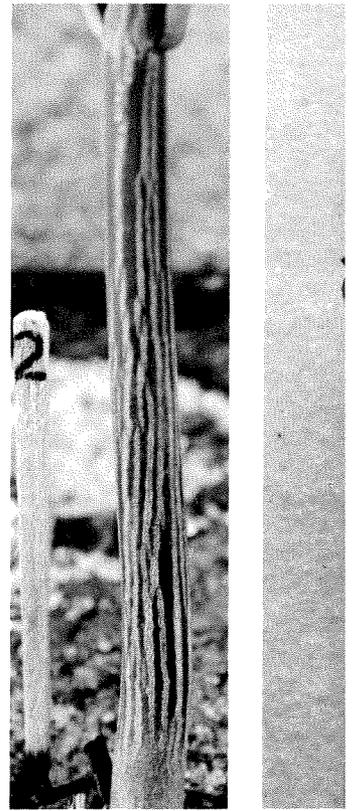


Pumpkin Ash  
*Fraxinus profunda* (Bush) Bush  
Family *Oleaceae*

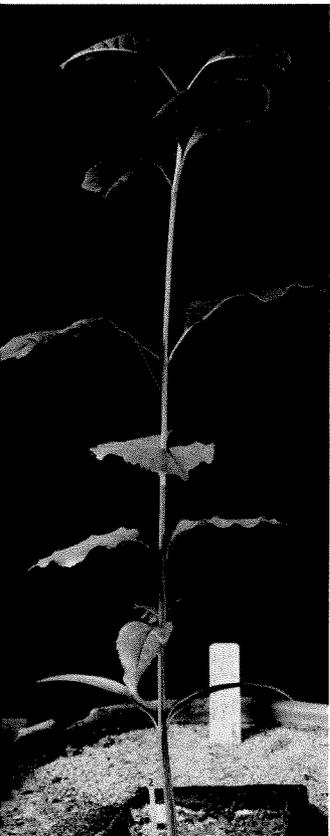
Leaves and cotyledons are larger than those of most ashes. Olive green stripes are found on basal portion of the stem 2½ months after germination.

*Cotyledons*.—Plant stem pushes through ground in U-shape and cotyledons emerge and unfold on second day after germination. Upon appearance, single cotyledon about 1½ inches long and ¼ inch wide, growing to 2½ inches long by 3/8 inch wide in first month. Linear with blunt, rounded apex and base; dark green above, lighter below, and smooth on both surfaces. Persist on undisturbed stems for as long as 8 months but cease growth after first month.

*Leaves*.—First true leaves appear within a week after germination as opposite, simple leaflets. Ovate-lanceolate with acuminate apex and wedge-shaped base; margin partly entire, undulate, or finely serrate; medium green above, paler below, both surfaces smooth; 2 to 3 inches long, including petiole. Compound leaves typical of mature trees occur occasionally during first year.



Stems are prominently striped at 10 weeks (left). Lenticel and leaf scars help identify 1 year-old seedling (right). X 2

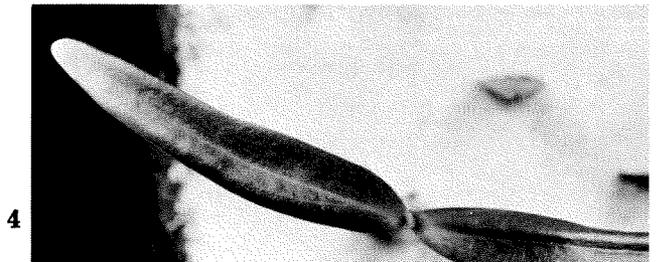


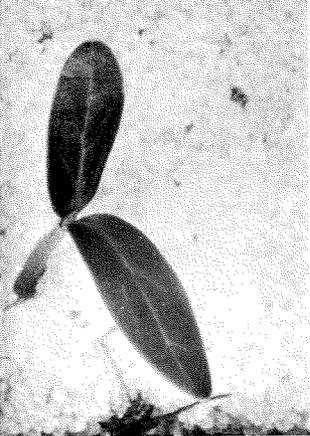
Seedlings at 10 weeks have simple leaves and persistent cotyledons. X 3/10

*Stem*.—Round, smooth, with a few small, white lenticels. Light green during first month, changing to dark green with prominent olive green stripes on basal portion by 10 weeks. Brown to gray and still streaked at 1 year.

*Buds*.—Opposite; ovate, obtuse, and flattened. Brown, slightly hairy, and 1/16 to 1/8 inch long.

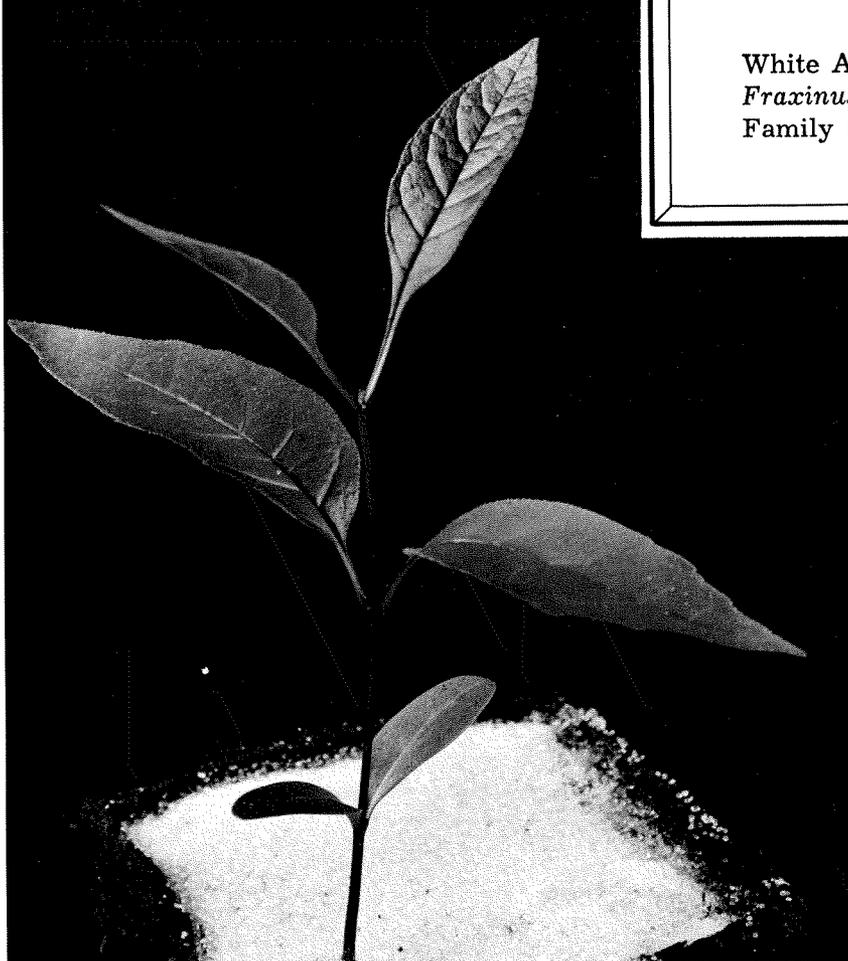
Cotyledon shape and size 3 days after germination. X 1





Cotyledons 1 week after germination. X 2

White Ash  
*Fraxinus americana*  
 Family Oleaceae



Seedling at 5 weeks. Cotyledons persist for 6 months. X 1



At 1 year terminal bud has just begun to open. X 2

White ash is difficult to distinguish from other species, especially green ash, during the first year. The site—uplands or ridges and high flats in bottom lands—on which it occurs is the most helpful guide, though not infallible. Green ash is common in low flats, sloughs, and shallow swamps.

*Cotyledons.*—Dark purple stem emerges in U-shape, and cotyledons appear within a few days. Elliptical with rounded apexes and bases; medium green; single cotyledons are  $\frac{1}{2}$  inch in length. Central vein prominent and light-colored with a few small branches. Persist on stem for at least 6 months but grow little after appearance.

*Leaves.*—Simple; opposite; ovate with short, acuminate apex and wedge-shaped base; margin

nearly entire or with small rounded teeth. Upper surface light green, paler below; smooth on both surfaces but with a few short hairs around margin. Typical compound leaves first appear after 6 months and have three to five leaflets similar to the first true leaves.

*Stem.*—Round throughout; dark purple on appearance, later changing to brown; smooth; lenticels pale.

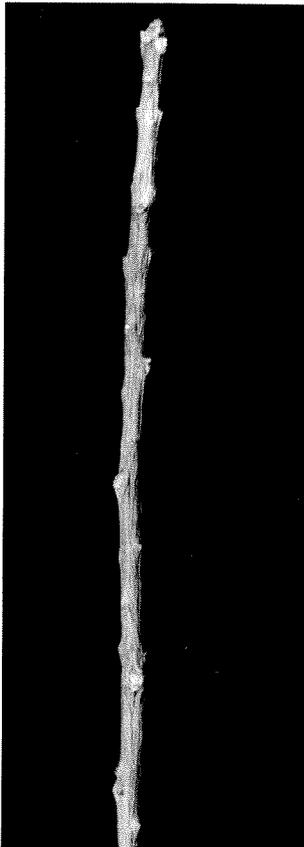
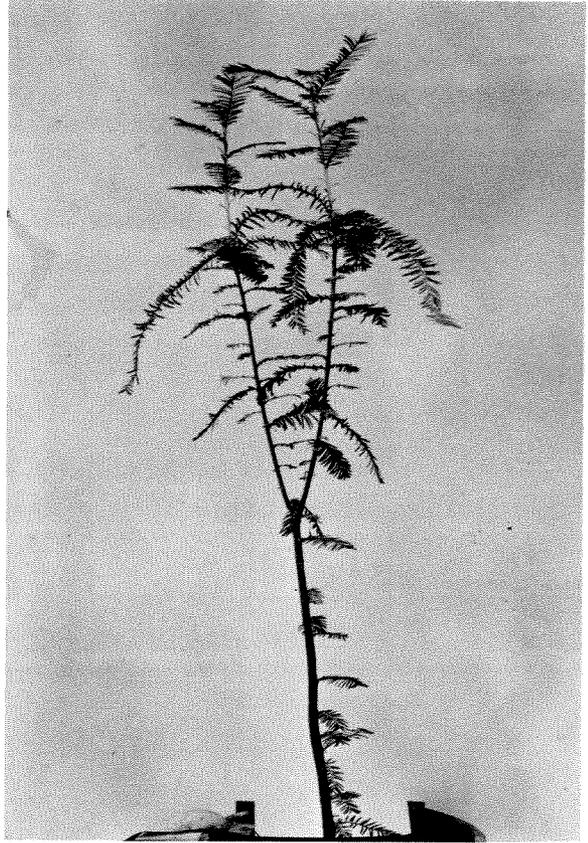
*Buds.*—Terminals conical to broad-ovoid, obtuse, dark brown to black with red-brown hairs, about  $\frac{1}{4}$  inch long. Axillary buds depressed, globular, brown with brown hairs, smaller than terminal bud.

Baldcypress  
*Taxodium distichum* (L.) Rich  
Family *Pinaceae*

At 1 year leaves resemble those of  
mature trees. X 1/4

Seedlings of this species resemble pines when germinating but are found in or near swamps or on very moist sites. Twigs bear needle-like leaves closely resembling those of mature trees.

*Cotyledons*.—Light green; linear, resembling pine needles.

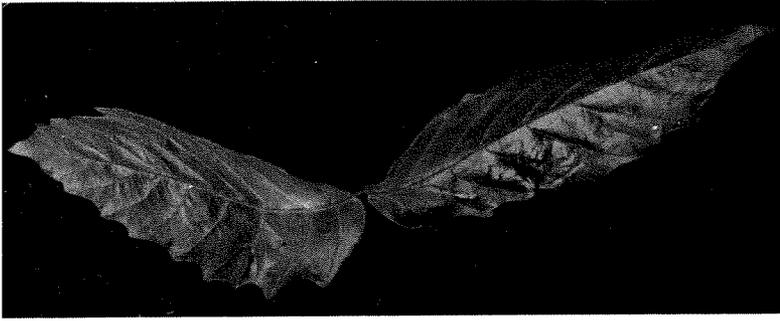


*Leaves*.—Alternate, in two ranks; linear, short pointed tip entire; sessile; flat. Light green, lustrous, with feathery look.

*Stem*.—Circular; smooth; red-brown with gray stripes on basal portion after first month. Twigs green to brown, smooth, and often deciduous. Round, slightly elevated twig scars give young stems rough surface.

*Buds*.—Brown terminal and lateral buds very small and partly submerged in twig.

Stem at 1 year with slightly elevated  
twig scars. X 1-1/4



At 3 weeks characteristic leaves have developed. X 4/5

Large size and truncated triangular shape of the cotyledons are distinguishing characteristics. Juvenile leaves are similar to those of the mature tree.

**Cotyledons.**—Among largest of hardwood species having germination above ground. Sturdy, thick, dark green, shaped roughly like truncated triangle  $\frac{5}{8}$  of an inch long and 1 inch in breadth. Grow little after unfolding and persist on seedling for a month or more.

**Leaves.**—First leaves develop on elongating stem about 3 days after germination and in 2 to 3 weeks closely resemble mature beech fo-

liage. Simple, straight-veined ovate-oblong with sharp-pointed apices, wedge-shaped or rounded bases, and coarsely serrated margins. Pale green when they unfold, covered on lower surface with long silky

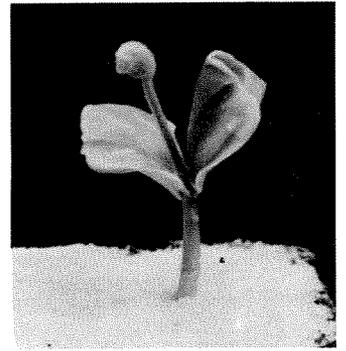
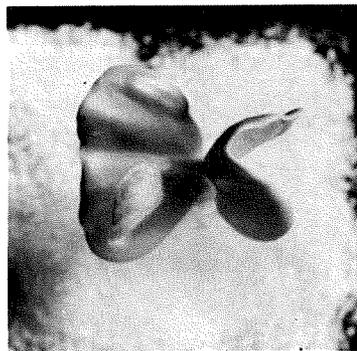
hairs. After several months, smooth and bluish green above, light yellow below, with tufts of hair in vein axils. Prominent stipules ovate-lanceolate to linear.

**Stem.**—Olive green with oblong, orange lenticels and coated with easily shed hairs during most of first season. Then becomes smooth, and orange or reddish brown. Round in cross section throughout.

**Buds.**—Brown; terminal buds cylindrical with prominent scales, sharp-pointed apices,  $\frac{1}{2}$  to 1 inch long and  $\frac{1}{8}$  inch in diameter; lateral buds ovoid,  $\frac{1}{32}$  inch long.



Terminal buds at 1 year with stipules and prominent scales. X 4



Cotyledons grow little after emerging (left). First leaves appearing 3 days after germination (right). X 1

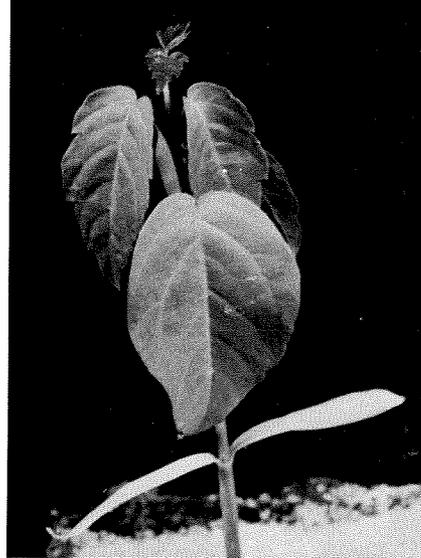
Boxelder  
*Acer negundo* L.  
Family *Aceraceae*

Buds are opposite on a shiny, bright green stem. Leaflets resemble those of poison-ivy or green ash.

*Cotyledons*.—Upon first appearance, medium green, lanceolate with bluntly rounded apex, 1 to 1½ inches long by ⅛ inch wide. Grow very little after unfolding, but persist for several weeks.

*Leaves*.—Opposite leaflets appear within first week after germination. Upon unfolding, leaflets densely coated with whitish hairs below and slightly hairy above, later smooth on both surfaces. Simple, ovate to elliptical with blunt, pointed apexes and rounded, often unsymmetrical bases; margins nearly entire or coarsely and irregularly serrate above middle, occasionally slightly lobed. Petioles smooth, slender. Leaflets light green, 1¼ inches long by 5/8 inch wide at 3 weeks. Typical odd-pinnately compound leaves of 3 to 5 leaflets first appear in latter half of first growing season.

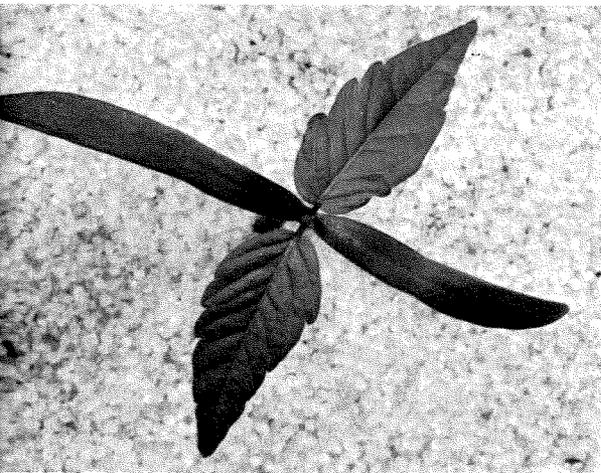
*Stem*.—Smooth and shiny at first, turning bluish (especially near base) toward end of



Juvenile leaf shape and arrangement at 3 weeks. Cotyledons persist for several weeks. X 1

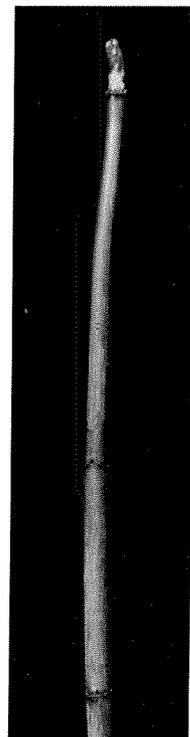
first year. Enlarged base of leaf petiole becomes large, conspicuous scar surrounding the stem when leaves are shed.

*Buds*.—Terminal buds, though only ¼ inch long, much longer and more acute than laterals. All buds purplish brown and covered with white hairs.



Cotyledons and first leaflets 1 week after germination. X 2

Stem and buds at 1 year. Note difference in size of terminal and lateral buds as well as circular scars left by leaf petioles below each lateral bud. X 2



Common Buttonbush  
*Cephalanthus occidentalis*  
Family *Rubiaceae*

This species occurs commonly as a shrub on wet sites. Prominent midrib and primary veins are found on dark green leaves with red petioles.

*Cotyledons*.—Light green; ovate-lanceolate with sharp-pointed apex; cotyledon  $\frac{1}{8}$  inch long by  $\frac{1}{16}$  inch wide on appearance. Shed within first month.

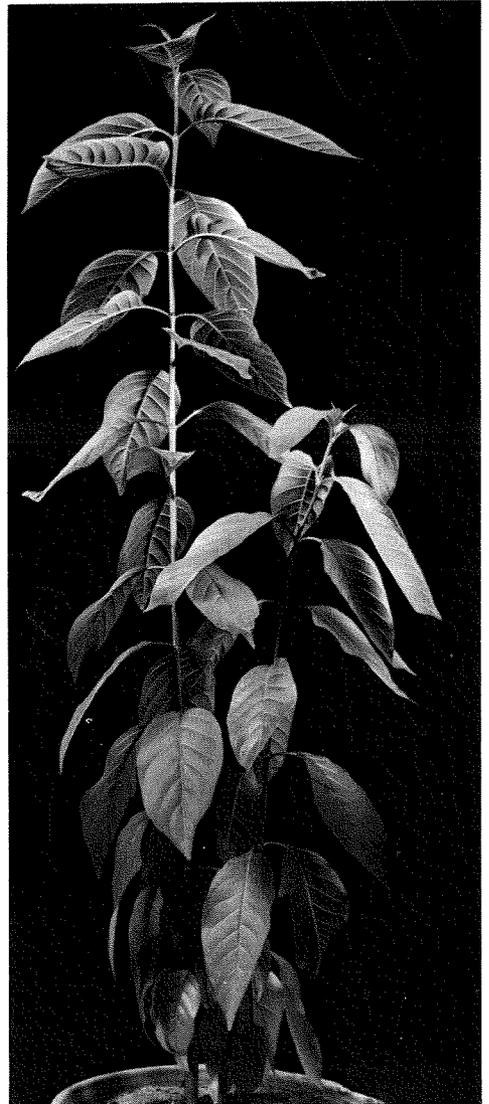
*Leaves*.—Simple; opposite; ovate to ovate-oblong with rounded base and acute to acuminate apex; margin entire. Dark green above, paler below; smooth on both surfaces; stout, light yellow midrib and several pairs of slender primary veins nearly paralleling margin; petioles red and with very small stipules at base. Whorls of three leaves frequently seen on more mature plants but not observed during first year.

*Stem*.—Circular; olive-green when young, reddish-brown when approaching maturity; lustrous and smooth; marked with a few elongate white lenticels. Leaf scars semicircular and connected by persistent, black stipules.

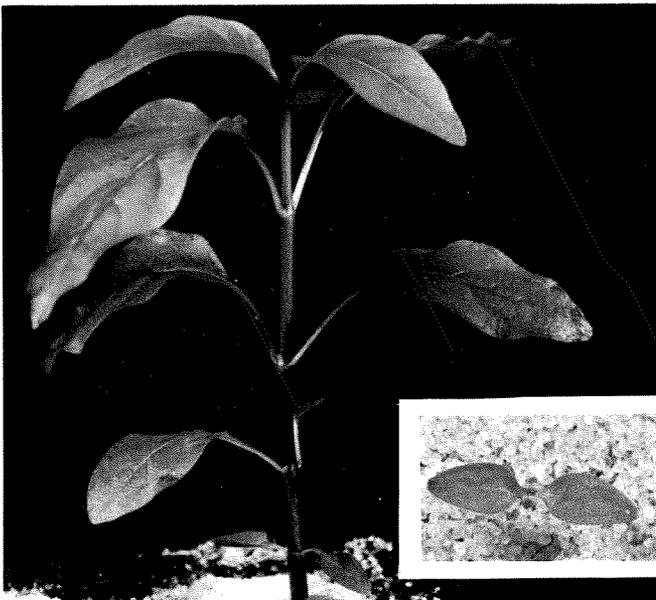
*Buds*.—No terminal bud; axillary buds opposite, red-brown, and minute.



Stem and buds at 1 year after germination. X 2



At 9 months leaf shape and venation typical. X  $\frac{1}{4}$



Buttonbush seedling at 3 weeks. X 1. Inset shows cotyledons at 1 week. X 2

Black Cherry  
*Prunus serotina* Ehrh.  
 Family Rosaceae

Leaves and stem have bitter-almond taste. Juvenile leaves resemble those of the mature plant.

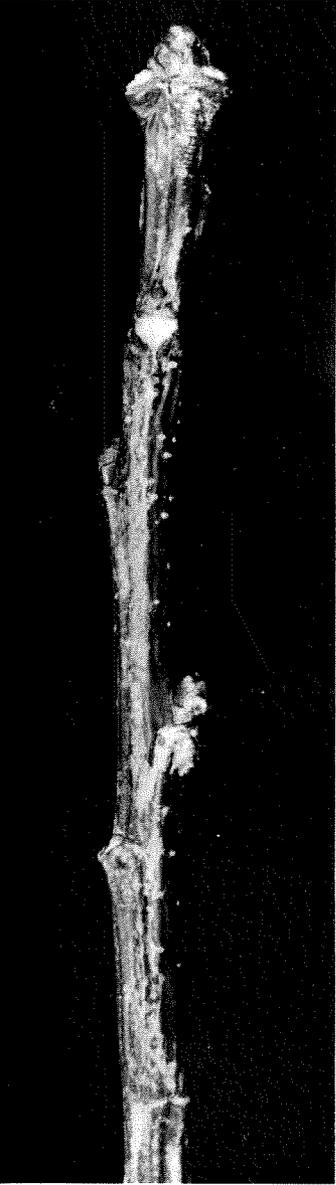
*Cotyledons*.—Do not appear above ground.

*Leaves*.—On appearance, light green and smooth. First pair opposite on stem. After several weeks, leaves simple, alternate, oblong or oblong-lanceolate with acuminate apices and wedge-shaped bases; margins finely serrate, dark green above, slightly paler below; smooth and shiny on both surfaces.

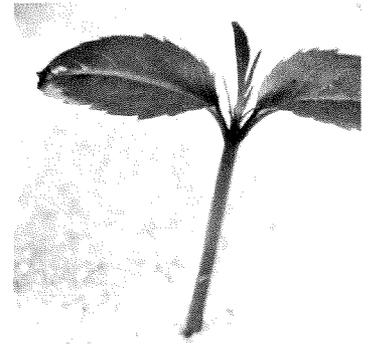
Midrib light-colored and prominent below. Lanceolate stipules about ½ inch long at base of leaf petiole that are shed early.

*Stem*.—At first, pink and smooth, turning reddish to reddish brown in a few weeks. By mid season, brown at base, changing to light green near terminus; smooth; small lenticels round white. Cross section round throughout entire length.

*Buds*.—Broad ovate with obtuse apex; chestnut brown; about ⅛ to ⅜ inch long.



Stem and buds at 1 year show small, white lenticels (left). X 2 Details of both terminal and lateral buds at end of 1-year-old stem (right). X 4



Cotyledons absent 1 week after germination. Leaf shape and arrangement typical. X 2

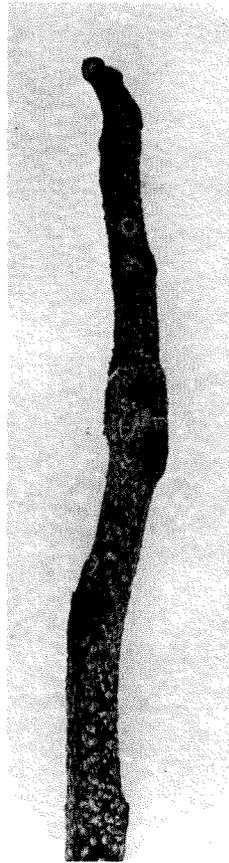


At 10 weeks leaf arrangement alternate after first pair. X ½

Kentucky Coffeetree  
*Gymnocladus dioica* (K. Koch)  
 Family Leguminosae



Seedling 5 days after germination. X 1



Superposed double buds occur frequently. X 4

Bark roughened by persistent scales and heart-shaped leaf scars at 1 year. Terminal bud lacking. X 2



Pinnately compound leaf has no terminal leaflet. Bark after midyear is roughened by small, persistent scales.

*Cotyledons.*—Do not appear above ground.

*Leaves.*—Alternate, pinnately compound with 10 to 12 leaflets opposite on rachis; no terminal leaflet; 2 to 3 inches long by end of first week. Leaflets ovate with acuminate apices and rounded bases; margin entire; ½ inch long by ¼ inch wide 1 week after germination; bronze-green and shiny when they unfold, becoming medium to dark green above and paler below after a week; smooth on

both surfaces. Bipinnately compound leaves characteristic of more mature trees do not develop in first year.

*Stem.*—Stout; round and smooth with white to orange lenticels; light green on appearance, turning greenish-brown by end of first year. Bark roughened by persistent scales at midyear and by conspicuous, heart-shaped leaf scars in late autumn.

*Buds.*—Usually partly sunken in small crater; globular; smooth; light brown and about 1/16 inch diameter. No terminal bud; axillary buds frequently occur in pairs, one above the other.

Eastern Cottonwood  
*Populus deltoides* Bartr.  
 Family *Salicaceae*

For the first few weeks, leaf shape resembles that of mature black willow. Triangular leaves typical of mature trees appear by midseason.

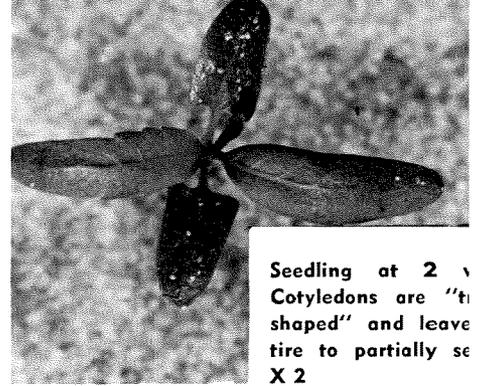
*Cotyledons*.—Elliptic during first week, with basal portion truncated and slightly notched; during second week, notch disappears, leaving cotyledons trowel-shaped. Smooth; dark green. Persistent for 2 months on red, smooth stem.

*Leaves*.—True leaves appear at end of first week. At first lanceolate with rounded apexes and wedge-shaped bases; moderately dark green, with entire to partially serrate margins and flat petioles. After several weeks, leaves grow broader, and by midseason some are typically triangular with rounded tooth margins. Smooth, alternate, light green above, slightly paler below.

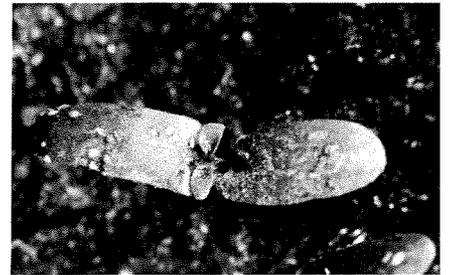
*Stem*.—Gray to reddish-brown with prominent elliptic, white lenticels. Stem cross section round near base, becoming angular higher up, especially near terminus.

*Buds*.—Reddish-brown, ovoid, and acute; lateral buds flatter than terminals. One-half inch or less in length, usually with light resinous coating and triangular leaf scar beneath bud.

Stem and buds at 1 year. Leaf scar triangular-shaped and lenticels prominent, white. X 2



Seedling at 2 weeks. Cotyledons are "trowel-shaped" and leaves begin to partially serrate. X 2



Cotyledons slightly notched at base 1 week after germination. First true leaves appearing. X 3½



At 6 weeks leaves starting to broaden and assume deltoid shape. Cotyledons still attached. X 2

Swamp Cottonwood  
*Populus heterophylla*  
 Family Salicaceae

Seedling at 6 weeks. Early leaves vary in shape. Cotyledons still persist. X 1



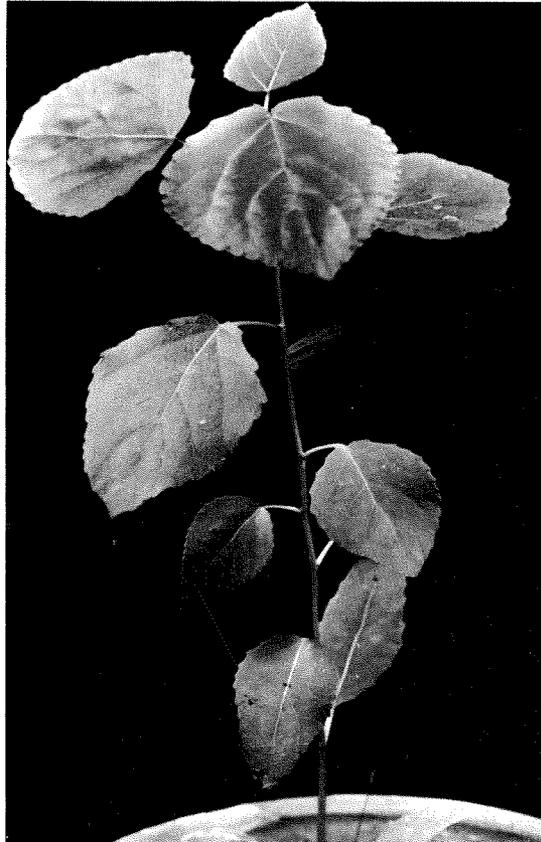
*Stem.*—Smooth by end of first year but lightly covered for 2 to 3 months with whitish hairs; olive green to red-brown; a few small, elongated, white lenticels. Stem cross section angular throughout.

*Buds.*—Red-brown; smooth; dull pointed. Terminal buds ovoid,  $\frac{1}{8}$  inch long; lateral buds more lanceolate and smaller.

Cotyledons are roughly kidney-shaped. Leaves are egg- or heart-shaped with round teeth and petioles. At first seedlings are easily confused with eastern cottonwood and black willow but are always identifiable by cotyledons and, within a few weeks, by leaf shapes.

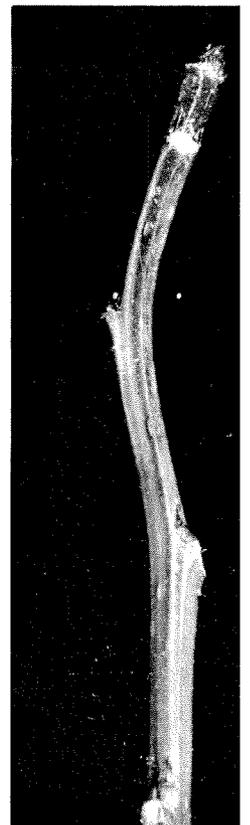
*Cotyledons.*—Oblate with narrow wedge-shaped junction where petiole joins long edge; opposite arrangement on reddish-brown, smooth stem. Medium green above and below; blade  $\frac{3}{8}$  inch long by  $\frac{1}{2}$  inch wide; persist on stem for about 2 months.

*Leaves.*—First leaves appear within 2 weeks after germination; simple, alternate, with round petioles. For first month ovate to slightly heart-shaped, medium green, with dense covering of deciduous hairs; margins coarsely serrate except on broad base. By midyear have assumed mature characteristics: broadly ovate, sharp-pointed or rounded at apexes, slightly heart-shaped, wedge-shaped or rounded at bases, margins with very rounded teeth; dark green above, paler below, round petioles.



At 6 months leaves have assumed typical mature shape. X  $\frac{1}{2}$

Stem and buds at 1 year. Cross section angular. Lateral buds small and lanceolate. X 2

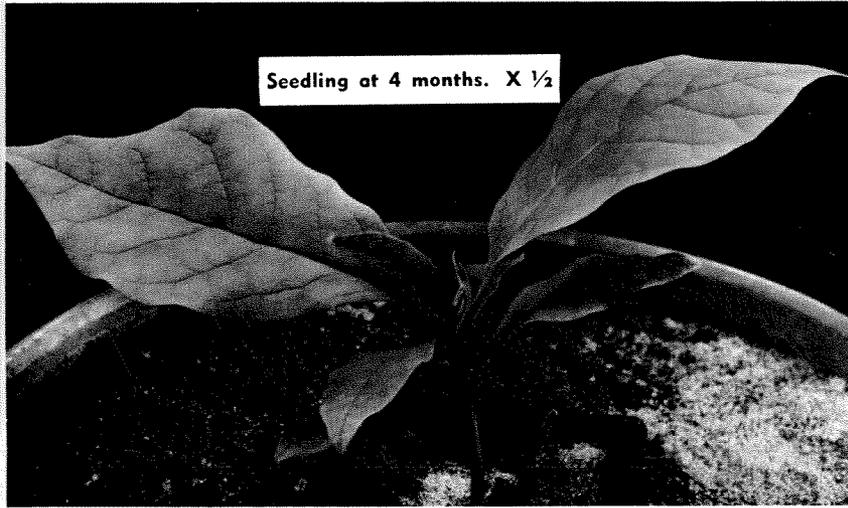


Cucumbertree  
*Magnolia acuminata* L.  
Family *Magnoliaceae*

Leaf development and cotyledons on 2-week-old seedling. Inset shows stem emerging before cotyledons appear. X 2



Seedling at 4 months. X 1/2



*Leaves.*—First true leaves appear within 2 weeks after germination. Simple; alternate; bunched near stem terminal; deciduous, unlike those of southern magnolia. Ovate to oblong-obovate with short-pointed to acuminate apices and rounded to wedge-shaped bases; margin entire and undulate on plane surface; medium green above, paler below; smooth on both surfaces; 4 inches long by 2 inches wide in 6 months.

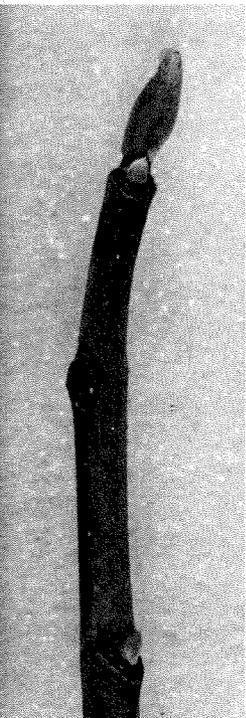
*Stem.*—Emerges from ground in U-shape; easily and rapidly frees cotyledons from soil. Stout; round, and smooth; red on appearance, changing to purple, then olive green or gray by year's end; marked with a few small white lenticels and horseshoe-shaped leaf scars whose ends are connected by narrow stipule scars extending around stem.

*Buds.*—Terminal: ellipsoid with acuminate but blunt-pointed apex, light green and densely covered with silky, white hairs; about  $\frac{3}{8}$  inch long and  $\frac{1}{8}$  inch wide. Axillary: ovoid compressed; light green; moderately pubescent with soft white hairs especially near apex; about  $\frac{1}{8}$  inch long and nearly surrounded by narrow leaf scar.

Typical magnolia leaves are medium green, undulate on the plane surface, and deciduous. Terminal buds are large and heavily coated with white, silky hairs.

*Cotyledons.*—Elliptical to oval with rounded to blunt pointed apices and rounded to slightly heart-shaped bases; moderate green and smooth on both surfaces; venation prominent. On appearance single cotyledons  $\frac{1}{2}$  inch long by  $\frac{3}{8}$  inch wide but more than double their size in first month. Persist on stem for almost 6 months after germination.

Stem at 1 year. Note relative size and arrangement of buds. X 2



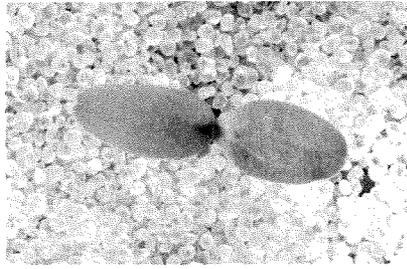
Compound leaves, frequently with spines, are clustered near the terminus of a spiny stem.

*Cotyledons*.—Oval with rounded apex and base; dark green and smooth on both surfaces;  $\frac{1}{4}$  inch long by  $\frac{1}{8}$  inch wide. Persist on plant through first 3 months.

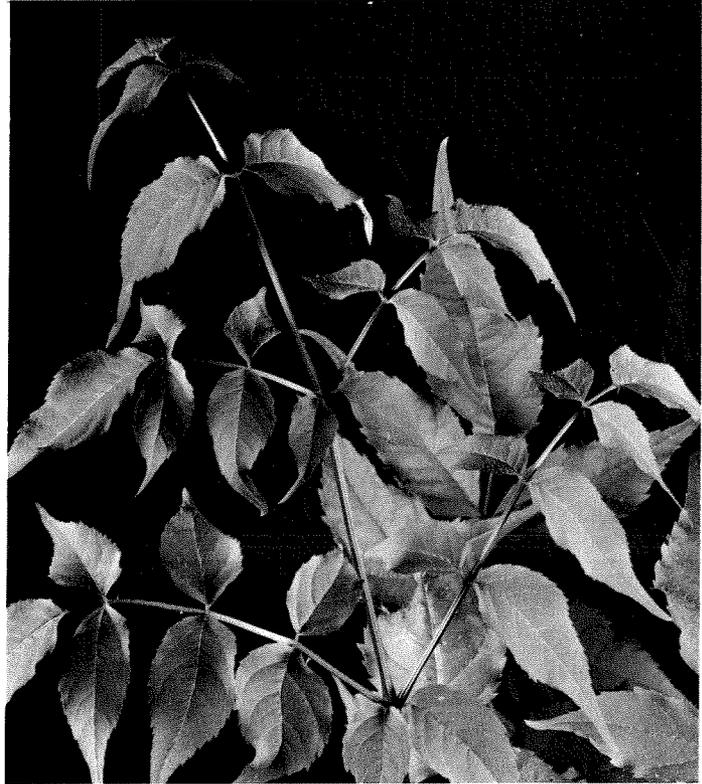
*Leaves*.—First true leaves appear 5 days after germination. First pair opposite, later ones alternate; pinnately compound with three to five leaflets. By end of first year some leaves doubly compound; pinnae with two to three pairs of leaflets and terminal leaflet. Leaflets ovate with acuminate apex and rounded base; margin finely serrate; medium green above, lighter gray-green below. Upper surface with quite a few fine spines, sparser below and mainly along midrib and main lateral veins. Leaf petioles light purple and with a few prickles; swollen at base.

*Stem*.—Reddish-violet for first few weeks, changing to brown on more mature portions by 3 months; smooth and circular. Leaf scars conspicuous, narrow and nearly encircle stem.

*Buds*.—Chestnut brown and smooth; terminal ones cone-shaped with blunt apexes,  $\frac{3}{16}$  to  $\frac{3}{8}$  inch long; axillary buds triangular and flattened, smaller than terminal ones.

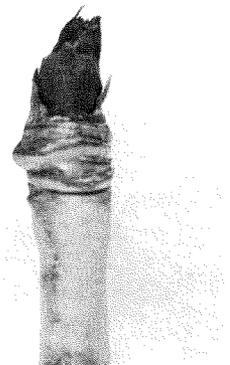


Cotyledons 2 days after germination. X 3

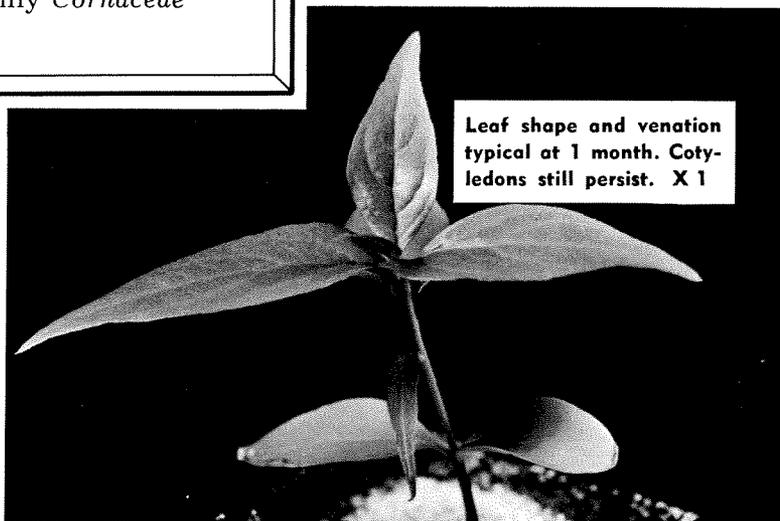


Leaf detail at 11 weeks. Note spines on upper surface. X 2/3

Stem and terminal bud at 1 year. Note prominent leaf scars bunched at end of stem. X 4



Flowering Dogwood  
*Cornus florida* L.  
Family *Cornaceae*



Leaf shape and venation typical at 1 month. Cotyledons still persist. X 1

near base; slightly hairy. Nearly encircled by narrow ring-like leaf scars.

*Buds*.—Ovoid, acute; light green; slightly hairy; about  $\frac{3}{16}$  inch long. Terminal buds with two valvate scales, and slightly longer than axillary buds.

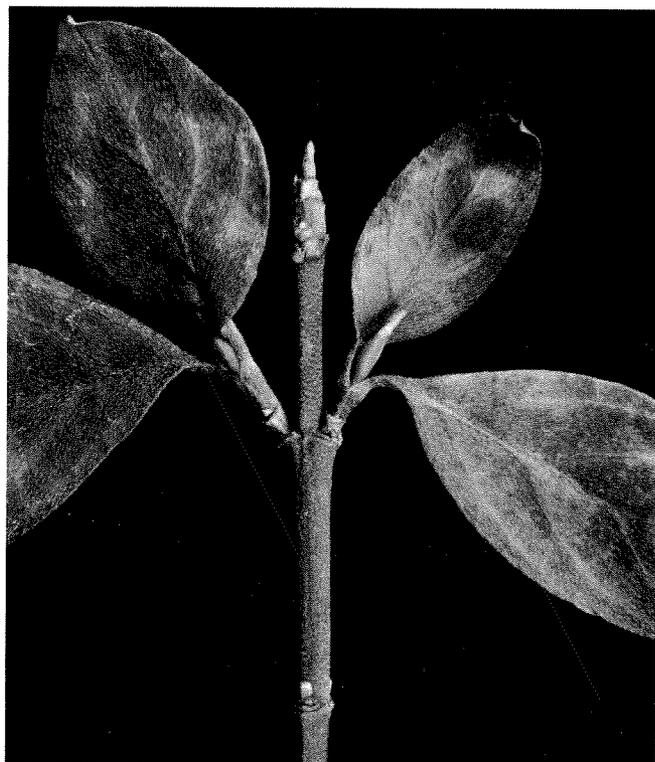
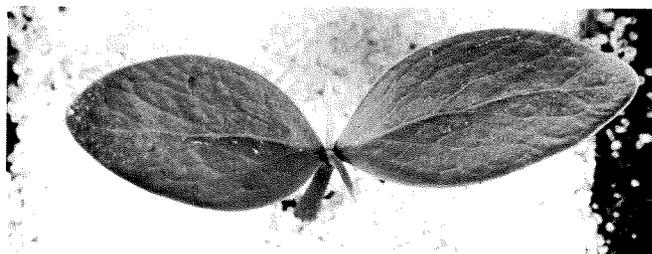
Cotyledons and first leaves 4 days after germination. X 2

Stems are red when young. Typical dogwood leaf venation shows lateral veins curving upward toward the leaf tip. Red coloration is occasionally seen along veins about a month after germination.

*Cotyledons*.—Ovate with bluntly rounded apex and slightly wedge-shaped base; medium green on upper surface, a little lighter below. Venation much like that of mature foliage. Size more than doubles in first month, growing from spread of  $\frac{3}{4}$  of an inch to 2 inches.

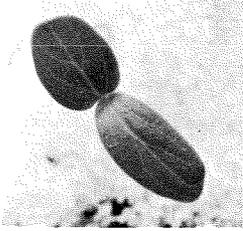
*Leaves*.—First true leaves appear about 4 days after germination; before unfolding resemble pine needles (see cotyledon photo) but are much more delicate. When unfolded, simple, opposite, ovate to elliptic, often narrowed to slender point at apex and with wedge-shaped base; light to medium green above, pale gray-green below; margin entire; smooth on both surfaces; and with prominent midrib and parallel lateral veins curving toward leaf tip.

*Stem*.—Circular; red at first, becoming bright green when actively growing, later turning reddish-brown, especially



Stem, buds, and leaves at 1 year. X 2

Roughleaf Dogwood  
*Cornus drummondii* C. A. Meyr  
Family *Cornaceae*



Cotyledons 3 days  
after germination.  
X 2

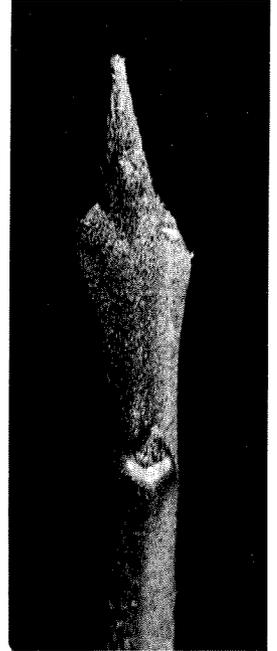
Opposite leaves with typical dogwood venation and rough upper surface develop within the first 6 months.

*Cotyledons*.—Elliptic to oblong with bluntly rounded apex and base; midrib and lateral veins noticeable; medium green and smooth on both upper and lower surface; single cotyledon  $\frac{3}{4}$  inch long and  $\frac{3}{8}$  inch wide.

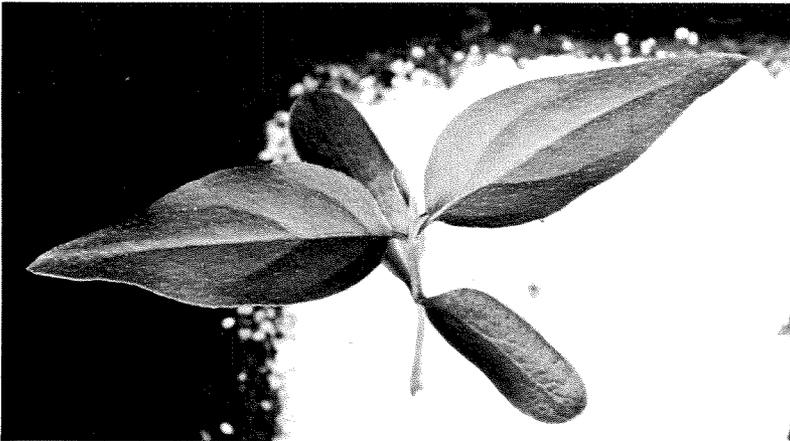
*Leaves*.—First leaves appear within a week after germination; simple, opposite; ovate to ovate-lanceolate with acute to acuminate apices and usually rounded bases; margins entire. Upper surface olive to medium green and roughened by short white hairs within a month, paler below with some pubescence; conspicuous veins run parallel to leaf margin.

*Stem*.—Round; light green and slightly hairy when they appear, usually turning pale red to red-brown toward end of first year; remaining slightly hairy.

*Buds*.—All buds reddish-brown and covered with whitish hairs. Terminal buds lanceolate with sharp point,  $\frac{3}{16}$  inch long; axillary buds ovoid and blunt, about  $\frac{1}{16}$  inch long.



Stem and buds hairy,  
reddish-brown at 1 year.  
X 4



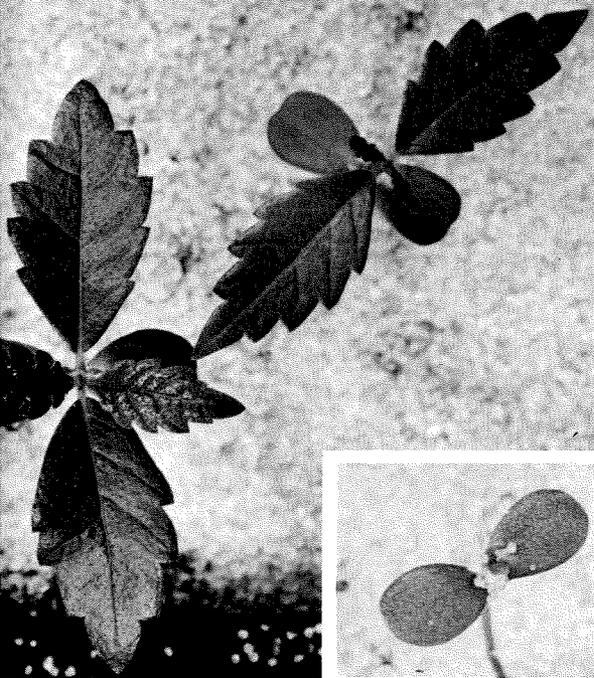
Seedling at 1 month. Note rough  
upper surface of leaves due to short  
white hairs. X 2

Table 2.—Comparison of first-year elm seedlings

Species	Leaves				Stem		Bud pubescence	Remarks
	Arrangement	Size and shape	Pubescence	Texture	Pubescence	Corky wings		
American elm	Opposite	2 to 4 inches long. Short pointed apex	None, to downy below	Rough upper surface	Moderate and soft at first. Rough to touch after a few weeks	None	None	
Cedar elm	Alternate	1 to 2 inches long. Rounded apex	None	Very rough upper surface	Moderately dense, stiff, white hairs, rough to touch	Few intermittent patches on main stem	Slight	
September elm	Opposite on main stem. Alternate on lateral branches	3 inches long. Acuminate apex	None at first. Fine down above after 6 months	Sometimes slightly rough above	Light on young stems	Heavy, in three ranks on lower portion of stem	None	
Slippery elm	Opposite but occasionally alternate	4 inches long. Acuminate apex	Slight amount below	Rough upper surface	Moderately dense rough red or white hairs	None	Moderately dense rusty hairs	
Waterelm (Planertree)	Alternate	2 to 4 inches long. Acute apex	None	Rough upper surface	Very light	None	Slight	Buds dark reddish-brown, other species chestnut brown
Winged elm	Alternate	1½ to 3 inches long. Acute to acuminate apex.	None	Both surfaces smooth	Light	Small amounts, two ranks on stem	Slight	Stems sometimes zigzag, especially near terminal. Cotyledons with slightly notched apexes. Buds slender and sharp-pointed

American Elm  
*Ulmus americana* L.  
 Family *Ulmaceae*

Seedlings at 2 weeks.  
 Inset shows cotyledons 1  
 week after germination.  
 X 2



Leaves and buds are opposite on first-year stems. Primary venation is parallel from midrib to leaf serration points. Leaf surface and stems are rough.

*Cotyledons.*—Medium green, broadly oval and smooth on both surfaces,  $\frac{1}{4}$  inch long by  $\frac{3}{16}$  inch wide. More nearly round at apex than those of other elms, but comparisons are necessary to make distinction clear. Persist on seedlings for several months after germination.

*Leaves.*—First leaves appear on elongating stem within 2 weeks after germination. Simple; oblong-elliptic, narrowing abruptly at apex to long sharp points; bases symmetrical and wedge-shaped; margins coarsely serrate; parallel primary veins extend from midrib to points of teeth. Dark green; leaf surface rough above, smooth to downy below. Opposite in first season, alternate thereafter and on sprouts growing from broken or severed first-year stems. Alternate the first year in other elm species, except September elm, and occasionally slippery elm.

*Stems.*—At first light green and coated with soft pale hairs, gradually changing to reddish-brown and marked by scattered



Stem and buds at 1 year. X 2

pale lenticels. After the first few weeks become rough to the touch. Round in cross section throughout.

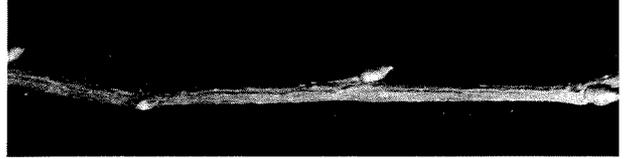
*Buds.*—Ovoid, pointed and slightly flattened,  $\frac{1}{8}$  inch or less in length with ovate chestnut brown smooth scales. Arrangement on stem like that of leaves: opposite during first year, later becoming alternate. On 1-year twigs, upper set of laterals and terminal form bud cluster like those of oaks, but smaller. Leaf scars below buds are prominent, elevated, semicircular, and show ends of three large fibrovascular bundles.



Leaf arrangement opposite at 2 months.  
 X  $\frac{1}{2}$

Cedar Elm  
*Ulmus crassifolia* Nutt.  
 Family *Ulmaceae*

Stem and buds at 1 year.  
 X 2



Small, typical elm leaves are alternate and have rounded tips. Upper surface is rough. Small corky wings develop on stem late in the first year.

*Cotyledons.*—On appearance dark green; smooth; roughly rectangular with decidedly truncate apices; 3/16 inch long by 1/8 inch wide. Grow little if any after appearance and are shed during first half year.

*Leaves.*—Simple; alternate; ovate with apices rounded or sometimes acute and bases rounded to slightly heart-shaped; margin coarsely, doubly serrate; dark green and lustrous above, paler below; small stipules present. Upper surface thickly covered with minute

sharp-pointed tubercles that produce rough texture. Lower surface smooth or with sparse white pubescence. Prominent parallel venation below, extending in straight lines from midrib to margin. This species, water elm, and winged elm only ones with alternate leaves, buds, and twigs at first appearance.

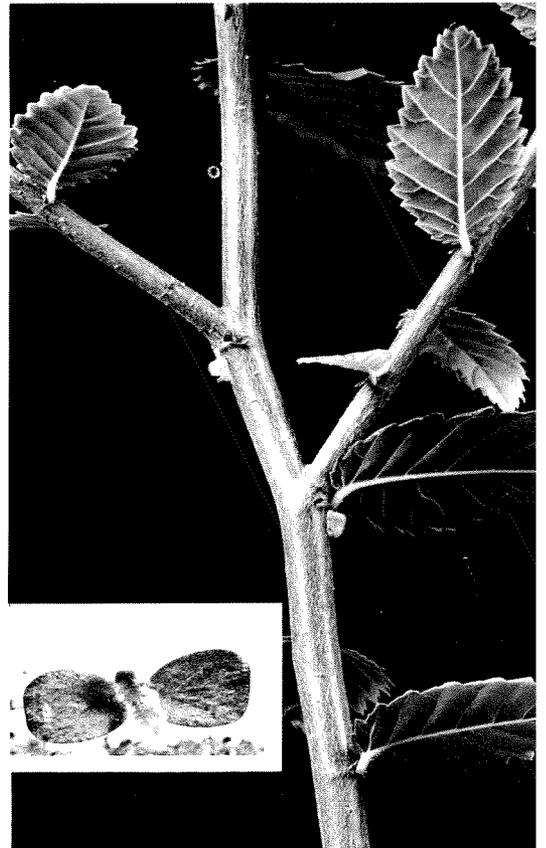
*Stem.*—Round; at first olive green to light brown, appearing slightly striped and covered with moderately dense coating of short, stiff white hairs that produce rough texture. By midyear changing to red-brown and becoming smooth; marked with very few, small, inconspicuous, round, white lenticels. A few scattered, intermittent patches of corky wings on stem and lateral twigs; wing development more extended after first year.

*Buds.*—Ovoid and blunt; chestnut-brown; slightly hairy; 1/8 inch or less in length. Terminal bud lacking.

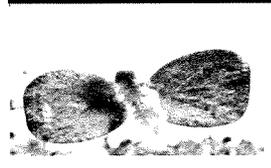


Seedling at 2 1/2 months.  
 Upper surface of leaves  
 rough. X 1

Corky wings on stem  
 at 8 months (just below both lateral  
 branches). X 1



Cotyledons at 5 days.  
 X 2





Basal portion of 6-month-old stems. Note three-ranked corky wings and first lateral branch (center) with alternate leaves. X 1/2

Corky wings develop abundantly in three ranks around the main stem by mid-season of the first year.

*Cotyledons*.—Oval with definitely truncated apexes and rounded bases; medium green and smooth on both upper and lower surface; single cotyledon 1/4 inch long and 3/16 inch wide on appearance. Grow little, if any, but persist on plant for about 3 months after germination.

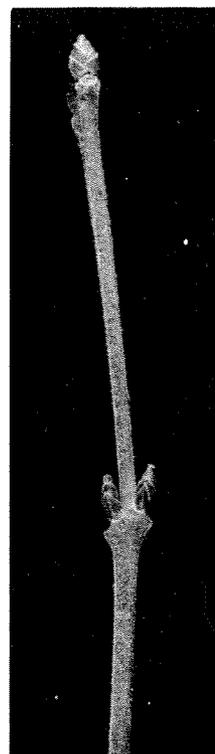
*Leaves*.—First leaves appear by close of first week. Simple; opposite; oblong to ovate with acute to acuminate apices and rounded bases; margins coarsely and doubly serrate; medium green above, paler below; at first smooth on both surfaces but after 6 months very finely pubescent above and starting to develop rough upper surface. About 3 inches long by 1 1/2 inches

wide 2 months after germination. First lateral branches opposite, developing in latter half of first year in leaf axils along main stem, but leaves forming on them arranged alternately.

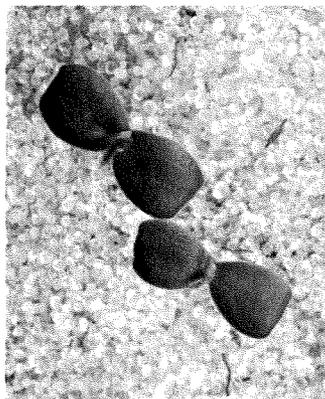
*Stem*.—Circular; at first green, turning to brown with maturity; lightly pubescent on younger portions. Usually, three ranks of light tan corky wings develop on lower portions of stems after 6 months. These wings more abundant and continuous along stem than on other species where they develop.

*Buds*.—Terminal ones lacking, axillaries ellipsoid with acute apices; smooth; chestnut brown; 1/8 inch long at end of first year.

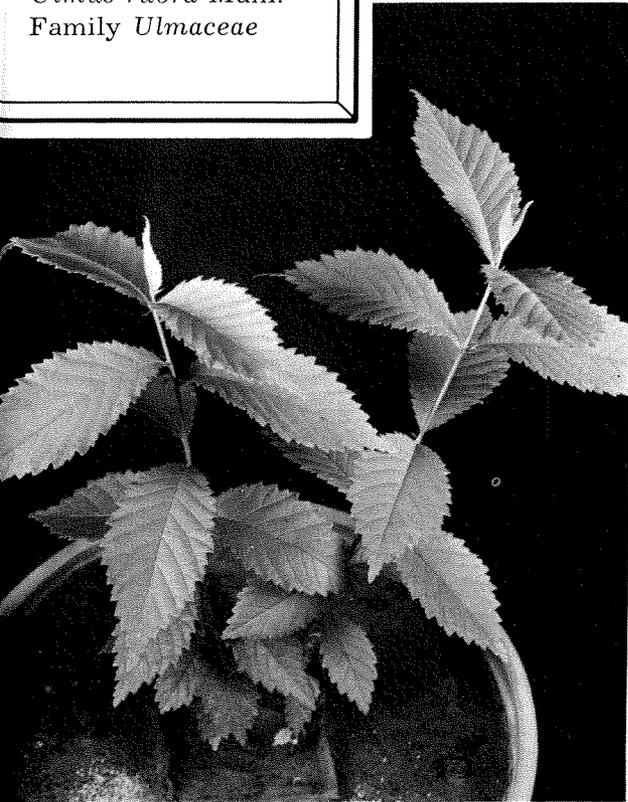
Stem and buds at end of first growing season. X 2



Cotyledons after 2 weeks. X 2



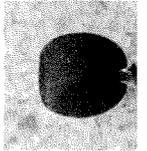
Slippery Elm  
*Ulmus rubra* Muhl.  
 Family *Ulmaceae*



Four-month-old seedlings. Plant at left illustrates occasional alternate arrangement of leaves during the first year. X 3/10



At 3 weeks leaf margins more coarsely serrate than on older plants. X 2



Cotyledons 3 days after germination. X 2

Leaves show characteristic elm form and venation but have rough, sandpapery upper surfaces and long tapering apices.

*Cotyledons.*—Oval with truncated apices and round to slightly heart-shaped bases; medium to dark green on both surfaces; at first slightly pubescent with short white hairs around margin and on upper surface; smooth below; becoming smooth on both surfaces after about a month.

*Leaves.*—First true leaves appear within 3 days after germination. Simple; principally opposite, occasionally alternate; ovate to oblong-ovate with acuminate apices and round to wedge-shaped bases; margins coarse and doubly serrate; dark green; smooth above and slightly pubescent below along veins and margin for first month;

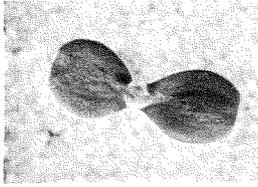


Terminal portion of stem at 1 year. Note typical leaf scar and stem pubescence. X 4

later, short tubercles pointing toward apex develop on upper surface producing characteristic rough texture of leaves; soft hairy below. About 1 inch long and 5/8 inch wide 1 month after germination; longer and broader than those of winged elm.

*Stem.*—Light red and moderately hairy on appearance, changing to green in a few weeks while remaining coated with short red or white hairs; turning brown and marked with considerable number of small, white lenticels and elevated nearly round leaf scars by close of first year. Round throughout length and roughly hairy.

*Buds.*—Broadly ovoid and blunt-pointed; dark chestnut-brown; moderately pubescent with rusty hairs; 1/8 to 1/4 inch long. Terminal buds lacking.



Cotyledons 2 days  
after germination.  
X 2

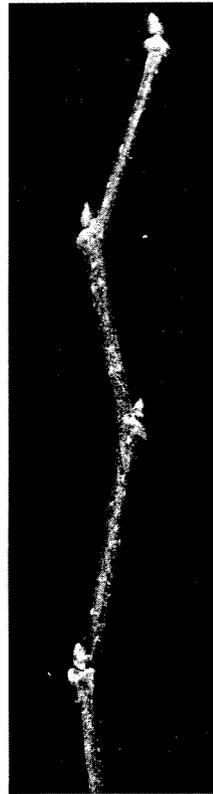


Typical leaf size, shape, and serration at 1  
month. X 1

Small, sharp pointed leaves have typical elm venation. Corky wings form on stem near end of the first year. This tree is not found on wet sites.

*Cotyledons*.—Oval; apexes shallowly notched and bases heart-shaped; light green and smooth on both surfaces; persist on plant for 1 to 2 months.

*Leaves*.—First leaves appear within 1 week after germination. Simple; first pair opposite,



Stem light reddish-brown at  
1 year and growth zigzag.  
Lenticels white to orange.  
X 2

subsequent ones alternate; ovate to oblong-lanceolate with acute to acuminate apexes and rounded to wedge-shaped bases; margins coarsely and doubly serrate; dark green above, slightly paler below; smooth on both surfaces. Small stipules present. Pointed leaves help distinguish seedlings of this species from cedar elm.

*Stem*.—Circular; zigzag, especially at end of stem; slightly hairy to smooth; at first light to olive green, becoming light reddish-brown in latter portion of first year; marked with a few small white to orange lenticels. Two corky wings begin to develop opposite each other on stem late in first year.

*Buds*.—Slender and sharp-pointed; chestnut brown; slightly hairy; 1/16 inch long. No terminal buds.

Hackberry  
*Celtis occidentalis* L.  
 Family *Ulmaceae*

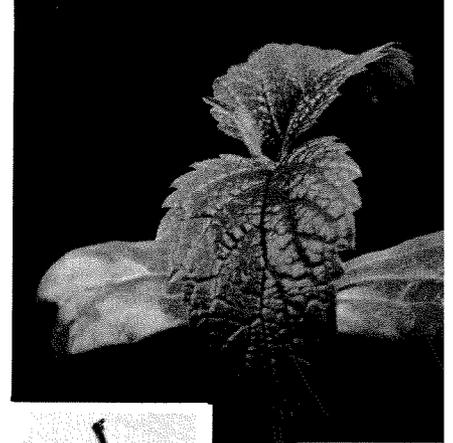
Notched cotyledons identify the genus but not the species. Like sugarberry, the young seedlings have a flat, spray-like appearance, resulting from alternate twig arrangement in the same plane.

*Cotyledons.*—Elliptical with deeply notched apex and round to truncated base; light green and smooth on both surfaces. Single cotyledons about  $\frac{5}{8}$  inch long and  $\frac{3}{8}$  inch wide upon emergence and grow very little. Persist on plant for 3 months.

*Leaves.*—First leaves appear during first week after germination and plant grows rapidly. Simple, alternate after first pair, which is opposite; ovate to ovate-lanceolate with acute to short-acuminate apices and rounded to truncate bases; margins coarsely serrate; upper surface dark green with moderate coating of short, stiff hairs or tubercles that produce rough texture; lower surface a little lighter green than upper and smooth; 2 to 3 inches long at 6 months.

*Stem.*—Circular throughout; green at first, changing to reddish or dark brown in latter half of first year, marked with moderate number of small, round to oblong, white lenticels; slightly pubescent with short white hairs. Growth zigzag; early leaves and lateral branches develop in single plane, producing typical spray-like appearance.

*Buds.*—Ovoid, blunt pointed; chestnut brown; sparsely pubescent;  $\frac{1}{16}$  inch long. Terminal buds lacking.



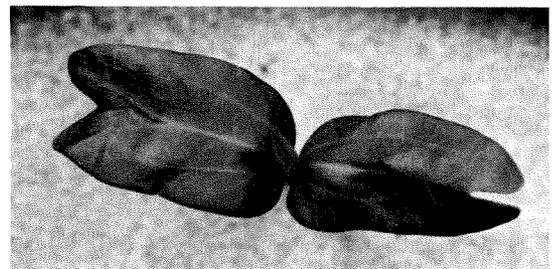
Leaf shape 1 week. X 1 1/2



Stem and buds at 1 year. X 2



At 6 months mature leaf traits and spray-like form of young plants help to identify species. X 1/4

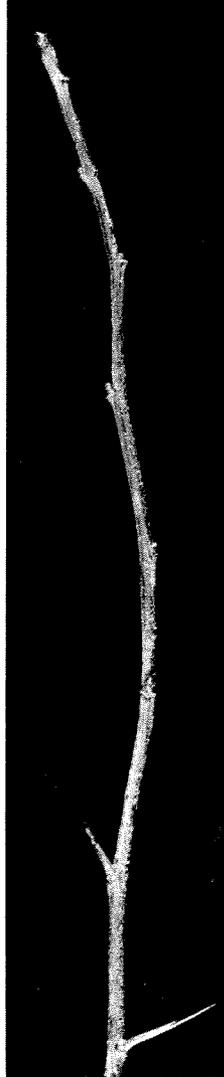


Cotyledons 3 days after germination. X 2

Hawthorn  
*Crataegus* L.  
Family Rosaceae



At 1 month lobing starts. X 3. Inset shows cotyledons and first leaf at 1 week. X 2



Stem at 1 year bears spines. X 1½

Note: The species of plant described below was not definitely established but appears likely to have been littlehip hawthorn, *C. spathulata* Michx. It is used to illustrate seedling development for the difficult-to-separate species of this genus.

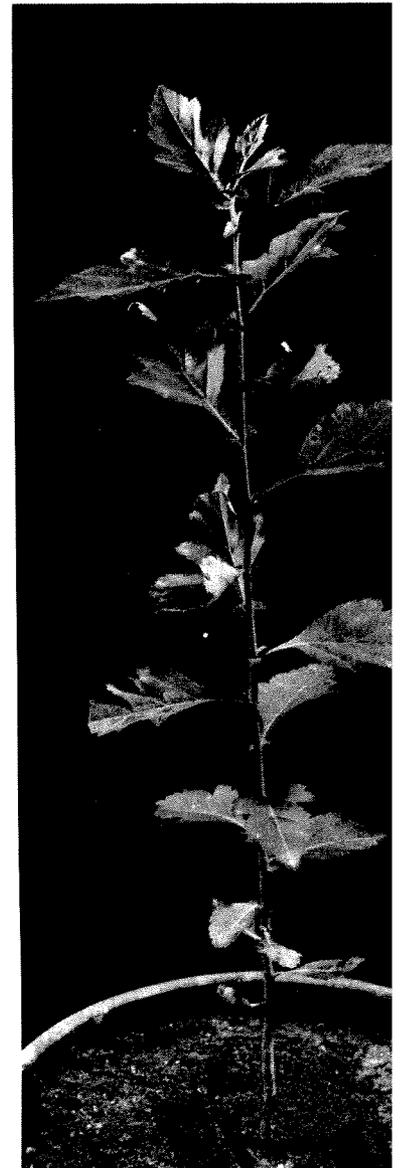
Hawthorn general: small leaves variously toothed, lobed, and notched; stems with long slender spines at nodes. Species illustrated: ovate leaves, three- to five-lobed at apex, tapering to winged petioles with large, foliaceous, serrate stipules at their base.

*Cotyledons*.—Oval with rounded apexes and rounded to truncate bases; medium green and smooth on upper surface; single cotyledon  $\frac{3}{8}$  inch long by  $\frac{3}{16}$  inch wide after 1 week. Persist on plant for about 1 month.

*Leaves*.—First leaves appear within week after germination. Simple; alternate; ovate, mostly three- to five-lobed at apex; finely serrate on margin, wedge-shaped base entire and tapering to winged petiole; apexes acute; dark green and smooth above, gray-green below with a few hairs along veins;  $2\frac{1}{2}$  to 3 inches long by 1 inch wide. Foliaceous stipules with serrate margins at base of leaves.

*Stem*.—Circular; greenish to red-brown; smooth; marked with a few round white lenticels. Growth slightly zigzag. Usually armed at nodes with slender, sharp, smooth, brown spines  $\frac{1}{2}$  inch or more in length.

*Buds*.—Globular; smooth; dark red-brown;  $\frac{1}{16}$  inch or less in diameter and occurring beside spines when stem is armed.



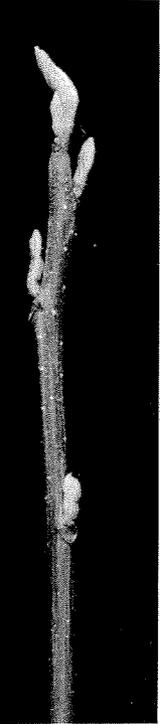
Seedling late in first year. X ½

Table 3.—Comparison of first-year hickory seedlings

Species	Leaves			Stem		Buds		Remarks		
	Type	Pubescence	Color	Leaflet size and shape	Pubescence	Color	Shape		Pubescence	Color
Bitternut	Compound. Three leaflets at first, later five.	At first heavy on both surfaces, later smooth	Tinged with red as they unfold, later moderate to light green on upper surface. Paler below.	Ovate-lanceolate. 3" long × 1½" wide at 6 mos.	Smooth	Red first month, then changing to brown with green stripes	Slender, pointed	Dense scurf	Bright yellow	Bud scales valvate
Mockernut	Compound. Three leaflets. Sometimes has simple leaves.	Smooth on both surfaces	Medium green on upper surface. Paler below.	Ovate to ovate-lanceolate. Terminal: 3-4" long × 2½" wide. Lateral: 1½" long × ¾" wide at 3 mos.	Smooth	Light brown	Broad ovoid	Smooth	Light brown	Leaflet margins coarse serrate. Leaves fragrant when crushed. Stipules prominent.
Nutmeg	Compound. Three leaflets.	Smooth, except for some hairs along midrib on lower surface	Medium green on upper surface. Paler below.	Terminal: ovate to elliptical, long tapering base, 1½" long × 1" wide. Lateral: elliptical. 1" long × ⅝" wide at 2 mos.	Covered with golden to brown scurf	Light red on appearance, becoming brown in a few mos.	Terminal: long ovoid. Lateral: similar but smaller.	Thick scurf	Brown	Bud scales valvate
Pecan (sweet)	Simple until late in first year	Sometimes hairy below	Dark yellow-green above	Lanceolate. 3-4" long × ¾" wide at 2 mos.	Coated with pale hairs at first, changing to slightly hairy near terminal	At first slightly red, later red-dish-brown	Ovoid, slightly compressed	Covered with light, jointed hairs	Red-brown	Typical compound leaves appear late in first year
Pignut	Compound. Three leaflets. Sometimes has simple leaves.	Smooth on both surfaces	Dark to medium green above. Paler below.	Terminal: ovate, 4-5" long × 1¾" wide. Lateral: lanceolate-ovate, 1½" long × ½" wide at 6 mos.	Hairy at first, becoming smooth by midyear	First weeks reddish to red-brown, later dark brown	Ovoid	Smooth	Light brown	
Water	Simple until late in first year	Sometimes hairy below	Red on unfolding, medium green on upper surface after a	Lanceolate-ovate. 3-4" long × ¾" wide at 6 mos.	Covered with pale hairs at first, becoming smooth	Dark red-dish-brown to gray	Ovoid, flattened; slight point	Slight	Dark red-brown	Typical compound leaves appear late in first year

Bitternut Hickory  
*Carya cordiformis*  
(Wangenh.) K. Koc  
Family Juglandaceae

Stem and buds at 1 year. X 2

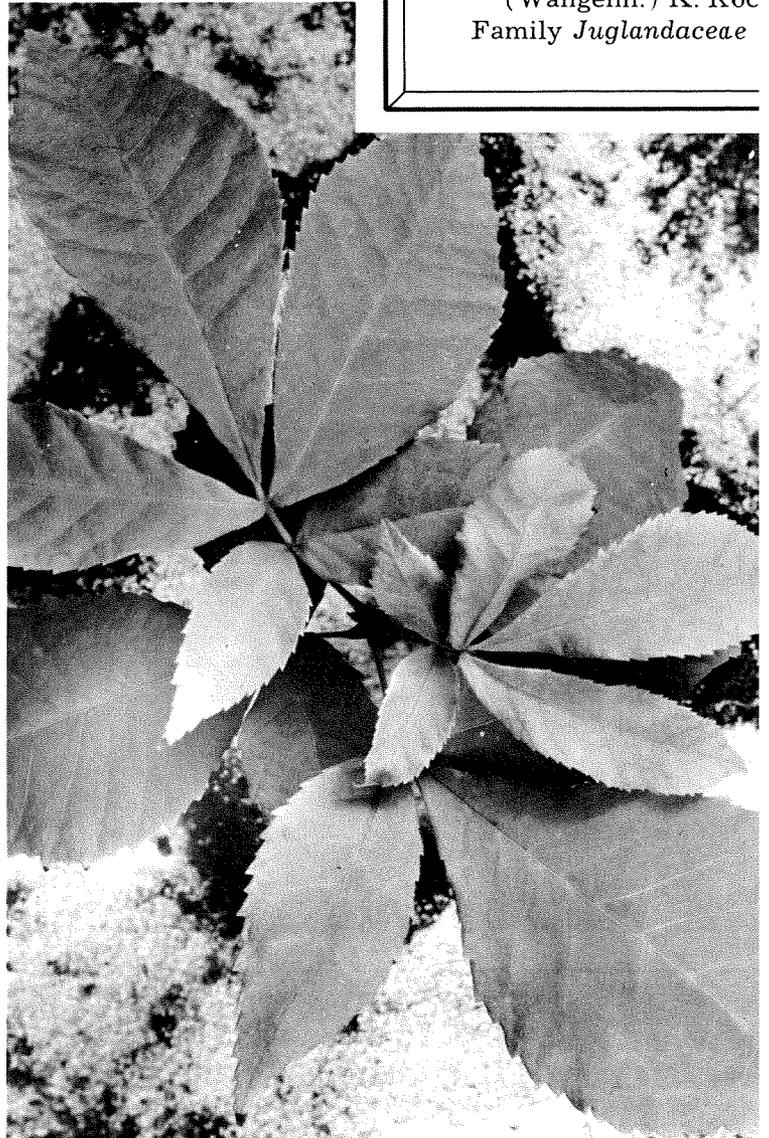


This species generally has smaller leaflets than other hickory species. The terminal bud is bright yellow.

*Cotyledons*.—Do not appear above ground.

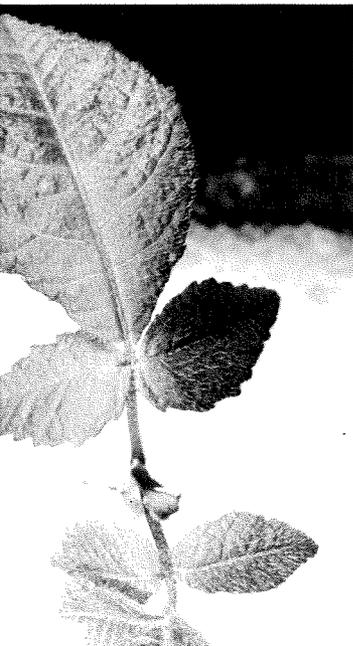
*Leaves*.—First leaves are opposite pair, odd-pinnately compound with three leaflets, terminal one large. Later leaves alternate and may have as many as five leaflets. Leaflets ovate to ovate-lanceolate and sessile or nearly so, terminal leaflets slightly petioled, acute

to acuminate at apex and with wedge-shaped bases; margins finely serrate; tinged with red as they unfold and heavily pubescent with short white hairs above and below, becoming moderate to light green above, slight-



Leaves at 6 months. X 1

Leaves at 2 weeks. X 2



ly paler below and smooth on both surfaces after a few weeks. Terminal and larger lateral leaflets 2½ to 3 inches long by mid-year, generally smaller than those of most other species of hickory.

*Stem*.—Round throughout; smooth; red for first month, changing to light brown striped with green by midyear; few small white lenticels.

*Buds*.—Slender and bright yellow with valvate scales; scurfy pubescent; terminal: ¼ to ½ inch long, oblique at apex; axillary: two-angled, often stalked; ⅛ to 3/16 inch long.

Mockernut Hickory  
*Carya tomentosa* Nutt.  
Family Juglandaceae

Stipules persist at 1 year. X 2

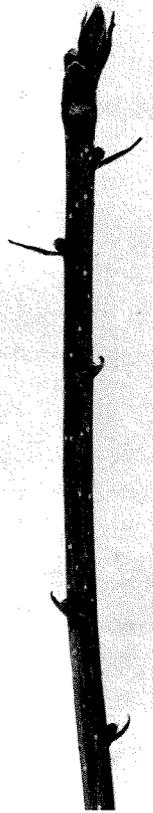


At 3 weeks plant sometimes has a simple leaflet. X 1/2

wide, laterals about 1½ inches long and ¾ inch wide 3 months after germination.

*Stem.*—R o u n d ; light brown; smooth and marked with conspicuous pale lenticels.

*Buds.*—Broadly ovoid, acute to blunt-pointed; light brown; smooth; terminal: ¼ inch long; axillary: 1/16 inch long.



Large, plump terminal buds are among the largest of those of hickories. Leaves have a resinous fragrance when crushed.

*Cotyledons.*—Do not appear above ground.

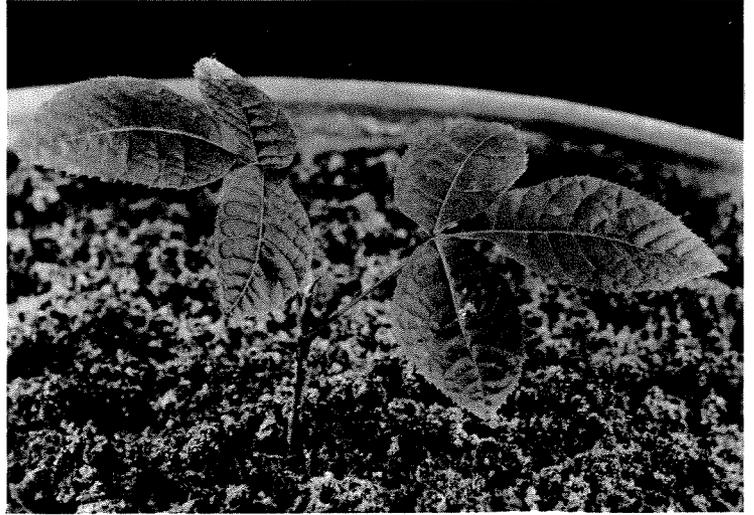
*Leaves.*—Alternate; odd-pinnately compound with three leaflets, single leaflets sometimes occur on plants in first year. Leaflets ovate to ovate-lanceolate with acute to acuminate apices and wedge-shaped to rounded bases; lateral leaflets sessile or nearly so, terminal ones with short petiole. Margins coarsely serrate; medium green above and paler below; smooth on both surfaces; prominent stipules. Terminal leaflets 3 to 4 inches long and 2½ inches



Leaf shape and size after 3 months. X 3/4

Nutmeg Hickory  
*Carya myristicaeformis* (Michx. f  
Nutt.  
Family Juglandaceae

Terminal portion of 1-year-old stem. Note scaly appearance and minute axillary buds. X 4



Leaf arrangement at 2 months. X 1

Midrib on the lower surface is hairy. The small brown buds are scurfy pubescent with valvate scales.

*Cotyledons*.—Do not appear above ground.

*Leaves*.—Alternate; compound, having three leaflets; terminal leaflets ovate to broadly elliptical with long tapering base and apex, petiole short, lateral leaflets elliptical with obtuse apices and rounded bases, nearly sessile; margins finely serrate; medium green and smooth on both surfaces except for some pubescence along midrib below. Terminal leaflets  $1\frac{1}{2}$  inches long and  $\frac{3}{4}$  to 1 inch wide; lateral ones 1 inch long and  $\frac{1}{2}$  to  $\frac{5}{8}$  inch wide 2 months after germination.

*Stem*.—Pink to light red on appearance, becoming brown by end of first year; round; coated with golden to brown scales.

*Buds*.—Covered with thick brown scurfy pubescence; bud scales valvate; terminal bud long ovoid with somewhat obtuse apex,  $\frac{1}{8}$  to  $\frac{1}{4}$  inch long; axillary much smaller, acute and slightly blunted.



Seedling at 1 week. X 2

Pignut Hickory  
*Carya glabra* (Mill.) Sweet  
Family Juglandaceae

Terminal portion of stem at 1 year.  
Lenticels white. X 4



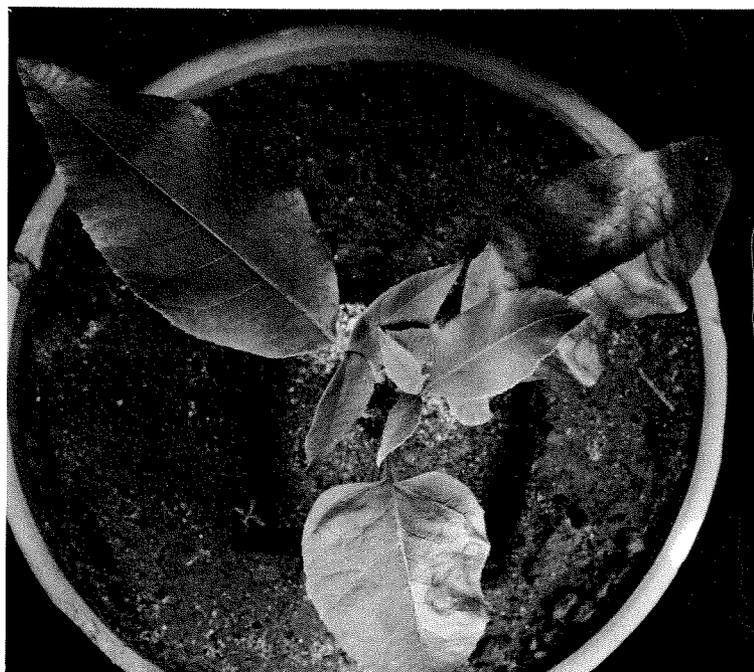
No particularly useful characteristics are observed. This species is difficult to distinguish from mockernut hickory.

*Cotyledons*.—Do not appear above ground.

*Leaves*.—Alternate; mostly odd-pinnately compound, terminal and two lateral leaflets, but simple leaves sometimes occur; terminal leaflets ovate, have short petiole and are 4 to 5 inches long and  $1\frac{3}{4}$  inches wide at midyear; lateral leaflets lanceolate-ovate, sessile, and  $1\frac{1}{2}$  inches long by  $\frac{1}{2}$  inch wide at midyear. All leaflets have acuminate apices and rounded or wedge-shaped bases; margins finely serrate; upper surface dark to medium green, lower surface a little paler; both surfaces smooth.

*Stem*.—Circular throughout; for first few weeks reddish to red-brown and slightly pubescent; becoming dark brown, smooth and marked with moderate number of small white lenticels.

*Buds*.—Ovoid with acute apices; light brown; smooth; terminal ones  $\frac{1}{4}$  inch long, axillary ones  $\frac{1}{8}$  inch long.

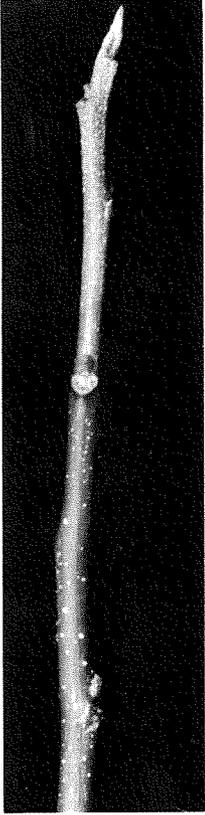


Leaf shape and size at midyear. X  $\frac{1}{2}$



Seedling at 3 weeks after germination.  
Note two types of leaves and arrangement on stem. X 1

Water Hickory  
 (frequently Bitter Pecan)  
*Carya aquatica* (Michx. f.) Nutt.  
 Family Juglandaceae

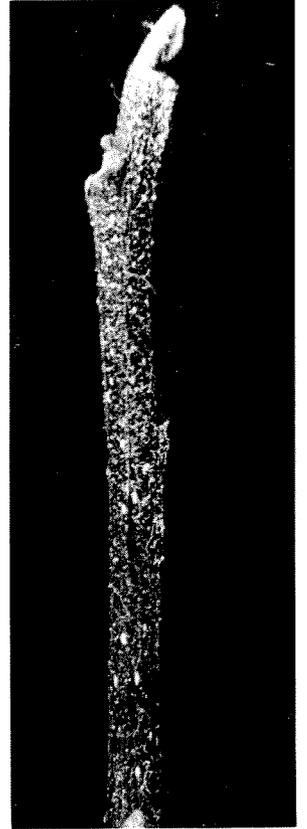


Stem and buds at 1 year. Note elevated leaf scars and prominent lenticels. X 2

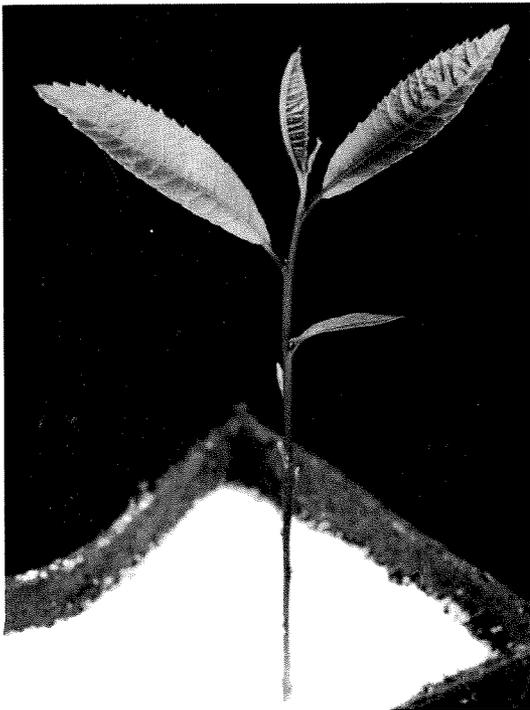
No outstanding characteristics separate this species from pecan (*Carya illinoensis*), the only seedling hickory with which it is easily confused. Site is probably the best identification guide; water hickory frequents low, wet flats, while pecan is found only along riverfronts and on ridges elsewhere.

*Cotyledons*.—Do not appear above ground.

*Leaves*.—Alternate; simple; lanceolate-ovate with acute apexes, bases symmetrical and rounded or unsymmetrical and wedge-shaped; margins finely serrate. Red to maroon on appearance,



Stem extremity and terminal bud slightly hairy at 1 year. X 4



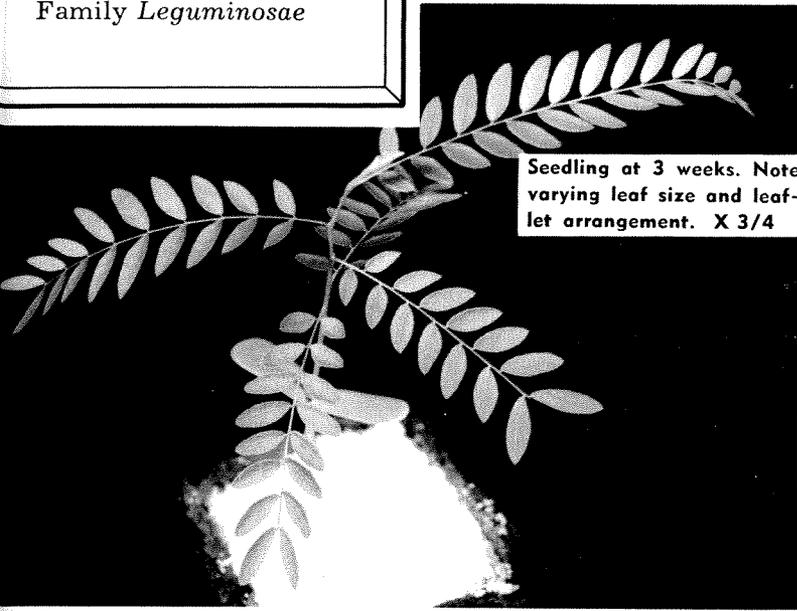
Seedling 3 weeks after germination. X1

changing to medium green after a few weeks; smooth and shiny above and sometimes hairy beneath. Typical odd-pinnately compound leaves of more mature plants do not develop until near end of first growing season or in second year.

*Stem*.—Dark reddish-brown to gray, at first coated with loose pale woolly hairs, later smooth with numerous, small, white lenticels. Marked in winter by small, nearly oval or triangular, elevated leaf scars. Stem cross section round throughout.

*Buds*.—Winter buds slightly flattened and pointed; dark reddish-brown; terminal  $\frac{1}{8}$  to  $\frac{1}{4}$  inch long, often hairy; lateral buds much smaller.

Honeylocust  
*Gleditsia triacanthos* L.  
 Family Leguminosae



Seedling at 3 weeks. Note varying leaf size and leaf-let arrangement. X 3/4

At 1 year stem is zigzag and light gray-green. X 2

with purple-brown, stout, rigid spines  $\frac{1}{4}$  to  $\frac{1}{2}$  inch long; mainly three-pointed but sometimes simple. Distribution along stem fairly uniform as contrasted with bunching near base found on water locust.

*Buds.*—Red-brown; smooth; terminal bud lacking; axillary buds minute and inconspicuous.

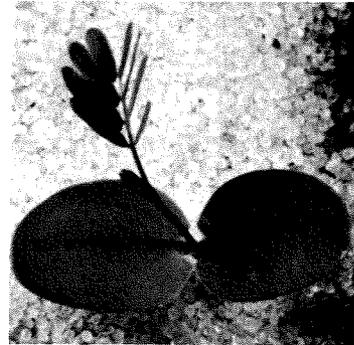
Small leaflets resemble those of mimosa. Abundant three-forked thorns are distributed uniformly along stem and are well developed by the latter half of the first year.

*Cotyledons.*—Oval with rounded apexes and slightly notched bases; light green and smooth on both surfaces; individual cotyledon  $\frac{1}{2}$  inch in length. Persist on stem for about a month.

*Leaves.*—First leaves appear within a few days after germination. Alternate; once pinnately compound during first year; 1 to  $2\frac{1}{2}$  inches long; leaflets 15 to 30 opposite or alternate on rachis; almost sessile;  $\frac{1}{2}$  inch long and  $\frac{3}{16}$  inch wide; oblong-lanceolate with rounded apexes and bases; margin with very small, rounded teeth to entire; medium green and lustrous above, paler below; both surfaces smooth.

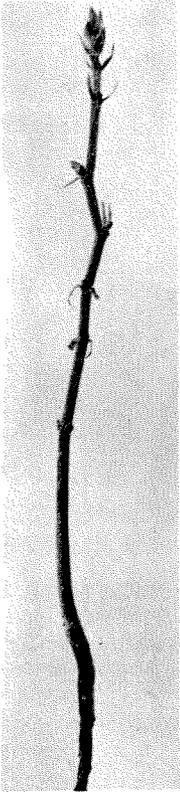
*Stem.*—Red-brown at first, becoming light gray-green by end of first year; zigzag; circular; and with minute lenticels. Armed after midyear

Cotyledons and first leaf at 3 days. X 2



Thorn development on 8-month-old locust seedlings. Evenly distributed along stem on honeylocust (left); larger and branched, with concentration near base on waterlocust (right). X 3/10

Eastern Hophornbeam  
*Ostrya virginiana* (Mill.)  
 Koch  
 Family *Betulaceae*

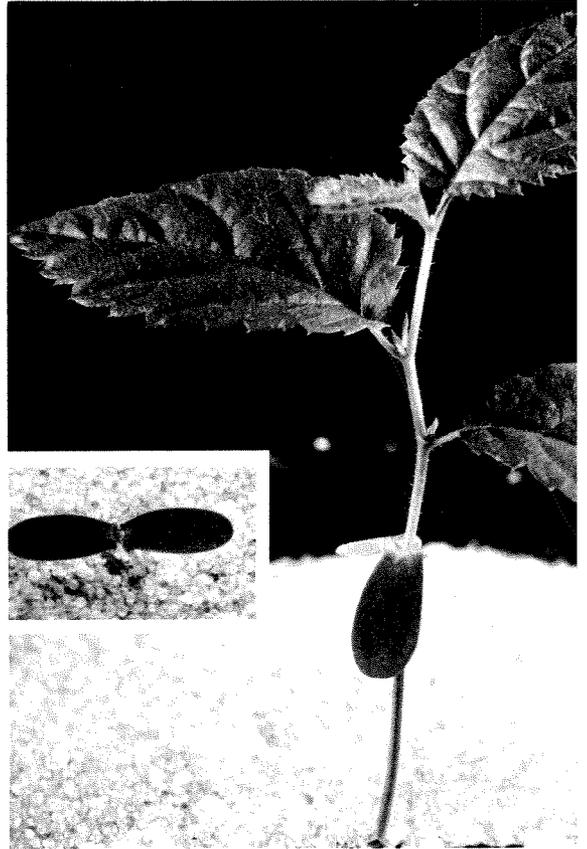


At 1 year stipules persist at nodes. X 2

Coarse, doubly serrate leaf margins have short bristles at serration tips. Venation is prominent and similar to that on elm leaves.

*Cotyledons.*—Elliptical with rounded apices, slightly notched bases, and very short petioles; dark green above, gray-green below, and smooth on both surfaces. Single cotyledon  $5/16$  inch long and  $1/8$  inch wide on appearance and grows little before being shed about 2 months after germination.

*Leaves.*—First leaves appear during first week. Simple; alter-



Cotyledons still attached to stem at 1 month. Inset shows cotyledons as they appear. X 2



Leaf characteristics at 1 month. X 2

nate; ovate tapering to dull acute apex and rounded or slightly heart-shaped base; margin coarsely, partially doubly serrate with small bristles present at serration apices. After a month,  $1\frac{1}{8}$  inches long by  $5/8$  inch wide; prominent, parallel venation similar to that of elm leaves; medium dull green above, paler below, and smooth on both surfaces.

*Stem.*—Zigzag; round; red and smooth on appearance, changing to light brown or tan and finely pubescent after a few weeks. Long narrow stipules persist at leaf scars.

*Buds.*—Ovoid and pointed; light brown or tan and with some white hairs. Terminal buds largest,  $1/8$  inch long; axillary ones minute to  $1/2$  size of terminals.

American Hornbeam  
*Carpinus caroliniana* Walt.  
 Family *Betulaceae*



Stem and buds at 1 year.  
 X 2



First lateral branches developing at 5 months.  
 X 1/4

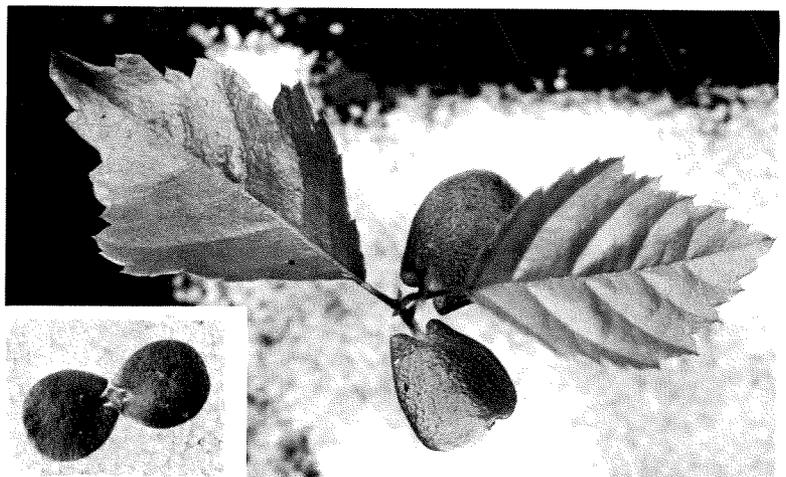
Pear-shaped cotyledons have short petioles and pronounced V-notch at base. Leaves are coarsely, doubly toothed with sharp-pointed serrations, and venation, as on elm leaves.

*Cotyledons.*—On appearance, nearly round with small V-shaped notch at base and very short petiole; dark green and smooth on both surfaces; single cotyledons  $\frac{1}{8}$  inch long. Growing in a week to  $\frac{3}{8}$  inch long by  $\frac{5}{16}$  inch wide, becoming pear-shaped with notch and petiole more pronounced than at first. There is no further growth. Persist on stem for about 3 months.

*Leaves.*—First true leaves appear during first week after germination. Simple; alternate; ovate with acute to acuminate apices and rounded to wedge-shaped or sometimes unequal bases; margin coarsely and doubly serrate, serration tips bearing short spines; medium green; smooth, and somewhat glossy on both surfaces;  $2\frac{1}{4}$  inches long by 1 inch wide at 6 months after germination. Veins prominent on upper surface of leaf, parallel, and extending at acute angle from midrib to leaf margin, similar to those on elm.

*Stem.*—Zigzag; circular; smooth; light green on appearance, becoming dark red and shiny by end of first year; marked by many small white lenticels.

*Buds.*—Ovoid with short, sharp-pointed tip; red-brown; smooth;  $\frac{1}{8}$  inch long with terminal buds a little plumper than axillary ones.

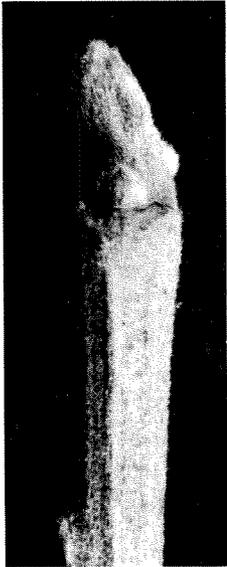


Seedling at 1 month. Short petiole present on cotyledons. Note basal notching of cotyledons on appearance (inset). X 2

Poison-Ivy  
*Rhus radicans* L. (*Toxicodendr.  
radicans* (L.) Kuntze)  
Family *Anacardiaceae*

Compound leaves with three leaflets have entire to lobed margins and are often shiny above. They exhibit characteristic poison-ivy foliage within a few weeks after germination.

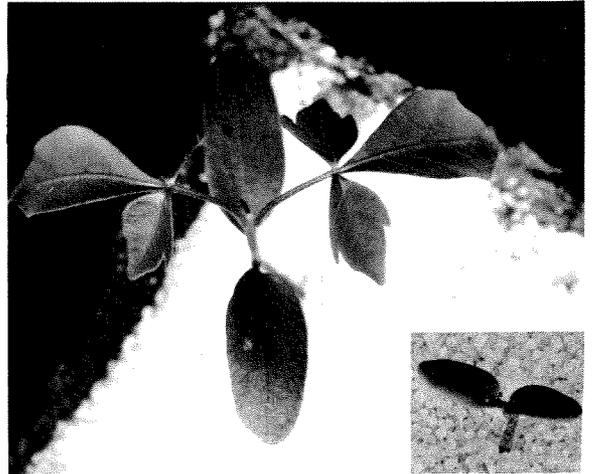
*Cotyledons*.—Elliptical with rounded apexes and bases; medium green and smooth on both surfaces; single cotyledon  $\frac{1}{4}$  inch long by  $\frac{1}{8}$  inch wide on appearance; double in size within first month. Persist on stem for about 6 weeks.



Terminal portion of 1-year-old stem including pubescent buds and typical leaf scar. X 4



Stem and buds at 1 year. X 2



Typical seedling at 1 month. X  $1\frac{1}{2}$ . Inset shows cotyledons at 2 days. X 2

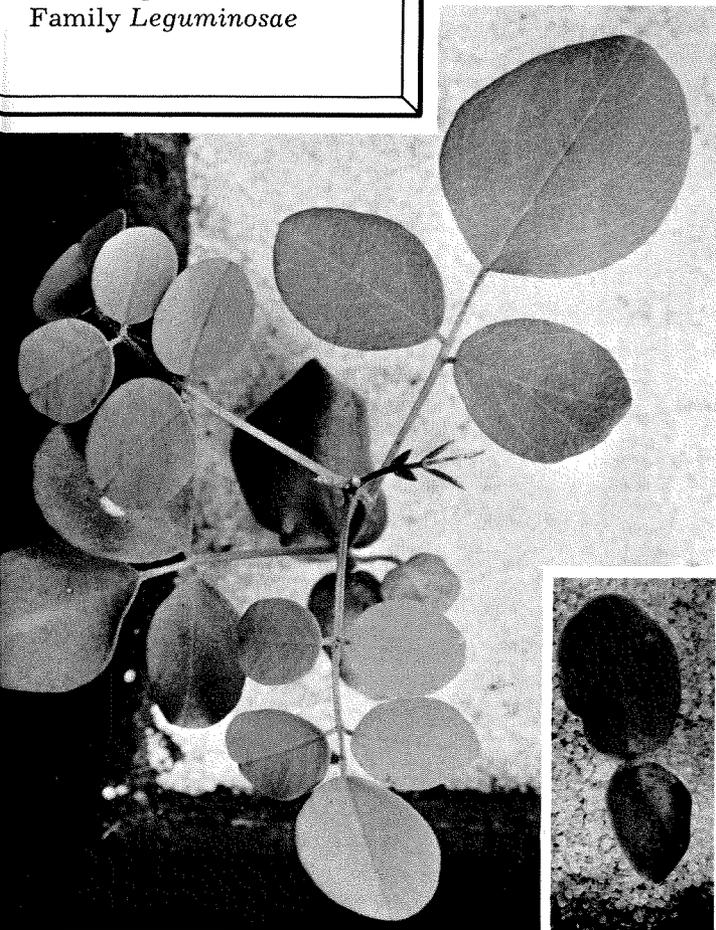
*Leaves*.—Alternate; compound, trifoliate; leaflets lanceolate, ovate, or occasionally obovate, narrowing gradually to long blunt point at apex; and bases rounded to wedge-shaped; axillary leaflets sessile or nearly so. Margin entire or lobed, extremely variable; medium green, smooth and frequently shiny on upper surface, slightly paler and hairy below; leaflets

$\frac{3}{8}$  to  $\frac{5}{8}$  inch long by  $\frac{3}{16}$  to  $\frac{3}{8}$  inch wide at 1 month; terminal leaflets larger.

*Stem*.—Circular; brownish-gray, smooth to slightly pubescent; leaf scars V-shaped; usually erect during first year but may begin climbing on other vegetation or support toward end of season.

*Buds*.—Brownish and moderately pubescent; without scales; terminal buds ovoid with blunt pointed apex,  $\frac{1}{8}$  inch long; axillary buds flattened and triangular-shaped,  $\frac{1}{16}$  inch long.

Black Locust  
*Robinia pseudoacacia* L.  
 Family Leguminosae



Leaf and leaflet details at 2 weeks. Note cotyledons at appearance (inset). X 2

Leaves are 3 to 4 inches long at 2 months. X 1/2



One-year stems are zigzag and bear thorns at nodes. X 2



Leaves are pinnately compound; leaflets are slightly larger than those of honeylocust or waterlocust. Stem is armed with short, straight, sharp thorns usually borne in pairs at the nodes.

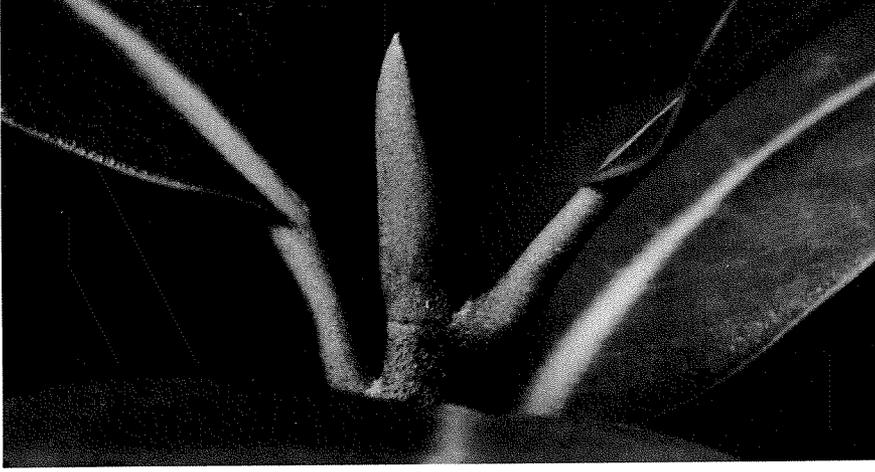
*Cotyledons*.—Oval to ovate with rounded apex and base; medium green above, paler below; smooth on both surfaces; 1/2 inch long by 3/8 inch wide on appearance; grow little.

*Leaves*.—First leaf appears within a week after germination. Alternate; odd-pinnately compound; 3 to 4 inches long after 2 months. Leaflets 3 to 15, opposite or alternate on rachis; nearly sessile; 1/2 to 1 inch long by 3/8 to 3/4 inch wide, terminal leaflets frequently a little larger; oval to ovate-oblong with rounded base and apex; margin entire;

dark green; when they unfold covered with white hairs that are shed early; later smooth on both surfaces.

*Stem*.—Zigzag; round to slightly angular in cross section; smooth; dark olive green to reddish-brown and with many small pale lenticels. Pairs of thorns develop from stipules at base of leaf petiole, becoming noticeable in latter half of first year. Unbranched spines straight to curved; sharp; attain length of 1/8 to 1/4 inch in first year.

*Buds*.—Terminal buds lacking; axillary buds minute; spherical; light tan and covered with sparse white pubescence; partially submerged in leaf scar.



Southern Magnolia  
*Magnolia grandiflora*  
 Family Magnoliaceae

Terminal bud at 1 year.  
 Note typical pubescence of  
 bud and upper stem. X 2

Evergreen leaves are large, shiny, and leathery. The large greenish, conical terminal bud is covered with rusty hairs.

*Cotyledons*.—Lanceolate to elliptical, tapering toward bluntly rounded apex; shiny medium green and smooth on both surfaces; single cotyledon  $\frac{1}{2}$  inch long and  $\frac{1}{4}$  inch wide on appearance and growing little. Persist on stem for approximately 2 months.

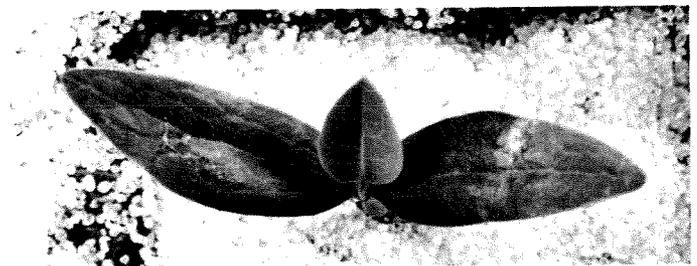
*Leaves*.—First true leaves appear within a week after germination. Simple; alternate; evergreen and leathery; variable in shape but most often elliptic or oval with short blunt-pointed or acuminate apices and wedge-shaped bases; margin entire. Dark green, shiny, and smooth above, paler below and usually with light coating of rusty hairs especially along veins;  $4\frac{3}{4}$  inches long and  $1\frac{1}{2}$  inches wide at 3 months after germination.

*Stem*.—Breaks through ground surface in U-shape, and cotyledons follow in a day or two. Circular; olive green; with moderate coating of short red hairs for first few months, then becoming smooth except on new growth.

*Buds*.—Terminal: conical and sharp-pointed; light green and heavily covered with tan pubescence;  $\frac{3}{4}$  inch long. Axillary: ovoid; green; and with covering of short white hairs, particularly near apex;  $\frac{1}{8}$  inch long.



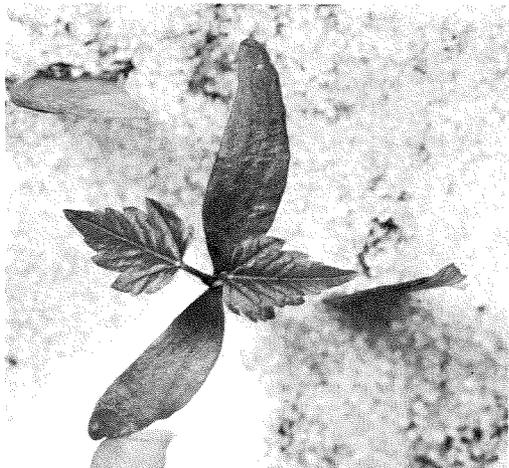
At 3 months foliage shiny, clustering on upper portion of stem. X  $\frac{1}{2}$



First leaf developing at 1 week. X 2

Red Maple  
*Acer rubrum* L.  
Family *Aceraceae*

Cotyledons and first leaves  
4 days after germination.  
X 2



Leaves are opposite and usually three-lobed; the middle lobe often is longer than the others. Dark red, shiny twigs have round red buds.

*Cotyledons.*—No special characteristics distinguish cotyledons from those of other maples, except that length is normally half that of boxelder, the other species prevalent in bottom lands. Cotyledons elliptical with blunt, rounded apices, smooth, medium green, and  $\frac{1}{2}$  inch long by  $\frac{1}{8}$  inch wide. Persist on plant for several weeks.

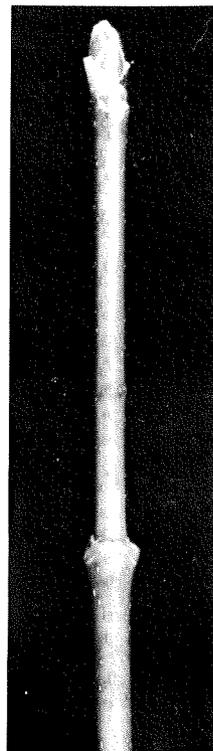
*Leaves.*—First true leaves appear within a day or 2 after cotyledons and are three-lobed, a characteristic accentuated in succeeding weeks. Simple; opposite; ovate to oval; truncate, slightly heart- or even wedge-shaped at base; apex long, narrow, blunt; margin coarsely serrate with V-shaped sinuses between lobes. Bright green and smooth on upper surface, lighter, even to white, and pubescent below, especially when unfolding. Within 2 weeks 1 inch long by  $\frac{5}{8}$  inch wide at broadest portion, and leathery.

*Stem.*—Young stems green or dark red during first few months, becoming dark or bright red and shiny above, shading into red-brown near base at close of first summer; smooth and marked by whitish longitudinal lenticels. Stem cross section round throughout.

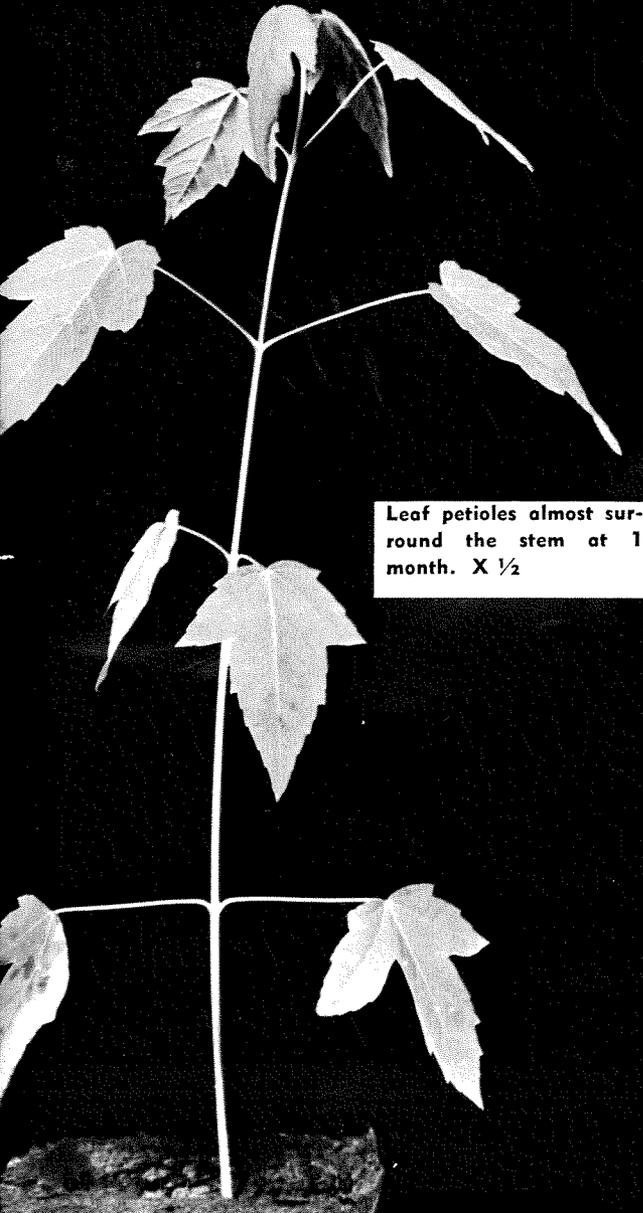
*Buds.*—Opposite on stem, round to obtuse with dark red outer scales ciliate on margins, and inner scales rounded at apex and bright scarlet. Lateral buds up to  $\frac{1}{8}$  inch long and terminal buds up to  $\frac{1}{4}$  inch long.



Seedlings 5 months after  
germination; leaf shape  
is typical. X  $\frac{1}{2}$



Stem and buds at 1  
year; lenticels are  
white and lateral buds  
have an opposite ar-  
rangement. X 2



Leaf petioles almost surround the stem at 1 month. X 1/2



Stem and buds at 1 year. Note rings formed by leaf scars. X 2



Leaf development 4 days after germination. No cotyledons are showing. X 2

Silver Maple  
*Acer saccharinum*  
Family Aceraceae

Leaves are opposite and deeply cut into five lobes; the middle lobe itself often is three-lobed. Under surface is silvery white.

*Cotyledons.*—Do not appear above ground. This feature helps to distinguish the species from other maples commonly found in bottom lands.

*Leaves.*—Simple; opposite; truncate or heart-shaped at base with sharp-pointed apex. Five-lobed with V-shaped or rounded sinuses between lobes, margin coarsely serrate, upper surface pale green, lower surface silvery white

and at first slightly hairy below, especially in axils of primary veins; petioles slender and red. Leaves begin to develop characteristic five-lobed form as early as 2 weeks after appearance, although pair of lobes nearest petiole remains indistinct for several additional weeks. Middle lobe clearly shows three-lobed form by this time.

*Stem.*—Light green at first, later becoming light chestnut brown, smooth and lustrous, covered with white lenticels. Narrow, opposite leaf scars almost meet around stem, forming noticeable lines. Round in cross section throughout.

*Buds.*—Opposite, ovoid with flattened point at apex; bright red outer scales ciliate on margins, 1/16 to 1/8 inch long; terminal buds largest.

Trident Red Maple  
*Acer rubrum* L. (var. *tridens*  
 Wood)  
 Family *Aceraceae*

Leaves are smaller than those of typical red maple, have rounded bases, and are usually three-lobed near the apical end. Buds are triangular and have blunted points.

*Cotyledons*.—Narrowly elliptic with rounded apexes and wedge-shaped bases; dark green; smooth. Single cotyledon  $\frac{1}{2}$  inch long by  $\frac{3}{16}$  inch wide on appearance and makes little growth.

*Leaves*.—Simple; opposite; ovate and three-lobed near apical end with acute to acuminate apexes and rounded or sometimes

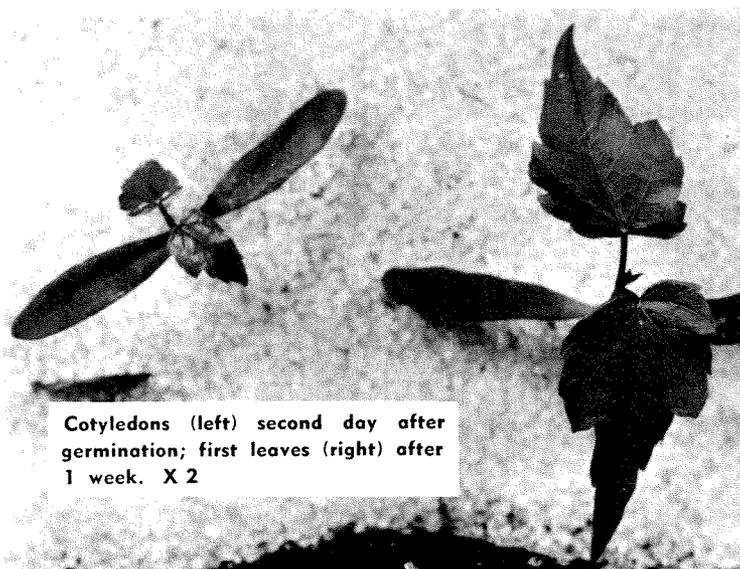


Stem and buds at 1 year. Note numerous lenticels, development of first lateral branch, and typical terminal bud. X 4

slightly heart-shaped bases; margin coarsely serrate to occasionally undulate below lobes; dark green and smooth on upper surface, glaucous with white hairs below;  $2\frac{1}{4}$  inches long by  $1\frac{1}{2}$  inches wide at 3 months.

*Stem*.—Round; smooth; red on appearance, becoming red-brown by close of first year except rapidly growing portion, which is green; marked with many conspicuous, small white lenticels.

*Buds*.—Reddish and smooth;  $\frac{1}{8}$  inch long. Terminal: conical, dull pointed; axillary: compressed, conical, rounded at apex.

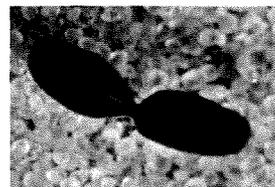


Cotyledons (left) second day after germination; first leaves (right) after 1 week. X 2

Typical trilobed leaves at 3 months. X  $\frac{1}{2}$



Seedlings at 1 month. Note typical leaf shape and upper surface appearance. X 2



Cotyledons on appearance. X 4

Sap is milky. Leaves vary in shape from ovate to mitten-like and often have three or more lobes. Veins prominent on underside.

*Cotyledons.*—Oval with rounded apex and rounded to slightly wedge-shaped base; medium green and smooth on both surfaces; single cotyledon about  $\frac{1}{4}$  inch long on appearance, makes little growth. Persist on stem for 1 month.

*Leaves.*—First leaves appear within 2 weeks after germination. Simple; first pair opposite, later ones alternate; ovate to oblong-ovate with acute, dull-pointed apexes and deeply heart-shaped to occasionally truncate bases; unlobed for first 3 months, after which mitten-shaped and three-lobed leaves may be found on some seedlings; margin coarsely serrate; medium green and smooth underneath, but rather rough above, smooth textured and with prominent veins below; 1 to  $1\frac{1}{2}$  inches long by  $\frac{3}{4}$  inch wide after 1 month. Milky sap exudes when leaf petioles are crushed or broken.

*Stem.*—Slightly zigzag; round; smooth; marked by considerable number of elliptic to oval, white to light tan lenticels; light green on appearance, later reddish-brown near base and gray on rest of stem. Breaking bark also results in exudation of milky sap.

*Buds.*—Ovoid and flattened, giving triangular appearance; sharp-pointed; chestnut brown with narrow, darker brown bands on bud scale rims, occasionally almost entirely black;  $\frac{1}{8}$  inch long. Terminal buds lacking.



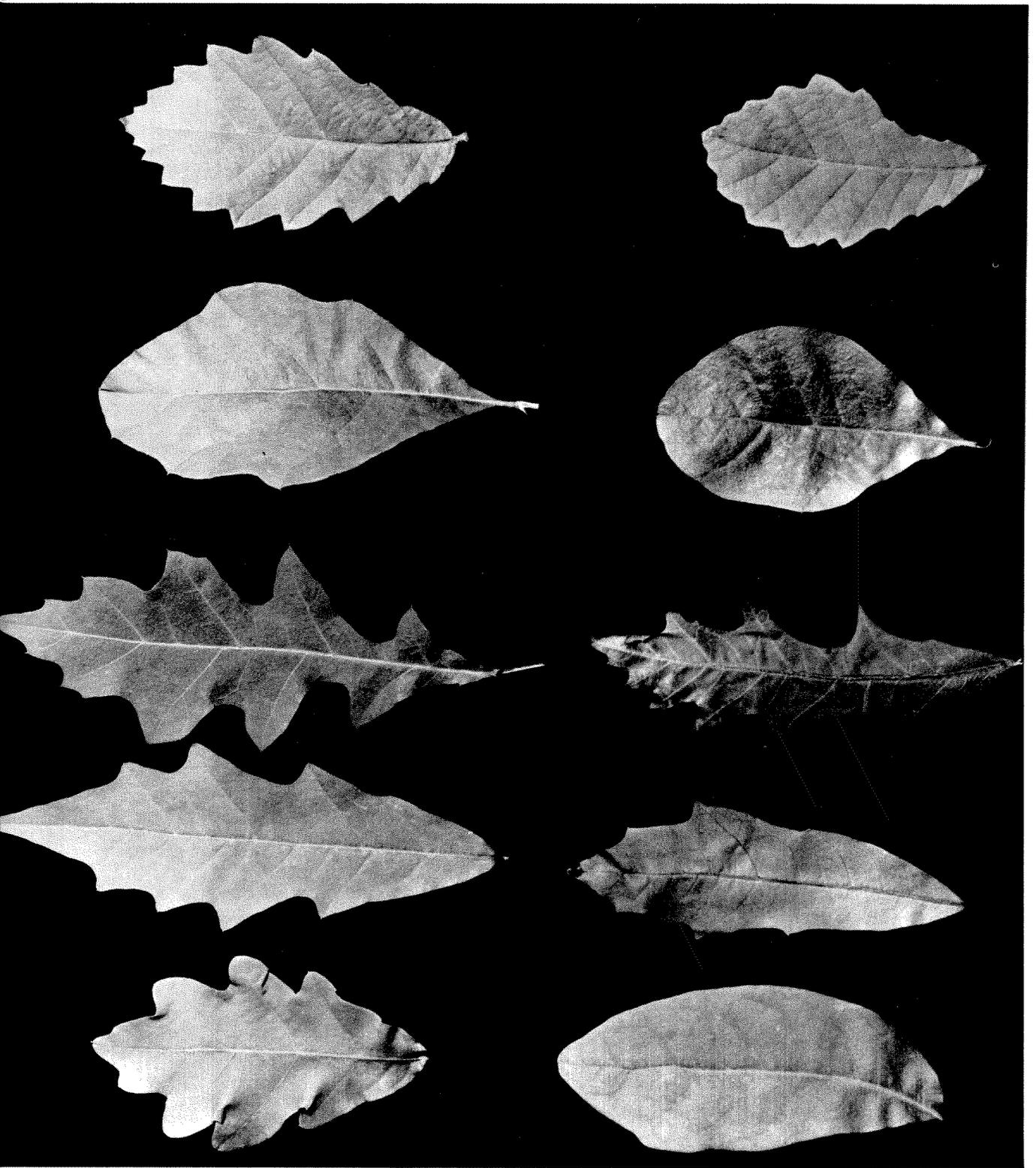
Stem and buds at 1 year. Zigzag growth due to lack of terminal bud. Rough leaf scars characteristic. X 4

Table 4.—Comparison of young red oak seedlings

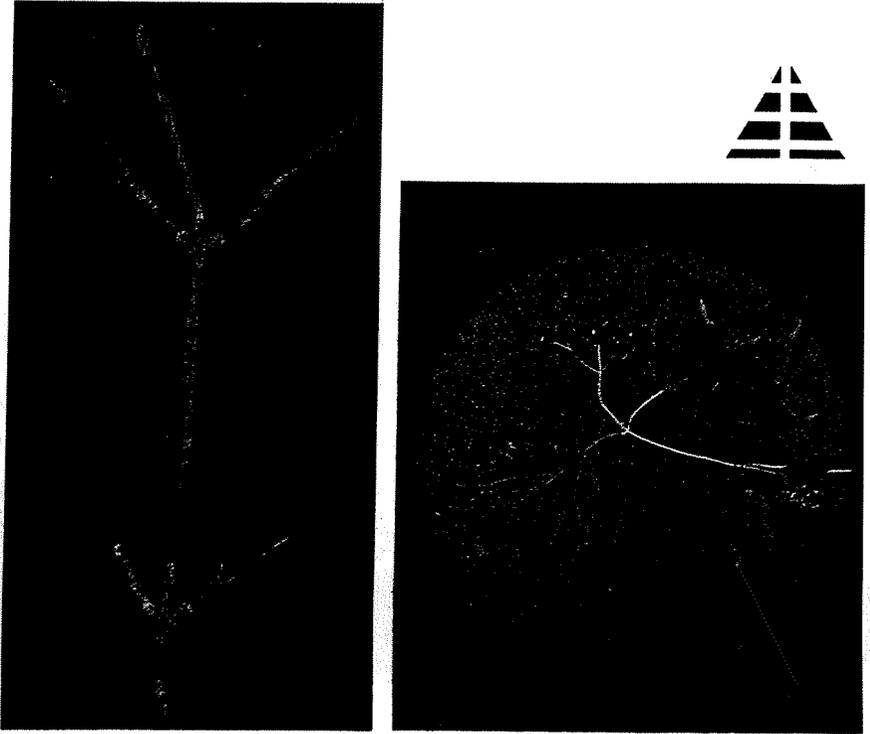
Species	Leaves		Stem pubescence	Size	Buds	
	Color	Pubescence			Pubescence	Color
Black oak	Dark green above, yellow-green below. Bright crimson when unfolding.	Scattered white hairs above, thick white hairs below. Brown hairs in vein axils.	Thick tawny hairs	½ inch long. Largest of species in this chart.	Downy with short tawny hairs	Dull tan
Cherrybark oak	Medium green above, paler below.	Fine down on lower surface	Heavy and gray	¼ inch long	Gray, moderate in amount	Red-brown
Shumard oak	Medium green, tinged with red when unfolding, later dark green	Tufts of hair in axils of veins on lower surface	None	¼ inch long	None	Grayish brown or dull straw
Southern red oak	Dark green above, pale gray-green below	Lustrous above, brown to grayish-white hairs below	Dense, rust-colored hairs at first, becoming sparser toward first winter	⅛ to ¼ inch long	Slightly downy with short pale hairs	Bright chestnut brown

Table 5.—*Comparison of young white oak seedlings*

Species	Leaves		Margin	Stem pubescence	Buds	
	Color	Pubescence			Pubescence	Color
Chinkapin oak	Medium green on upper surface, paler below	Smooth above, few gray hairs below	Coarse, large, sharp pointed serrations	Smooth to slightly coated with short white hairs	Absent	Chestnut-brown scales with white margins
Overcup oak	Dark green above, pale green or silvery below	Soft distinct hairs above and slightly downy beneath	Slightly lobed, sinuses very shallow	Slightly pubescent on appearance, becoming smooth later in year	Scales covered, especially near margin, with loose pale hairs	Light chestnut brown
Swamp chestnut oak	Bright yellow-green above, paler below	Thick coat white or rust-colored woolly hairs on under surface	Regularly scalloped with rounded lobes	Absent, except for slight coating of easily shed hairs near terminal end	Fine hairs along edges of bud scales	Light brown
White oak	When unfolding, bright red above, pale below. Later light green above, paler below.	Soft pubescence below, turning silvery white	Shallowly lobed at first, later becoming more noticeable	Covered with loose mass of brown colored hair	Smooth	Dark red-brown



Juvenile oak leaves at 8 weeks. X 1



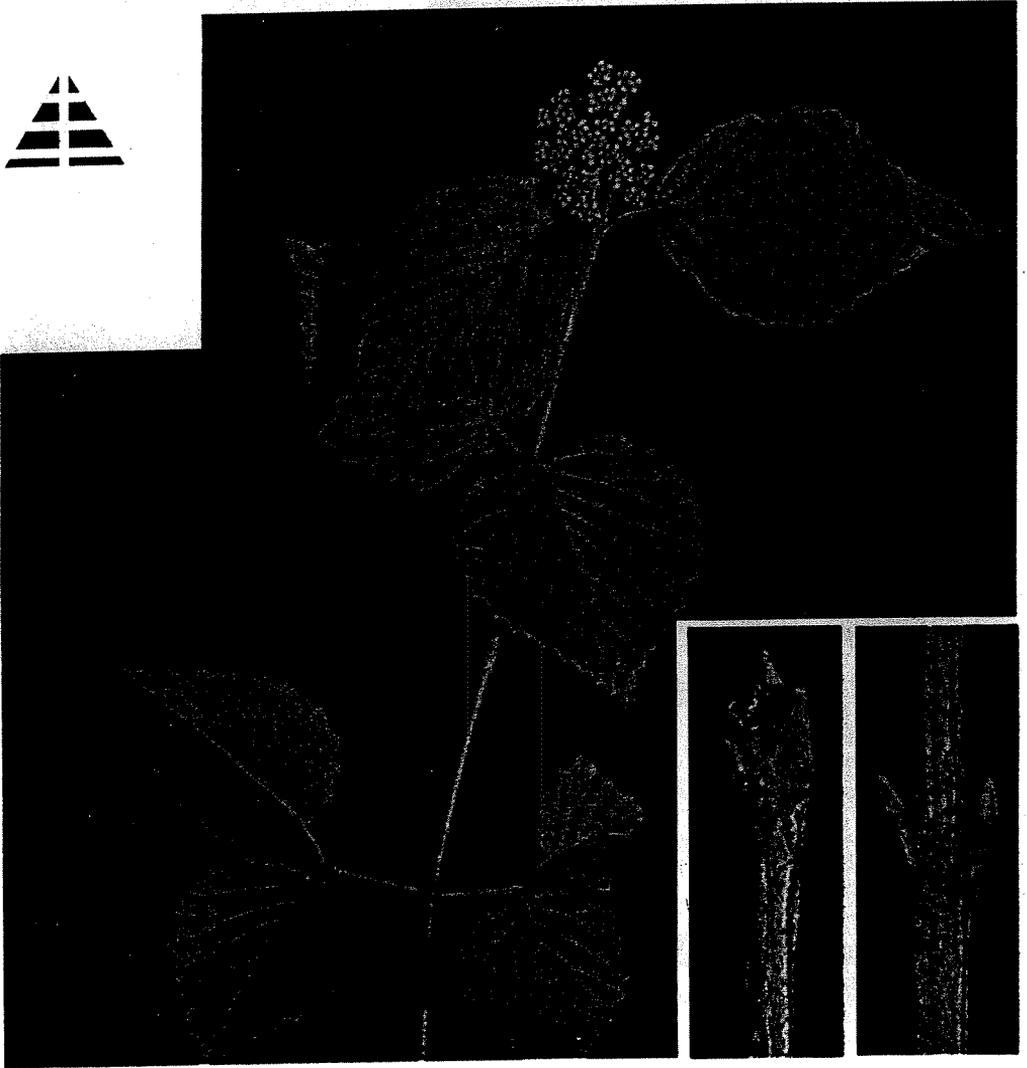
*Viburnum acerifolium* L.—MAPLELEAF VIBURNUM

Deciduous shrub with opposite leaf scars and buds. Twigs finely puberulent, becoming glabrous in 1 to 2 years. Twigs gray to brownish-gray, becoming mottled gray. Leaf scars narrow, U-shaped to crescent shaped, connecting around twig. Bundle scars three. Buds yellowish to rusty, lightly pubescent along midrib and toward tips of scales only.

Leaves simple, margin coarsely dentate and often with three lobes, venation palmately three-ribbed.

Flowers creamy white in flattened or convex cymes, May to August.

Fruit a persistent, reddish- to purplish-black flattened drupe with shallow grooves on each side, July to October.



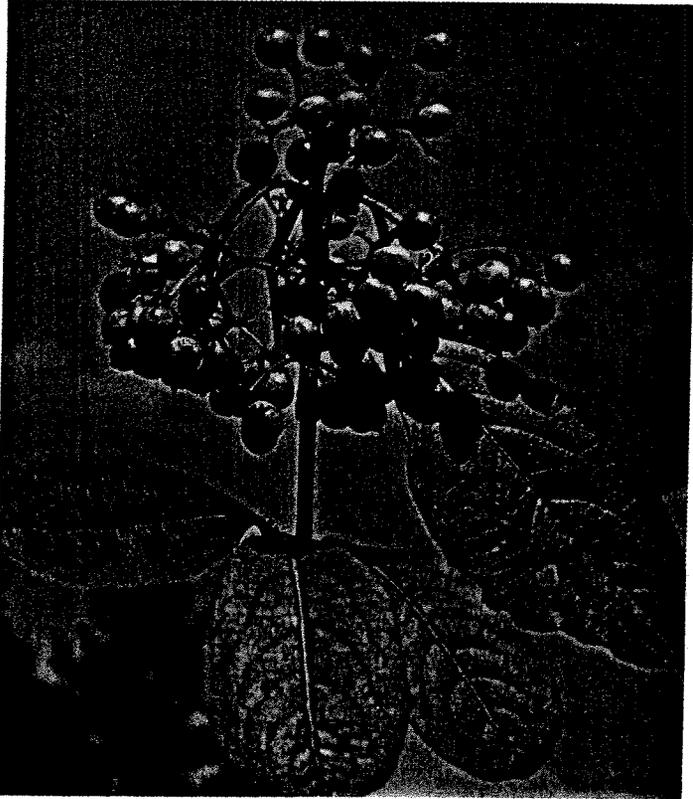
*Viburnum dentatum* L.—ARROWWOOD VIBURNUM

Deciduous shrub with opposite buds and leaf scars. Twigs reddish-tan to reddish-brown; gray on older growth; stellate-pubescent at first, becoming glabrous in 1 to 2 years. Leaf scars narrow and V-shaped, continuous around twigs. Bundle scars three. Buds small, reddish-brown and glabrous except for fringe on edges of scale tips.

Leaves simple, margin serrate to dentate, the teeth rather triangular, many single or tufted hairs at fork of branched veins on underside.

Flowers white in cymes, June to August.

Fruit a bluish-black drupe with shallow grooves on one side, August to November.



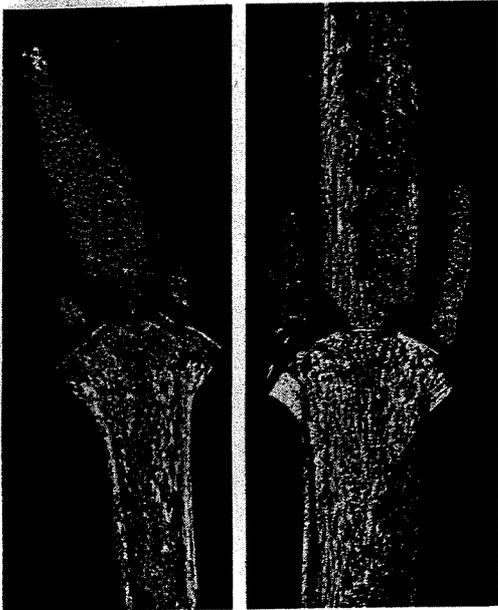
*Viburnum nudum* L.—POSSUMHAW VIBURNUM

Deciduous shrub with opposite buds and leaf scars. Twigs reddish-brown to purple-brown; glabrous or with sparse minute hairs. Older twigs gray and glabrous. Leaf scars U- to V-shaped and narrow, encircling young stems but later separated or only inconspicuously connecting. Bundle scars three. Terminal buds slender, elongate to one half-inch or more, with scales. Sides of buds nearly parallel. Roughness due to abundant rusty-brown scales and glands. Pubescence only along margins of scale or absent. Lateral buds similar in appearance but usually much smaller and somewhat more flattened. Pith white and soft.

Leaves simple, leathery, margin entire or obscurely serrulate, olive green to dark green and lustrous above, lower surface paler and with rusty-brown scales.

Flowers white in flat or round-topped cymes, April to June.

Fruit a drupe, pink at first but glaucous blue later, maturing in autumn.



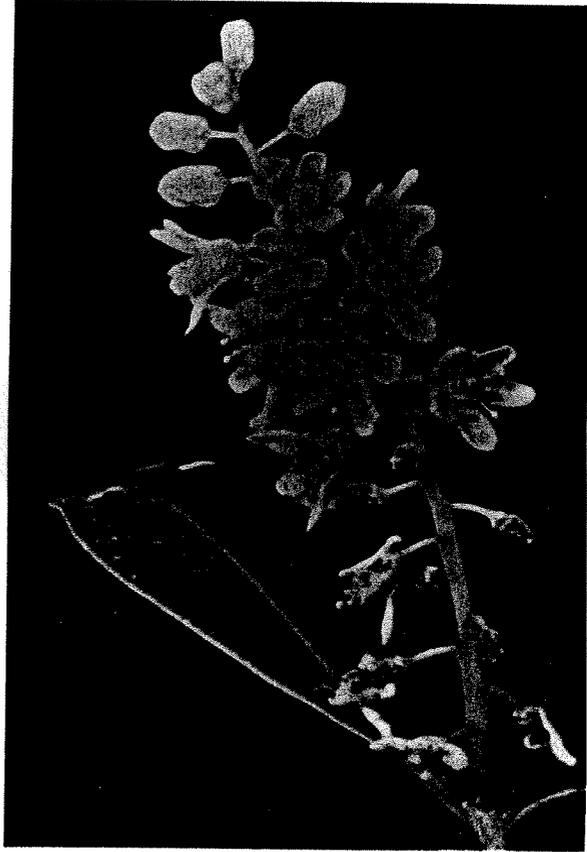
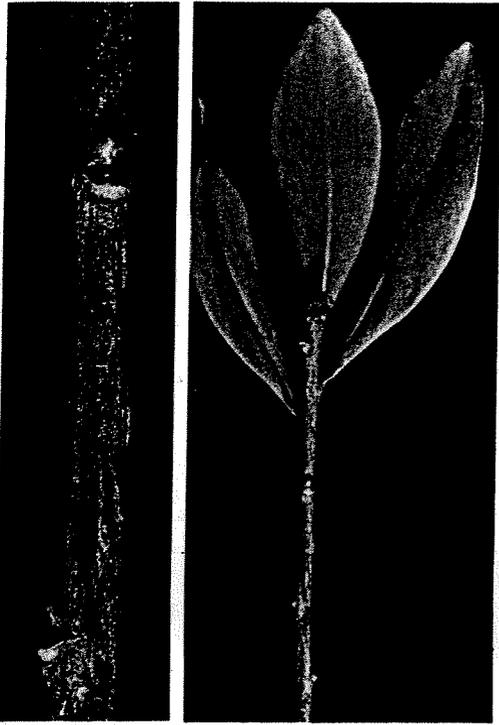
*Viburnum rufidulum* Raf.—RUSTY BLACKHAW

Deciduous shrub with opposite leaf scars. Twigs glabrous, purple-brown with bluish-gray waxy bloom. Buds naked and covered with short rust-colored pubescence. Leaf scars U-shaped to narrowly V-shaped with three dot-like bundle scars. Pith white, soft, and one-third or less of total twig diameter.

Leaves simple, dark green, leathery, shiny above, paler below; red hairs on veins, margin finely serrate.

Flowers white in flat cymes, April and May.

Fruit a bluish-black glaucous drupe in drooping clusters, July to October.



**SHRUBS OR TREES WITH  
ALTERNATE STEMS, BUDS,  
AND LEAF SCARS; LEAVES  
PERSISTENT**

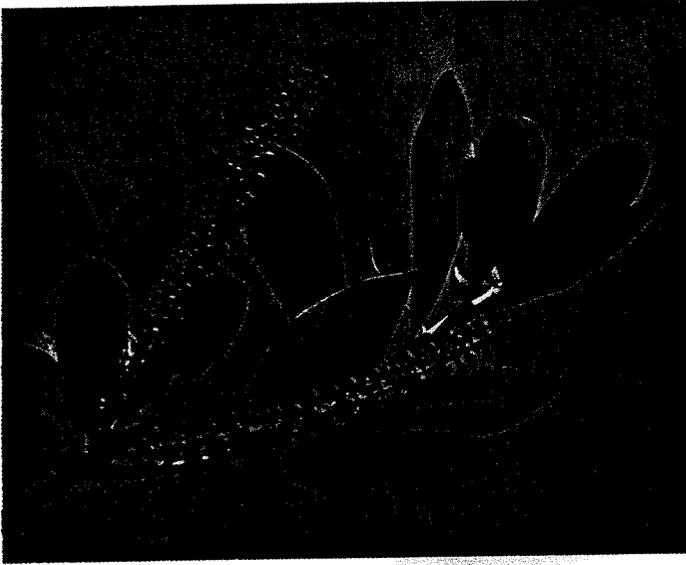
*Cliftonia monophylla* (Lam.) Britt.—BUCKWHEAT-TREE

Evergreen shrub with alternate leaves. Twigs reddish-brown to gray. Pith at least one half the diameter of stem. Leaf scars shield-shaped. Bundle scars slit-like to U-shaped. Tip of largest scale on terminal bud overtops other scales with long curved tip.

Leaves entire, tapering acutely toward base, firm, green and shiny above, paler beneath.

Flowers fragrant, small, white or pinkish in slender spikes, erect when blooming, late winter or early spring.

Fruit a reddish-brown nut-like drupe with 2 or 3 light brown seeds, August and September.



*Cyrilla racemiflora* L.—SWAMP CYRILLA

Evergreen shrub to small tree with alternate leaf scars. Leaf scars half round to triangular with one circular to U-shaped bundle scar. Twigs glabrous, gray to brown with pith one-half or more of total stem diameter. Typically found in wet or swampy sites.

Leaves entire, glabrous, acutely tapered at bases and often clustered toward twig tips.

Flowers white in slender racemes opening in spring.

Fruit a dry, light yellowish-brown capsule, seeds minute, maturing in late summer.



*Ilex coriacea* (Pursh) Chapm.—LARGE GALLBERRY

Evergreen shrub to small tree with alternate leaves. Pith one-third or less of total twig diameter. Stems puberulent, becoming glabrous, gray to greenish in color. Leaf scars half round to triangular, with one bundle scar.

Leaves glabrous above, puberulent to somewhat glaucous beneath. Tiny sharp spines sparingly borne on leaf margins from about midpoint to tips.

Flowers small and white, April and May.

Fruit a shiny black drupe, smooth, soft and pulpy, ripening in fall.



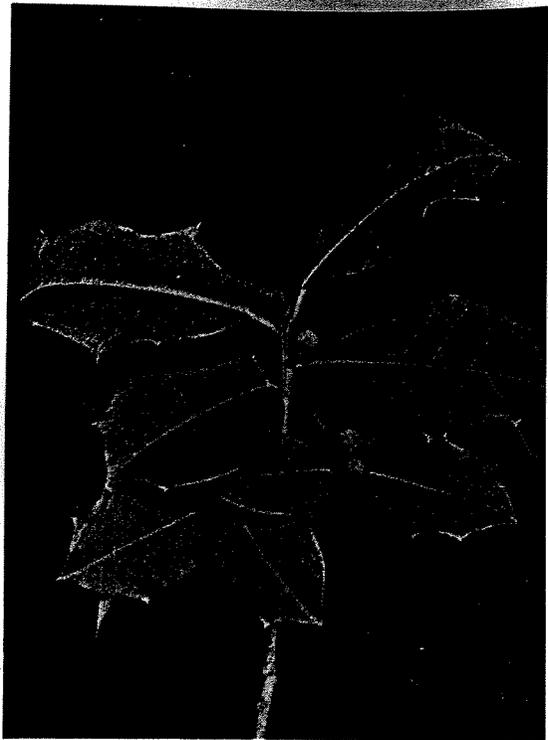
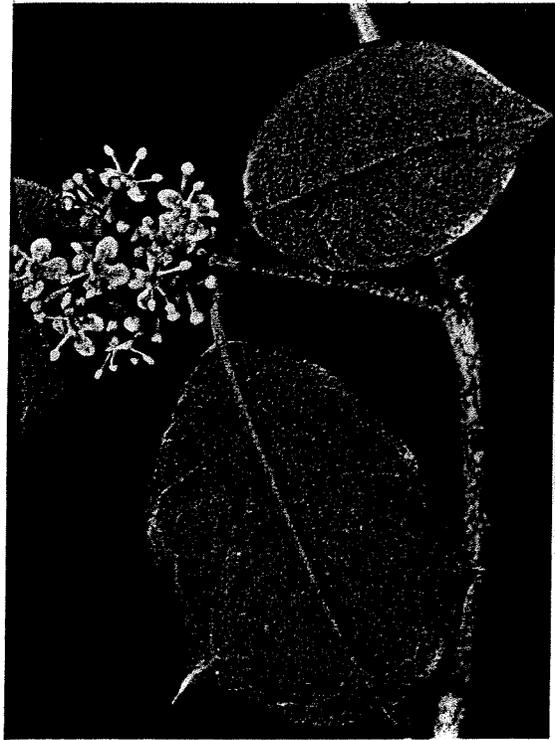
*Ilex glabra* (L.) Gray—INKBERRY

Evergreen shrub with alternate leaves. Twigs mottled green and light brown, very finely puberulent becoming glabrous. Pith one-third or less of total stem diameter. Leaf scars half round to flat oval and protruding. One bundle scar.

Leaves glabrous, green on top and bottom, somewhat lighter underneath. Margins entire or more commonly with few, small, blunt low teeth towards tips.

Pistillate flowers mostly solitary, staminate flowers in small pediceled clusters, petals white, February to July.

Fruit a black globose drupe, persistent, solitary or 2 to 3 together, matures in late autumn.



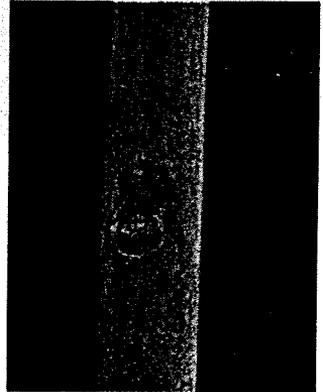
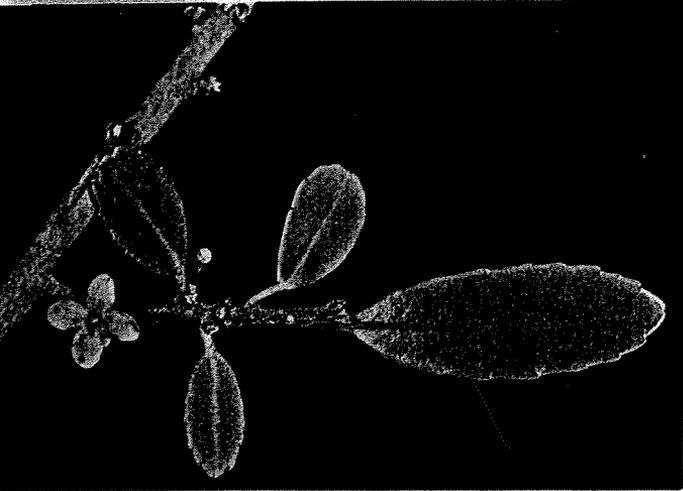
*Ilex opaca* Ait.—AMERICAN HOLLY

Evergreen tree. Stems stout, green to light brown or gray, glabrous or densely puberulent. Buds nearly globose, single bundle scar.

Leaves alternate, dark green above, paler beneath, ovate to oblong, stiff and coriaceous; margins wavy with sharp, stiff spines, sometimes spineless.

Staminate flowers small and white, 3 to 10 in cymes; pistillate flowers solitary or 2 to 3 together, April to June.

Fruit a globose or ellipsoid drupe, red, rarely yellow or orange; nutlets prominently ribbed, November and December.



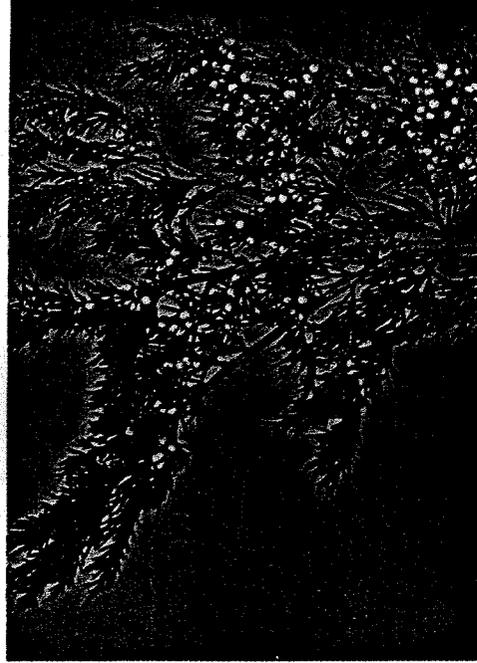
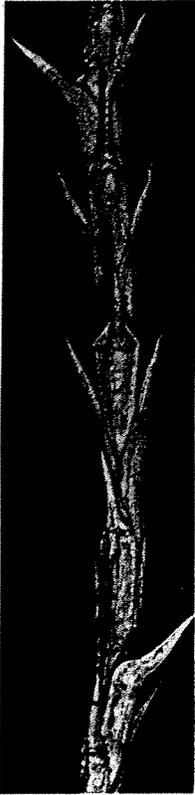
*Ilex vomitoria* Ait.—YAUPON

Evergreen shrub with alternate leaves. Twigs stout, reddish-gray to gray, lightly puberulent becoming glabrous. Plants form dense shrubs under excessive utilization. Pith one-third or less of total twig diameter.

Leaves glabrous, shiny dark green above, light green below. Leaf bases rounded to a reddish petiole. Leaf scar small, half round to circular with one bundle scar.

Flowers small and white in warty sessile clusters on branches of previous year, April and May.

Fruit a bright red drupe maturing in October and persisting into winter.



*Juniperus virginiana* L.—EASTERN REDCEDAR

Evergreen tree with alternate branching. Young stems covered with scales, older stems with flaky and shreddy fibrous bark. Sap clear but sticky. Heartwood of larger stems purple. Characteristic cedar odor to stems when broken.

Leaves tiny, scale-like, overlapping, flat appressed and sharp-pointed.

Flowers small and cone-like, at end of short twigs.

Fruit a fleshy, sweet, pale blue berry-like cone with 1 or 2 seeds, September to December.



*Magnolia virginiana* L.—SWEETBAY

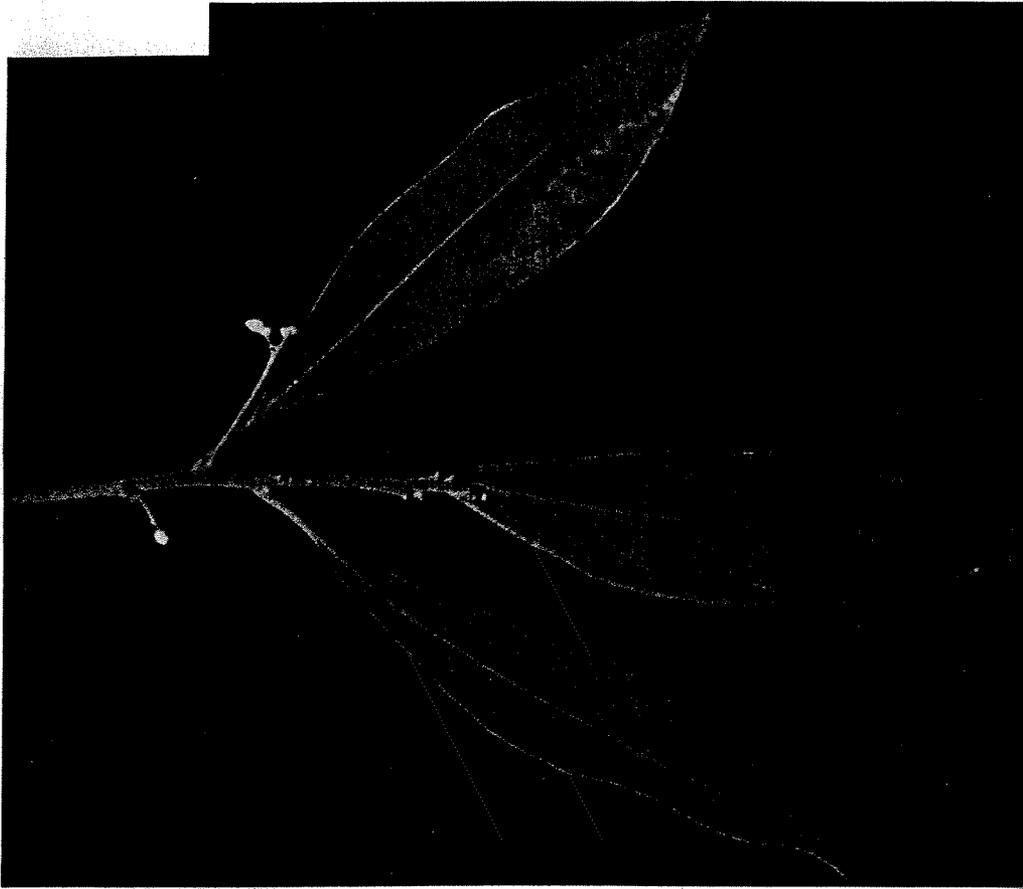
Tardily deciduous tree with alternate leaf scars and buds. Twigs mottled light and dark green to tan, becoming tan with age; softly pubescent on young stems. Terminal buds large, naked, light green with soft silvery pubescence. Leaf scars half round. Bundle scars 10 or more; arranged laterally on the face of the scar as a line or open ellipse paralleling the edges of the leaf scar. Lenticel scars completely encircling twigs. Pith homogeneous but diaphragmed.

Leaves simple, leathery, pungently aromatic; upper surface dark green, lower chalky white and often silky.

Flowers white and fragrant, May to July.

Fruits a cone-like aggregate of small follicles, yellow or reddish when ripe.





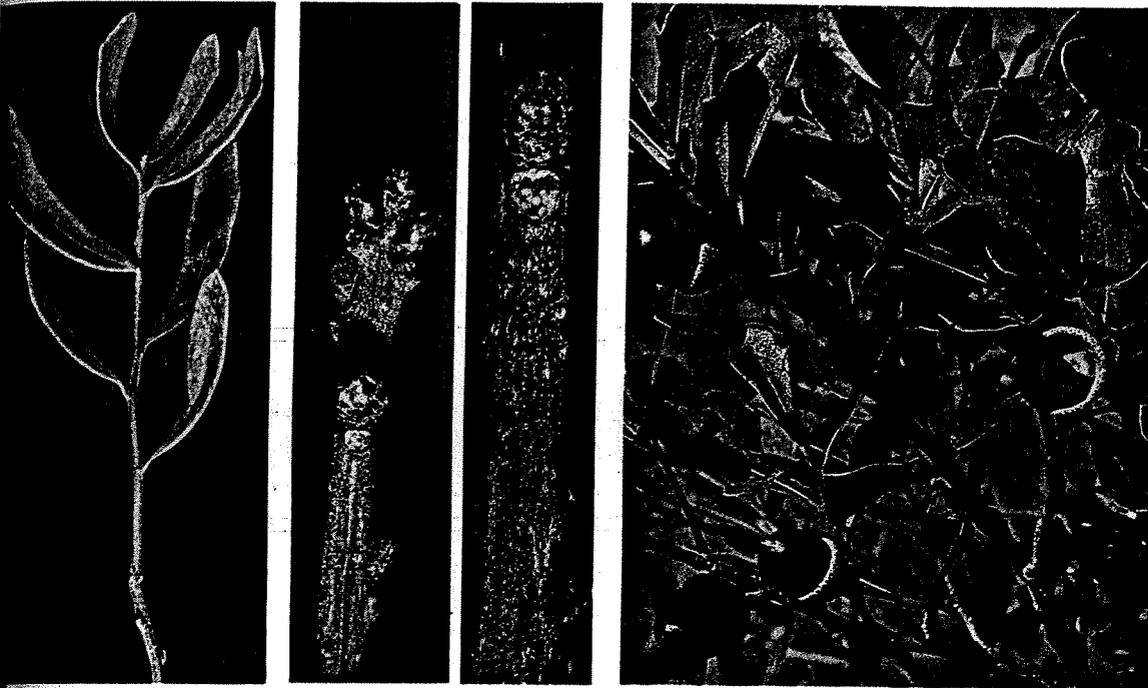
*Persea borbonia* (L.) Spreng.—REDBAY

Evergreen tree with alternate leaves and buds. Twigs dark green with gray woolly pubescence. Older twigs lighter brown, becoming glabrous. Buds small, generally globose with two outer scales gray woolly. Leaf scars terete. One bundle scar, dot-like. Pith near one-half of total twig diameter, firm but softer than surrounding wood, angular in cross section.

Leaves simple, bright green and elliptic to lanceolate, tapering to points at both ends, margins entire.

Flowers small, pale yellow, borne in axillary panicles, May to July.

Fruit an egg-shaped drupe, dark blue or deep purple, seed solitary.



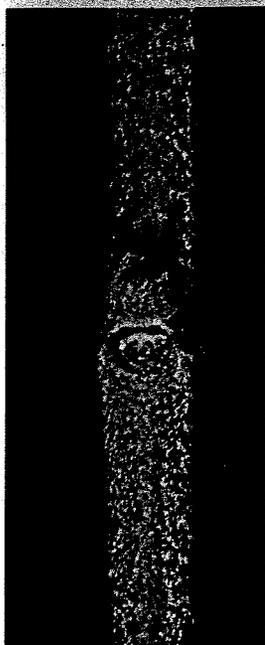
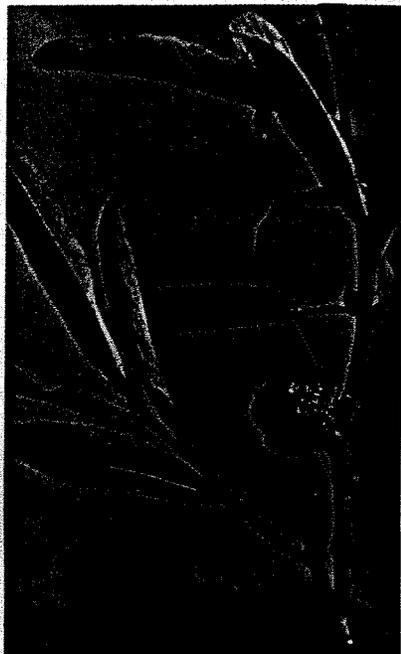
*Quercus minima* (Sarg.) Small—DWARF LIVE OAK

Evergreen shrub with alternate leaves. Twigs reddish to grayish-brown. Pith star-shaped in cross section, terminal buds obtuse or rounded, clustered. Leaf scars triangular to circular with three bundle scars. No subtending bracts encircling buds.

Leaves simple, rounded or short-pointed at apex, often toothed, glabrous above, puberulent beneath.

Flowers staminate and pistillate, borne in separate catkins on same tree.

Acorns often long-stalked, solitary or several on a peduncle; cup hemispheric, nut avoid or ellipsoid, inner surface of shells hairless, July to November.



*Quercus pumila* Walt.—RUNNING OAK

Evergreen shrub with alternate leaves. Twigs reddish-brown to brown with star-shaped pith. Leaf scars triangular to half round with three bundle scars. Buds pointed, with long subtending bracts, especially towards twig tips.

Leaves simple, ending in a bristle-tip, usually entire and not toothed, glabrous above and beneath.

Acorns sessile or nearly so, cup saucer-shaped, inner surface of the shells densely hairy, July to November.



*Vaccinium myrsinites* Lam.—GROUND BLUEBERRY

Evergreen shrub with alternate leaves. Stems green even on 2- and 3-year-old portions. Leaf scars small, half round to circular. One bundle scar, inconspicuous.

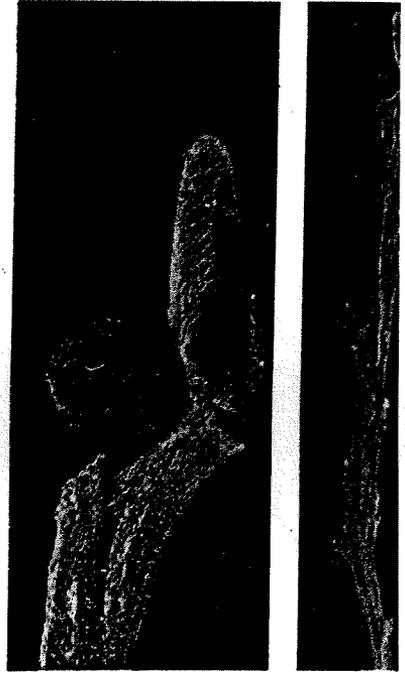
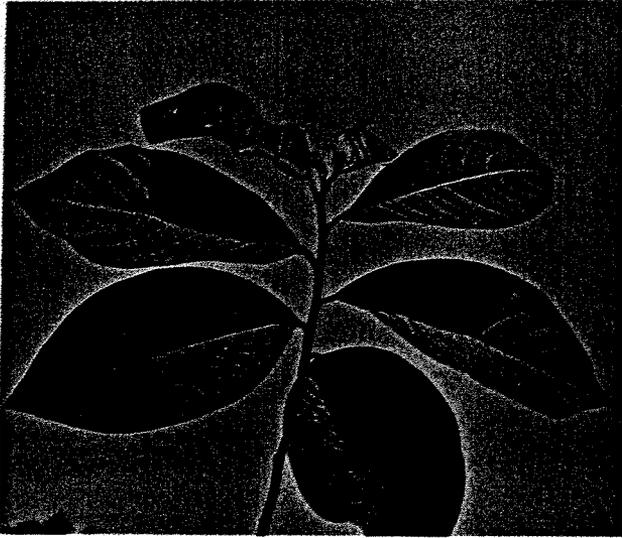
Leaves simple, tapering toward base, less than 1 inch long with serrulate margins, glabrous, green above, paler below with scattered, brown, gland-tipped, short hairs.

Flowers white to deep pink in umbel-like clusters.

Fruit a many-seeded black berry, May.



**SHRUBS OR TREES WITH ALTERNATE STEMS, BUDS,  
AND LEAF SCARS; LEAVES DECIDUOUS**



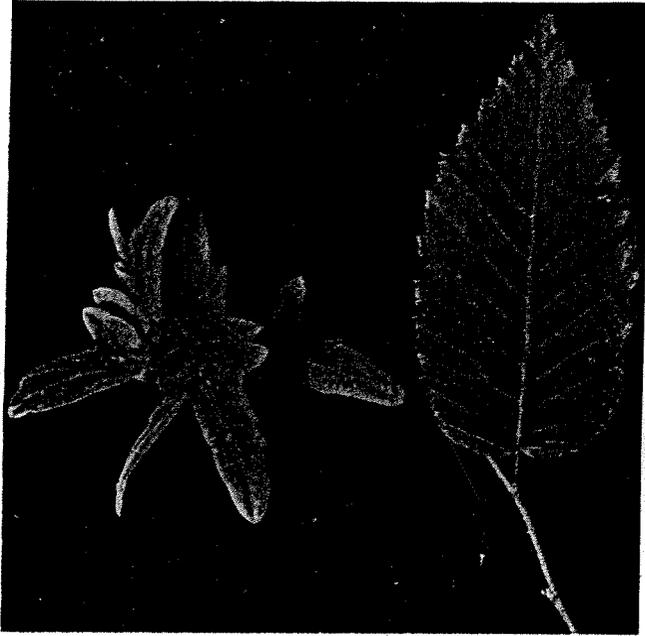
*Asimina triloba* (L.) Dunal—PAWPAW

Deciduous shrub to small tree, with alternate leaf scars and buds. Twigs dark gray to olive brown; pubescent at first, becoming glabrous with age. Leaf scars slightly raised on lower lip; U-shaped to V-shaped. Bundle scars five and dot-like. Terminal buds elongate and densely covered with dark-brown hairs. Lateral buds globose, covered with dark-brown hairs. Pith continuous but diaphragmed.

Leaves simple, rusty-pubescent when young, glabrous later.

Flowers purplish-green, solitary on rusty-hairy stems, appearing with or before the leaves.

Fruit banana-like with several seeds, maturing in autumn.



*Carpinus caroliniana* Walt.—AMERICAN HORNBEAM

Small deciduous tree. Glabrous reddish-brown twigs with alternate buds and leaf scars. True terminal buds absent. Bundle scars three. Trunk of larger specimens fluted. Bark smooth, gray, and tight.

Leaves simple, margin sharply double-serrate.

Staminate flowers green, borne in linear-cylindric catkins; pistillate catkins with arrowhead-like bracts that develop into a three-lobed involucre, April to June.

Fruit a nutlet, August to October.



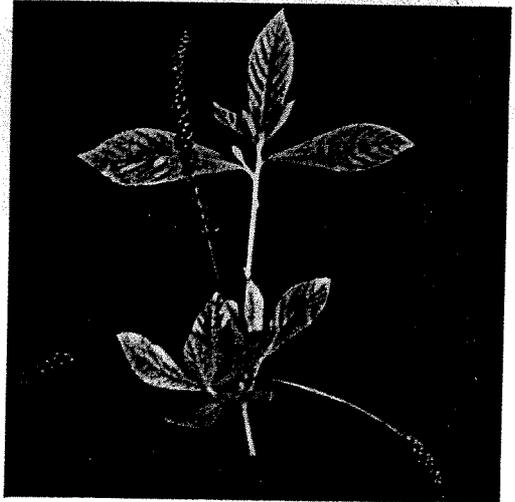
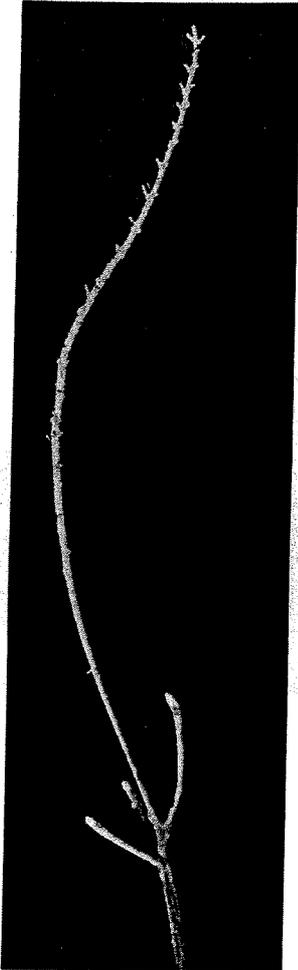
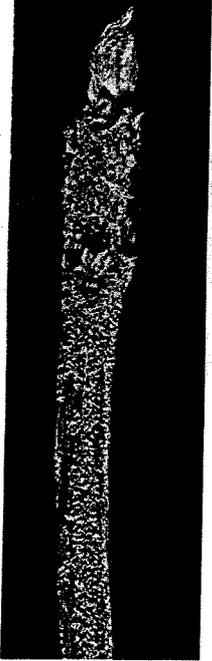
*Castanea pumila* Mill.—ALLEGHENY CHINKAPIN

Deciduous thicket-forming shrub to tree with alternate leaf scars. Bundle scars several. Twigs pubescent at first, later glabrous. Pith angled or star-shaped in cross section. True terminal bud absent.

Leaves simple, margins coarsely serrate with pointed teeth.

Flowers appearing after the leaves, staminate catkins cylindrical, slender, tomentose; pistillate flowers in threes or scattered toward base of catkins; involucre prickly.

Fruit a one-seeded nut enclosed in burs that form spike-like clusters.



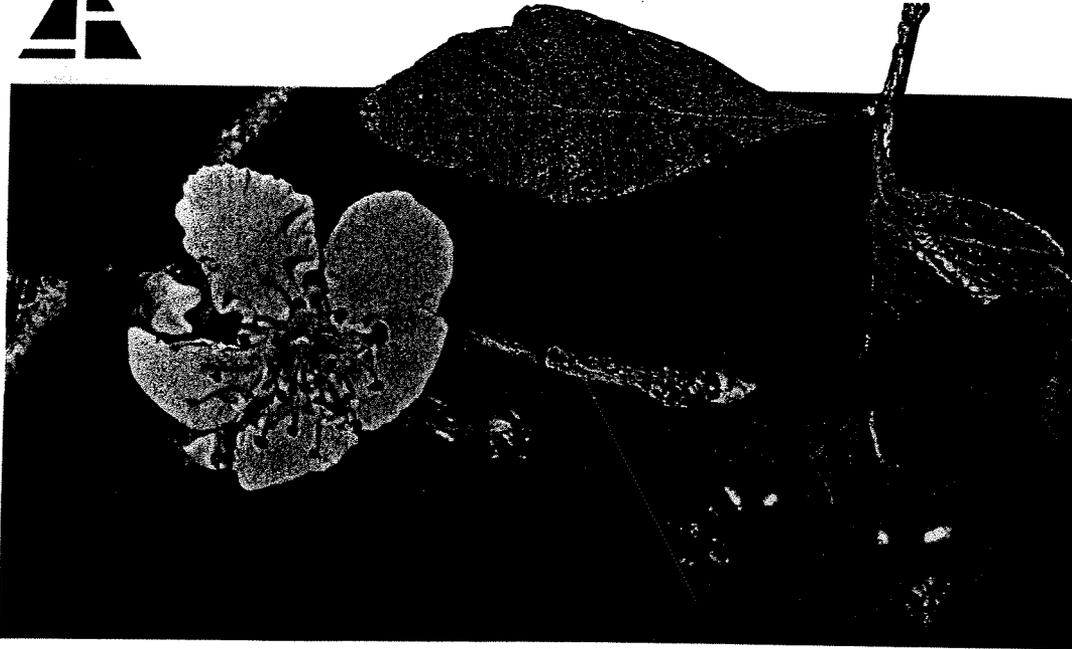
*Clethra alnifolia* L.—SUMMERSWEET CLETHRA

Deciduous shrub with alternate buds and leaf scars. Stems ascending. Twigs pubescent, becoming glabrous. Gray to reddish-gray. Single bundle scar. Light tan to silvery gray terminal buds with villous valvate scales. Remnants of previous season's fruit stalks persist until spring. Pith soft, pale green, and continuous.

Leaves simple, margins conspicuously serrate.

Flowers white, fragrant, borne in erect racemes, June to September.

Fruit a round three-sectioned capsule, erect, persistent.



*Crataegus opaca* Hook. & Arn.—RIVERFLAT HAWTHORN

Deciduous shrub or small tree, with alternate leaf scars and buds. Twigs brown to reddish-brown, becoming gray with some mottling. Scattered white pubescence on young twigs, becoming glabrous. Spines up to 1.5 inches long on most twigs; dark-brown to reddish-brown, becoming brittle and mottled gray with age. On older growth the flower buds commonly occur on short, stout spurs. Buds small, round and glabrous, reddish. Leaf scars slender and flat to slightly U-shaped. Bundle scars three. Pith hard.

Leaves simple, dark green and usually glabrous above, densely rusty-brown pubescent below.

Flowers white, borne before leaves in February or March.

Fruit a pome with 3 to 5 nutlets, April and May.



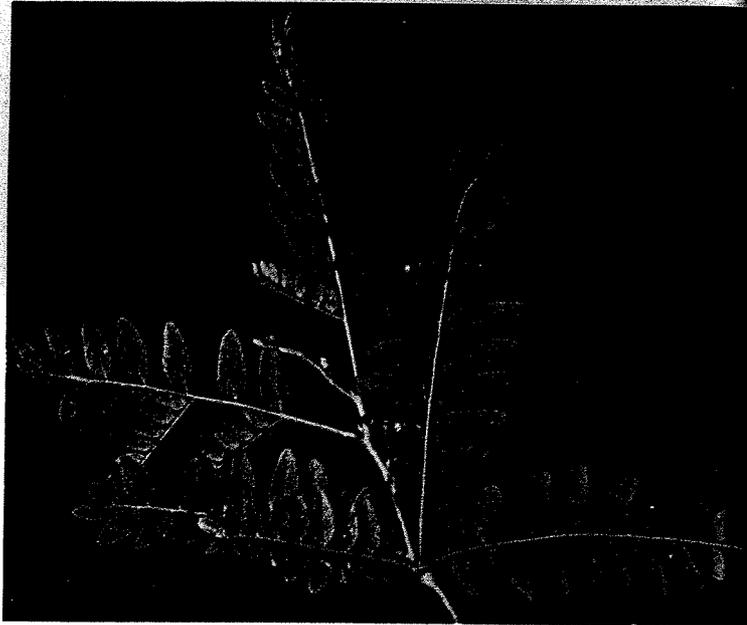
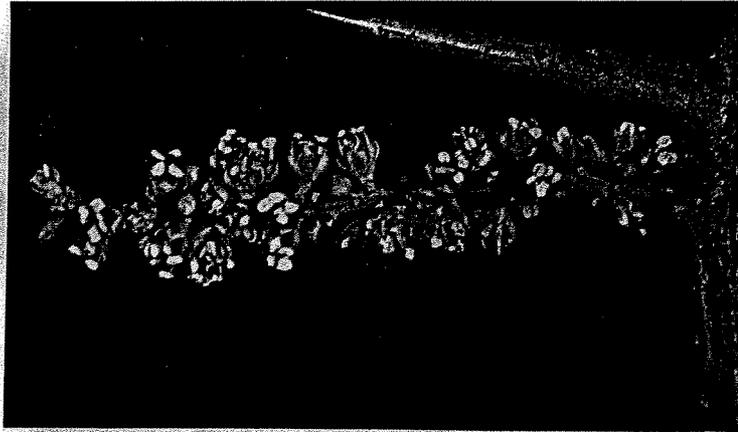
*Fagus grandifolia* Ehrh.—AMERICAN BEECH

Deciduous tree with alternate leaf scars and buds. Leaf scars small, flat oval to half round with one dot-like bundle scar. Buds elongate up to 1 inch; at least six times longer than wide. Bud scales reddish-tan with light gray to tan tips. Terminal buds present. Twigs reddish-brown on new growth, becoming light-gray mottled with darker gray. Light tan lenticels frequent on new growth. Pith hard. Stem cross section with radial rays.

Leaves simple, coarsely serrate on margin; when mature glabrous and dark green above, paler and pubescent beneath.

Flowers form after leaves unfold in April and May, staminate in globose heads pendant on hairy peduncles, pistillate in clusters of 2 to 4 borne on short hairy peduncles.

Fruit a pair of small brown three-angled sweet nuts in a bur-like involucre, full grown in midsummer but becoming brown and persistent on branches. September to November.



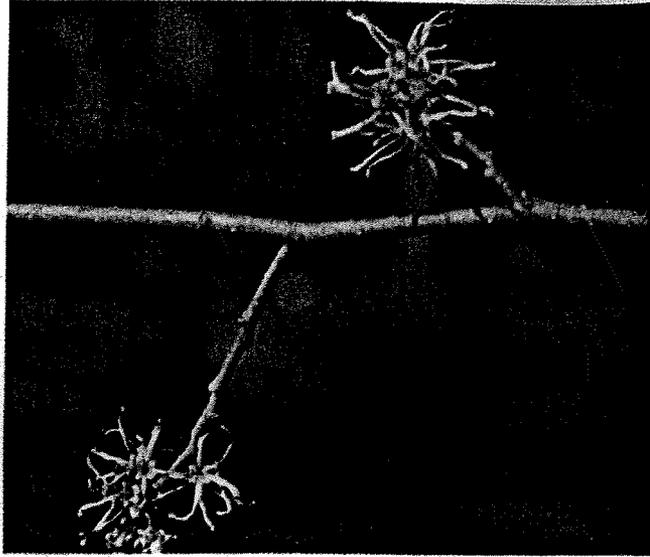
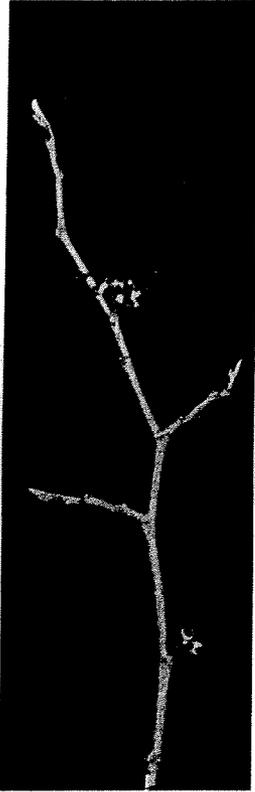
*Gleditsia triacanthos* L.—HONEYLOCUST

Deciduous tree with alternate buds and leaf scars. Twigs glabrous, grayish-brown to reddish-brown. Older twigs greenish-gray to dark gray with silver-gray longitudinal striations. Stout, sharp, thorns present at most nodes and positioned above leaf scars and buds. Thorns straight or branched, purple-red to purple-black. Terminal buds absent. Lateral buds scaly, small, and oval. U-shaped leaf scars appearing three-lobed with one bundle scar in each lobe. Pith homogeneous, light-colored, and softer than surrounding wood.

Leaves once- or twice-pinnate.

Flowers borne in axillary, dense, green racemes. Staminate flowers often clustered. Pistillate flowers few, usually solitary, May and June.

Fruit a legume borne on short peduncles, usually in twos or threes.



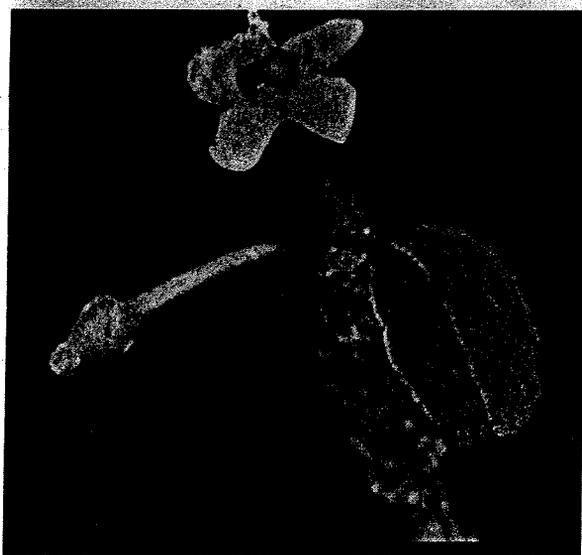
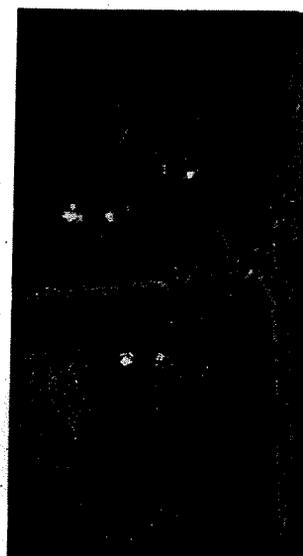
*Hamamelis virginiana* L.—WITCH-HAZEL

Deciduous shrub to small tree with alternate leaf scars. Twigs pubescent, becoming glabrous. Buds without scales. Lateral buds superposed. Terminal bud on short stalk and asymmetric. Leaf scars half round to triangular with three bundle scars. Pith firm, small, and darker than surrounding wood.

Leaves simple, wavy-toothed, usually glabrous above, somewhat pubescent beneath.

Flowers bright yellow in axillary or terminal clusters, usually surrounded by a scale-like three-part involucre, September to November.

Fruit a woody capsule with two bony, shiny, black seeds; matures a year after flowering.

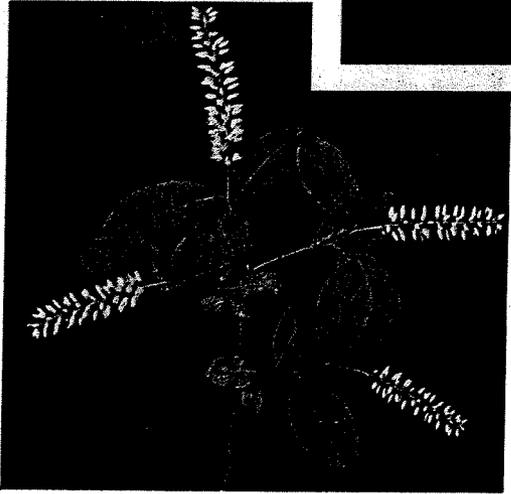
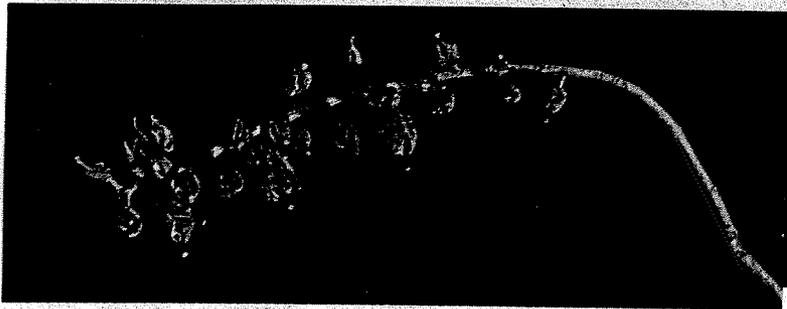
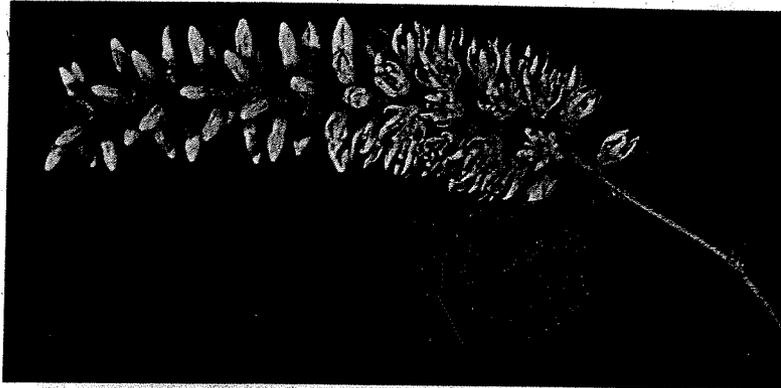


*Ilex decidua* Walt.—POSSUMHAW

Deciduous shrub to small tree with alternate buds and leaf scars. Twigs greenish-gray and puberulent, becoming mottled gray and glabrous with age, often with spur-like lateral twigs. Buds small with two scales. Leaf scars small, half-circular or occasionally narrow slits. One bundle scar. Pith homogeneous, white, and much softer than surrounding wood. Shiny red to red-orange spherical fruit 0.25 inch diameter commonly persistent long after leaves have fallen.

Leaves in crowded groups at end of short branchlets, thick and firm. Flowers small, whitish, March to May.

Fruit a globose drupe, orange to scarlet, ripens in fall.



*Itea virginica* L.—VIRGINIA SWEETSPIRE

Deciduous shrub with alternate leaf scars. Twigs pubescent, becoming glabrous, reddish-brown. Pith interrupted at regular intervals by air spaces. Leaf scars triangular to crescent shaped, with three bundle scars. Terminal racemes persist through winter.

Leaves with finely serrated margin except near base, turn reddish-brown before falling.

Flowers white in conspicuous racemes that persist through winter, April to June.

Fruit a two-grooved capsule, July to September.



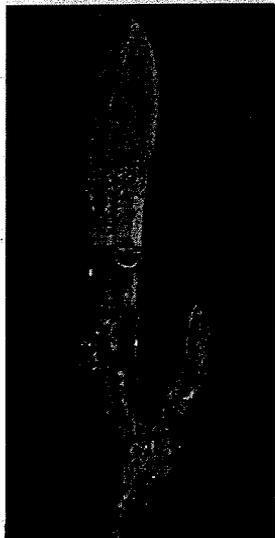
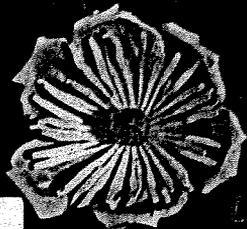
*Liquidambar styraciflua* L.—SWEETGUM

Deciduous tree with alternate buds and leaf scars. Twigs gray to tan, glabrous; occasionally with corky wings. Twigs and buds strongly aromatic if crushed when fresh. Buds shiny and glabrous except for short marginal pubescence on scales. Bud scales greenish-yellow with purple-brown on keel and margins. Leaf scars half circular. Bundle scars three. Pith homogeneous, white, and much softer than surrounding wood.

Leaves simple with 3 to 7 acuminate lobes.

Flowers very small, greenish; staminate flowers in terminal, erect, tomentose racemes; pistillate flowers in axillary, globose, long-peduncled, drooping heads, March to May.

Fruit an aggregate of many two-celled ovaries tipped by two-beaked or horn-like styles, September to November.



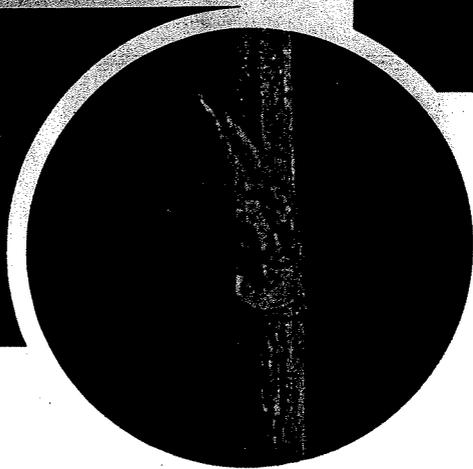
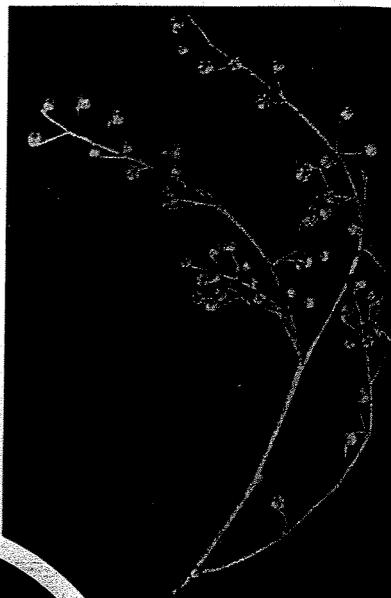
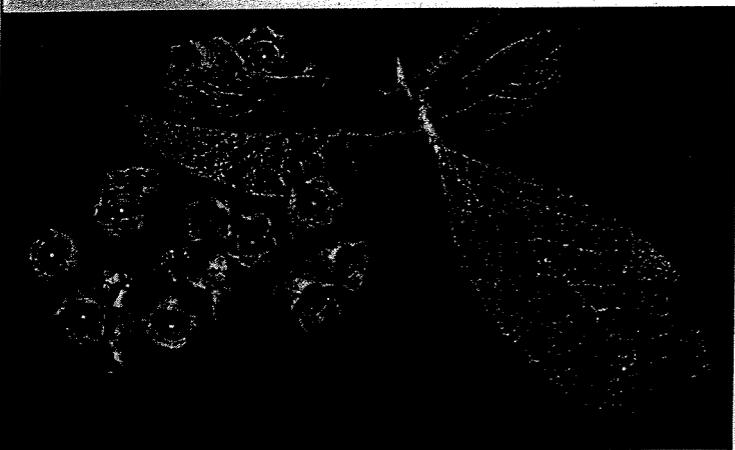
*Liriodendron tulipifera* L.  
YELLOW-POPLAR

Deciduous tree with alternate buds and leaf scars. Twigs glabrous, grayish-tan to reddish-tan; glaucous toward tips. Buds two-scaled and distinctly short-stalked, grayish-green to yellowish and glaucous. Leaf scars circular. Six or more bundle scars roughly arranged in a circle. Lenticel scars completely encircling twigs at each node. Pith soft, white, homogeneous but diaphragmed.

Leaves simple, truncate, four-lobed.

Flowers conspicuous, greenish-yellow, orange-banded at base, tulip-like, April and May.

Fruit a samara-bearing cone, September to November.



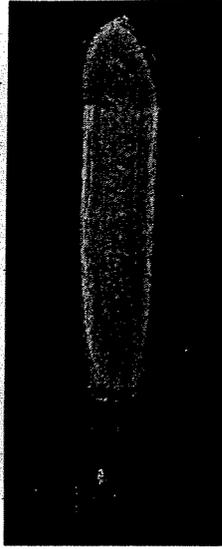
*Lyonia ligustrina* (L.) D C.—HE-HUCKLEBERRY

Deciduous shrub with alternate leaf scars and buds. Commonly 6 to 12 feet high. Leaf scars somewhat raised; half circular with one dot-like bundle scar. Buds light to dark red; acute tip. True terminal buds absent. New growth puberulent, later becoming glabrous. Stems light yellow-green to dark brown or gray; commonly with small black spots.

Leaves simple, margin entire or obscurely serrulate.

Flowers white in elongate panicles with umbel-like clusters of 2 to 6 flowers, May to July.

Fruit a dry capsule. Panicles remain on plant through winter.



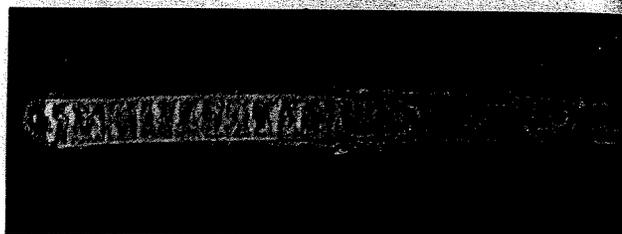
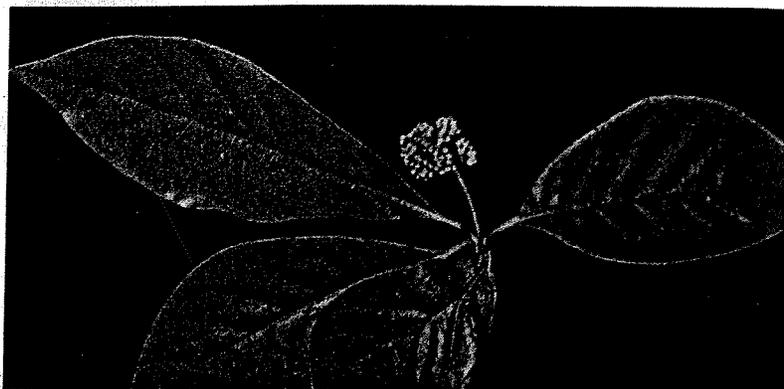
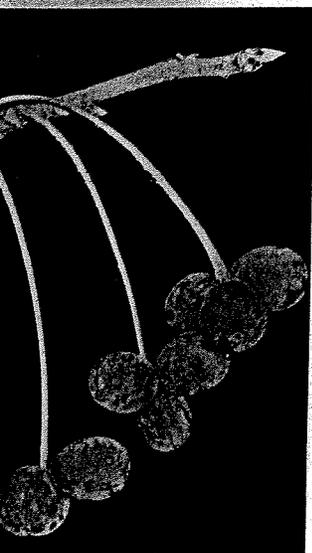
*Morus rubra* L.—RED MULBERRY

Deciduous tree with alternate leaf scars. Twigs glabrous, yellowish-tan to bluish-gray. Pith soft, continuous, and white. Inner bark of fresh twigs turns orange when outer bark is scraped away. Sap milky and sticky. Bud scales orange-tan with dark edges. Leaf scars half round to flat oval or circular. Bundle scars many in one central cluster.

Leaves simple, doubly serrate, some with numerous lobes, rough and glabrous above, soft pubescent beneath.

Flowers appear with leaves in spring, staminate spikes cylindrical, pistillate spikes cylindrical and sessile.

Fruit resembles a blackberry, red at first and then purplish-black, juicy; May to August.



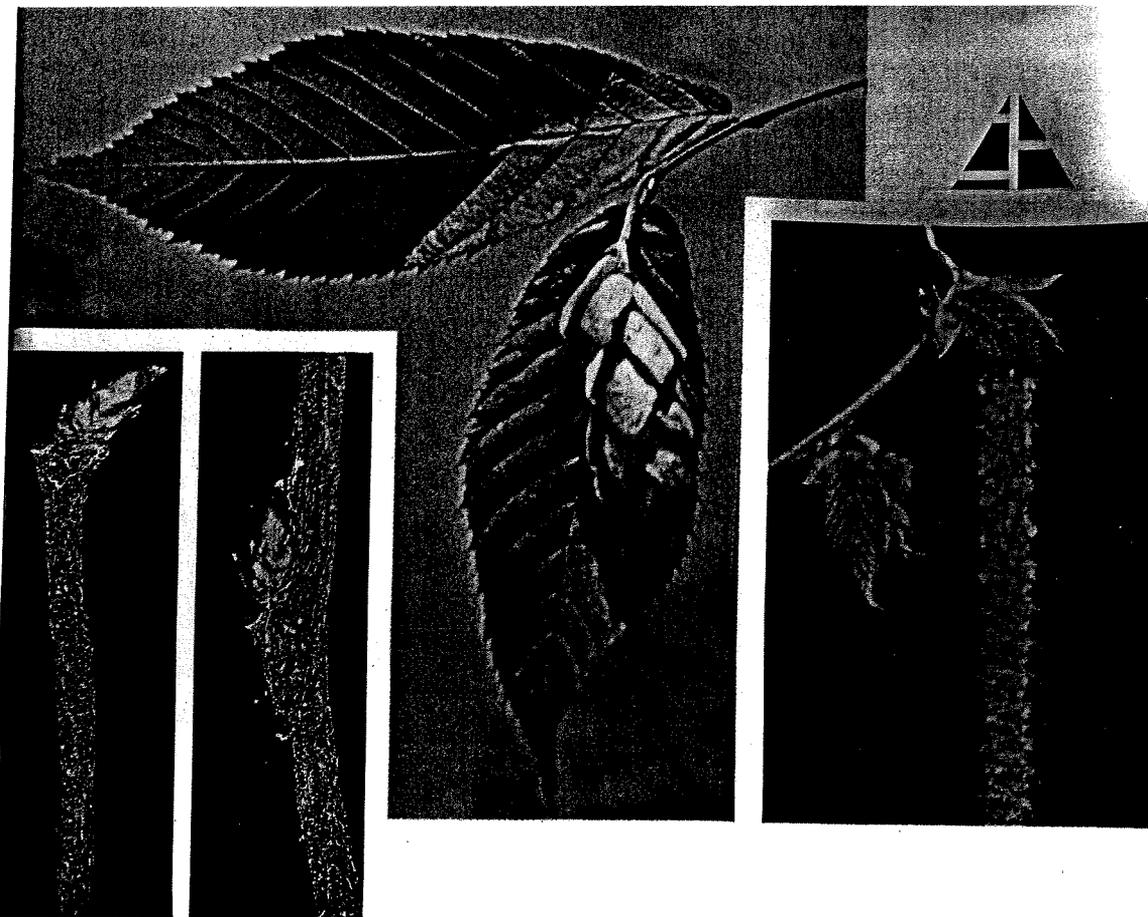
*Nyssa sylvatica* Marsh.—BLACKGUM

Deciduous tree with alternate branching and leaf scar arrangement. Twigs slightly appressed-pubescent, becoming glabrous, light tannish-gray. Pith continuous but with diaphragms. Leaf scars half round, somewhat protruding particularly towards twig tips. Bundle scars three. Visible terminal bud scales three, two large and one small.

Leaves simple, lustrous green above, paler and hairy below.

Flowers axillary; staminate flowers in long-peduncled capitate clusters, pistillate flowers in slender-peduncled clusters of two or more, April to June.

Fruit an egg-shaped drupe, acid, dark-blue to black, September and October.



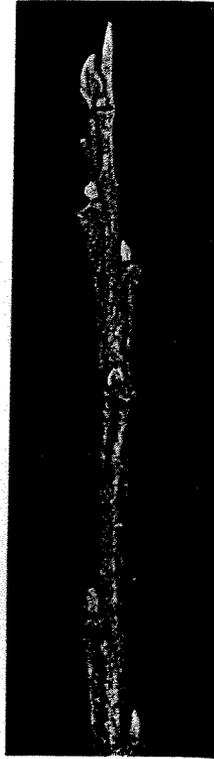
*Ostrya virginiana* (Mill.) K. Koch  
EASTERN HOPHORNBEAM

Deciduous tree with alternate leaf scars. Twigs reddish to brown with white lenticels. Bud scales with fine longitudinal striations, yellow-green with purple-brown edges. Leaf scars half round to crescent shaped, with three bundle scars. Trunk bark on larger specimens broken into small elongate brownish-gray scales.

Leaves simple, margin sharply and doubly serrate, glabrous and yellowish-green above, hairy and paler below, turning yellow in autumn.

Staminate catkins 1 to 3 at end of branches, pistillate catkins small, usually solitary, slender; catkins open with leaves in spring.

Fruit a flattened-ovoid nutlet in cone-like imbricate clusters, nuts enclosed in the sac, September and October.



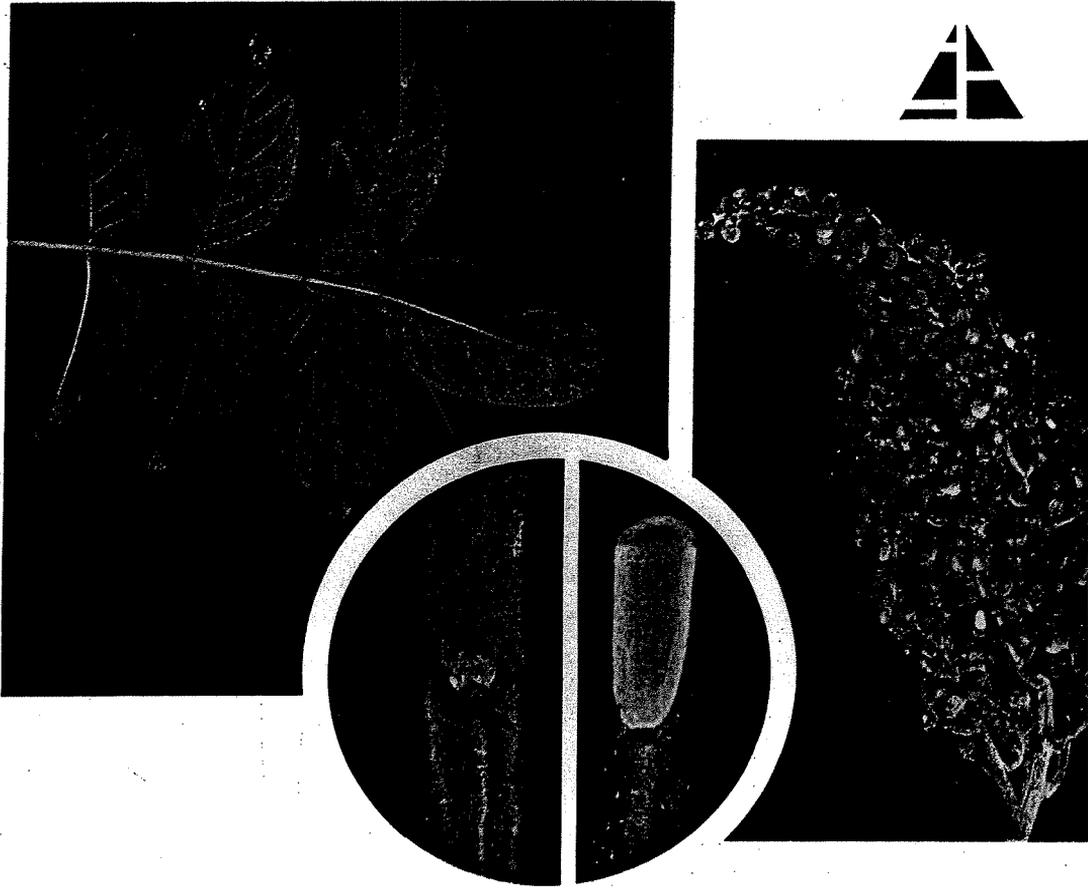
*Rhamnus caroliniana* Walt.—CAROLINA BUCKTHORN

Deciduous shrub with alternate buds and leaf scars. Twigs purple-gray to purple-brown; fine woolly pubescence near tips, becoming glabrous. Leaf scars half circular to oval with no lobes. Bundle scars three. Lateral and terminal buds woolly, tan, without scales. Terminal buds larger and sessile to twig tips. Stipules persistent, especially toward twig tips. Pith white, homogeneous, and soft. Inner bark of stems greenish-yellow.

Leaves simple, with prominent parallel veins.

Flowers small greenish-yellow, solitary or 2 to 10 in peduncled umbels, May and June.

Fruit a drupe with 2 to 4 (usually 3) seeds, persistent, red at first but turning black and lustrous at maturity, August to October.



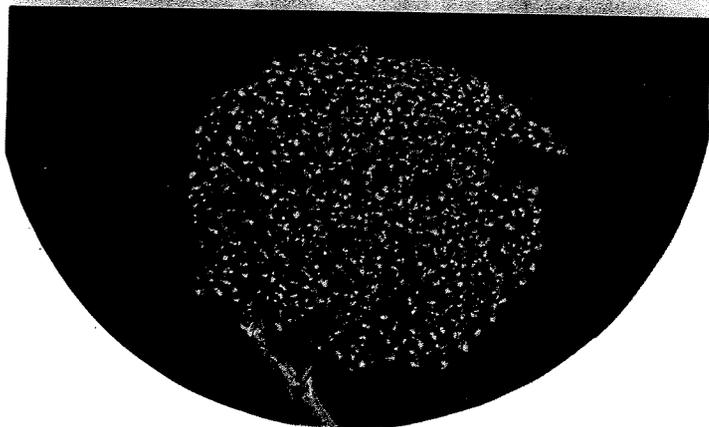
*Rhus copallina* L.—SHINING SUMAC

Deciduous shrub with one primary stem, occasionally reaching heights of 30 feet. Twigs velvety pubescent becoming glabrous, reddish-brown to gray. Buds silvery-tan, pubescent, and without scales. True terminal buds absent. Leaf scars horseshoe-shaped, encircling buds halfway. Bundle scars many. Pith dark tan, occupying well over one-half stem diameter. Sap milky and sticky. Lenticels dark rusty-brown and numerous.

Leaves alternate, pinnate with 7 to 17 leaflets, entire or with a few teeth, lustrous; rachis pubescent and broadly winged.

Flowers borne in a densely pubescent, compact terminal panicle, petals greenish-white, July to September.

Fruit a red, glandular-hairy drupe in compact panicles, erect or drooping; seed solitary, smooth, ripens in fall and stalks commonly persist through winter.



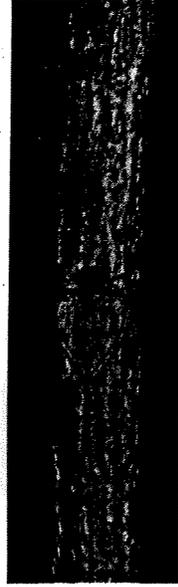
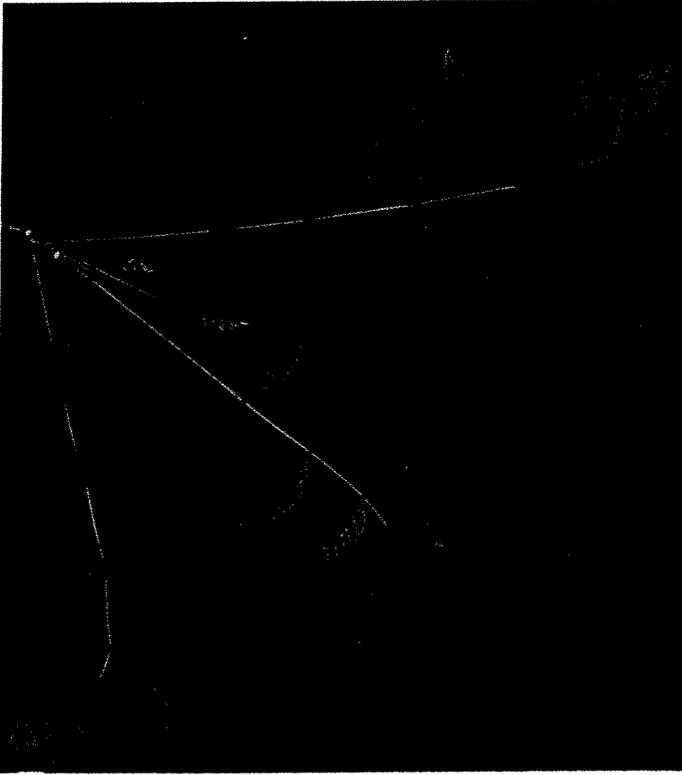
*Rhus glabra* L.—SMOOTH SUMAC

Deciduous shrub with one main stem up to 20 feet. Twigs glabrous, sparingly puberulent when young, tan to blotchy gray. Buds with tan to silvery dense pubescence. True terminal buds absent. Leaf scars encircle buds. Bundle scars many. Pith orange, occupying over one-half twig diameter. Sap milky and sticky. Lenticels light brown and scattered.

Leaves alternate, pinnate with 11-31 leaflets, sharply serrate, usually dark green above, lighter to white beneath.

Flowers in terminal compact panicles, petals white, June to August.

Fruit a drupe with short red-velvety hairs, one-seeded, smooth; ripens September and October.

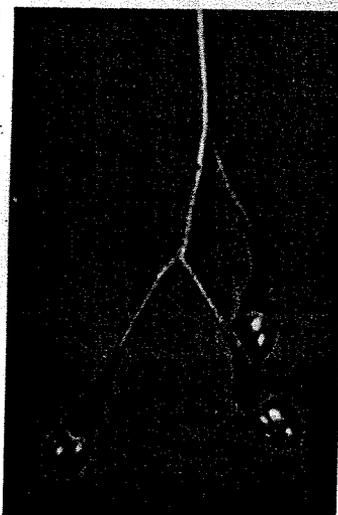
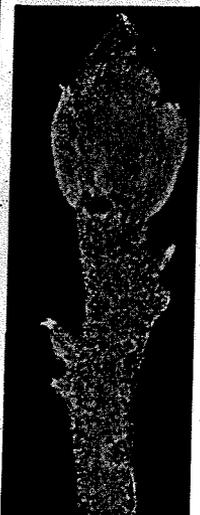
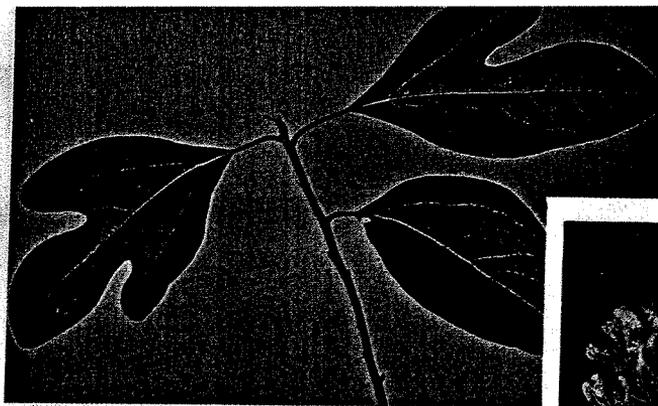


*Rhus vernix* L.—POISON SUMAC

Deciduous shrub to small tree with one primary stem, 12 to 25 feet high. Terminal buds present. Leaf scars heart-shaped. Bundle scars several, arranged around edges of leaf scars. Twigs light orange-gray to dark gray, with dark gray to black mottling; glabrous but with numerous lenticels. Pith soft and homogeneous. Stem cross section revealing dark strands in outer edges of white pith.

Leaves alternate, odd-pinnate with 7 to 13 leaflets, entire, smooth, shining above and more or less pubescent beneath. Flowers green in axillary panicles, April to July.

Fruit a greenish-white or gray drupe, August to November.



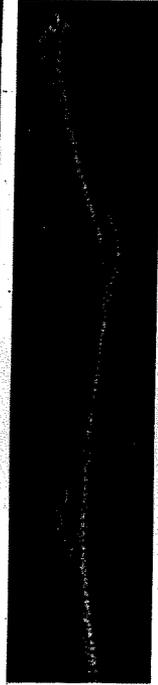
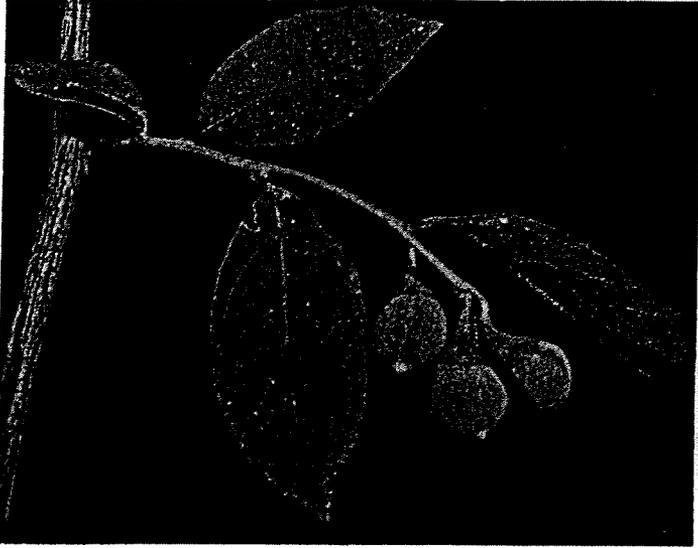
*Sassafras albidum* (Nutt.) Nees—SASSAFRAS

Deciduous tree with alternate leaf scars. Twigs light green, mottled with dark green and grayish-brown, pubescent, becoming glabrous. Stems and roots with strong spicy odor. Pith soft and white. Leaf scars half round to crescent-shaped. One bundle scar, straight to crescent-shaped.

Leaves simple, thin, aromatic, entire on the margin or divided into 2 to 3 mitten-shaped lobes, bright green above, glabrous and glaucous beneath.

Flowers greenish-yellow; loose open clusters appear before leaves unfold.

Fruit a blue spicy drupe borne erect on bright red club-shaped stalk, August to October.



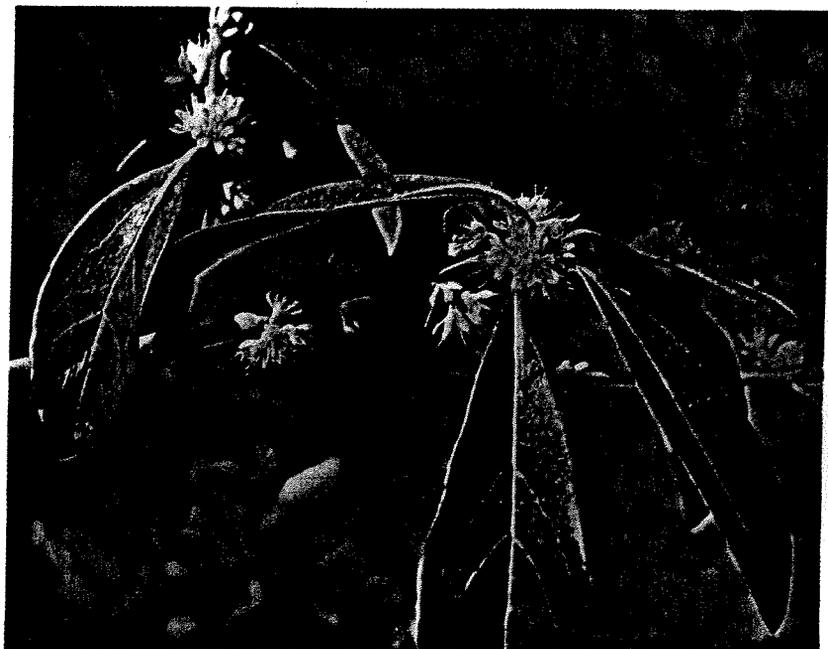
*Styrax americana* Lam.—AMERICAN SNOWBELL

Deciduous shrub to small tree with alternate buds and leaf scars. Twigs greenish, becoming purple-gray; stellate pubescence at first, glabrous on older stems. Leaf scars U-shaped with V-notch on upper margin. Scar lobes pointed. One bundle scar, curved and raised with short points on both sides. Buds two per joint and superposed. Old fruiting stems commonly persist through winter. Pith homogeneous, white, with a darker center.

Leaves simple, margin varying from entire to serrate or remotely toothed, upper surface dark green, lower surface paler.

Flower fragrant, on short lateral leafy branches; racemes axillary, subtended by small leafy bracts; corolla white; anthers bright yellow; May and June.

Fruit a persistent dry drupe, finely tomentose, seed usually solitary, September and October.



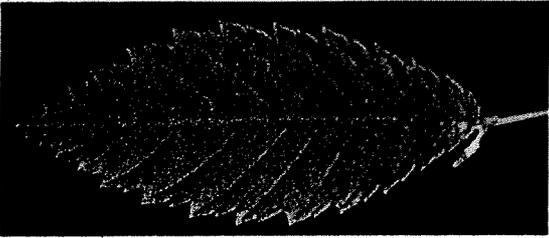
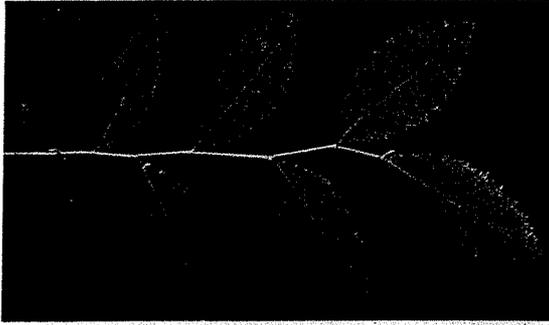
*Symplocos tinctoria* (L.) L'Her.—COMMON SWEETLEAF

Deciduous shrub arising from one main stem. Alternate leaf scars. Twigs sparingly pubescent, becoming glabrous, gray to reddish-brown. Terminal buds two-scaled, pubescence appressed. Leaf scars half round with one round to crescent-shaped bundle scar. Pith interrupted by air spaces.

Leaves simple, drooping on upcurved twigs, persistent in the South. Margin obscurely and remotely serrate or almost entire, thick and leathery, upper surface dark green, glabrous and lustrous, lower surface paler and pubescent.

Flowers fragrant, small yellowish-white in axillary clusters on branches of previous year, March to May.

Fruit orange-brown drupe, seed solitary, early autumn.



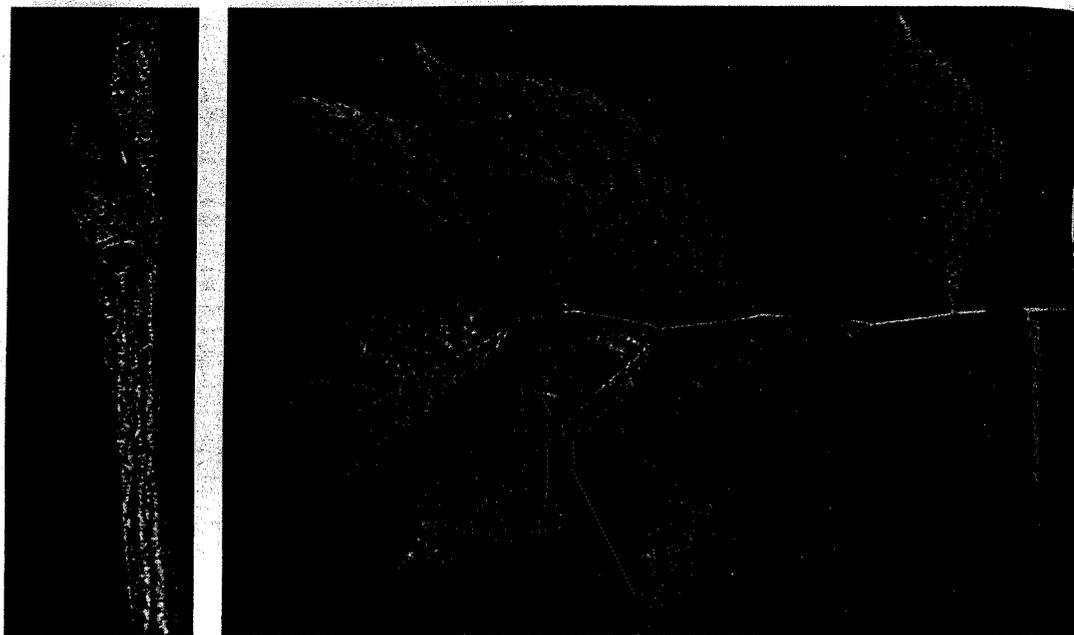
*Ulmus alata* Michx.—WINGED ELM

Deciduous shrub or small tree with alternate leaf scars. Twigs reddish-brown to gray-brown, pubescent to puberulent, becoming glabrous. Corky ridges on older growth. Buds fairly slender, acutely pointed, reddish-brown, and puberulent. Leaf scars half round to flat oval, with three dot-like bundle scars. Pith small, hard, and white.

Leaves simple, coarsely and doubly serrate.

Flowers borne in few-flowered drooping fascicles that appear before leaves in the spring, red to yellow.

Fruit a reddish or greenish samara, seed and wing hairy especially on margin, March to June.



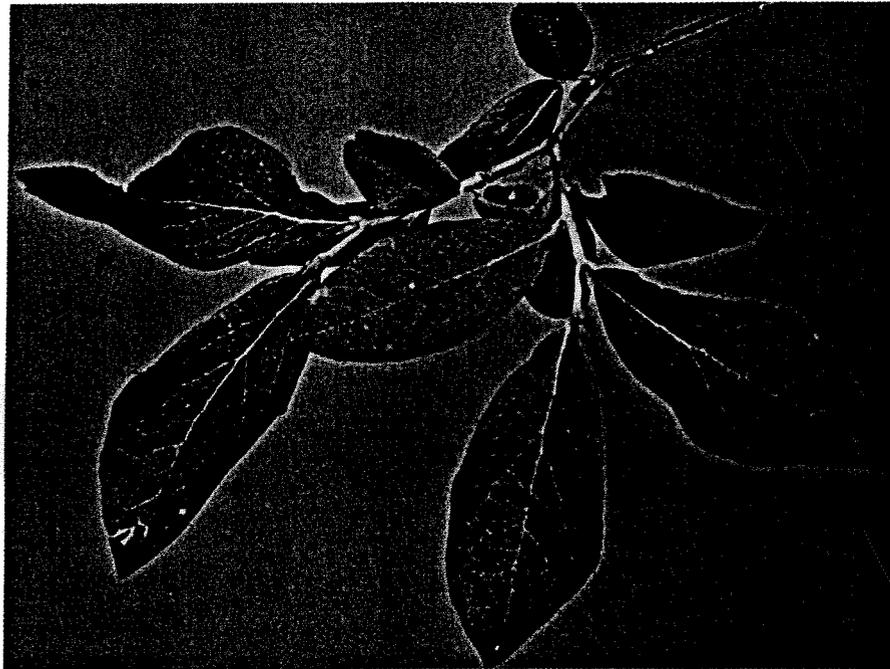
*Ulmus americana* L.—AMERICAN ELM

Deciduous tree with alternate leaves. Twigs reddish- to grayish-brown, pubescent to puberulent, becoming glabrous. Buds acutely pointed, reddish to brown, and puberulent. Leaf scars half round to flat oval with three dot-like bundle scars. Pith small, white, and hard. Twigs without corky ridges.

Leaves simple, somewhat cordate on one side at base and rounder or cuneate on other side, margin coarsely and doubly serrate.

Flowers borne before leaves in spring, axillary in 3- to 4-flowered fascicles, calyx red to green.

Fruit a red to green samara consisting of a central flattened seed surrounded by a membranous wing, ciliate on the margin, March to June.

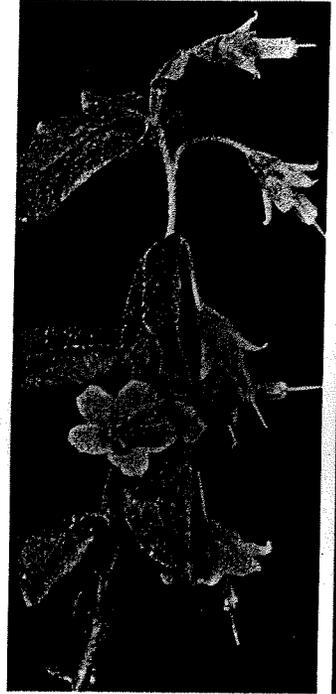
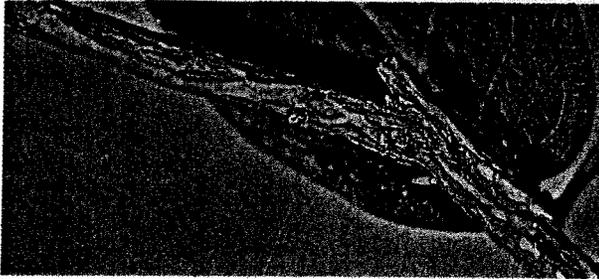
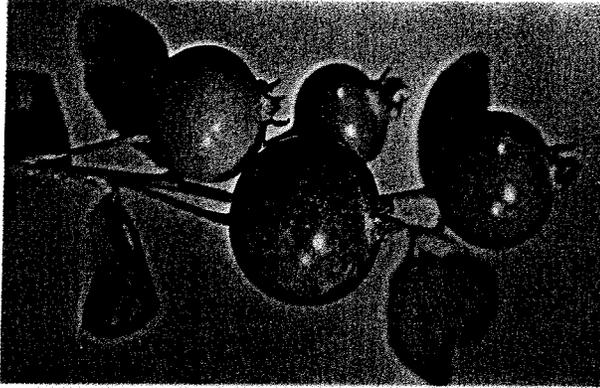


*Vaccinium vacillans* Torr.—LOW BLUEBERRY

Deciduous shrub with alternate leaf scars. Twigs green on one side and reddish on other, even when 2 to 3 years old. Leaf scars small, narrow, crescent-shaped with one bundle scar. Branchlets erratically bent or zigzag at nodes. Pith hard, exceeding one-third total twig diameter.

Leaves simple, U-shaped at base, leathery when mature. Flowers greenish to purplish on ends of branchlets or from old axils, appear before leaves are fully expanded.

Fruit a blue to black globose berry, June to September.



*Vaccinium stamineum* L.—COMMON DEERBERRY

Deciduous shrub with alternate leaf scars. Twigs—even when 2 to 3 years old—commonly green on one side, red on the other. Twigs slender, branchlets straight or gently curved. Leaf scars small, half round to circular with one dot-like, inconspicuous bundle scar.

Leaves simple, margin entire and ciliate, rounded at base.

Flowers greenish-white to purple on specialized flowering branches subtended by leafy bracts, April to June.

Fruit a green or yellowish globose berry, July to September.

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