Serviss, B.E. and R. Tumlison. 2021. Guide to the naturalized, escaped, and adventive woody flora of Arkansas. Phytoneuron 2021-29: 1–193. Published 5 July 2021. ISSN 2153 733X

GUIDE TO THE NATURALIZED, ESCAPED, AND ADVENTIVE WOODY FLORA OF ARKANSAS

BRETT E. SERVISS
Department of Biological Sciences
Henderson State University
1100 Henderson Street
Arkadelphia, Arkansas 71999
servisb@hsu.edu

RENN TUMLISON
Department of Biological Sciences
Henderson State University
1100 Henderson Street
Arkadelphia, Arkansas 71999
tumlison@hsu.edu

ABSTRACT

A total of 134 species of nonnative/exotic, woody (trees, shrubs, and lianas) seed plants are documented from the Arkansas flora. These species vary in their condition of occurrence and establishment in the flora, from naturalized and escaped to adventive waifs or spontaneous juvenile plants produced from reproductively mature plants in cultivation. All are treated within this guide. An additional 19 nonnative woody species not currently known from the state's flora, but with a high likelihood of occurrence, also are treated. Keys and/or details for identification of genera, along with characteristics used to distinguish these species from similar native species, current county distributions of taxa, photographic plates of taxa, and notes on occurrence, habit, and general ecology are provided. Keys for those genera with similar, easily confused species are provided. A series of photographic plates of most species in their juvenile stages also are included.

Arkansas possesses a rich and diverse woody flora, consisting of a little over 500 native and introduced species of trees, shrubs, and lianas, including groups not covered in this treatment, such as *Rubus* with biennial canes, along with "woody" arborescent and shrubby monocotyledonous taxa that do not undergo the production of a secondary plant body via the activity of a true vascular cambium — see authors' note at end of introduction. Of these roughly 500 species, 386 are native to Arkansas (Ogle et al. 2020) and most of them elsewhere in the USA, whereas 134 species are exotic introductions that are established to various degrees outside of cultivation in the state, or in a few instances, documented to reproduce spontaneously but not truly established in the flora. This treatment covers the 134 nonnative species, plus an additional 19 that occur in bordering states that have a high likelihood of occurrence in Arkansas. Most of the escaped and naturalized exotic woody plants in Arkansas are Asiatic in origin. About 23–25% of the Arkansas woody flora consists of nonnative species.

Much floristic investigation has been conducted in Arkansas over the past century, including the publication of well over 1,200 articles by nearly 100 botanists documenting and explaining the diversity, abundance, and distribution of the state's flora and vegetation (Peck & Peck 1988; Peck et al. 2001; Peck 2003). Continued floristic work in Arkansas led to the establishment of the Arkansas Vascular Flora Committee (AVFC) in 1998, tasked with the creation of a checklist, atlas, and identification manual for the over 3,000 species of native and naturalized vascular plants present in the flora. The AVFC published the *Checklist of the Vascular Plants of Arkansas* in 2006, and later the *Atlas of the Vascular Plants of Arkansas* (Gentry et al. 2013). Over roughly the past two decades,

numerous woody species have been added to or re-affirmed in the state's flora (Peck 2003; Arkansas Vascular Flora Committee 2006; Peck & Serviss 2006; Serviss et al. 2006, 2007a, 2007b; Serviss & Peck 2008; Nesom 2009; Serviss 2009; Peck & Serviss 2011; Serviss et al. 2012; Gentry et al. 2013; Serviss & Peck 2013; Serviss et al. 2014, 2015; Peck & Serviss 2016; Serviss & Peck 2016a, 2016b; Serviss et al. 2016a, 2016b, 2016c, 2017a, 2017b, 2018a, 2018b, 2018c, 2018d; Serviss & Peck 2019; Ogle et al. 2020; Serviss et al. 2020; Serviss & Serviss 2020a, 2020b).

Figure 1. *Clerodendrum trichotomum* naturalized in Clark Co., Arkansas. All of the plants shown in the photograph with large, ovate leaves are *C. trichotomum*, most probably representing root suckers from a single clone. Seed production also may have contributed to the population, as it has been observed in some Arkansas locations where this species is present.

Nonnative, exotic plant species regularly have been introduced into the USA, including Arkansas, through both accidental and intentional means; a number of them intentionally via the horticultural trade (Mack & Erneberg 2002). Figure 1 shows establishment of *Clerodendrum trichotomum*, a fairly recently documented exotic species in Arkansas. Many of these species never become established in the flora, or if establishment occurs, do not seriously threaten native plant species assemblages and ecosystems (Williamson & Fitter 1996). However, a considerable number of exotic plant species have become invasive subsequent to establishment and naturalization (Reichard & White 2001). Invasive species can alter native habitats and ecosystems, and often reduce native biodiversity (Pyšek & Richardson 2010). Some of the worst invasive plants are nonnative ornamental trees, shrubs, and lianas (Reichard & Campbell 1996). Even nonnative species that at present are not obviously invasive could become so at a future time (White 1998). A few examples of the most invasive woody ornamentals that have established in the Arkansas flora include: *Ligustrum sinense* (Chinese privet), *Lonicera japonica* (Japanese honeysuckle), *Lonicera maackii* (amur honeysuckle), *Nandina domestica* (nandina), *Pueraria montana* (kudzu), *Pyrus calleryana* (Bradford pear), *Rosa multiflora* (multiflora rose), and *Triadica sebifera* (Chinese tallow tree). Several others, such as *Elaeagnus pungens* (silver thorn), *Euonymus alatus* (winged burning bush), *Ligustrum lucidum*

(glossy privet), *Mahonia bealei* (leatherleaf mahonia), and *Photinia serratifolia* (Chinese photina), appear to be rapidly increasing in abundance in the state's flora (Figs. 2–3).

Figure 2. *Elaeagnus pungens* (center) and *Photinia serratifolia* (far right) naturalized in rocky, urban woods in Pulaski County, Arkansas. Several plants of both species were present at this location, along with many other naturalized woody species. Disturbed, wooded habitats with large numbers of exotic woody species in and around urban environments are common in Arkansas.

Figure 3. *Mahonia bealei* and *Nandina domestica* naturalized in rocky, urban woods in Pulaski County, Arkansas (same location as Fig. 2). Two plants of *M. bealei* may be seen (center and right) and one plant of *N. domestica* (left). Many dozens of individuals of both species were present at this location.

Most nonnative woody plants typically are observed escaped or naturalized in pastures, along fencerows, roadsides, woodland edges, disturbed wooded areas, riparian zones, urban greenbelts and woods, waste places, and other low-quality habitats (Fig. 4); however, several species, including *Ligustrum sinense*, *Lonicera japonica*, *Lonicera maackii*, *Nandina domestica*, and *Triadica sebifera* are encountered regularly in more pristine habitats, sometimes even those with only minimal levels of disturbance. Based on our observations in Arkansas, disturbed wooded and semi-wooded habitats (other than wetlands), particularly those in or near urban areas, often contain one to multiple exotic woody species. Species composition of nonnative woody plants in these environments is somewhat variable, but appears to most often involve different combinations of two or more of the following 11 species: *Mahonia bealei*, *Nandina domestica*, *Elaeagnus pungens*, *Euonymus alatus*, *Ilex cornuta*, *Ligustrum japonicum*, *Ligustrum lucidum*, *Ligustrum sinense*, *Lonicera japonica*, *Lonicera maackii*, and *Photinia serratifolia*. These observations are based on our unpublished field data collected from 2006–2012. All of these species have been introduced into Arkansas as ornamentals and are Asiatic in origin.

Figure 4. Disturbed, urban area in southwestern Arkansas, with several exotic woody species — three of them: *Ailanthus altissima* (lower left), *Broussonetia papyrifera* (center, top and bottom), and *Firmiana simplex* (right) can be seen in the photograph.

These invasive plants share several characteristics that facilitate their ability to invade and colonize new habitats: (1) adults and juveniles are shade-tolerant; (2) fruits with seeds that are bird-dispersed (nonnative woody species with bird-dispersed seeds often are highly invasive); and (3) all appear to be fairly plastic with regard to specific habitat requirements/tolerances. With the exception of *E. alatus* and *L. maackii*, they are evergreen so continue to photosynthesize and remain metabolically active, to some extent, during fall and winter periods (*L. sinense* sometimes only is semi-evergreen). In southwestern Arkansas, *Ilex cornuta*, *Ligustrum lucidum*, *Mahonia bealei*, *Nandina domestica*, *Photinia serratifolia*, and *Prunus caroliniana* often are observed together as prominent understory species. Contrastingly, in northwestern Arkansas, *Euonymus alatus* and *Lonicera maackii* sometimes occur together as prominent understory species (Fig. 5). *Ligustrum sinense*, *Lonicera japonica*, and to a somewhat lesser extent *Nandina domestica*, are widespread

throughout much of the state in a variety of habitats and can be more abundant than many native species of shrubs and lianas.

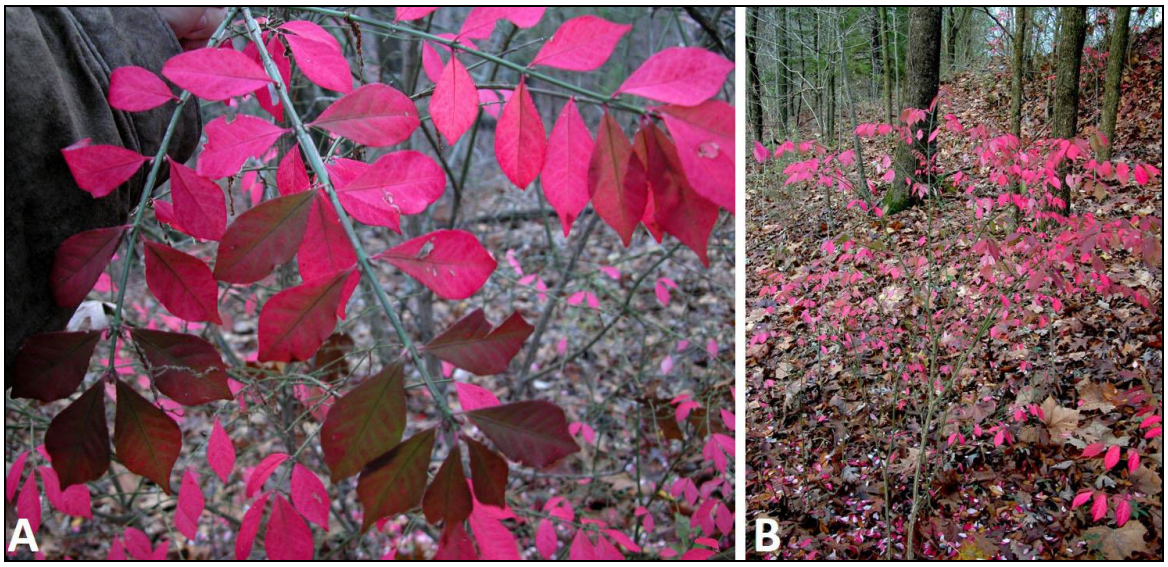


Figure 5. (A–B) *Euonymus alatus* naturalized in Washington County, Arkansas. (A) Leaves and stems with autumn color. (B) Plants in a naturalized population — many more plants were present at the site than is shown in the photograph.

Two additional characteristics possessed by many of these species deserve special mention: (1) the ability to self-seed and/or reproduce asexually to establish escaped or naturalized populations in a relatively rapid period of time, often from only an individual plant, and (2) a short period until reproductive maturity is reached, sometimes in as little as 2–3 years (Figs. 6–9). It is not uncommon for a single plant of many of these species to produce dozens to hundreds of offspring in a single location in the course of only a few years once reproductive maturity has been reached. Additionally, many of the species that have this capability for elevated levels of fecundity also reach reproductive maturity at a relatively young age, often in a period of 10 years or less. Some notable examples of species that often exhibit one or both of these characteristics include: *Clerodendrum trichotomum* (harlequin glorybower) — via both seeds and root suckers, *Firmiana simplex* (Chinese parasol tree), *Jasminum nudiflorum* (winter jasmine) — via stoloniferous offsets, *Koelreuteria bipinnata* (Chinese flame tree), *Ligustrum lucidum*, *Manihot grahamii* (Graham's cassava), *Nandina domestica*, and *Vernicia fordii* (tungoil tree).

The species presented in this guide represent four categories of exotic plants, as pertains to their occurrence and relative abundance in the Arkansas flora. The first category, termed *naturalized*, includes those species which are well-established and more or less entrenched components of the flora or have clearly demonstrated the ability to establish and maintain wild populations. The second category, termed *escaped*, consists of species which have been documented in the wild condition in the flora but are not necessarily well-established in the state. The third category, termed *adventive*, are species with potential to become escaped or naturalized in the flora; however, at present are not known truly in the wild condition in the state. Some of these species have demonstrated the ability to reproduce successfully through production of spontaneous offspring from cultivated plants, whereas others occur as rare waifs, with limited, or at least unknown, capability for establishment. Species in the final category are cultivated in Arkansas and many are established in the floras of adjacent states; however, to date, no evidence of successful establishment has been documented in Arkansas. These

species should be expected in the wild condition in Arkansas, based on prior documented occurrences elsewhere or an ability to successfully reproduce through sexual and/or asexual means.

Figure 6. *Jasminum nudiflorum* naturalized in Hot Spring County, Arkansas. Hundreds of ramets/stoloniferous offsets may be seen in the photograph. Plants occurred in and along edge of disturbed woods, and probably originated via asexual spread from once cultivated material.

Figure 7. *Trachelospermum asiaticum* naturalized in Clark County, Arkansas. An expansive colony of plants covered a large section of a steep, north-facing bank in a disturbed riparian habitat. A residential area is present near the riparian zone, offering a source pool for the establishments of exotics.

Figure 8. Escaped juvenile plants of *Koelreuteria bipinnata* and *Manihot grahamii* in southwestern Arkansas. Nine plants of *K. bipinnata* (center — five clustered together, and upper-right) and three plants of *M. grahamii* (upper-left, bottom) can be seen in the photograph. Additional juveniles of both species (not shown) also were present. These plants were produced via self-seeding from single individuals of the species initially present at the site.

Figure 9. *Rosa lucieae* naturalized in Clark County, Arkansas. An expansive colony (about 155 meters long) of plants was present at a lowland site in disturbed habitat on both sides of a road. Plants were climbing in and over existing vegetation and substrate, including an electric utilities pole. Numerous stems also were trailing along the ground and adventitiously rooting, allowing for vegetative spread.

Although a number of guides to the woody flora of Arkansas have been produced previously (Moore 1972; Hunter 1995; Moore & Sundell 2014; Ogle et al. 2020), the principal focus has been on native species, with only the most abundant or invasive nonnative species covered. Until now (2021), a comprehensive guide for the identification of the exotic woody flora of Arkansas did not exist. Authors' note: in relation to this treatment, we do not include "woody" taxa, such as *Arundo* and *Phyllostachys* that do not undergo true secondary growth, *Smilax* and *Yucca* that undergo an anomalous secondary thickening mechanism other than from a true vascular cambium, or *Rubus* that regrow their stems biennially. *Capsicum annuum* (pepper), which in its native habitat is a small shrub, sometimes escapes in the Arkansas flora; however, it is not treated here as it is not cold-hardy and in a single growing season, probably never develops much of a secondary body prior to the onset of freezing temperatures. Unless stated, the photographs in this paper were taken by the authors. Where photographs from other individuals or agencies are used, credit is provided directly in the figure caption with those photographs.

Identification of Juvenile Stages

An ability to detect and identify juvenile stages of exotic woody species is an important initial step in potential eradication or minimization of spread in the flora, at least on a localized basis. In areas where there is a large source pool of propagules from these species, coupled with adequate levels of disturbance, it is common to observe escaped juveniles and naturalized plants of multiple species together at the same location — some examples of this are shown in figures 10–13. This guide provides a series of photographic plates to assist in rapid identification of the juvenile stage of many of the nonnative woody species that have demonstrated the ability to naturalize, or at least reproduce successfully, in Arkansas. Whereas, not all of the species treated have images of juveniles included, many are, with some additional emphasis placed on those species that have not yet become well-established in Arkansas, with the hope of increasing public awareness to their presence, before establishment might occur.

The juvenile stages of many species are similar in form to their mature phenotypes; however, a few only somewhat resemble the mature form. Close examination of the photographs of juvenile stages presented herein will allow for reliable identification when these taxa are encountered in the field in the juvenile stage.

Figure 10. Escaped juveniles of *Ligustrum vulgare* (plant at upper left) and *Lonicera maackii* (plant on right). Multiple plants of each species, among other nonnatives, are present at this site; here, the two species are growing side by side.

Figure 11. Escaped juveniles of *Elaeagnus pungens* (plants with glossy foliage), *Firmiana simplex* (pale green plants), and *Vernicia fordii* (large plant on right) in Clark County, Arkansas. Multiple plants of each species are present at this site, with dozens of juveniles of *F. simplex* present beyond the area shown in the photograph.

Figure 12. Escaped juveniles of *Koelreuteria bipinnata* (right) and *Paulownia tomentosa* (left) in Clark County, Arkansas. Plants are present in a highly-disturbed area, with cultivated plants of both species in the vicinity. Several juveniles of both species are present at the location.

Figure 13. Escaped juveniles of *Mahonia bealei* (right) and *Photinia serratifolia* (left). Multiple juveniles and escaped/naturalized reproductive age plants of both species are present at the location.

The photographic plates of juvenile plants (Figs. 163–171) are presented after the literature cited section and include juvenile stages for 86 of the species covered in this treatment. In some instances, the photograph is of a young root sucker, for those species that sucker prolifically; the foliage of the sucker is characteristic of or approaches that of the juvenile stage. A few species are represented with two photographs to illustrate variation in color or other features that sometimes are encountered. Unless noted, species are presented in alphabetical order — notes: *Citrus trifoliata*, *Erythrostemon gilliesii*, and *Styphnolobium japonicum* are listed under *Poncirus*, *Caesalpinia*, and *Sophora*, respectively; *Celastrus orbiculatus* and *Lonicera japonica* are included in Fig. 171.

Key to genera of nonnative trees, shrubs, and lianas

It is important to understand that there is intergradation between the shrub and tree growth forms and that some species, such as *Lagerstroemia indica*, *Ligustrum lucidum*, *Manihot grahamii*, *Robinia hispida*, and *Vitex negundo* can occur and be reproductive in both forms. If a specimen does not key in the tree category, for example, attempt to key it as a shrub.

1. Plant a liana (vine) or liana-like with climbing habit; stems elongate and flexuous, running along the ground and/or climbing some type of substrate for support; plants climbing by means of twining stems, tendrils, aerial roots, or clambering (scandent shrubs, such as *Elaeagnus pungens* and *Euonymus fortunei* that climb opportunistically, also will key as a shrub).

2. Plants sparsely to densely armed with prickles on stems and/or leaves; stipules large and conspicuous and at least partially adnate to the petioles; leaves pinnately compound with toothed leaflets .....**Rosa**

2. Plants armed with prominent thorns arising from the leaf axils (*Elaeagnus*) or unarmed; stipules various or absent but not fused to the petioles; leaves pinnately compound with entire leaflets (*Cayratia* has toothed leaflets) or simple (leaves sometimes lobed in *Pueraria*).

3. Leaves compound.

4. Plant climbing by twining; leaves once pinnately compound or ternately compound; flowers papilionaceous, white, lavender, purple, or maroon; fruit a legume.

5. Leaves ternately compound with 3 leaflets; stems densely hirsute-pubescent; leaves whitish-green on the abaxial (lower) surface; flowers dark purple to maroon; fruit a densely hirsute-pubescent capsule ..... **Pueraria**
5. Leaves pinnately compound with 7 or more leaflets; stems pubescent but not hirsute; leaves green on the abaxial surface; flowers lavender to purple, occasionally white ..... **Wisteria**

4. Plant climbing by tendrils; leaves bipinnately compound but reduced to one shortened, lateral pinna on each side of the rachis (each pinna bearing two leaflets) and a terminal leaflet, giving the leaf a palmately compound appearance; tendrils without adhesive discs at the tips; flowers green, yellowish-green, or orange-pink; fruit a berry, but rarely if ever produced in North America ..... **Cayratia**

3. Leaves simple, laminas sometimes deeply lobed but not compound.

6. Plants climbing exclusively or primarily by twining (a few species, such as *Trachelospermum asiaticum*, also will climb secondarily by adventitious roots) or via tendrils (*Ampelopsis*).

7. Stems and leaves hirsute to hispid-pubescent, with large, red or white-colored trichomes, leaf margins toothed; fruit a large, hirsute- to hispid-pubescent berry..... **Actinidia**
7. Stems and leaves glabrous to pubescent, but not hirsute to hispid-pubescent with large, red to white-colored trichomes; leaf margins toothed or entire; fruit a follicle or small, glabrous berry or drupe.

8. Leaves toothed.

9. Leaves coarsely toothed; young stems with axillary buds that are conspicuously sharp-pointed at the apex; fruit a yellow-colored, few-seeded capsule; seeds enclosed in a fleshy, bright red to orange aril ..... **Celastrus**
9. Leaves deeply palmately lobed in addition to being toothed; young stems without sharp axillary buds; fruit a magenta or blue-purple berry..... **Ampelopsis**

8. Leaves entire (trailing stems of *Lonicera japonica* sometimes will have deeply lobed leaves, however, the margins of the lobes still are entire).

10. Plants exude white-milky sap when damaged or cut; leaves leathery and often with conspicuous pale-green to whitish-green venation on the adaxial (upper) surface; flowers white to cream or yellow; fruit an elongate, linear follicle with brown-pubescent seeds ..... **Trachelospermum**
10. Plants without white-milky sap; leaves membranous and without conspicuously pale green or whitish green venation; flowers white to yellow (rarely pale pink); fruit a black berry ..... **Lonicera**

6. Plants climbing via adventitious roots and/or clambering.

11. Leaves shallowly to prominently 3–7 lobed or unlobed and diamond-shaped, margins entire, venation on adaxial surfaces conspicuously pale green to whitish-green; plants climbing by numerous aerial roots; fruit a rounded, blue-black to black, few-seeded berry ..... **Hedera**
11. Leaves not lobed nor diamond-shaped, margins toothed, venation on adaxial surface +/- lighter colored than lamina; plants climbing by aerial roots and/or clambering; leaf margins toothed; fruit an ellipsoid, red drupe with lepidote scales or a few-seeded, white or pinkish-white capsule, with seeds enclosed in a bright red, pink, or orange-colored, fleshy aril.

14. Plant often with thorns; leaves alternate; foliage covered in a dense indument of silver and brown lepidote scales; fruit a drupe ..... **Elaeagnus**
14. Plant unarmed; leaves opposite; foliage without lepidote scales; fruit a white to pink-colored capsule ..... **Euonymus**

1. Plant a shrub or tree with a more or less erect growth habit; stems not requiring substrate for support and plants usually not climbing, but occasionally partially scandent or liana-like in habit.

15. Plant a shrub.

16. Leaves compound.

17. Plants with armed appendages (with prickles, spines, or thorns).

18. Leaves ternately compound and plants armed with stout, generally green-colored, thorn-like stipular spines, some several cm in length; fruit a yellow to yellowish-orange, many-seeded berry ..... **Citrus**
18. Leaves variously compound; plant armed with prickles, spines, or stout, thorn-like stipular spines (*Prosopis*); fruit a capsule, hip, or small, blue berry.

19. Leaves bipinnately compound but restricted to two lateral pinnae giving an overall appearance of leaves that are once pinnately compound, lateral pinnae parapinnate (evenly compound); leaflets linear to narrowly elliptic, ca. 3–6 mm wide; at least some leaves subtended by one to two stout, thorn-like stipular spines ..... **Prosopis**
19. Leaves one time compound and imparapinnate (odd compound), leaflets wider (most to all leaflets wider than 6 mm); stipules leafy (sometimes armed) but not modified into thorn-like spines.

20. Stems lacking prickles; leaflets and stipules thick-coriaceous, with large, prominent, spinose teeth; wood of stems bright yellow; fruit an ellipsoid, blue-colored berry ..... **Mahonia**
20. Stems often with prickles; leaflets and stipules not thick-coriaceous, without large, prominent, spinose teeth; wood of stems not yellow; fruit an orange to red-colored hip..... **Rosa**

17. Plants unarmed (lacking prickles, spines, or thorns).

21. Leaves opposite.

22. Leaflets typically ternately compound (a few may be simple) with entire margins, abaxial surface green; flowers axillary and bright golden-yellow ..... **Jasminum**
22. Leaves palmately compound, mostly with 5 or more leaflets (a few leaves may be ternately compound) generally with toothed margins, abaxial surface white to glaucous; flowers in terminal panicles and blue (rarely pink or white)..... **Vitex**

21. Leaves alternate.

23. Leaves two or more times compound.

24. Leaflets small, less than 1 cm in length; wood not bright yellow; flowers yellow with long-exerted, red stamens; fruit a flattened, leguminous capsule ..... **Erythrostemon**
24. Leaflets larger, 1 cm or more in length; wood bright yellow; flowers white to creamy white and stamens yellow and not long-exerted; fruit a red (rarely yellow to yellowish-white), few-seeded drupe ..... **Nandina**

23. Leaves one time compound.

25. Leaves wholly or mostly ternately compound with 3 leaflets (a few leaves occasionally will have 4–5 leaflets)..... **Lespedeza**
25. Leaves clearly pinnately compound with 4 or more leaflets.

26. Leaflets prominently toothed or lobed; fruit a drupe ..... **Rhus**
26. Leaflets entire; fruit a legume.

27. Leaves with 4–8 leaflets; flowers nearly actinomorphic; fruit cylindric..... **Senna**
27. Leaves with 12–50 leaflets; flowers strongly zygomorphic; fruit somewhat flattened and winged along the edges ..... **Sesbania**

16. Leaves simple, sometimes deeply lobed but not compound.

28. Leaves small and scale-like, bluish-green; flowers pale pink to pinkish-white ..... **Tamarix**
28. Leaves larger, appearing as "typical" leaves; flowers variously colored.

29. Leaves opposite to subopposite or verticillate (some leaves of *Lagerstroemia* may be alternate toward the tips of the stems).

30. Most to all of the leaves verticillate; fruit an elongate, semi-cylindric, longitudinally grooved follicle ..... **Nerium**
30. Most to all of the leaves opposite (a few leaves may be verticillate, particularly those on a given stem); fruit various but not a follicle.

31. Leaves with entire margins (a few leaves may be lobed in *Lonicera* but the margins of the lobes are entire).

32. Plant generally armed with elongate, slender, often leafy thorns; flowers large (4 cm or more long) and solitary or occasionally in 2–3-flowered cymes, scarlet-red, reddish-orange, or rarely yellow; fruit a large (2–12 cm wide) red to pink-or yellowish-pink, many-seeded berry; seeds with a red to pink-colored, juicy sarcotesta ..... **Punica**
32. Plants unarmed; flowers smaller (less than 4 cm long) in 2 to many-flowered inflorescences; fruit smaller (less than 2 cm wide); seeds not enclosed in a red or pink-colored, juicy seed coat.

33. Leaves small (1.2–3.8 cm long) and tightly clustered on the stem, mostly glabrous but the abaxial midvein with appressed trichomes on either side ..... **Buxus**
33. At least some leaves larger (4 cm or more long) and generally not tightly clustered on the stem, glabrous or pubescent but trichomes, if present, not exactly as above.

34. Younger stems and branches clearly and strongly 4–6-sided, the angles sometimes with narrow wings; fruit a spherical, smooth, green capsule; seeds brown, winged..... **Lagerstroemia**
34. Younger stems and branches terete (round), subterete, 2-sided, or sometimes weakly 4-sided; fruit a drupe, berry, or capsule, but if a capsule then it and the seeds not as described above.

35. Stems and leaves glabrous; base of lamina strongly to weakly cordate; flowers lavender, purple, or rarely white and arranged in many-flowered terminal panicles..... **Syringa**
35. Stems and leaves pubescent or glabrous; base of lamina attenuate, cuneate, or truncate, but not cordate; inflorescences axillary, or if terminal then flowers white to cream-colored or rarely pale pink.

36. Bark smooth; foliage glabrous or pubescent; inflorescences terminal or terminal on short lateral shoots; fruit a dark blue, purple, or black drupe..... **Ligustrum**
36. Bark shredding or with narrow plates that sometimes exfoliate; foliage generally pubescent; inflorescences consisting of axillary pairs or clusters of flowers on a short stem; fruit generally an orange or red berry (fruit is black in *Lonicera japonica*)..... **Lonicera**

31. Leaves with toothed margins (teeth may occur only toward the leaf apex in *Forsythia*).

37. Leaves large, at least some of them 10 cm wide or wider; inflorescence a large, many-flowered, terminal, flat-topped corymb or panicle.

38. Plants colonial via suckering, forming large colonies; foliage malodorous when bruised; fruit a drupe ..... **Clerodendrum**
38. Plants not colonial; foliage not malodorous; fruit a capsule ..... **Hydrangea**

37. Leaves smaller, less than 9 cm wide and/or inflorescences of various forms but not as described above (*Viburnum* has flattened, corymbose inflorescences and leaves occasionally to 11 cm wide, but the stellate-pubescent stems distinguish it from the above taxa).

39. At least the very young stems clearly four-sided (sometimes weakly four-sided in *Forsythia suspensa* or three-sided in *Euonymus*).

40. Stems and leaves glabrous or mostly glabrous (sometimes young stems and/or abaxial surface of leaves with sparse pubescence but often becoming glabrous with age).

41. Young stems with or without conspicuous corky wings; leaves membranous, margins toothed along the entire length, teeth small; flowers pale green or cream; seeds bright orange to reddish-orange ..... **Euonymus**
41. Stems without corky wings; leaves thick-membranous, margins mostly entire except for the distal one-third to one-half of the blade, teeth large; flowers bright golden-yellow; seeds brown ..... **Forsythia**

40. Stems and leaves sparsely to densely pubescent, pubescence persistent even with age.

42. Young stems densely white-pubescent, without prickles; leaves densely white to greenish-white and pubescent on the abaxial surface; flowers purple, lavender, pink, or white and arranged in elongate, many-flowered, terminal panicles; fruit a capsule ..... **Buddleja**
42. Young stems sparsely to densely pubescent, but not white, often with prickles; leaves not white or greenish white on the abaxial surface; flowers red, orange, lavender, pink, yellow, or white and arranged in many-flowered, flattened, axillary cymes borne on a long, slender peduncle; fruit a blueish-black, lustrous drupe ..... **Lantana**

39. Young stems terete to subterete or flattened, but not clearly four-sided.

43. Leaves with venation conspicuously raised abaxially and impressed or sunken adaxially; terminal buds ovoid and acute, grayish-brown, 3–5 mm long; inflorescence a densely-flowered, flattened corymbose panicle; fruit a red drupe ..... **Viburnum**
43. Leaves without venation conspicuously raised abaxially and impressed or sunken adaxially (except *Rhodotypos*); terminal buds not as described above; inflorescence an open-flowered raceme, cyme, cymose panicle, or flowers solitary; fruit a capsule, achene, purple drupe, or an aggregate of four black nutlets or drupelets.

44. Leaves rough scabrous-pubescent and with stellate trichomes ..... **Deutzia**
44. Leaves not both rough scabrous-pubescent and with stellate trichomes.

45. Stems and leaves glabrous or nearly so, especially with age.

46. Axillary buds large and conspicuous, elongate-conical in shape; fruit a small, whitish-green to creamy-pink colored capsule; seeds with a bright reddish-orange to pink sarcotesta ..... **Euonymus**

46. Axillary buds small and not elongate-conical; fruit a brown or beige capsule or an aggregate of black nutlets or drupelets; seeds without a reddish-orange sarcotesta.

47. Leaf margins biserrate; flowers and fruits solitary, borne on long (several cm) axillary peduncles; fruit a cluster of black, lustrous, nutlets or drupelets ..... **Rhodotypos**
47. Leaf margins serrate or entire; flowers often more than one per inflorescence, axillary or terminal; fruit a yellow to brown capsule ..... **Philadelphus**

45. Stems and leaves moderately to densely pubescent.

48. Leaves lanceolate to narrowly obovate, sessile to subsessile and abaxially with yellow-glandular stellate trichomes along the margins; fruit a purple drupe ..... **Callicarpa**
48. Leaves ovate, subsessile to clearly short-petiolate, without yellow-glandular trichomes; fruit an achene (bristly in *Kolkwitzia*).

49. Flowers with corolla white to pinkish-white, sepals 2–5 per flower, even on same plant; pedicels, ovaries, and fruits glabrous to pubescent but not densely bristly-hirsute; leaves pubescent only on the abaxial surface..... **Abelia**
49. Flowers with corolla pale to dark pink, occasionally almost white, sepals 5; pedicels, ovaries, and fruits densely bristly-hirsute; leaves pubescent on both surfaces ..... **Kolkwitzia**

29. Leaves clearly alternate.

50. Leaves prominently lobed, margins entire or toothed (some forms of *Ilex* will have unlobed leaves with only a single spine present at the apex of the lamina).

51. Plants armed with spine-tipped lobes on the leaves (leaf margins otherwise entire) or leaves without lobes and only a single spine at the apex of the lamina; leaves coriaceous ..... **Ilex**
51. Plants unarmed; leaves not coriaceous.

52. Leaves large, at least some of them 10 cm wide or wider.

53. Leaves palmately veined and palmately lobed.

54. Leaf margins entire, the lobes often conspicuously widened toward the apex ..... **Manihot**
54. Leaf margins toothed; lobes consistently narrowing toward the apex.

55. Leaves and stems mostly to completely glabrous ..... **Ricinus**
55. Leaves and stems densely pubescent, with abaxial surfaces of leaves covered in a dense, white to whitish-brown indument of floccose (flakey) trichomes that are easily shed or dislodged..... **Tetrapanax**

53. Leaves pinnately veined and pinnately lobed, some of the major veins of the leaf possibly palmate, but the leaf clearly with some level of pinnate venation and lobing (not strictly palmate) ..... **Ficus**

52. Leaves smaller, 9 cm wide or less; some leaves occasionally without lobes.

56. Veins prominently raised on adaxial leaf surface; some sinuses deep on some leaves, extending well into the lamina, one-half or more to the midvein; flowers white, pink, maroon, lavender, or bluish-lavender with pistil and stamens included..... **Hibiscus**

56. Veins sunken on adaxial surface; sinuses shallow, most to all of them extending much less than one-half or more the width of the lamina; flowers red with pistil and stamens exerted ..... **Malvaviscus**

50. Leaves not lobed, margins entire or toothed, teeth, if present, may be small or large and coarse.

57. Foliage, especially stems and abaxial surfaces of leaves, covered in a dense indument of lepidote (scale-like), silver or silver and brown trichomes ..... **Elaeagnus**
57. Foliage not covered in a dense indument of lepidote trichomes.

58. Plant armed with thorns or spines, including stipular spines.

59. Armed appendages consisting of slender, paired, unbranched stipular spines ..... **Ziziphus**
59. Armed appendages consisting of thorns, unbranched or trifid stipular spines, or spines on leaf margins.

60. Leaf margins entire.

61. Plant with straight, thorn-like stipular spines or thorns not bearing leaves (leaves may be clustered at the base of the thorn on small spur branches); flowers purple or greenish-yellow; fruits ellipsoid and red to reddish-orange.

62. Leaves elliptic or narrowly elliptic to oblong-elliptic; flowers purple ..... **Lycium**
62. Leaves spatulate; flowers greenish-yellow to pale yellow ..... **Berberis**

61. Plant with thorns and these often bearing leaves or at least buds; flowers white or pale cream; fruits round or globose, red, orange-red, or orange ..... **Pyracantha**

60. Leaf margins toothed.

63. Stipules large and circular in shape; flowers red or pink, rarely white ..... **Chaenomeles**
63. Stipules various but not large and circular; flowers yellow, cream, or white, sometimes tinged with pink when young.

64. Plant with thorns or prominent, thorn-like stipular spines; leaves small, 6 cm or less long and 2 cm or less wide.

65. Plant with trifid stipular spines; flowers yellow; fruits bluish-black ..... **Berberis**
65. Plant with thorns; flowers white to cream; fruits red ..... **Pyracantha**

64. Plant lacking thorns but often with sharp or spine-tipped teeth on leaf margins; leaves large (6–)7–22 cm long and 3–6.5 cm wide ..... **Photinia**

58. Plant unarmed (teeth may be stiff and "spine-like" in *Prunus caroliniana*).

66. Leaf margins toothed.

67. Leaves coriaceous to subcoriaceous.

68. Leaves with crenate teeth and dark, rounded, plate-shaped glands on the abaxial surface ..... **Ilex**
68. Leaves with serrate teeth and/or without rounded, plate-shaped glands on the abaxial surface.

69. Leaves with relatively few teeth and these widely spaced on margin.....**Prunus**
69. Leaves with numerous teeth and these closely spaced.

70. Stipules prominent; inflorescences many-flowered; fruit a red drupe or blue to purple drupe-like pome.

71. Plant a large shrub to small tree, taller than 2 m; fruit a red drupe .....**Photinia**
71. Plant a small shrub, generally 2 m or less tall; fruit a blue to purple, drupe-like pome .....**Rhaphiolepis**

70. Stipules not prominent; inflorescences of a solitary flower; fruit a capsule .....**Camellia**

67. Leaves chartaceous to membranous.

72. Plant generally 3 m or more tall, eventually arborescent; fruit a drupe .....**Prunus**
72. Plant clearly a shrub, generally less than 3 m tall; fruit a capsule or follicle.

73. Leaf apices rounded, obtuse, or acute; flowers white, pink, or magenta; twigs and older stems orange, orange-brown, brown, or gray.....**Spiraea**
73. Leaf apices acute to acuminate; flowers yellow to orange; twigs and older stems green to yellow-green .....**Kerria**

66. Leaf margins entire (young plants or even mature individuals may have a few leaves with some teeth).

74. Leaves coriaceous, often positioned close enough to one another as to give a whorled appearance, petioles red; seeds with an orange-red aril ..... **Ternstroemia**
74. Leaves membranous to coriaceous, not appearing whorled, petioles usually not red; seeds without an orange-red aril.

75. Foliage, at least stems, covered in a dense indument of brown to white-colored, stellate trichomes; fruit an ovoid, stellate-pubescent capsule.....**Loropetalum**
75. Foliage glabrous; fruit a 5-lobed, glabrous capsule .....**Exochorda**

15. Plant a tree.

76. Stems of plant bearing linear, needle-like leaves in fascicles .....**Pinus**
76. Stems not bearing needle-like leaves in fascicles.

77. Leaves compound.

78. Leaves ternately or palmately compound ..... **Vitex**
78. Leaves pinnately compound.

79. Leaves mostly to completely bipinnately compound.

80. Leaflets entire, elliptic to oblong-elliptic, small, to 12 mm long and ca. 4 mm wide; mature bark smooth.....**Albizia**
80. Leaflets toothed or sometimes entire, ovate to oblong-ovate, larger, longer than 15 mm and wider than 5 mm; mature bark with flattened ridges or plates.

81. Leaflets conspicuously toothed; flowers pink-to purple; fruit a drupe..... **Melia**
81. Leaflets mostly entire to entire; flowers yellow; fruit a papery, inflated capsule .....**Koelreuteria**

79. Leaves once pinnately compound or bipinnately compound but reduced to a single set of pinnae and appearing once compound (*Prosopis*).

82. Plant armed with thorns or stipular spines (these sometimes small or mostly absent).

83. Young stems and leaves without stipitate glandular or bristly trichomes; leaflets less than 10 mm wide.....**Prosopis**
83. Young stems and leaves with prominent glandular stipitate or bristly trichomes; leaflets 10 mm wide or wider .....**Robinia**

82. Plants unarmed.

84. Leaflets toothed or shallowly lobed along their entire margin.

85. Stems, leaves (rachis at least), and fruits with a dense indument of long-pilose trichomes; fruit a drupe ..... **Rhus**
85. Stems, leaves, and fruits glabrous or pubescent, if pubescent, not covered in a dense indument of long-pilose trichomes; fruit a capsule.

86. Leaflets, at least some, with prominent lobes; flowers yellow; fruit a thin-walled, inflated capsule.....**Koelreuteria**
86. Leaflets without lobes, toothed only; flowers pink; fruit a woody, three-lobed capsule, not inflated .....**Ungnadia**

84. Leaflets entire or with only a few teeth on the basal portion.

87. Leaflets with one to two basal teeth with prominent plate-shaped glands on the abaxial surface .....**Ailanthus**
87. Leaflets with entire margins and without prominent plate-shaped glands.

88. Leaves glabrous or nearly so, leaflets lanceolate to lanceolate-elliptic; foliage malodorous when bruised .....**Pistacia**
88. Leaves pubescent, at least along rachis, leaflets ovate to elliptic to oblong-elliptic; foliage not malodorous..... **Styphnolobium**

77. Leaves simple, may or may not be lobed.

89. Plants armed with thorns, spines, or stipular spines.

90. Plant bearing thorns, these sometimes restricted to the tips of the stems; leaves mostly to wholly opposite (a few alternate leaves also may be present) .....**Rhamnus**
90. Plant bearing spines or stipular spins; leaves alternate.

91. Leaves with one to several prominent spines (sometimes only the leaf apex with a spine) .....**Ilex**
91. Leaves without spines, but nodes with prominent, paired stipular spines ..... **Ziziphus**

89. Plants unarmed.

92. Margins of leaves entire, with or without large lobes (young leaves in *Camptotheca* may have a few, large, widely spaced teeth).

93. Leaves linear or linear-lanceolate to linear-elliptic; plant a gymnosperm; seeds covered by a blue to purplish-blue, fleshy sarcotesta ..... **Podocarpus**
93. Leaves usually wider (may be similarly narrow in some species of *Ligustrum*); plant an angiosperm with flowers and fruits enclosing the seeds.

94. Leaves with 2–3 prominent, clustered red or brown glands on the petiole where the petiole meets the lamina ..... **Vernicia**
94. Leaves without prominent, clustered glands on the petiole in proximity of the lamina.

95. Leaves conspicuously scabrous and/or pubescent, at least on the abaxial surface or petiole.

96. Leaves with 8–12 prominent, raised veins on either side of the rachis and arcuate venation..... **Camptotheca**
96. Leaves without 8–12 prominent, raised veins and without arcuate venation.

97. Leaves relatively small, less than 10 cm long and 10 cm wide; fruit a large (3.5–10 cm in diameter), yellow, orange, or reddish-orange berry ..... **Diospyros**
97. At least some leaves larger, longer than 10 cm, wider than 10 cm, or both; fruit a capsule or aggregate of follicles.

98. Leaves three or more times longer than wide; flowers actinomorphic, white, perianth segments separate; fruit an aggregate of follicles; seeds with a red, fleshy seed coat ..... **Magnolia**
98. Leaves about as long as wide; flowers zygomorphic, white, yellow, pinkish-purple, lavender, or purple, perianth segments united; fruit a capsule.

99. Lamina pubescent, sometimes scabrous, but not tomentose; corolla white or yellow; fruit a linear-cylindric capsule many times longer than wide; bark plated or ridged ... **Catalpa**
99. Lamina tomentose-pubescent; corolla pinkish-purple, lavender, or purple (rarely almost white); fruit a conical capsule about as long as wide; bark smooth ..... **Paulownia**

95. Leaves glabrous or nearly so, not clearly and conspicuously scabrous and/or pubescent.

100. Some to all leaves with 3–5(–7) large lobes.

101. Bark green, very old bark light gray with vertically-aligned, linear, green lines, smooth; fruit a follicle..... **Firmiana**
101. Bark brown to grayish-brown with narrow, flattened, somewhat exfoliating plates; fruit a linear-cylindric capsule..... **Catalpa**

100. Leaves without lobes.

102. Leaves clearly and only alternate; bark ridged and furrowed or with irregular, rough-textured, semi-exfoliating plates.

103. Abaxial surface of leaves white to greenish-white; foliage spicy-aromatic when bruised..... **Cinnamomum**
103. Abaxial surface of leaves green; foliage not aromatic ..... **Triadica**

102. Leaves opposite or mostly opposite, with a few sometimes subopposite or alternate in *Lagerstroemia*; bark smooth, sometimes exfoliating.

104. Young stems and twigs with conspicuous, narrow ridges ..... **Lagerstroemia**
104. Young stems and twigs smooth, lacking narrow ridges ..... **Ligustrum**

92. Margins of leaves toothed, with or without large lobes (many leaves on mature plants of *Quercus virginiana* will have entire to mostly entire margins).

105. Leaves opposite..... **Acer**
105. Leaves alternate.

106. Foliage when cut exudes a white-milky sap; leaves often with 1–3, large, conspicuous lobes.

107. Leaves and twigs covered in a dense indument of hirsute trichomes; plants colonial via suckering..... **Broussonetia**
107. Leaves and twigs pubescent to glabrous, but not hirsute-pubescent; plants not forming colonies via root suckers..... **Morus**

106. Plants without white-milky sap; leaves lobed or unlobed.

108. Leaves white on the abaxial surface and/or narrowly lanceolate to oblong-elliptic.

109. Leaves ovate with prominent, irregularly sized teeth; plant typically forming large colonies via root suckers..... **Populus**
109. Leaves lanceolate to oblong-elliptic with numerous small, equally sized teeth; plant not colonial..... **Salix**

108. Leaves green, bluish-green, or whitish-green on abaxial surface but not white and/or not narrowly lanceolate to oblong-elliptic.

110. Abaxial surface of leaves densely pubescent with stellate and/or tomentose trichomes.

111. Teeth of leaves with bristles; fruit a nut enclosed in a spiny set of bracts; plant monoecious ..... **Castanea**
111. Teeth of leaves without bristle tips; fruit a yellow to yellowish-orange, fleshy pome; plant synoecious..... **Eriobotrya**

110. Abaxial surface of leaves glabrous or variously pubescent but not densely pubescent.

112. Plant with prominent stipules; plant often bearing thorns; flowers white to pink, with an obvious perianth; fruit a fleshy drupe or pome.

113. Fruit a drupe; bark with prominent, horizontal lenticels ..... **Prunus**
113. Fruit a pome; bark without prominent, horizontal lenticels.

114. Leaf adaxial surface glossy; pomes with abundant stone cells ..... **Pyrus**
114. Leaf adaxial surface generally not glossy; pomes with few or no stone cells..... **Malus**

112. Plant lacking prominent stipules; plant without thorns; flowers green to yellowish green; perianth small and inconspicuous or lacking; fruit a samara or nut.

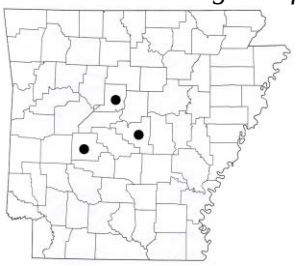
115. Twigs with two or more buds clustered at the apex; fruit a nut partially enclosed in a set of bracts ..... **Quercus**
115. Twigs with only one bud at the apex; fruit a samara ..... **Ulmus**

Catalog of Genera and Species

Abelia, Abelia, Caprifoliaceae

Abelia is a small genus of five species of deciduous to semi-evergreen shrubs native to Asia, mostly China (Yang et al. 2011a). Several of the species are important ornamentals for their showy flowers and glossy foliage.

Abelia × grandiflora (Rovelli ex André) Rehd. (Fig. 14).



Abelia × grandiflora (glossy abelia) is a semi-evergreen shrub to 2.5 m tall of interspecific hybrid origin between *A. chinensis* and *A. uniflora* (Bailey & Bailey 1976; Krüssmann 1976; Rehder 1990; Yang et al. 2011a). In addition to Arkansas, it has been reported as a component of the naturalized floras of Alabama, Arizona, Florida, Georgia, Mississippi, North Carolina, and Texas (Diamond & Woods 2009; Wunderlin & Hansen 2011; Poindexter 2013; Kartesz 2015; Serviss & Peck 2019; Weakley 2020; Keener et al. 2021; USDA, NRCS 2021). In Arkansas, it is known from Conway, Garland, and Pulaski counties.

Abelia × grandiflora frequently is cultivated in the southern USA, including Arkansas. It is grown for its showy, usually fragrant flowers and attractive, arching growth form. A number of horticultural varieties and forms exist for *A. × grandiflora*, and this taxon has been used repetitively in hybridization and introgression with other *Abelia* species to produce a variety of additional cultivars (Krüssmann 1976; Yang et al. 2011a; Landrein et al. 2017).

Apparently, under natural conditions, *Abelia* species generally do not establish populations via vegetative/clonal growth and viable seed production typically is low (Landrein et al. 2017). Establishment in Arkansas may have been from horticultural discards, or possibly from seeds (Serviss & Peck 2019) — in the horticultural trade, *Abelia* commonly is propagated through stem cuttings, and adventitious rooting of stem discards could give rise to escaped plants. Because of its long-time and frequent use in landscaping, persistence from cultivation cannot unequivocally be excluded as the origin of at least some *A. × grandiflora* plants. ***Habitat***: disturbed sites and waste places, dumpsites for horticultural waste, in some instances possibly long-persistent from cultivation.

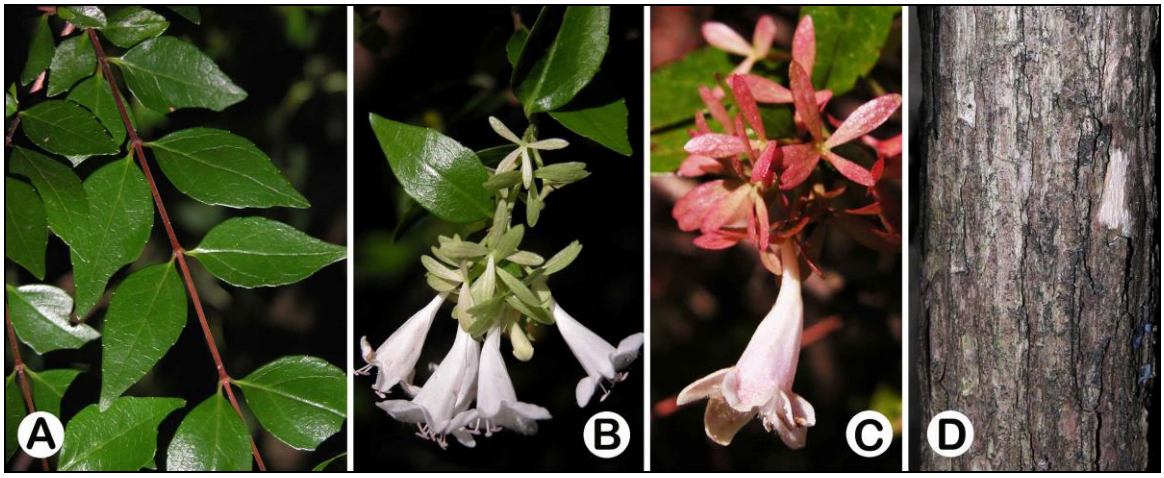


Figure 14. (A–D) *Abelia × grandiflora* plant and habit. (A) Stem and leaves. (B–C) Flowers and inflorescence. (D) Bark.

In Arkansas, *Abelia × grandiflora* is similar to the introduced *Kolkwitzia amabilis* (beauty bush). Although the two species are somewhat morphologically similar, they can be distinguished using the following key.

1. Flowers with corolla white to pinkish-white, sepals 2–5 per flower, even on same plant; pedicels, ovaries, and fruits glabrous to pubescent but not densely bristly-hirsute; leaves pubescent only on the abaxial surface .....**Abelia × grandiflora**
1. Flowers with corolla pale to dark pink (occasionally almost white), sepals 5; pedicels, ovaries, and fruits densely bristly-hirsute; leaves pubescent on both surfaces..... **Kolkwitzia amabilis**

Acer, Maple, Sapindaceae (formerly Aceraceae)

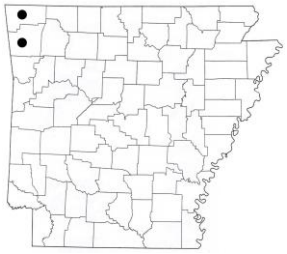
Acer is a genus of about 130 species of deciduous or evergreen shrubs and trees distributed over both temperate and tropical regions of Africa, Asia, Europe, and the Americas (Krüssmann 1976; Xu et al. 2008). Many species of *Acer* are important ornamentals that are grown for their attractive foliage and growth form, bright autumn colors, and for shade (Xu et al. 2008). The xylem sap of a number of maple species, such as *A. nigrum*, *A. rubrum*, and *A. saccharum*, among others, is used to produce maple syrup. The wood of maples is used for the production of furniture and other products that require a hard, dense wood (Bailey & Bailey 1976).

Six species of *Acer* occur in the Arkansas flora. Sometimes the morphologically diverse subspecies of the native *A. saccharum* are considered separate species, although this is not universally accepted. Two of the six species, *A. ginnala* and *A. palmatum*, are nonnative; neither are widespread in the state, with *A. palmatum* only documented as spontaneous or escaped via the presence of juvenile plants in the vicinity of cultivated trees of the species.

Species of *Acer* have opposite, simple, palmately lobed to rarely once pinnately compound leaves and small green, yellow-gold, or red perfect or imperfect flowers. The fruit is a schizocarp that disarticulates into two single-seeded samaras. Based on the combination of these characteristics, the genus is easy to distinguish from other woody taxa in the flora.

Acer ginnala Maxim. (Fig. 15).

Acer ginnala (amur maple, Siberian maple) is a large, deciduous shrub or small tree to about 6 m tall that is native to China and Japan (Xu et al. 2008). *Acer ginnala* has been documented from the floras of several states in the north-central and northeastern USA (Rhoads & Klein 1993; Rhoads & Block 2007; Kartesz 2015; USDA, NRCS 2021), and from Benton and Washington counties in northwestern Arkansas; however, it should be expected elsewhere in the state outside of cultivation. *Acer ginnala* is grown as an ornamental but also used as a windbreak or snow fence. A number of cultivars exist, including dwarf and variegated foliage forms, and some plants produce vivid, scarlet-colored foliage in autumn (Krüssmann 1976; Yatskievych 2006).



This species is extremely variable in regard to leaf shape and degree of lobe development, and although leaves generally are three-lobed or unlobed and ovate in outline, five-lobed leaves, leaves with deep sinuses between lobes, and elliptic-shaped or rhombic-shaped leaves also are encountered. The size and length of the teeth also is somewhat variable. Different combinations of the aforementioned leaf variations regularly occur on the same individual.

In Arkansas, *A. ginnala* is somewhat similar to the native *Acer rubrum* (red maple). It can be distinguished from *A. rubrum* by its clusters of fragrant, yellow flowers (produced with the leaves), persistent fruits that often remain on the plant into the next growing season, and by having a more or less green color on the lower surfaces of the leaves (*A. rubrum* generally has red, unscented flowers that are produced prior to leaf emergence in the spring, fruits that do not persist on the tree after maturation, and leaves that typically have white to glaucous lower surfaces). ***Habitat***: disturbed sites and waste places, urban woods, and roadsides.

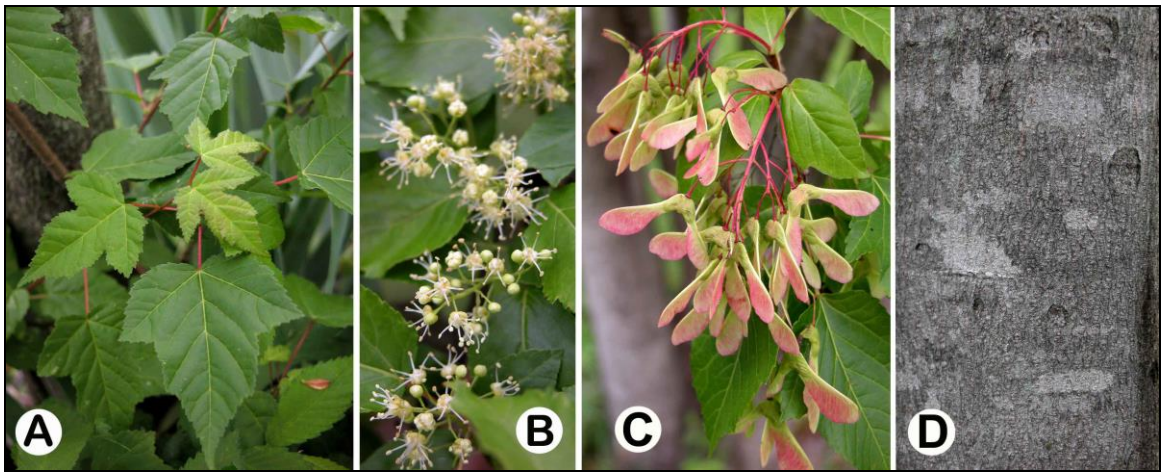


Figure 15. (A–D) *Acer ginnala* plant and habit. (A) Leaves. (B) Flowers. (C) Fruits. (D) Bark.

Acer palmatum Thunb. (Fig. 16).

Acer palmatum (Japanese maple) is a deciduous shrub or small tree to 8 m tall that is native to Korea and Japan (Xu et al. 2008). This species has been documented from the floras of a number of mostly northeastern states (Kartesz 2015; Shelter & Orli 2000; USDA, NRCS 2021); however, it also occurs in Arkansas and Louisiana. In Arkansas, it is known from Clark County based on the presence of numerous spontaneous juvenile plants produced from cultivated trees of the species (Fig. 163B–C). Escaped plants of *A. palmatum* should be expected elsewhere in Arkansas.

Acer palmatum regularly is cultivated as a specimen or accent tree for its outstanding autumn foliage, attractive growth form, deeply lobed to dissected leaves, and some cultivars for their anthocyanic, red-purple foliage (Bailey & Bailey 1976; Xu et al. 2008). It has been cultivated for centuries and over 400 horticultural varieties exist (Xu et al. 2008).

The prominently 7–9–lobed to deeply dissected leaves of *A. palmatum* clearly distinguish it from other *Acer* species in the state's flora. ***Habitat***: disturbed sites and waste places, especially in the vicinity of where plants of the species are cultivated.

Figure 16. (A–D) *Acer palmatum* plant and habit. (A–B) Stem and leaves (Fig. B shows a cultivar with laciniate leaves). (C) Fruits. (D) Bark.

Actinidia, Kiwi, Actinidiaceae

Actinidia is a genus of about 55 species of deciduous, twining, lianas widely distributed in Asia (Li et al. 2007). A few species, including *A. chinensis*, *A. arguta*, and *A. kolomikta* are grown for their high-quality edible fruits. Some species also are cultivated as ornamentals for their vining habit and showy, tropical-looking, often colorful foliage (Bailey & Bailey 1976).

Actinidia species have flowers that are functionally dioecious: plants have perfect flowers (with both pistils and stamens); however, one of the two whorls is reduced and generally nonfunctional, rendering the flowers (functionally) pistillate or staminate.

Actinidia chinensis Planch. var. **deliciosa** (A. Chev.) A. Chev (Fig. 17A).

Actinidia chinensis (green kiwi) is a large, twining, deciduous liana that grows to 10 m or more in length that is native to China (Li et al. 2007). It has been documented outside of cultivation in Arkansas in Saline County, and is escaped or naturalized in a number of other states (Serviss et al. 2012; Ladd & Thomas 2015; Tepe & Conover 2019; Serviss 2021). This species is easy to distinguish from other lianas in the state by the combination of the dense indument of large, red, reddish-brown, or white, setose or hispid trichomes that cover the young stems and leaves, relatively thick, robust stems, and large (at maturity — up to 20 cm long), cordate-acuminate, pubescent, prominently-veined leaves.

A somewhat similar species, *A. arguta* (hardy kiwi; Fig. 17B) also is naturalized in a few scattered states, mostly in the north-central and northeastern USA (Wilder & McCombs 2002; Serviss 2021); it sometimes is cultivated in Arkansas. This species, while not known currently from the state's flora, has become somewhat popular as a fruit commodity in the USA, and could potentially be encountered in the state outside of cultivation. *Actinidia arguta* differs from *A. chinensis* by lacking the dense indument of setose to hispid trichomes and by having smaller, glabrous green to reddish-green fruits.

Actinidia chinensis is the standard kiwifruit of commerce and represents one of the few temperate fruit crop species to have been domesticated in the last 100 years (Ferguson 1999). The kiwifruit industry began in 1904 when seeds collected in China were brought to New Zealand, and by 1970, the green kiwifruit had been developed into a production crop (Ferguson & Bollard 1990). *Actinidia chinensis* is grown commercially on a large-scale in four principal countries: Italy, China, New Zealand, and Chile, and although only small amounts are produced commercially in the USA, it

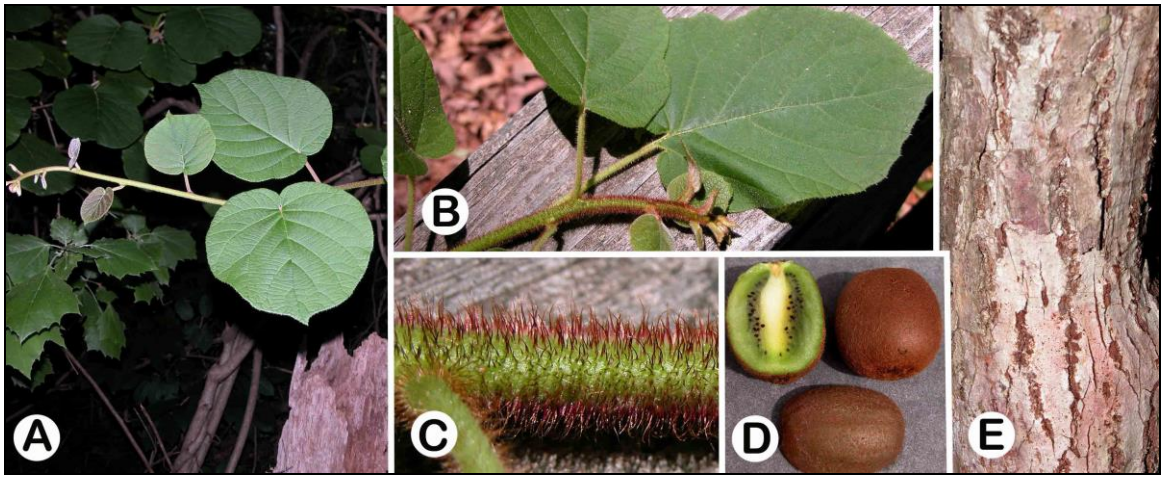


Figure 17A. (A–E) *Actinidia chinensis* plant and habit. (A) Twining stem with leaves. (B) Young leaves and stem. (C) Hirsute trichomes — these distinguish *A. chinensis* from other lianas in the flora. (D) Fruits (flesh can range in color from green to yellow). (E) Bark.

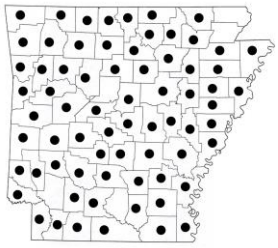
has become a popular commodity in this country (Ferguson 1999). As a result of its functionally dioecious flowers, however, both pistillate and staminate plants generally are required for fruit production. ***Habitat****:* disturbed areas and waste places, woodland edges, urban greenbelts, fencerows, roadsides; should be expected in the vicinity of where plants are cultivated or fruits are discarded.

Figure 17B. (A–D) *Actinidia arguta* plant and habit. (A–B) Leaves and stem (notice the lack of setose or hispid trichomes). (C) Mature fruits (notice they are glabrous and greenish-red; can have more red coloration; compare to the brown, usually pubescent fruits of *A. chinensis*, Fig. 17A, photograph D). (D) Bark.

Ailanthus, Varnish Tree, Simaroubaceae

Ailanthus is a genus of about 10 species of deciduous trees distributed over much of continental Asia and in Oceania (Peng & Wayt Thomas 2008). One species, *A. altissima*, is well-naturalized in the USA, including Arkansas, and is considered highly invasive.

Ailanthus altissima (Mill.) Swingle (Fig. 18).



Ailanthus altissima (tree-of-heaven) is a large, deciduous, colonial tree to 25 m tall that is native to Taiwan and China (Krüssmann 1976; Peng & Wayt Thomas 2008). It is naturalized over much of the USA, including Arkansas, where it occurs essentially statewide (Kartesz 2015; Weakley 2020; USDA, NRCS 2021). It is considered invasive in Arkansas (Gentry et al. 2013). In addition to prolific seed production, *A. altissima* is capable of aggressive asexual reproduction via root suckers that, over time, can produce large clonal stands of plants; this aggressive, suckering habit allows it to rapidly establish populations and become invasive.

This species regularly is planted in urban settings because of its tolerance to air pollution, heat, and a wide variety of soil types (Bailey & Bailey 1976). When the foliage of *A. altissima* is crushed or bruised, the plant produces a strong odor reminiscent of peanut butter. *Ailanthus altissima* produces metabolites (such as ailanthone) that probably function as allelochemicals (Lawrence et al. 1991) and may contribute to its invasive tendencies. It is an important plant in traditional Chinese medicine, especially as an astringent (Peng & Wayt Thomas 2008). The foliage also can be used as a food source for silkworms (Peng & Wayt Thomas 2008). A few species of birds feed on the seeds and the plant is browsed by deer (Hunter 1995).

In Arkansas, *A. altissima* somewhat resembles the arborescent species of *Rhus*: *R. glabra* (smooth sumac), *R. copallina* (winged sumac), and *R. typhina* (staghorn sumac), both in its general form and clonal habit. *Ailanthus altissima* can be distinguished, however, from species of *Rhus* by its large mature size, larger leaves with more (and larger) leaflets, and diagnostically by the one to two large, plate-shaped glands that occur at the apices of the large teeth that are present at the base of

many of the leaflets. Arkansas species of *Rhus* are shrubs or small trees and lack these glands on the leaflets. ***Habitat:*** disturbed sites and waste areas in urban environments, especially in the vicinity of where *A. altissima* is cultivated, also riparian zones, woodland edges, and mesic woods.

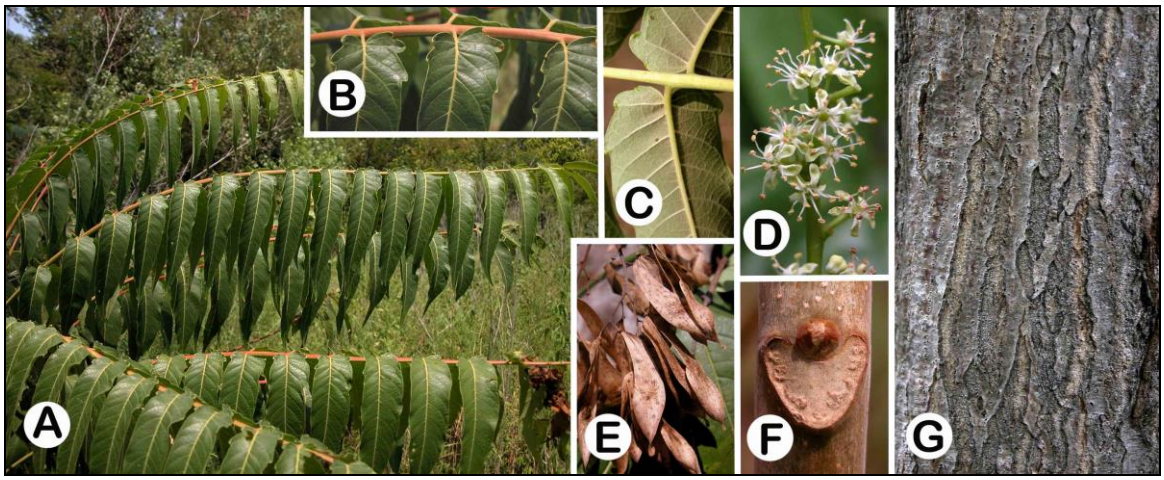
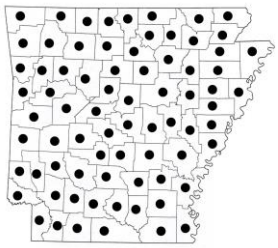


Figure 18. (A–G) *Ailanthus altissima* plant and habit. (A–C) Leaves and leaflets (Fig. C shows a close-up view of the leaflet lower surface with plate-shaped glands on the teeth). (D) Staminate flowers. (E) Fruits. (F) Prominent leaf scar. (G) Bark.

Albizia, Albizia or Mimosa, Fabaceae

Albizia is a genus of 120–140 species of deciduous trees and shrubs distributed over warm-temperate, subtropical, and tropical regions worldwide (Isely 1998; Wu & Nielsen 2010). Although a number of species are cultivated in warm regions for their showy, "fluffy-looking" flowers and attractive foliage, only a few, such as *A. julibrissin* (mimosa) and *A. coreana* (Korean silk tree), are grown in temperate regions, as unlike most species of *Albizia*, they are relatively cold-tolerant. *Albizia julibrissin* is the only species in the genus that is widely naturalized in the USA, outside of subtropical zones (Isely 1998).

Albizia julibrissin Duraz. (Fig. 19).



Albizia julibrissin (silk tree, mimosa) is a small to medium-sized, deciduous tree to 20 m tall that is native to much of Asia, from Iran to Japan (Wu & Nielsen 2010). Despite its relative abundance in the Arkansas (and USA) flora, *A. julibrissin* still commonly is sold and used as an ornamental for its colorful flowers, attractive, "feathery-looking" foliage, relatively small mature size, and ease of cultivation. Though *A. julibrissin* is a relatively short-lived species (typically 30–45 years), the ability to prolifically self-seed and produce large numbers of offspring has allowed it to become relatively common, sometimes even weedy, in Arkansas. It is not uncommon to observe large numbers of juveniles in the proximity of adult, reproductive age trees, which can eventually give rise to large colonies of plants.

Albizia julibrissin is used mostly for ornamental and landscape purposes, but flowers are attractive to butterflies, bees, and hummingbirds. The seeds sometimes are eaten by squirrels and a few types of birds, and the foliage occasionally is browsed by deer; however, the species is only of limited wildlife value (Hunter 1995).

Mimosa vascular wilt, caused by the fungus *Fusarium oxysporum*, commonly infects *A. julibrissin* and the infection generally is fatal to the tree. Yellowing of the leaves, followed by wilting and defoliation are the early symptoms of infection, with subsequent death of the tree usually

occurring between a few weeks to a few months post-infection. The route of infection is generally entry via the root system, with subsequent spread of the fungus through the xylem tissue.

The combination of the mimosoid flowers, bipinnately compound leaves with numerous, closely spaced, small leaflets, and spreading or arching, "umbrella-like" growth form distinguish *A. julibrissin* from other woody species in the state's flora. ***Habitat***: disturbed sites and waste places, roadsides, fencerows, old fields, and woodland edges; however, it also may be found in rocky or mountainous areas, riparian zones, and occasionally as a large tree in mesic or bottomland wooded habitats.

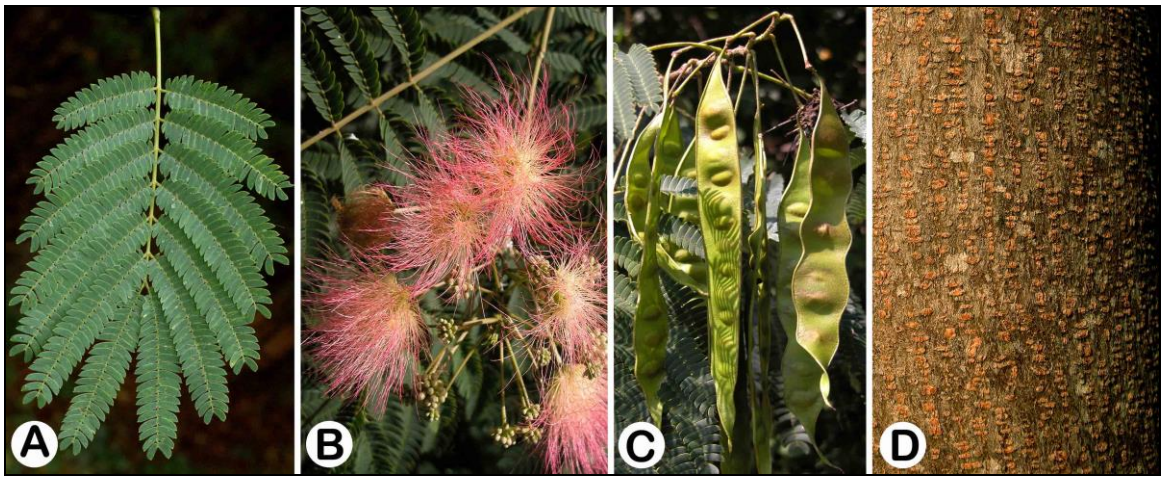
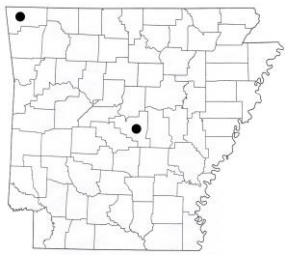


Figure 19. (A–D) *Albizia julibrissin* plant and habit. (A) Leaf and leaflets. (B) Flowers. (C) Mature fruits. (D) Bark.

Ampelopsis, Peppervine, Vitaceae

Ampelopsis is a genus of 15–30 species of deciduous, tendrillate, lianas distributed primarily over North America and Asia (Chen & Wen 2007; Moore & Wen 2016). A few species, such as *A. glandulosa*, are cultivated as ornamentals for their attractive foliage, vining habit, and showy, transitionally-colored fruits. Three species of *Ampelopsis* occur in the Arkansas flora; all are native with the exception of the highly invasive *A. glandulosa*. *Ampelopsis arborea* sometimes is placed in the genus *Nekemias* (*N. arborea*).

Ampelopsis glandulosa (Wall.) Momiy.; Syn.: *Ampelopsis brevipedunculata* (Maxim.) Trautv. (Fig. 20).



Ampelopsis glandulosa (porcelain berry, amur peppervine) is a large, deciduous, tendrillate liana to 8 m or more in length that is native to China, Japan, Korea, and Russia (Chen & Wen 2007). It is naturalized in several states in the eastern USA (Moore & Wen 2016; Weakley 2020), including Arkansas, where it currently is known from Benton and Pulaski counties. *Ampelopsis glandulosa* is, however, highly invasive and sometimes cultivated in the state, and thus should be expected elsewhere in the flora. Cultivars of the species with very deeply lobed leaves and white and pink variegated foliage exist (Krüssmann 1976).

The fruits of *Ampelopsis* species readily are eaten and the seeds subsequently dispersed by birds. Mammals and possibly water also may function as dispersal vectors for seeds (Robertson et al. 1994; Williams et al. 2008). *Ampelopsis glandulosa* produces densely leafy stems that cover and shade existing plants. It prefers habitats with at least partial sun, and most commonly is observed in disturbed riparian zones or woodland edges. It is tolerant of wet soils.

Ampelopsis glandulosa resembles the native *A. cordata* (heartleaf pepper vine), but may be distinguished from it by its pubescent stems and leaves that are shallowly to deeply palmately lobed. *Ampelopsis cordata*, contrastingly, has glabrous to nearly glabrous stems and leaves that are either unlobed, or if lobed, the lobes small and not prominent. *Ampelopsis glandulosa* also somewhat resembles *Muscadinia rotundifolia* (muscadine, scuppernong) and many species of *Vitis* (grape) — it may be distinguished from *M. rotundifolia* by its white-colored pith and from *Vitis* by its white, continuous pith at the nodes, tight, smooth bark, and flattened, cymose inflorescences (*M. rotundifolia* and *Vitis* have brown pith, and *Vitis* has interrupted pith, exfoliating bark, and thyrsate inflorescences). ***Habitat***: mesic to wet soils of disturbed sites, bottomland forests, woodland edges, thickets, riparian zones, riverbanks, lake shores, swamp margins, fencerows, and roadsides.

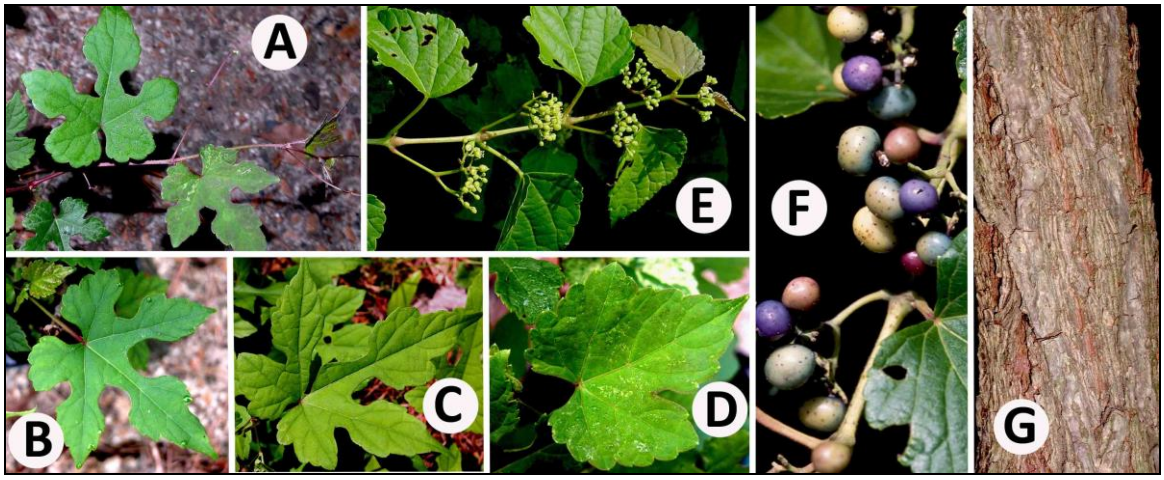


Figure 20. (A–G) *Ampelopsis glandulosa* plant and habit. (A) Leaves and stem. (B–D) Leaves showing some of the variation in lobing that can occur. (E) Flowers. (F) Fruits (notice the range of colors from cream and pale blue to magenta and purple. (G) Bark. Photo credits: E–F: James H. Miller, USDA Forest Service, Bugwood; G: Leslie J. Mehrhoff, University of Connecticut, Bugwood.

Berberis, Barberry, Berberidaceae

Berberis is a large genus of about 450–500 species of deciduous and evergreen shrubs distributed essentially worldwide (Whittemore 1997; Ying 2011). Several species in the genus are used as ornamentals for their attractive foliage forms and colorful fruits (Bailey & Bailey 1976; Krüssmann 1976). The berries of many species are edible and frequently are used for making jam and jelly (Whittemore 1997).

Berberis thunbergii is the only nonnative species in the genus currently documented in the Arkansas flora. It commonly is cultivated and also well-naturalized in Arkansas and much of the eastern USA (Whittemore 1997; Weakley 2020). It is considered highly invasive over much of its naturalized range. The genus *Mahonia* often is included within *Berberis*, as the range of characteristics among a number of species of both genera show considerable intergradation.

Berberis julianae C.K. Schneider (Fig. 21).

Berberis julianae (wintergreen barberry, Chinese barberry) is an evergreen shrub to 3 m tall that is native to China (Ying 2011). At present, this species is not known to occur outside of cultivation in Arkansas, but it has been documented from the floras of a few other southeastern states, including Alabama and Mississippi (Kartesz 2015; Weakley 2020), the latter of which borders Arkansas. It should be expected in the state outside of cultivation. *Berberis julianae* sometimes is cultivated for its unusual evergreen foliage and attractive, bright-yellow flowers.

The thick-coriaceous, prominently spine-toothed, narrow leaves, trifid stipular spines to 4 cm in length, bright yellow flowers arranged in (3–)10–25-flowered fascicles, and blue-black ellipsoid

fruits distinguish *B. julianae* from other shrubs in the flora, including the other species of *Berberis* known from the state. ***Habitat***: disturbed sites and waste places.

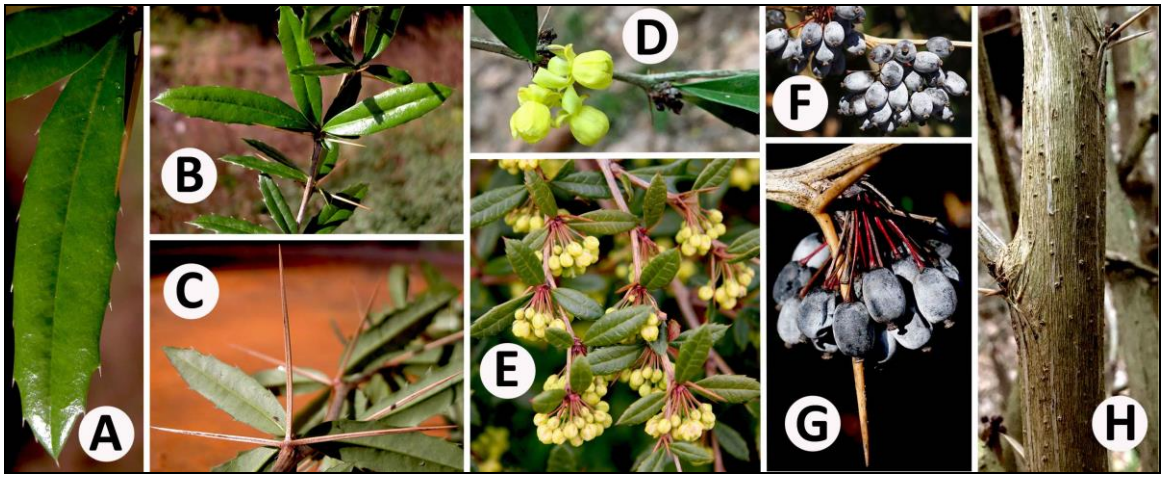
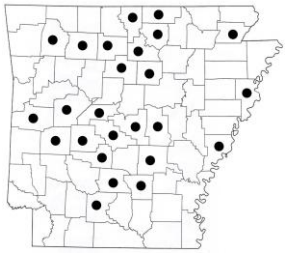


Figure 21. (A–H) *Berberis julianae* plant and habit. (A–B) Leaves and stems. (C) Trifid stipular spine. (D–E) Flowers. (F–G) Mature fruits. (H) Bark. Photo credits: E: Robert Vidéki, Doronicum Kft., Bugwood; F–G: NC State Extension Gardner Plant Toolbox.

Berberis thunbergii DC. (Fig. 22).



Berberis thunbergii (Japanese barberry) is a small, deciduous shrub to about 2 m tall that is native to Japan (Whittemore 1997). It is naturalized in Arkansas, where it occurs in several counties. This species is common in cultivation and invasive and thus may be more frequent in the state than current records indicate. *Berberis thunbergii* is naturalized across much of the central and eastern USA (Whittemore 1997; Kartesz 2015; Weakley 2020). It is considered invasive in Arkansas (Gentry et al. 2013).

Berberis thunbergii will tolerate dense shade, allowing it to invade and establish in wooded habitats. It also is tolerant of well-drained or moist soils. The fruits of *B. thunbergii* are bird-dispersed, contributing to its invasive habit. Numerous horticultural forms of this species exist, including dwarf types, and forms with red, purple, yellow, or variegated foliage (Krüssmann 1976).

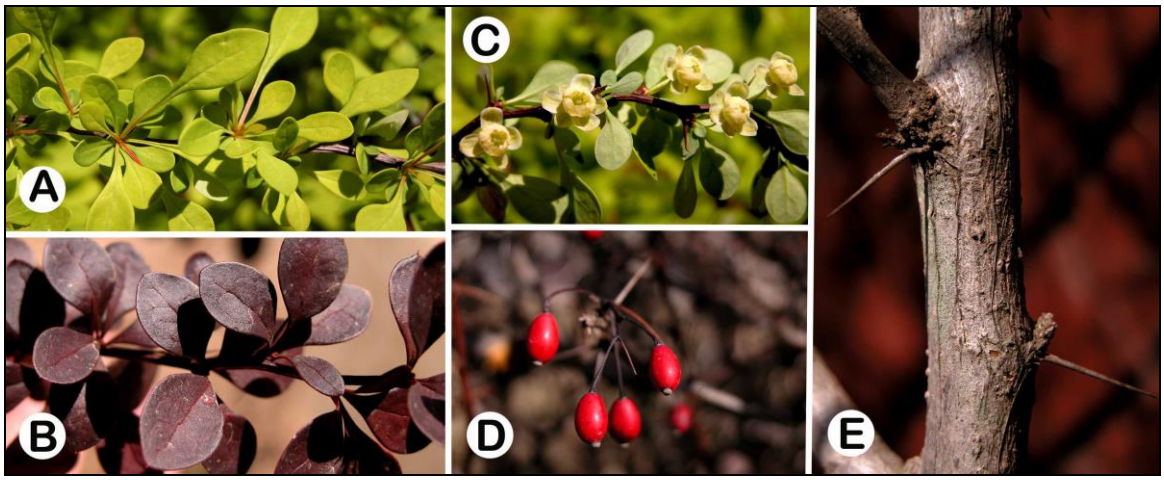


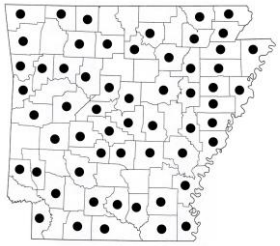
Figure 22. (A–E) *Berberis thunbergii* plant and habit. (A–B) Leaves and stems. (C) Flowers. (D) Mature fruits. (E) Bark and stipular spines.

The combination of small, tightly clustered leaves with long-tapering bases, prominent, slender spines, and angled, striate stems distinguish *B. thunbergii* from other shrubs in the Arkansas flora. ***Habitat***: woods, woodland edges, thickets, riparian zones, fields, and roadsides.

Broussonetia, Paper Mulberry, Moraceae

Broussonetia is a small genus of seven or eight species of deciduous trees with milky sap that are native to Asia and Polynesia (Wunderlin 1997a; Wu et al. 2003a). A single species, *B. papyrifera*, is cultivated and widely naturalized in the eastern USA, including Arkansas.

Broussonetia papyrifera (L.) Vent. (Fig. 23).



Broussonetia papyrifera (paper mulberry) is a small to medium-sized, deciduous, colonial tree to 20 m tall that is native from temperate East Asia to Polynesia (Wunderlin 1997a; Wu et al. 2003a). It is well-naturalized in the USA (Wunderlin 1997a; Kartesz 2015; Weakley 2020) and Arkansas, where it occurs in most counties. This species often is encountered as large, clonal stands of trees, with numerous root suckers spreading from larger plants via an aggressive and invasive root system. It often spreads vegetatively into adjacent areas from cultivated plants. Staminate plants of *B. papyrifera* are more frequently encountered in the flora than pistillate individuals.

Broussonetia papyrifera sometimes is cultivated as a small shade tree and the wood is used for furniture (Wu et al. 2003a). A high-quality paper or barkcloth is made from the fibrous bark (Wunderlin 1997a).

In Arkansas, *B. papyrifera* very closely resembles *Morus rubra* (red mulberry) and *Morus alba* (white mulberry), but easily can be differentiated from them by the dense indument of long, hirsute trichomes that cover young stems, twigs, and leaves. Like the aforementioned *Morus* species, *B. papyrifera* has the characteristically variable leaves that may be lobed with one, two, or three lobes, or unlobed, and the white-milky sap that is exuded when portions of the plant are damaged. The combination of the large leaves and dense indument of stiff, hirsute trichomes covering the foliage aids in distinguishing *B. papyrifera* from most other woody plants in the state. ***Habitat***: disturbed or open woods, urban woods and greenbelts, woodland edges, thickets, roadsides, and other waste places.

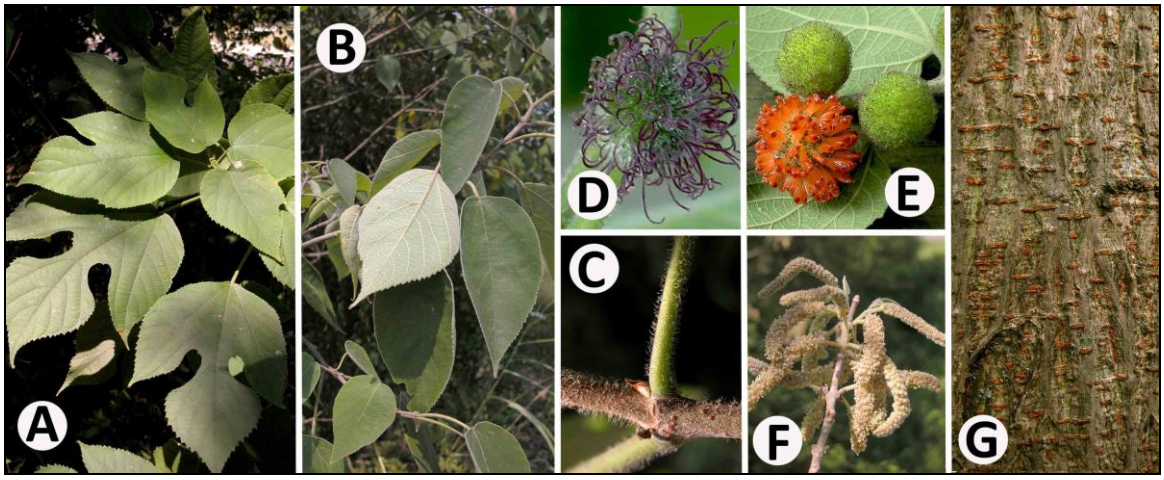


Figure 23. (A–G) *Broussonetia papyrifera* plant and habit. (A–B) Leaves. (C) Stem showing hirsute trichomes. (D) Pistillate flowers and inflorescence). (E) Fruits. (F) Staminate flowers and catkins. (G) Bark. Photo credit: D–E: Adam Agosta and Suanne Taylor, LSU School of Renewable Natural Resources.

Buddleja, Butterfly Bush, Buddlejaceae (formerly Loganiaceae)

Buddleja is a genus of about 100 species of deciduous or evergreen shrubs or occasionally trees or lianas distributed over warm-temperate, subtropical, and tropical Africa, Asia, and the Americas (Krüssmann 1976; Li & Leeuwenberg 1996). Species of *Buddleja* are prized as ornamentals for their colorful, showy, sometimes fragrant flowers.

Buddleja davidii Franch. (Fig. 24).

Buddleja davidii (orange-eye butterfly bush, summer lilac) is a deciduous to semi-evergreen shrub or small tree to 5 m tall that is native to China (Krüssmann 1976; Li & Leeuwenberg 1996). In Arkansas, it is known from Clark County based on the presence of spontaneous juvenile plants produced from cultivated individuals of the species (Fig. 163I). *Buddleja davidii* is naturalized in several eastern states, including Tennessee, which borders Arkansas (Kartesz 2015; Weakley 2020), and is considered invasive as a state-listed noxious weed in Oregon and Washington (Washington State Noxious Weed Control Board 2021). Moreover, in Arkansas, *B. davidii* is common in cultivation and sometimes produces fruits and seeds; it should be expected elsewhere in the flora.

Numerous horticultural forms of this species exist, and differ primarily in regard to mature size and flower color (Krüssmann 1976). Plants with purple (various shades), lilac, blue, pink, maroon, and white-colored flowers may be encountered in cultivation. Hummingbirds, along with many types of insects, in particular forms of Hymenoptera and Lepidoptera, are attracted to the flowers of *Buddleja* species.

Buddleja lindleyana Fort. ex Lindl. (Lindley's butterfly bush) is a morphologically similar species to *B. davidii*, and while not currently documented outside of cultivation in Arkansas, should, as *B. davidii*, be expected in the state's flora. It is frequent in cultivation, and naturalized in several southeastern states, including Louisiana, Mississippi, Tennessee, and Texas (Kartesz 2015; Weakley 2020), all of which border Arkansas. *Buddleja lindleyana* may be distinguished from *B. davidii* by its flowers that lack orange coloration in the throat, more open inflorescences, and leaves that are only slightly pubescent on the lower surface. *Buddleja davidii*, in contrast, has flowers that are orange to yellowish-orange inside, densely-flowered inflorescences, and leaves that are densely white-tomentose-pubescent on the lower surface. ***Habitat***: disturbed sites and waste places, especially on well-drained, rocky sites or highly disturbed sites in urban environments, such as masonry walls, along sidewalks and roadsides; also along riparian zones.

Figure 24. (A–G) *Buddleja davidii* plant and habit. (A) Leaves. (B) Stem showing dense indument of white trichomes. (C–E) Flowers showing some of the range of colors that occur. (F) Mature fruits. (G) Bark.

Buxus, Boxwood, Buxaceae

Buxus is a genus of about 70 species of evergreen shrubs and small trees distributed over Africa, Asia, Europe, and Central America (Krüssmann 1976). Two species, *B. microphylla* and *B. sempervirens*, are important ornamentals.

Buxus sempervirens L. (Fig. 25).

Buxus sempervirens (common boxwood) is an evergreen shrub or small tree to 9 m tall that is native to Europe, North Africa, and Asia Minor (Bailey & Bailey 1976; Krüssmann 1976). It is naturalized sporadically in a number of eastern states, including Arkansas, where it has been documented from Clark County (Diamond 2013; Serviss et al. 2020; Weakley 2020). It should be expected elsewhere in the state's flora. It frequently is cultivated in Arkansas.

Buxus sempervirens is used predominately as an evergreen accent specimen or as a living hedge. It has been cultivated for centuries and numerous forms and cultivars currently exist, and much natural variation occurs within the species. (Krüssmann 1976).

In the Arkansas flora, the small, opposite, leathery leaves, sharply quadrangular stems, and dense growth form of *B. sempervirens* distinguish it from most other shrubs. It potentially could be confused with some of the smaller-leaved, evergreen hollies, such as *Ilex vomitoria* (yaupon holly) and *I. crenata* (Japanese holly). However, *B. sempervirens* has oppositely arranged leaves, whereas both *Ilex* species have alternate phyllotaxy. ***Habitat***: disturbed sites and waste places, riparian zones, and urban woods and greenbelts.

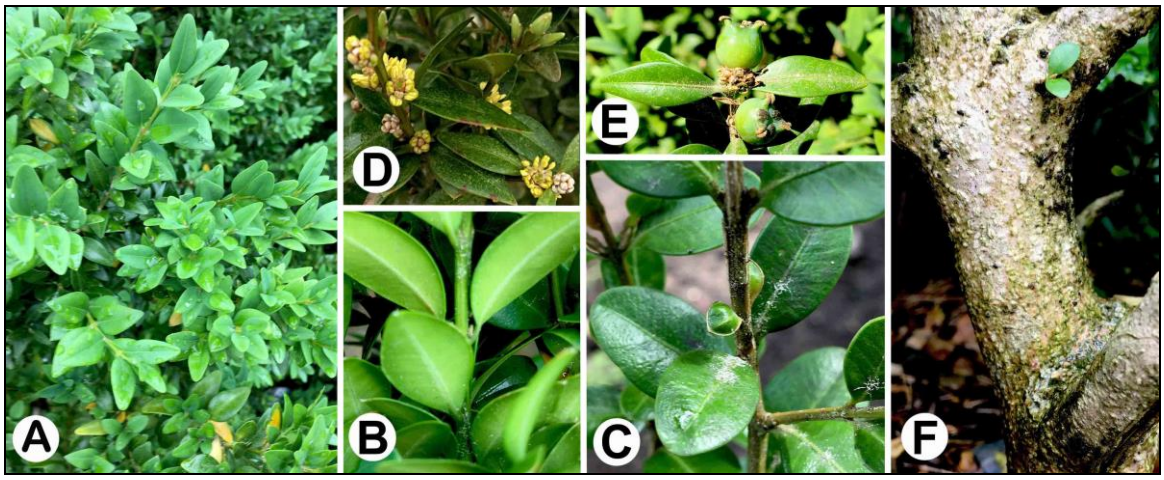


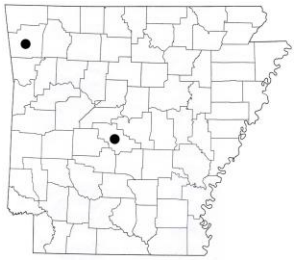
Figure 25. (A–F) *Buxus sempervirens* plant and habit. (A–C) Leaves and stems. (D) Flowers. (E) Mature fruits. (F) Bark. Photo credit: D–E: Tricia Serviss.

Callicarpa, Beautyberry, Lamiaceae (formerly Verbenaceae)

Callicarpa is a genus of about 140 species of deciduous or evergreen, often aromatic shrubs or rarely trees, distributed mostly over subtropical and tropical Asia, with only a few species present in temperate regions (Chen & Gilbert 1994a). The genus is of only minor economic importance; a small number of species are used as ornamentals for their showy, brightly-colored fruits that are produced in late summer and autumn.

Species of *Callicarpa* have opposite or occasionally verticillate, simple, toothed leaves and small, perfect (bisexual) flowers produced in many-flowered, axillary cymes. The fruit is a small, few-seeded drupe.

Callicarpa dichotoma (Lour.) Koch (Fig. 26).



Callicarpa dichotoma (Chinese beautyberry, purple beautyberry) is a small, deciduous shrub to 3 m tall that is native to China (Chen & Gilbert 1994a). It currently is known in the Arkansas flora only from Saline and Washington counties; however, based on its tendency to prolifically self-seed it should be expected elsewhere in the state, especially in the vicinity of where cultivated plants of the species are present. It has been documented from the naturalized floras of a few other eastern states (Campbell & Medley 2012; Kartesz 2015; Atha et al. 2019; Riley et al. 2020; Weakley 2020).

Callicarpa dichotoma morphologically is similar to, and possibly confused with, the native *C. americana* (American beautyberry); however, can be distinguished from it by the conspicuous and clearly exposed peduncles of its inflorescences that are 1–2 cm long and longer than the petiole of the subtending leaf, and leaves that are narrowly elliptic to obovate with acute to short-acuminate apices. In contrast, *C. americana* has peduncles that are 1–5 mm long, shorter than the petiole of the subtending leaf, and usually obscured by the flowers and/or fruits, and leaves that are broadly elliptic with long-acuminate apices. ***Habitat***: open woods and woodland edges, including upland woods, urban greenbelts, disturbed areas, and waste places, especially in the vicinity of where plants of the species are cultivated; also in habitats with moist soils.

Callicarpa japonica Thunb. (Japanese beautyberry), while not currently known from the Arkansas flora, sometimes is cultivated and occasionally escapes in the USA (Atha et al. 2019; Weakley 2020). *Callicarpa japonica* morphologically is similar to both *C. dichotoma* and *C. americana*. It can be distinguished from both species, however, by its glabrous branches (young branches may be slightly pubescent, but soon become glabrous); both *C. dichotoma* and *C. americana* have branches (at least while young) with stellate trichomes.

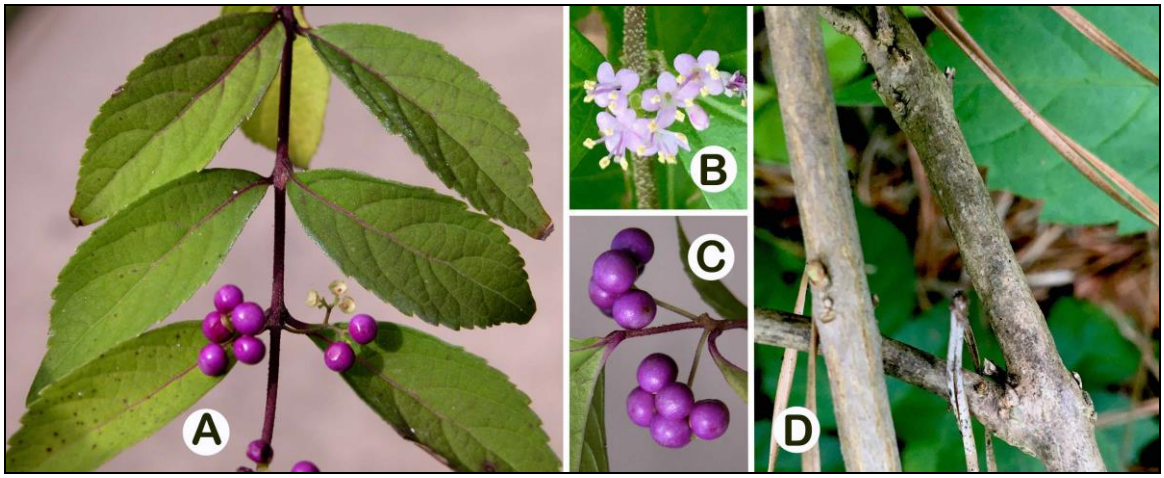


Figure 26. (A–D) *Callicarpa dichotoma* plant and habit. (A) Leaves and stems (laminas sometimes are wider relative to the length than what is shown). (B) Flowers. (C) Mature fruits. (D) Bark.

Camellia, Camellia, Theaceae

Camellia is a genus of about 120 species of evergreen shrubs and trees widely distributed across much of Asia (Bailey & Bailey 1976; Min & Bartholomew 2007a). A few species, such as *C. japonica*, *C. sasanqua*, and *C. reticulata*, are prominent, highly regarded ornamentals for their large, showy, colorful flowers and glossy, evergreen foliage.

Camellia sinensis is the most economically important species in the genus, as it is the commercial source of tea, which is obtained by harvesting young leaves. In China, the seeds of *C. oleifera* are an important source of oil used in cooking (Min & Bartholomew 2007a).

Species of *Camellia* have alternate, simple, toothed leaves and perfect (bisexual), often large, solitary or paired flowers arranged in axillary inflorescences. The fruit is a large, few-seeded capsule.

Camellia japonica L. (Fig. 27).

Camellia japonica (Japanese camellia, common camellia) is a large, evergreen shrub or sometimes a small to medium-sized tree to 12 m tall that is native to China, Japan, South Korea, and Taiwan (Min & Bartholomew 2007a). Though widely cultivated in Arkansas, this species is not established in the flora; however, cultivated individuals sometimes produce seedlings, providing the possibility of escape and occurrence outside of cultivation in the state (Serviss & Peck 2008, 2016a). Spontaneous seedlings have been observed in Clark County (Fig. 163K), but should be expected anywhere plants of *C. japonica* are grown. *Camellia japonica* is known from the floras of a few other southeastern states (Diamond 2013; Weakley 2020).

This species generally is considered one of the preeminent ornamentals in southern landscaping. It is reasonably easy to cultivate in warm-temperate climates with well-drained, at least mildly acidic soils and adequate precipitation. Few shrubs rival its attractive display of large, colorful flowers, ranging from white to various shades of pink and red (produced in late autumn and early to mid-winter). Numerous (over 2,000) named horticultural varieties and forms exist, mostly based on variations in flower color and morphology, including ones with "semi-doubled" and "doubled," rose-like flowers and forms with two-toned, variegated flowers in white and shades of pink or red (Bailey & Bailey 1976). It has been cultivated in Asia for centuries. In Arkansas, *Camellia japonica* morphologically is similar to *C. sasanqua* (see entry for *C. sasanqua* for distinguishing characteristics between the species — juvenile forms of the two species are extremely similar; compare Fig. 163K with Fig. 163L). ***Habitat***: disturbed areas in the vicinity of cultivated individuals of the species.

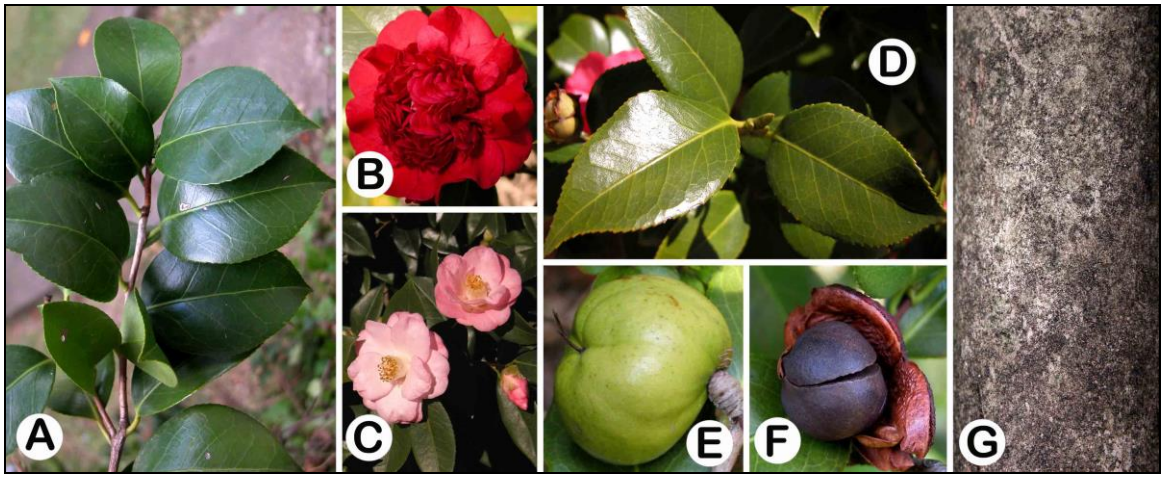


Figure 27. (A–G) *Camellia japonica* plant and habit. (A) Leaves and stems. (B–C) Flowers. (D) Young leaves and stem tip. (E) Mature fruit. (F) Seeds. (G) Bark.

Camellia sasanqua Thunb. (Fig. 28).

Camellia sasanqua (fall-flowering camellia) is a large, evergreen shrub or small tree to 5 m tall that is native to Japan (Min & Bartholomew 2007a). It sometimes is cultivated in Arkansas and has been recorded as escaped in Clark County (Serviss & Peck 2016a). Although it is not well-established in the state, *C. sasanqua* does prolifically self-seed and produce large numbers of spontaneous juveniles in the vicinity of reproductive age plants; it should be expected elsewhere in the flora. *Camellia sasanqua* also is a component of the naturalized floras of Alabama, Florida, Georgia, and the Carolinas (Kartesz 2015; Byrd & Diamond 2018; Weakley 2020). This species is a

high-quality ornamental with attractive, glossy, evergreen foliage and large showy flowers ranging in color from white to lavender, pink, or magenta. It is easy to cultivate, provided the soils are well-drained and at least mildly acidic.

Camellia sasanqua is similar to *C. japonica*, which has been documented to successfully reproduce in Arkansas (Serviss & Peck 2008). *Camellia sasanqua* can be distinguished from *C. japonica* by its pubescent stems (on new growth) and leaves (along midvein of upper surface), and smaller flowers (3.8–5.2 cm in diameter). *Camellia japonica* has completely glabrous foliage and larger flowers (7.6–17.8 cm in diameter). ***Habitat***: disturbed areas, urban woods and greenbelts, woodland edges, and riparian zones, especially in the vicinity of cultivated plants of the species.

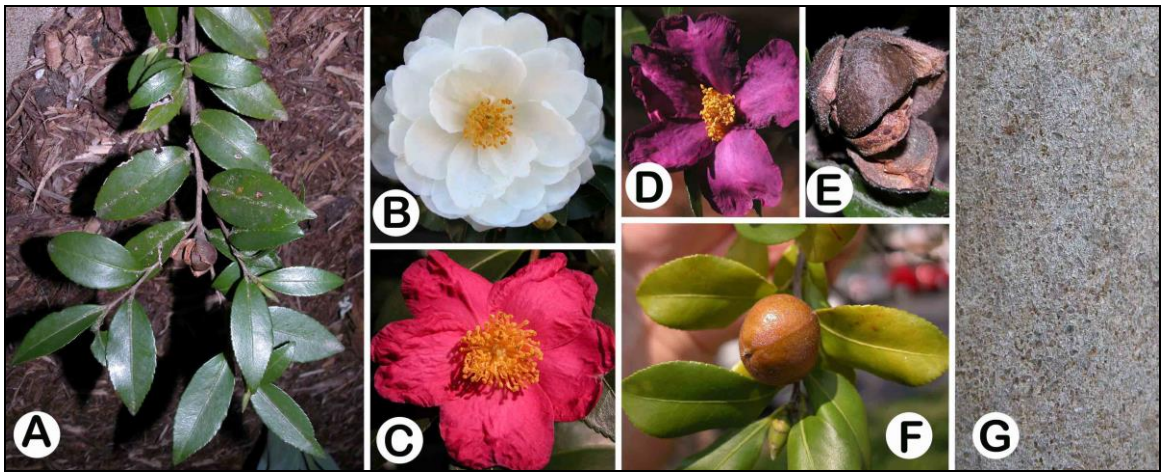


Figure 28. (A–G) *Camellia sasanqua* plant and habit. (A) Leaves and stems. (B–D) Flowers. (E) Seeds. (F) Mature fruit. (G) Bark.

Camptotheca, Trees-of-life, Nyssaceae

Camptotheca is a small genus of two species, both native to China (Qin & Phengklai 2007). *Camptotheca acuminata*, and its congener, *C. lowreyana*, are the principal source of the alkaloid camptothecin, which has been demonstrated to have strong anti-cancer qualities.

Camptotheca acuminata Decne. (Fig. 29).

Camptotheca acuminata (tree-of-life, cancer tree) is a medium-sized, deciduous tree to 20 m tall that is native to China (Qin & Phengklai 2007). It occasionally is cultivated in the southern USA, including Arkansas. In Arkansas, it is known from Clark County based on the presence of spontaneous juvenile plants produced from cultivated individuals of the species (Fig. 164A). Though this species currently is not naturalized in the state, it appears from initial observations to prolifically self-seed and escaped individuals should be expected in areas where *C. acuminata* plants are cultivated.

The combination of its large leaves with numerous, prominent lateral veins, horizontal branching pattern, rounded infructescences of large, tightly-clustered, elongate samaras, and gray, deeply ridged and furrowed bark distinguish *C. acuminata* from most other woody species in the state. *Camptotheca acuminata*, however, morphologically is similar to the native *Nyssa sylvatica* (black gum), but may be distinguished from it by its larger leaves (13.5–31 cm long) with numerous, (4–)8–11(–15) pairs of prominent, lateral veins. The leaves of *N. sylvatica* are smaller — 5.5–12(–16) cm long and lack this venation pattern. ***Habitat***: disturbed sites, especially in the vicinity of cultivated plants of the species.

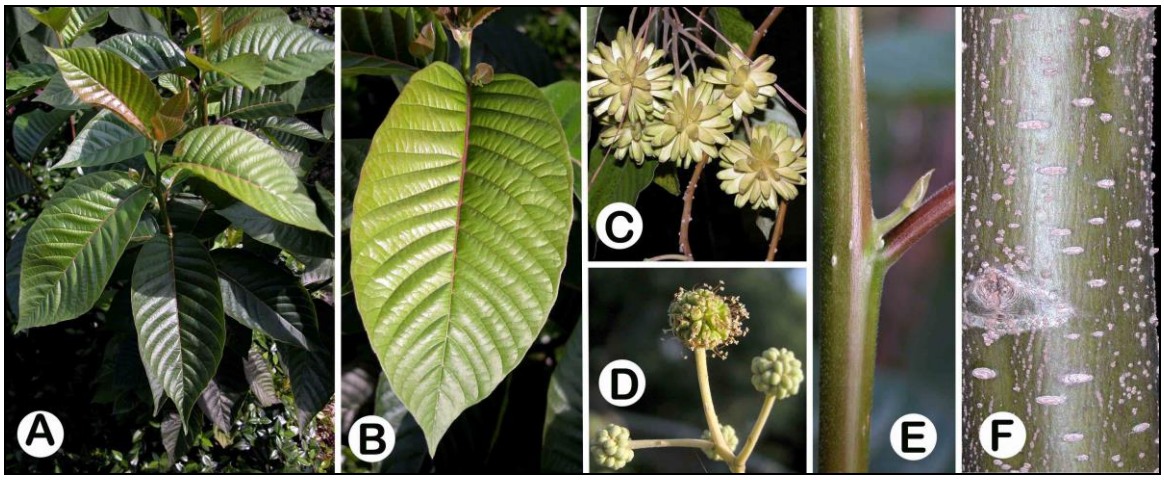


Figure 29. (A–F) *Camptotheca acuminata* plant and habit. (A–B) Leaves. (C) Mature fruits. (D) Flowers and inflorescences. (E) Stem. (F) Young bark (older bark is light gray and ridged and furrowed, with flattened ridges).

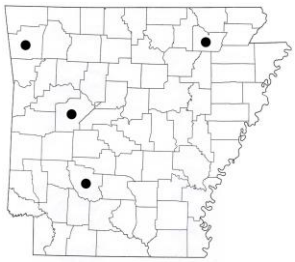
Castanea, Chestnut or Chinquapin, Fagaceae

Castanea is a small genus of about 12 species of deciduous trees distributed over Asia, Europe, and North America (Nixon 1997a; Huang et al. 1999a). Most species are cultivated for their edible fruits (nuts) and as a source of highly durable wood for the production of furniture, veneers, and coffins (Huang et al. 1999a). Two species of *Castanea* occur in the Arkansas flora: the native and relatively widespread *C. pumila* (Alleghany/Ozark chinquapin), which is separated into two botanically distinct varieties, and the nonnative *C. mollissima*.

Species of *Castanea* have alternate, simple, coarsely toothed leaves and small, nondescript, imperfect (unisexual) flowers with staminate (male) flowers arranged in many-flowered, terminal inflorescences and pistillate (female) flowers positioned at the base of the staminate inflorescences, or separate in small axillary clusters or solitary. The fruit is a large, woody nut enclosed by a series of fused, spiny bracts that form an involucre or cupule that encloses the nut(s).

Species of *Castanea* closely resemble some of the oaks (*Quercus*); however, *Castanea* may be distinguished from *Quercus* by their twigs which lack clustered buds at the apex and the spiny bracts that enclose the fruits (*Quercus* species have twigs with two or more buds clustered together at the apex of the twig and bracts that are not spinose).

Castanea mollissima Blume (Fig. 30).



Castanea mollissima (Chinese chestnut) is a shrub or small to medium-sized, deciduous tree to 20 m tall that is native to Korea and China (Huang et al. 1999a). It is naturalized in several eastern states (Pittillo & Brown 1988; Peck & Serviss 2011; Yatskievych 2013; Kartesz 2015; Riley et al. 2020; Weakley 2020), including Arkansas, where it is known from four counties. *Castanea mollissima* also is cultivated in the state.

Unlike *C. dentata* (American chestnut), *C. mollissima* is not killed by the chestnut blight; it is resistant, but not immune. The nuts provide desirable forage for a number of small mammal species and also are eaten by humans.

When mature, the spines on the bracts/cupules that cover the nuts become very hard. Cupules fallen on the ground pose a threat of injury to anyone who may step or fall onto them.

In Arkansas, *C. mollissima* may be confused with a few species of *Quercus* that have toothed rather than deeply lobed leaves: *Q. acutissima* (sawtooth oak), *Q. muehlenbergii* (chinquapin/chestnut oak), *Q. michauxii* (swamp chestnut oak), and *Q. prinoides* (dwarf chestnut oak), along with the

native species of *Castanea*, *C. pumila* (Alleghany/Ozark chinquapin). *Castanea mollissima* may be distinguished from the oaks by the absence of clustered buds at the tips of the twigs (*Quercus* species possess tightly packed clusters of two or more buds at the tips of the twigs, including a terminal bud, which is not present in *Castanea*) and by the large, pronounced, spiny bracts (cupule) that enclose the nuts (the bracts of *Quercus* fruits are not sharp-spiny and generally do not enclose the nut). *Castanea mollissima* may be distinguished from *C. pumila* by the large diameter of the bracts (3–6 cm) and number of nuts enclosed in the bracts (usually 2–3 enclosed per set of bracts). In contrast, the diameter of the bracts of *C. pumila* is much less (2.5–3.8 cm) and with only one (rarely 2) nut per set of bracts. ***Habitat***: disturbed sites and waste places, especially in the vicinity of reproductive age plants of the species; also sometimes in woods, woodland edges, and fields.

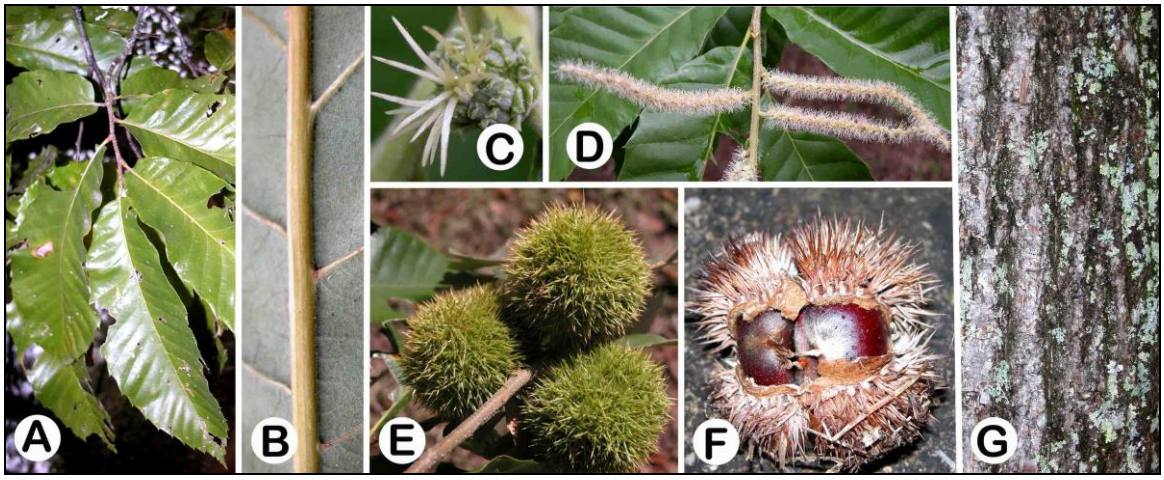
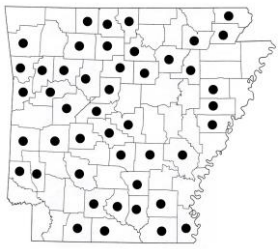


Figure 30. (A–G) *Castanea mollissima* plant and habit. (A–B) Leaves (Fig. B shows lower surface with dense indument of trichomes). (C) Pistillate flowers. (D) Staminate flowers and catkins. (E) Mature fruits. (F) Spiny cupule with fruits and seeds. (G) Bark.

Catalpa, Catalpa or Cigar Tree, Bignoniaceae

Catalpa is a small genus of about 13 species of deciduous trees distributed over temperate Asia and eastern North America (Zhang & Santisuk 1998). Three species occur in the North American flora — two are native: *C. bignonioides* and *C. speciosa*; both occur in Arkansas. *Catalpa ovata* is naturalized in a few states bordering Arkansas, offering the possibly of its occurrence in the state outside of cultivation.

Catalpa bignonioides Walt. (Fig. 31).



Catalpa bignonioides (southern catalpa, Indian bean, catawba tree) is a small to medium-sized, deciduous tree from 10–15 m tall (Krüssmann 1976; Yatskievych 2006). It is native to the southeastern USA; however, it is considered introduced in Arkansas (Hunter 1995; Yatskievych 2006; Ogle et al. 2020). Regardless of its status, it is widespread in Arkansas, occurring essentially statewide.

The leaves of *C. bignonioides* possess conspicuous exrtrafloral nectaries in the axils of the veins on the lower surface. The flowers are pollinated by various species of bees and moths. It is cultivated for its showy flowers and large leaves. The wood is durable and sometimes used for the production of railroad ties and fence posts, or occasionally combined with that of other hardwood species for pulp production (Hunter 1995; Yatskievych 2006).

This species, along with *C. speciosa* (northern catalpa), is the principal food plant for the larvae of the catalpa sphinx moth (*Ceratomia catalpa*). Two (or sometimes more) broods of the

caterpillars may be produced during a single growing season, and severe infestations often completely defoliate trees. Damage to the leaves from feeding induces increased secretion from the nectaries, which may function to attract ants and predaceous insects that may prey on the caterpillars. The caterpillars often are collected by fisherman and prized as bait for numerous species of game fishes, including sunfish (bream), bass, and catfish.

Catalpa bignonioides potentially may be confused with *Paulownia tomentosa* (princess tree, royal paulownia); however, it may be distinguished from *P. tomentosa* by its usually verticillate leaves that are pubescent on the lower surface but not tomentose, glabrous, white-colored flowers, and linear fruits that are 10 times or more as long as wide. *Paulownia tomentosa*, contrastingly, has oppositely-arranged, densely tomentose-pubescent leaves, flowers that are tomentose-pubescent and lilac to purple in color (white-flowered forms of *P. tomentosa* also occur), and ovate-shaped fruits that are three times or less as long as wide. ***Habitat***: bottomlands and floodplain forests, river terraces and overflow areas, stream sides, and disturbed sites and waste places in urban environments.

Additionally, *Catalpa speciosa* Warder ex Engelm. is a highly similar species to *C. bignonioides* that is native to the Great Plains and eastern USA, including Arkansas. *Catalpa speciosa* is a large, deciduous tree to 30 m (Yatskievych 2006). In Arkansas, it is distributed essentially statewide, but infrequent in the south-central portion; and likely only native to the northwestern portion of the state (Ogle et al. 2020). Although *C. bignonioides* and *C. speciosa* are extremely similar and easily confused, they generally can be distinguished using the following key.

1. Mature bark with small, scaly plates; foliage with a musky, malodorous odor when bruised or damaged; leaves with a short or abruptly-acuminate apex; corolla 2.5–4 cm long, middle of the lower lip entire; mature fruit 1 cm or less wide ..... **Catalpa bignonioides**
1. Mature bark generally ridged and furrowed; foliage not malodorous when bruised or damaged; leaves with a long-acuminate apex; corolla 4–5 cm long, middle lobe of the lower lip notched; mature fruit 1–1.5 cm wide ..... **Catalpa speciosa**

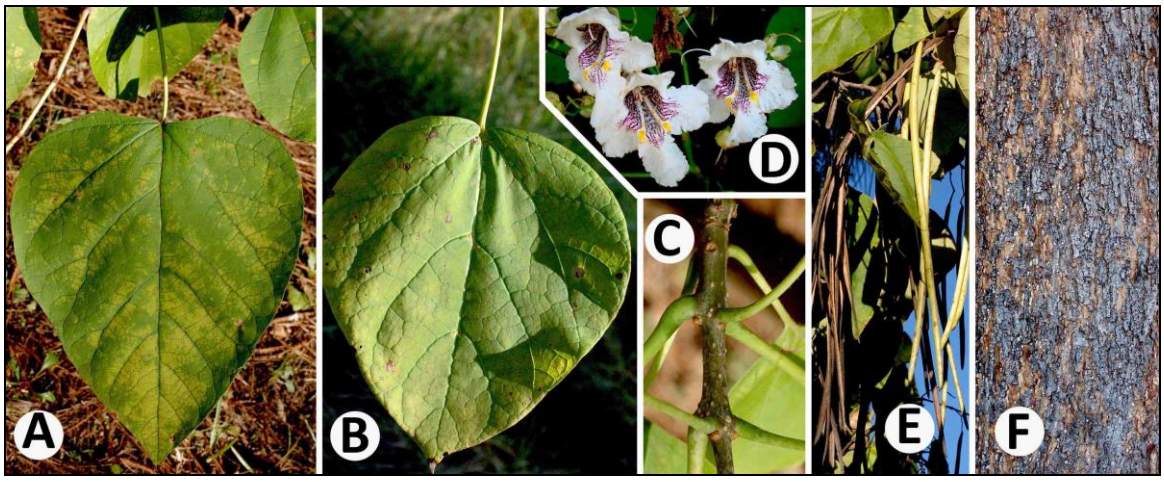


Figure 31. (A–F) *Catalpa bignonioides* plant and habit. (A–B) Leaves. (C) Stem showing verticillate phyllotaxy. (D) Flowers. (E) Mature fruits. (F) Bark. Photo credit: D: Rebekah D. Wallace, University of Georgia, Bugwood.

Catalpa ovata G. Don (Fig. 32).

Catalpa ovata (Chinese catalpa) is a small to medium-sized, deciduous tree to 15 m tall that is native to China (Zhang & Santisuk 1998). At present, it has not been documented in the state's flora. It sometimes is cultivated and is well-naturalized in the USA in a number of states, including Missouri, which borders Arkansas (Manning 2000; Yatskievych 2006; Kartesz 2015). Weakley

(2020) indicates that it could become invasive in southeastern USA. *Catalpa ovata* should be expected outside of cultivation in the state, especially in northern Arkansas.

In Arkansas, *C. ovata* closely resembles the two native *Catalpa* species; however, it may be distinguished from them by its yellow-colored flowers and scabrous (rough-textured), distinctly three-lobed leaves. In contrast, native *Catalpa* species have white-colored flowers and leaves that are not scabrous and generally unlobed. *Catalpa ovata* and *C. bignonioides*, although traditionally considered separate species, produce fertile hybrids when crossed (Stebbins 1950; Manning 2000); as a result they sometimes are classified as semispecies.

In addition to the native *Catalpa* species, *C. ovata* potentially could be confused with *Firmiana simplex* (Chinese parasol tree), *Paulownia tomentosa* (princess tree), and *Vernicia fordii* (tungoil tree). However, *C. ovata* may be distinguished from them by its scabrous laminas and linear-cylindric fruits up to 30 cm in length. *Firmiana*, *Paulownia*, and *Vernicia* have glabrous or tomentose (*Paulownia*) leaves that are not scabrous, and fruits that are not linear-cylindric. ***Habitat***: disturbed sites and waste places, bottomlands and floodplain forests, woodland edges, riverbanks and riparian zones, and roadsides.

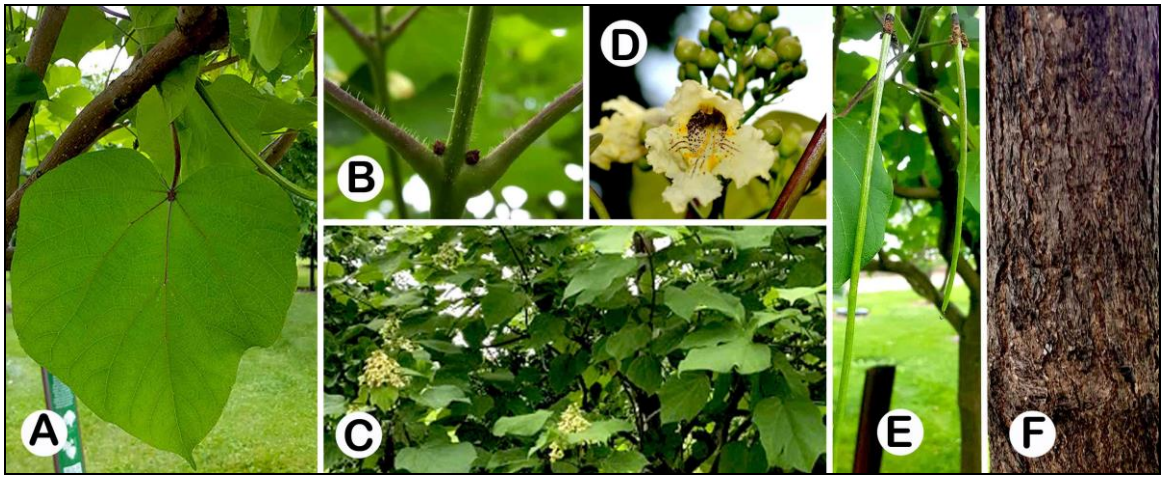


Figure 32. (A–F) *Catalpa ovata* plant and habit. (A–B) Leaves and stems (notice the long trichomes on the petioles in Fig. B). (C) Inflorescences and leaves (notice the leaves are lobed). (D) Flowers. (E) Mature fruits. (F) Bark. Photo credit: Urban Forestry Outreach Research and Extension Nursery, University of Minnesota.

Cayratia, Sorrel Vine, Vitaceae

Cayratia is a genus of about 60 species of lianas (usually), shrubs, or occasionally herbaceous vines that is distributed over Africa, Asia, and Oceania (Hui & Wen 2007). One species, *C. japonica*, is highly invasive and has become well-naturalized in some areas of the southeastern USA.

Cayratia japonica (Thunb. ex Murray) Gagnep (Fig. 33).

Cayratia japonica (sorrel vine, bushkiller) is a robust and vigorous herbaceous vine, sometimes to several meters in length, which climbs by means of branched tendrils. It is native to China, Japan, Malaysia, and New Caledonia, and is established and invasive along the Gulf coast in the USA (Hansen & Goertzen 2006; Krings & Richardson 2006; Hui & Wen 2007; Soule et al. 2008). At present, it has not been documented outside of cultivation in Arkansas; however, is included here because it does occur in several bordering states, is highly invasive, and its large vegetative size (giving the appearance of being woody) and close morphological similarity to the native liana, *Parthenocissus quinquefolia* (Virginia creeper), with which it easily is confused. *Cayratia japonica* can be distinguished from *P. quinquefolia* by its herbaceous growth habit and leaves that are bipinnately compound, though they give the appearance of being palmately compound like those of *P. quinquefolia* — the lateral leaflets (two per side) are produced on a pair of shortened, reduced pinnae

making the leaf pinnately compound). In contrast, *P. quinquefolia* has a woody habit and leaves that are once palmately compound, and thus are without pinnae. The flowers of *C. japonica* species are particularly attractive to hymenopteran insects (bees, wasps, and ants), and it is common to observe ants, along with multiple species of bees and wasps simultaneously foraging on the flowers. Butterflies also sometimes visit the flowers.

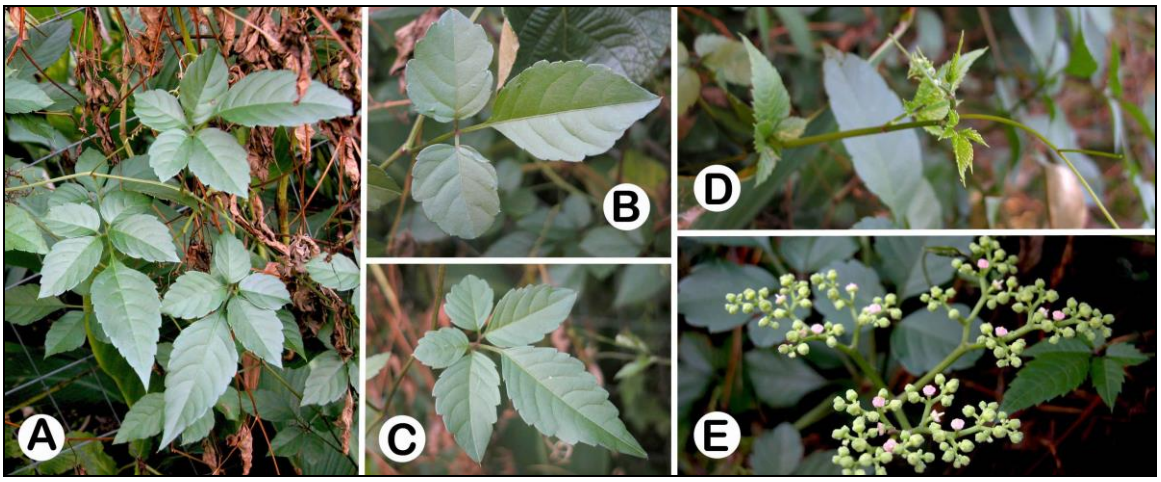


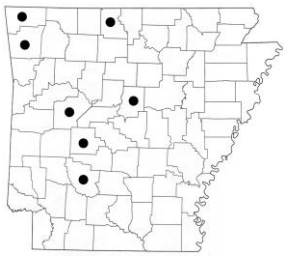
Figure 33. (A–E) *Cayratia japonica* plant and habit. (A–C) Leaves (notice the overall similarity of the leaves and growth form to *Parthenocissus quinquefolia*). (D) Stem and tendril. (E) Flowers.

Cayratia japonica spreads vegetatively from an aggressive and highly invasive root system. Plants also aggressively climb and cover existing vegetation. Based on its extensive root system and prolific and repetitively ability to produce root suckers, *C. japonica* is extremely difficult to eradicate once established. Root segments that are transported by erosion, water, soil movement, or through anthropogenic means can quickly allow for the establishment of new plants. *Cayratia japonica*, apparently, does not typically set seed in the USA, thus spread mostly is vegetative via suckering. ***Habitat***: disturbed sites and waste places, or spreading vegetatively into other environments in the vicinity of where plants of the species are cultivated.

Celastrus, Bittersweet, Celastraceae

Celastrus is a genus of about 30 species of evergreen or deciduous shrubs and lianas that is distributed primarily over Asia, Australia, and the Americas (Zhang & Funston 2008; Ma & Levin 2016a). Two species of *Celastrus* occur in the Arkansas flora: the native *C. scandens* and the nonnative and invasive *C. orbiculatus*. The two species are morphologically similar and somewhat difficult to distinguish. Both species are cultivated for their showy, colorful fruits.

Celastrus orbiculatus Thunb. (Fig. 34).



Celastrus orbiculatus (Oriental bittersweet) is a large, deciduous, liana to 12 m or more in length. It is native to China and Japan, and is naturalized over much of the eastern USA (Ma & Levin 2016a), including Arkansas, having been documented from several counties in the western one-half of the state. *Celastrus orbiculatus* is a highly invasive species and (in Arkansas) typically is observed in greenbelts, disturbed woods and woodland edges, and riparian zones, where it aggressively climbs and covers trees and other vegetation via twining stems. In addition to climbing, *C. orbiculatus* can form extensive colonies through the production of root suckers; this capacity also makes eradication more difficult as plants vigorously regrow after being cut back. Dreyer et al. (1987) notes that *C. orbiculatus* is more aggressive with a higher seed viability than the

native *C. scandens* (American bittersweet), and Yatskievych (2006) indicates that *C. orbiculatus* is invasive, through rapid growth can cover large areas of vegetation, and that it is replacing *C. scandens* in some areas. The large, twining stems of *C. orbiculatus* can constrict and even kill small trees (Lutz 1943).

The seeds of *Celastrus* are bird-dispersed and the fruits are fed upon by numerous species of birds (Hunter 1995; Yatskievych 2006). The fruits, seeds, and other portions of the plant, in at least some species of *Celastrus*, are considered toxic to humans and some species of mammals, at least in part because of the presence of cardenolides. Rabbits and squirrels, apparently, can feed on fruits and seeds without problems (Burrows & Tyrl 2001). ***Habitat***: disturbed urban woods and greenbelts, woodland edges, and riparian zones.

Celastrus scandens is an ecologically and morphologically similar species to *C. orbiculatus*, and the two species easily are confused. *Celastrus scandens* is native to the central and eastern USA, including Arkansas, where it has been recorded from several counties, mostly in the northern one-third of the state. Although *C. scandens* and *C. orbiculatus* are similar, they can be distinguished most easily by their inflorescences — *C. scandens* has a many-flowered (6 or more), terminal raceme or panicle, whereas *C. orbiculatus* has a few-flowered (generally 2–4), axillary (very rarely terminal) cyme. The two species can be distinguished using the following key.

1. Inflorescence and infructescence an axillary (rarely terminal) cyme of (1–)2–5(–7) flowers or fruits; mature fruit wall yellow; leaves often suborbicular to obovate or broadly oblong-obovate ..... **Celastrus orbiculatus**
1. Inflorescence and infructescence a terminal panicle of (6–)12–40 flowers or fruits; mature fruit wall orange; leaves ovate, elliptic, or ovate-lanceolate ..... **Celastrus scandens**

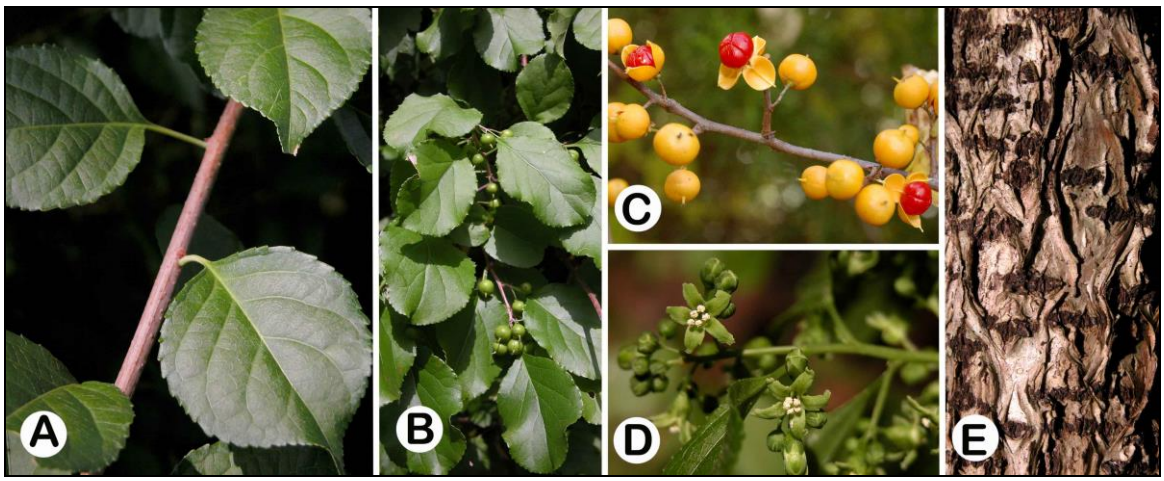


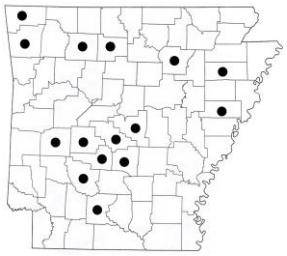
Figure 34. (A–E) *Celastrus orbiculatus* plant and habit. (A–B) Leaves and stem. (C) Mature fruits. (D) Flowers. (E) Bark.

Chaenomeles, Quince, Rosaceae

Chaenomeles is a small genus of five species of evergreen or deciduous trees and shrubs; all Asiatic (Gu & Spongberg 2003a; Catling & Mitrow 2014a). One species, *C. speciosa*, commonly is cultivated in the USA, including Arkansas, for its large, scarlet-red to reddish-pink-colored flowers, attractive foliage, and ease of cultivation.

Chaenomeles speciosa (Sweet) Nakai (Fig. 35).

Chaenomeles speciosa (flowering quince, Japanese quince) is a tardily deciduous shrub to about 3 m tall that is native to China (Gu & Spongberg 2003a). It is naturalized in the eastern USA (Catling & Mitrow 2014a), including Arkansas, where it occurs in several scattered counties.



Chaenomeles speciosa commonly is cultivated for its large and showy scarlet, pinkish-red, or rarely white colored flowers that are produced in early spring and large, apple-sized yellow-colored fruits that persist well into autumn. The fruits are "edible" but highly acidic, and sometimes are used to make preserves and jellies.

Chaenomeles speciosa is not to be confused with the morphologically and "nominally" similar *C. japonica* (Japanese or dwarf quince), as the two are considered distinct species, despite the confusing nature of their common names. Putative interspecific hybrids of *C. japonica* and *C. speciosa* are referred to as *C.* × *superba* (Frahm) Rehd. (Catling & Mitrow 2014a). These hybrids are cultivated and may be expected to spread occasionally through the dumping of garden waste. They also are difficult to distinguish from *C. speciosa* (Catling & Mitrow 2014a).

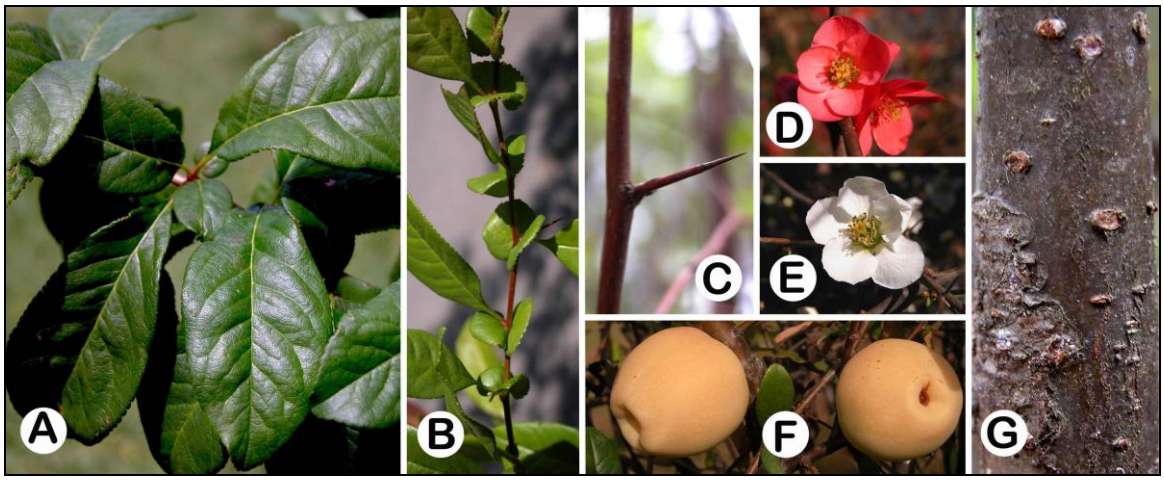


Figure 35. (A–G) *Chaenomeles speciosa* plant and habit. (A–B) Leaves and stem (notice the large, orbicular stipules). (C) Thorn. (D–E) Flowers. (F) Mature fruits. (G) Bark.

The combination of stout thorns, large, scarlet or pinkish-red flowers, large, apple-sized fruits, and prominent, leathery, foliaceous (leaf-like) stipules that partially or completely encircle the stem clearly distinguish flowering quince from other shrubs in the Arkansas flora. ***Habitat:*** disturbed sites and waste places, woodland edges, greenbelts, bluffs, roadsides, and old fields.

Cinnamomum, Camphor Tree, Lauraceae

Cinnamomum is a large genus of about 250 species of evergreen trees and shrubs distributed over subtropical Asia and Australia, with a few species also in the Pacific Islands (Li et al. 2008). One species, *C. camphora*, is the principal source of commercially produced camphor.

Cinnamomum camphora (L.) Presl. (Fig. 36).

Cinnamomum camphora (camphor tree) is a large, evergreen tree to 30 m tall that is native to China, Taiwan, and Japan (Li et al. 2008). In southern Arkansas, *C. camphora* occasionally is cultivated and a few spontaneous seedlings have been observed in the vicinity of cultivated, reproductive age plants of the species (Fig. 164F). It is naturalized in several Gulf-coastal states, including Louisiana, Mississippi, and Texas (van der Werff 1997), all of which border Arkansas. Although at present *C. camphora* is not known outside of cultivation in Arkansas, it could be encountered as escaped in the southern portion of the state.

Cinnamomum camphora is cultivated in subtropical and tropical regions worldwide and is naturalized in many of these areas (Valder 1999). It is considered invasive in Florida and elsewhere (Firth 1981; Binggeli et al. 1998; Batianoff & Butler 2002; Henderson 2001, 2007; UF, IFAS, Center

for Aquatic and Invasive Plants 2021). The seeds of *C. camphora* are dispersed by birds and water (Miller 2003), which contributes to its invasive character. Plants also can spread via suckering (Miller 2003) and often produce suckers when cut back or damaged.

The foliage emits a spicy, aromatic odor reminiscent of camphor when crushed or bruised; this species is the principal source of commercial camphor (Li et al. 2008). The wood is chipped and the stems and leaves undergo steam distillation to produce camphor. The wood also is used for the manufacture of furniture, cabinets, and interior finish work (Li et al. 2008).

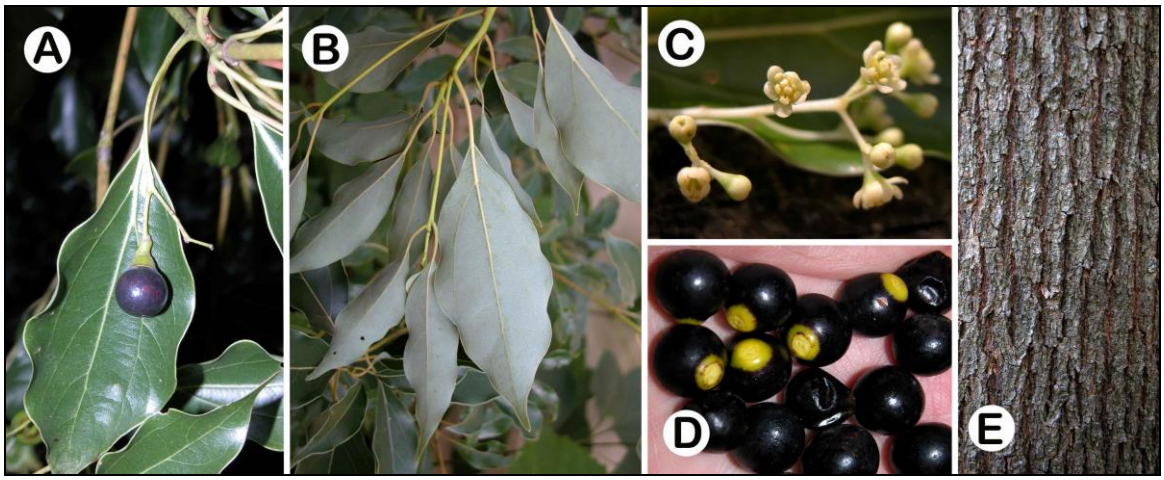


Figure 36. (A–E) *Cinnamomum camphora* plant and habit. (A–B) Leaves and stem (a mature fruit also is present in Fig. A). (C) Flowers. (D) Mature fruits (notice the bright, lemon-yellow coloration where the fruit attaches to the pedicel). (E) Bark.

Cinnamomum camphora somewhat resembles (in Arkansas) the native Lauraceous species: *Lindera benzoin* (northern spicebush), *Persea borbonia* (red bay), and *Sassafras albidum* (sassafras); however, it can be distinguished from all three species by the presence of conspicuous glands in the axils of some of the veins on the lower surface of the leaves (the native Lauraceous taxa lack these glands). Additionally, *C. camphora* can be distinguished from *Persea* and *Sassafras* by its smaller, unlobed leaves and/or dark, blue-black colored fruits with a bright yellow area where the fruit attaches to the pedicel. *Persea* has leaves that are longer and elliptic-oblong in shape and *Sassafras* has fruits that are bluish-black, but are attached to a bright red receptacle and pedicel, and leaves that generally have one to three lobes (occasionally, plants are encountered that do not have any lobed leaves). *Cinnamomum camphora* further may be distinguished from *Lindera* by its green twigs and dark, blue-black fruits (*Lindera* has gray-brown twigs and red-colored fruits). ***Habitat***: waste places and disturbed areas, thickets, fencerows, and roadsides.

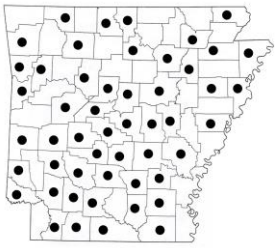
Citrus, Rutaceae

Citrus is a genus of 20–25 species of spiny, evergreen (rarely deciduous) trees and shrubs distributed mostly over subtropical and tropical Asia, Australia, and the Pacific Islands (Zhang & Mabberley 2008). *Citrus* is one of the most economically important genera of plants worldwide, as it is the source of a number of important commercially-grown fruit crops, including grapefruit (*C. × paradisi*), kumquat (*C. japonica*), lemon (*C. × limon*), lime (*C. aurantiifolia*), minneola or tangelo (*C. × tangelo*), pomelo (*C. maxima*), sweet orange (*C. × sinensis*), tangerine (*C. reticulata*), and tangor (*C. × nobilis*; Bailey and Bailey 1976). A number of these species, such as grapefruit, lemon, sweet orange, and tangelo are interspecific hybrids. The fruits of *Citrus* are prized for their rich flavor, high vitamin C content, and juice. In addition to food, the fruits also are important sources of aromatic essential oils that are used for medicines, flavoring agents for foods, and as perfumes. Some species, including *C. aurantium* and *C. trifoliata*, are used in the citrus industry as rootstocks for grafting

scions of citrus cultivars (Bailey & bailey 1976). Most species (and hybrids) also are cultivated as ornamentals for their glossy-green foliage and large, colorful fruits.

Citrus trifoliata is the only species in the genus that is reliably cold-hardy in Arkansas. Some varieties of kumquats and tangerines, particularly those grafted onto rootstocks of *C. trifoliata*, along with *C. ×wilsonii*, occasionally are cultivated in southern Arkansas.

Citrus trifoliata L.; Syn.: *Poncirus trifoliata* (L.) Raf. (Fig. 37).



Citrus trifoliata is a large, deciduous to semi-evergreen shrub or small tree to 7 m tall that is native to Korea and China (Zhang & Mabberley 2008; Nesom 2014a). It is well-naturalized and invasive in the eastern USA (Nesom 2014a; Weakley 2020), including Arkansas, occurring in several counties, especially in the southern two-thirds of the state.

The thorn-like stipular spines of *C. trifoliata* are stout, hard, and extremely sharp, sometimes reaching a length of several centimeters. They pose a threat to humans and domestic animals that enter areas where *C. trifoliata* is naturalized. This species is prolific, with the capacity to produce large numbers of fruits and seeds during a growing season. Seeds are dispersed by animals or water; however, seedlings will germinate from rotten fruits without dispersal or mechanical breach of the pericarp. Older plants of *C. trifoliata* readily produce root suckers. Large colonies of plants often are observed in places where it is naturalized, and dense populations can be nearly impenetrable because of the dense, armed foliage.

Citrus trifoliata is the most cold-hardy member of the genus. The fruits, although bitter, are edible and are sometimes used to make marmalade. A number of interspecific hybrid taxa have been produced by crossing trifoliate orange with other species of *Citrus*. Some of these hybrids have the potential to allow for commercial production of citrus-type fruit crops at temperate latitudes.

'Flying dragon' is an extremely cold-hardy and unusual ornamental form of *C. trifoliata* with large, curved thorns and twisted stems. ***Habitat*:** pastures, fencerows, thickets, woodland edges, floodplain forests, bottomland areas, and riparian zones.

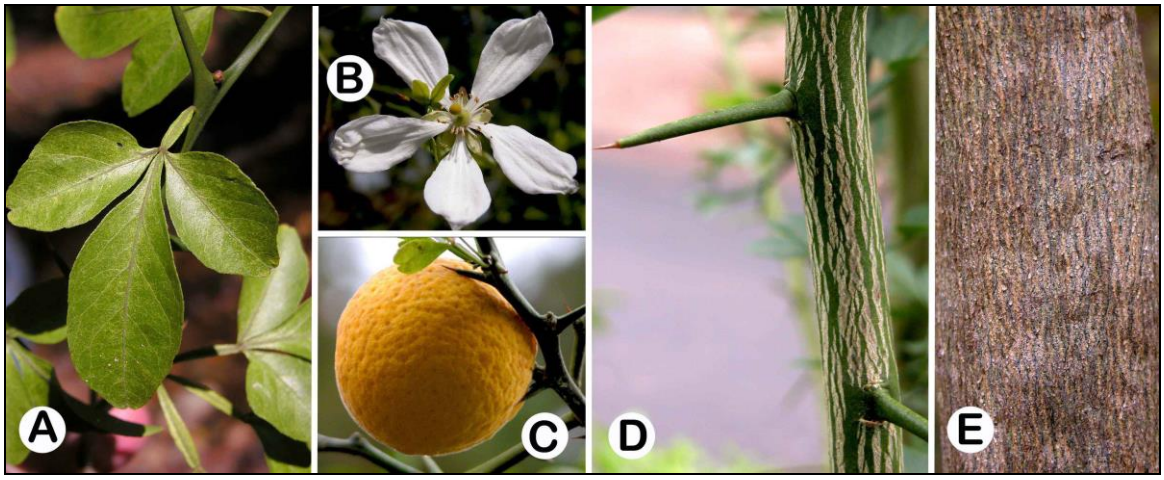


Figure 37. (A–E) *Citrus trifoliata* plant and habit. (A) Leaves. (B) Flower. (C) Mature fruit. (D) Stem with thorn-like stipular spines (these can be large, up to several centimeters in length). (E) Bark.

Clerodendrum, Glorybower, Lamiaceae (formerly Verbenaceae)

Clerodendrum is a large genus of about 400 species of deciduous, semi-evergreen, or evergreen shrubs, trees, and twining lianas (rarely herbaceous), distributed predominantly in tropical and subtropical regions worldwide; a few species occur in temperate zones (Chen & Gilbert 1994b).

Numerous species of *Clerodendrum* are prized as ornamentals for their showy, colorful, often richly fragrant flowers, colorful fruits, and large, "tropical-looking" leaves. A few species have become established to various degrees outside of cultivation in the USA, with *C. bungei* and *C. indicum* probably the most widespread, where they have become naturalized in many southeastern states. Many species of *Clerodendrum* reproduce both by seeds and asexually via an invasive, suckering root system that allows for rapid, localized colonization.

Species of *Clerodendrum* have opposite or rarely verticillate, simple, toothed or entire leaves and perfect (bisexual) flowers arranged in many-flowered, axillary or terminal inflorescences. The fruit is a white, blue, purple, or black drupe, and often subtended by or enclosed within a persistent, sometimes brightly colored calyx.

Clerodendrum bungei Steud. (Fig. 38).

Clerodendrum bungei (rose glorybower) is a small, evergreen (deciduous in temperate zones), sparsely-branched shrub to 2.5 m tall that is native to China (Chen & Gilbert 1994b). While currently not naturalized in Arkansas, it occasionally is cultivated in the state and spreads aggressively from plants in cultivation into surrounding areas via suckering (observed by Serviss in Clark and Union counties). It also is naturalized in many areas of the southeastern USA, including adjacent Louisiana and Mississippi, where it has been recorded from several parishes/counties (Hill & Horn 1997; Wunderlin & Hansen 2011; Kartesz 2015; Weakley 2020). It should be expected naturalized in the state's flora.

The flowers of *C. bungei* are strongly fragrant and their odor is highly reminiscent of some varieties of roses. Its flowers also are highly attractive to butterflies. The foliage is malodorous when bruised or crushed and the odor is reminiscent of peanut butter. *Clerodendrum bungei* is tolerant of dense shade or full sun conditions.

Clerodendrum bungei rapidly spreads asexually via an invasive root system, and a single plant is capable of producing a large colony. Plants in cultivation spread to surrounding sites, such as adjacent woods or fields, via suckering. It prefers moist soil, but is somewhat drought-tolerant once established. In the USA, fruit production does not appear to be common and most spread probably is asexual. **Habitat**: disturbed sites and waste places, urban woods and greenbelts and woodland edges, especially in the vicinity of where plants of the species are cultivated.

In Arkansas, *Clerodendrum* species are most easily confused with the native *Hydrangea arborescens* (wild hydrangea) or possibly the introduced *H. macrophylla* (French hydrangea), as the

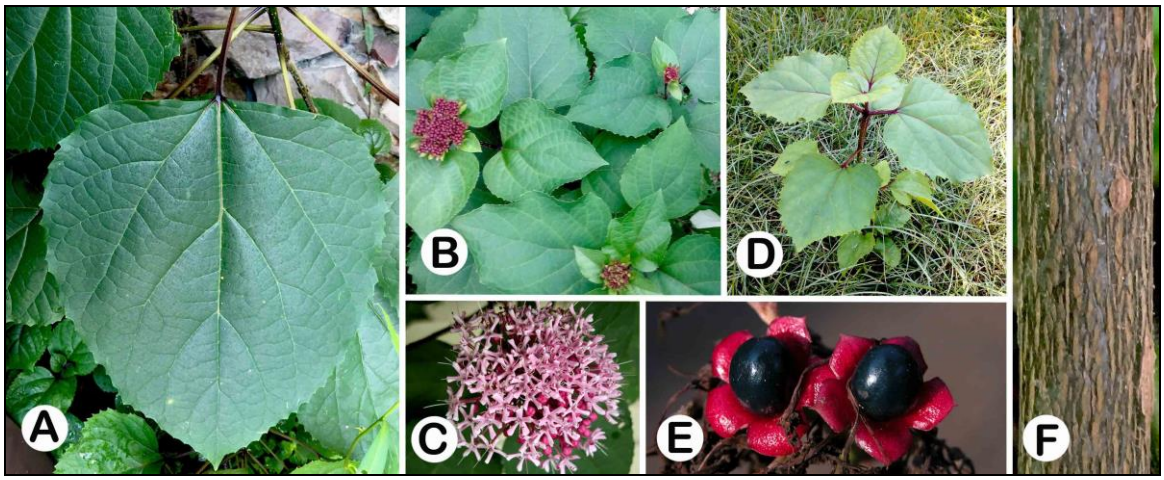
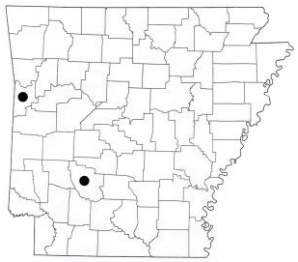


Figure 38. (A–F) *Clerodendrum bungei* plant and habit. (A) Leaves. (B) Plants. (C) Flowers and inflorescence. (D) Root sucker. (E) Mature fruits. (F) Bark.

growth form and foliage overall are similar between *Clerodendrum* and *Hydrangea*. *Clerodendrum* may be distinguished from *Hydrangea* by its highly fragrant flowers, lack of sterile flowers, fleshy, drupaceous fruits, malodorous foliage, and aggressive suckering habit. In contrast, *Hydrangea* species have flowers with little to no fragrance, sterile flowers at the periphery of the inflorescence, dry, capsule-type fruits, and do not form colonies via suckering.

Clerodendrum trichotomum Thunb. (Fig. 39).



Clerodendrum trichotomum (harlequin glorybower, peanut butter tree) is a large, deciduous shrub or small tree to an eventual 10 m tall that is native to China, India, Japan, Korea, and much of Southeast Asia (Chen & Gilbert 1994b). It is naturalized in a few eastern states (Poindexter et al. 2011; Wunderlin & Hansen 2011; Kartesz 2015; Serviss et al. 2018a; Weakley 2020; Keener et al. 2021; USDA, NRCS 2021), including Arkansas, where it has been documented from Clark and Sebastian counties.

Similar to *C. bungei*, this species spreads rapidly via asexual reproduction from a suckering root system which may produce a substantial colony of plants over time. *Clerodendrum trichotomum* is shade-tolerant and will invade into wooded or open habitats from areas of cultivation. Plants are tolerant of well-drained sites, but moist habitats seem to be preferred.

The common name of peanut butter tree is in reference to its foliage that when crushed or bruised produces a strong odor that is reminiscent of peanut butter. The flowers of *C. trichotomum* are sweetly fragrant and highly attractive to hummingbirds, butterflies, and moths. The fruits are bird-dispersed. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, and rubbish heaps where horticultural waste is dumped.

In Arkansas, the combination of large, opposite leaves, pinkish-red to purple terminal buds, blue fruits with a persistent red calyx, and malodorous foliage distinguish *C. trichotomum* from most other shrubs. It can, however, be confused with its morphologically similar congener, *C. bungei*. The two species of *Clerodendrum* may be distinguished reliably using the following key.

1. Plants to 10 m tall, becoming arborescent; leaf margins often entire, sometimes toothed (especially in young plants); flowers white to whitish-cream, calyx 10 mm or more in length ..... **Clerodendrum trichotomum**
1. Plants generally 1–2(–2.5) m tall with little to no branching of stems; leaf margins with large, serrate teeth; flowers rose-pink, calyx 8 mm or less in length ..... **Clerodendrum bungei**

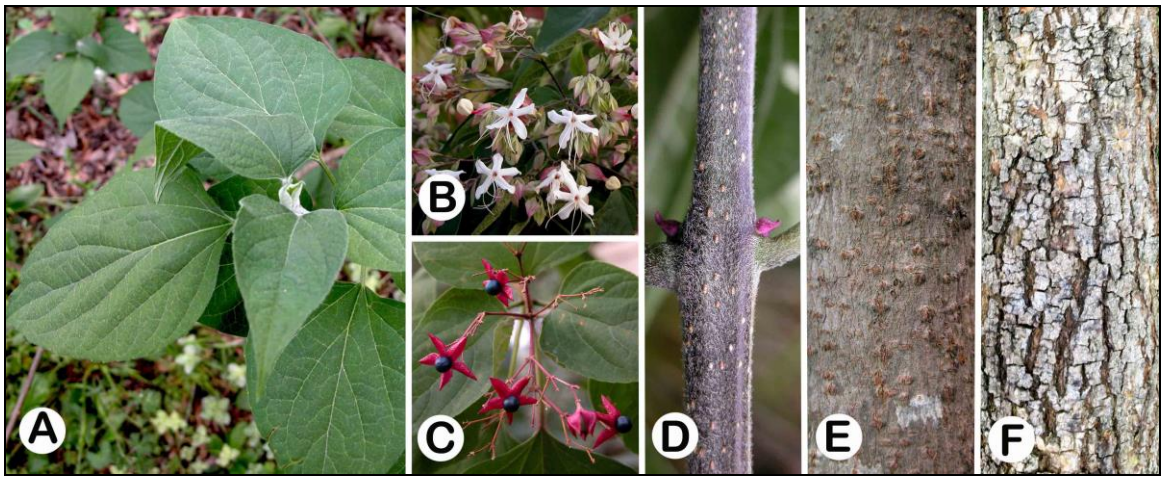
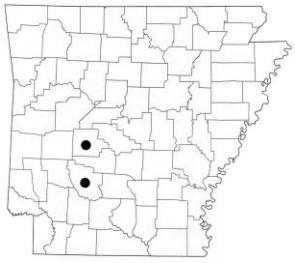


Figure 39. (A–F) *Clerodendrum trichotomum* plant and habit. (A) Leaves. (B) Flowers. (C) Mature fruits. (D) Stem showing pinkish-red bud. (E) Young Bark. (F) Older bark.

Deutzia, Deutzia, Hydrangeaceae (formerly Saxifragaceae)

Deutzia is a genus of about 60 species of deciduous shrubs distributed principally over warm-temperate regions of the Northern Hemisphere; mostly Asiatic (Huang et al. 2001). Several species of *Deutzia* are cultivated for their showy flowers.

Deutzia scabra Thunb. (Fig. 40).



Deutzia scabra (rough-leaf deutzia) is a deciduous, multi-stemmed shrub to 3 m tall that is native to Japan (Krüssmann 1976; Huang et al. 2001). It is naturalized in several states in the USA (McGregor 2016), including Arkansas, where it is known from Clark and Garland counties (Gentry et al. 2013; Serviss et al. 2014). *Deutzia scabra* spreads at least in part through air layering, where stems in contact with moist ground or other substrate form adventitious roots and produce new plants.

In Arkansas, *D. scabra* may be confused with species in the related and morphologically similar genus *Philadelphus* (mock orange); however, *D. scabra* may be distinguished from species of *Philadelphus* by the stellate trichomes on its leaves and stems, and flowers with five petals and five sepals. In contrast, the foliage of *Philadelphus* species is either pubescent with simple (unbranched) trichomes or glabrous, and the flowers have only four petals and four sepals. Several horticultural forms of *D. scabra* exist, including cultivars with variegated foliage, "doubled" flowers, and pink instead of white-colored flowers (Bailey & Bailey 1976; Krüssmann 1976). ***Habitat***: disturbed woods, woodland edges, and riparian zones.

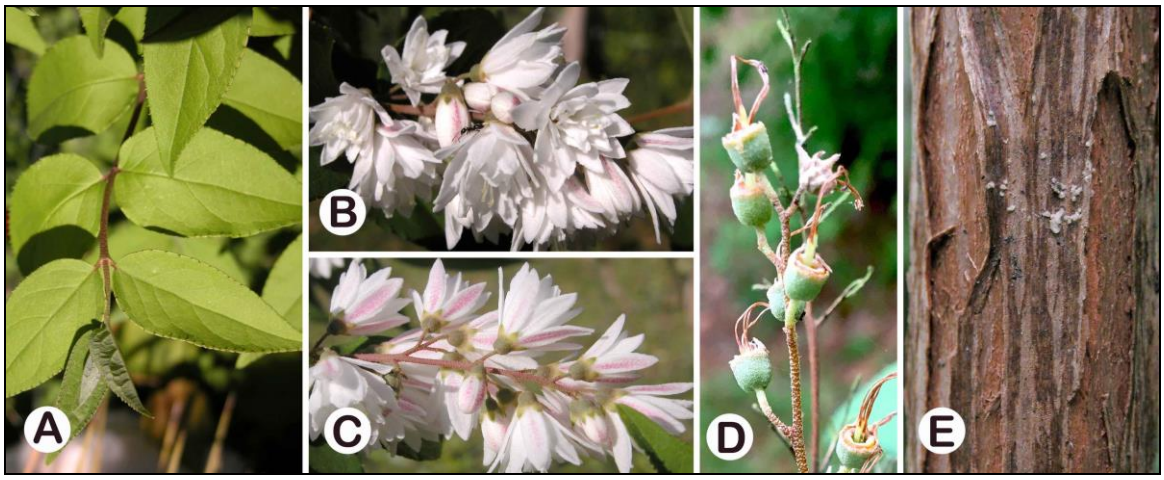


Figure 40. (A–E) *Deutzia scabra* plant and habit. (A) Leaves and stem. (B–C) Flowers and inflorescence. (D) Fruits. (E) Bark.

Diospyros, Persimmon, Ebenaceae

Diospyros is a genus of about 485–500 species of deciduous or evergreen shrubs and trees; mostly pantropical but extending into temperate regions (Krüssmann 1976; Li et al. 1996; Eckenwalder 2009). *Diospyros kaki*, the persimmon of commerce, regularly is cultivated in warm-temperate regions for its edible, high-quality fruits, which are prized in many Asian cultures.

Diospyros kaki Thunb. var. **kaki** (Fig. 41).

Diospyros kaki (Japanese persimmon, Chinese persimmon) is a small to medium-sized, deciduous tree to 27 m tall, but often smaller, that is native to China (Krüssmann 1976; Li et al. 1996). It is grown commercially in California and cultivated elsewhere in the southern USA, including Arkansas, for its edible fruits. *Diospyros kaki*, while not currently established in the Arkansas flora, has been observed in the state to produce spontaneous plants from seeds (Fig. 164J),

and escaped plants should be expected in the flora in areas where it is cultivated or fruits containing seeds are discarded, although fruits often are seedless.

Three recognized varieties of this species exist; however, only variety *kaki* is economically important. The numerous cultivars of variety *kaki* vary in size, color, texture, and flavor of the fruits. Fruits may be eaten fresh or dried, or may be used in various types of cuisine. Many cultivars of *D. kaki* are parthenocarpic and will produce fruit even without pollination. Cross-pollination sometimes will result in fruits with seeds; however, the aforementioned fruit characteristics are variable in plants produced from seeds. *Diospyros kaki* has been cultivated in China and Japan for centuries (Valder 1999).

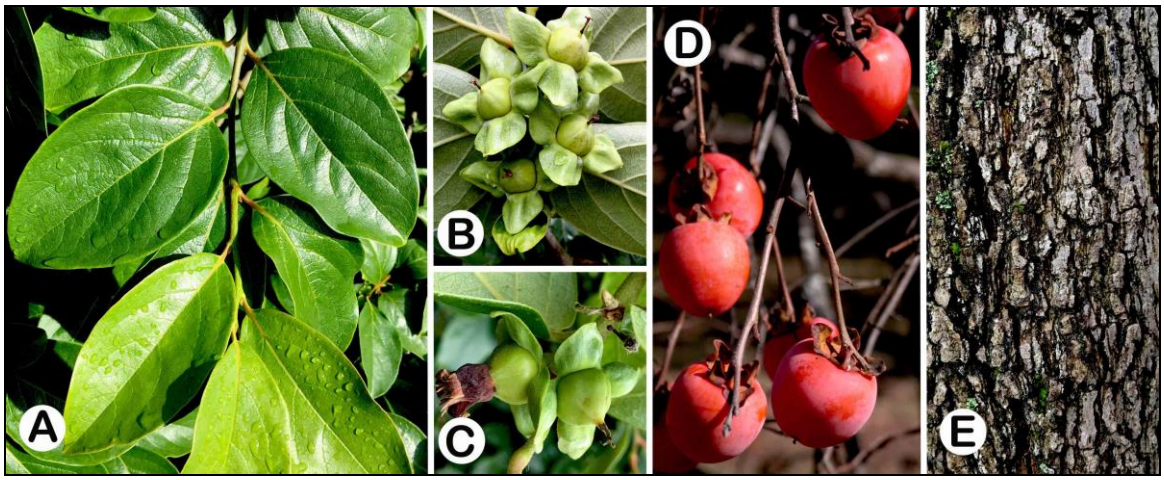


Figure 41. (A–E) *Diospyros kaki* plant and habit. (A) Leaves and stem. (B–C) Pistillate flowers with young fruits (an old corolla may be seen in Fig. C). (D) Mature fruits. (E) Bark.

In Arkansas, *D. kaki* could be confused with the native *Diospyros* species, *D. virginiana* (common persimmon); however, it can be distinguished from *D. virginiana* by its larger fruits (3.5–10 cm in diameter) and leaves with pubescent lower surfaces. Contrastingly, *D. virginiana* has smaller fruits (generally 2–3.5 cm, although can be larger) and leaves that are glabrous on the lower surface (sometimes young leaves are pubescent, but it is lost with age). ***Habitat***: disturbed sites and waste places, especially in the vicinity of cultivated plants of the species.

Elaeagnus, Oleaster, Elaeagnaceae

Elaeagnus is a genus of about 70–90 species of evergreen (mostly) to semi-evergreen or deciduous, often thorny shrubs and small trees; mostly Asiatic in origin, with one species in Europe and North America (Quin & Gilbert 2007). Some species are important ornamentals in the horticultural trade, and commonly are cultivated as hedges and windbreaks, or as specimen plants for their evergreen foliage, highly fragrant flowers, and unusual growth form (some species); some produce edible fruits (Borell 1971; Bailey & Bailey 1976; Krüssmann 1976; Bruggers 1986). At least four species are naturalized in the USA (Weakley 2020); most to all are invasive. The fruits (and seeds) of *Elaeagnus* species are primarily bird-dispersed, facilitating their invasive tendencies. *Elaeagnus* species form nitrogen-fixing associations with prokaryotes in the genus *Frankia* (Zitzer & Dawson 1989).

At present, two species of *Elaeagnus*: *E. pungens* and *E. umbellata*, are well-naturalized in Arkansas. *Elaeagnus pungens* is highly shade-tolerant, and naturalized plants often are observed in the understory of urban, semi-wooded and wooded habitats. A third species, *E. angustifolia*, has been documented from Marion County in extreme northern Arkansas, but is well-naturalized in several

surrounding states and should be expected outside of cultivation elsewhere in northern portions of the state.

Species of *Elaeagnus* are characterized, and easily recognized, by stems with short, stout thorns, and a dense indument of silver and sometimes brown-colored, scale-like trichomes on the leaves and young stems. These trichomes give vegetative portions of the plant a conspicuous silvery-reflective character, and may be used to readily distinguish species of *Elaeagnus* from other trees and shrubs in Arkansas. The flowers of *Elaeagnus* species typically are sweetly fragrant.

Key to *Elaeagnus* species:

1. Plant an evergreen, scandent, sometimes climbing shrub; leaves typically with numerous brown scales on the abaxial surface, in addition to silver ones ..... **Elaeagnus pungens**
1. Plant a deciduous, erect shrub or small tree; leaves usually lacking brown scales on the abaxial surface (a few leaves in *E. umbellata* may have a few brown scales, especially when young).

2. Stems (young) and abaxial surfaces of leaves with stellate trichomes..... **Elaeagnus angustifolia**
2. Stems and leaves without stellate trichomes.

3. Fruiting pedicels 6 mm or less long ..... **Elaeagnus umbellata**
3. Fruiting pedicels 10–20 mm long ..... **Elaeagnus multiflora**

Elaeagnus angustifolia L. (Fig. 42).

Elaeagnus angustifolia (Russian olive, Trebizond date) is a large, deciduous shrub or small tree to 10 m tall that is native to Europe and much of Asia, including China, India, and Mongolia (Quin & Gilbert 2007). Although it is naturalized and invasive over much of the continental USA (excluding some areas of the southeast), *E. angustifolia* only is known outside of cultivation in Arkansas from Marion County (Kartesz 2015; Weakley 2020) — it has been documented from Missouri, Tennessee, Oklahoma, and Texas, all of which border Arkansas. Naturalized plants of the species should be expected in other areas of the state.

Elaeagnus angustifolia is invasive and highly flexible in regard to environmental conditions and will tolerate dry or moist soils, low nutrient soils, salinity, and extremes of heat and cold (Katz & Shafroth 2003). It is capable of sexual reproduction at 3–5 years of age, and also will form dense,

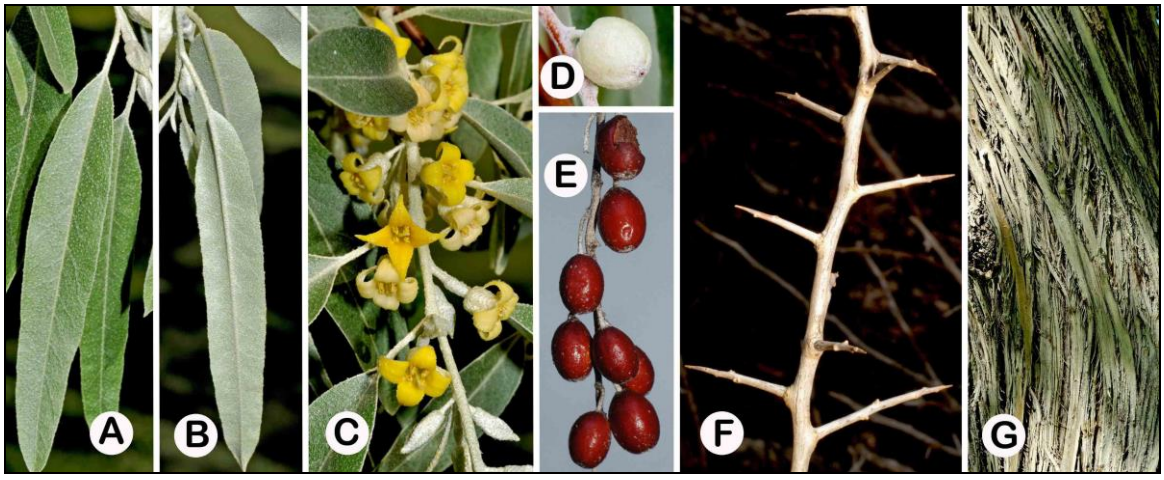


Figure 42. (A–G) *Elaeagnus angustifolia* plant and habit. (A–B) Leaves and stem. (C) Flowers. (D–E) Mature fruits (fruit color can range from silver-green to red. (F) Thorns and stem. (G) Bark. Photo credits: D: Ed Jensen; A–C, E–G: John Seiler, Virginia Tech University.

thorny thickets over time (Borell 1971).

Vegetatively, *E. angustifolia* resembles the two other naturalized species of *Elaeagnus* that occur in Arkansas: *E. pungens* and *E. umbellata*. *Elaeagnus angustifolia*, however, may be distinguished from *E. pungens* by its deciduous habit (*E. pungens* is evergreen), and from both species by the stellate (star-shaped) trichomes present on its leaves and young stems. The other *Elaeagnus* species in the state lack stellate trichomes on their foliage. ***Habitat***: disturbed sites and waste places, fields, pastures, roadsides; also moist sites, such as depressions, ditch banks, pond and lake margins, riverbanks and floodplains, and riparian zones.

Elaeagnus multiflora Thunb. (Fig. 43).

Elaeagnus multiflora (cherry elaeagnus, goumi) is a deciduous shrub to 3 m tall that is native to China, Japan, and Korea (Quin & Gilbert 2007). While not currently known from the Arkansas flora, this species is present in the floras of several eastern states, including Mississippi and Texas (Kartesz 2015; Weakley 2020), both of which border Arkansas. It previously was reported for Missouri, although Yatskievych (2006) excluded it from the Missouri flora based on inadequate voucher specimens.

Elaeagnus multiflora is cultivated for both ornamental purposes and for its high-quality, edible fruits. Based on this and the fact that it is naturalized in surrounding states, it should be expected in Arkansas outside of cultivation.

In Arkansas, *E. multiflora* is similar in overall form and habit to *E. umbellata*; however, it may be distinguished from *E. umbellata* by its ellipsoid, pendulous, long-pedicellate fruits, with pedicels that are 1–2 cm long. The fruits of *E. umbellata* are more spherical, with shorter pedicels that are 6 mm or less long. ***Habitat***: disturbed sites and waste places.

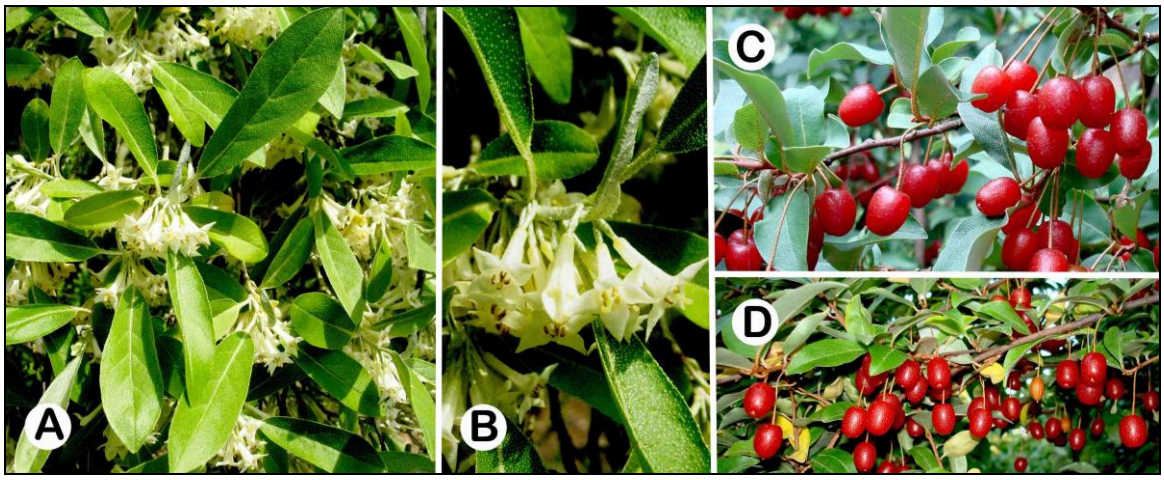
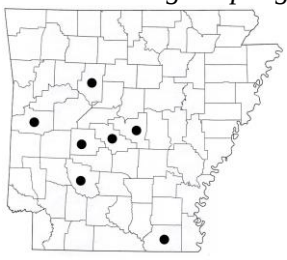


Figure 43. (A–D) *Elaeagnus multiflora* plant and habit. (A–B) Leaves and flowers. (C–D) Stems and mature fruits (notice the long pedicels; compare with those of *E. umbellata*, Fig. 45E). Photo credits: A–B: Missouri Botanical Garden; C–D: Sven Maksymiuk, Carya Nursery.

Elaeagnus pungens Thunb. (Fig. 44).



Elaeagnus pungens (silverthorn, thorny olive) is a large, clambering, evergreen shrub to 7 m tall that is native to China and Japan (Quin & Gilbert 2007). It is naturalized in the eastern USA (Kartesz 2015; Weakley 2020), including Arkansas, where it occurs in several scattered counties. It is highly invasive into a variety of habitats, but is most commonly encountered (in Arkansas) in moist to wet soils of disturbed wooded habitats and along riparian zones. Based on our observations, this species undoubtedly is more widespread in the state than current records indicate.

In addition to its conspicuous indument of silver and brown scale-like trichomes, *E. pungens* is unusual in that flowering generally occurs in late fall or early winter. Flowers are sweetly fragrant and followed by scaly, pinkish-red to red fruits with bird-dispersed seeds in late winter or early spring; the fruits also are edible by humans.

Elaeagnus pungens may be distinguished from the somewhat morphologically similar, *E. umbellata*, which also is naturalized in Arkansas, by its evergreen habit and abundant brown, scale-like trichomes on the lower surfaces of the leaves. *Elaeagnus umbellata* is deciduous and generally lacks the brown scales on the lower surface of its leaves (a few leaves may have brown scales, especially when young). ***Habitat***: disturbed sites and waste places, including disturbed woods, woodland edges, riparian zones, and roadsides; naturalized plants often are observed in the vicinity of where plants of the species are cultivated.

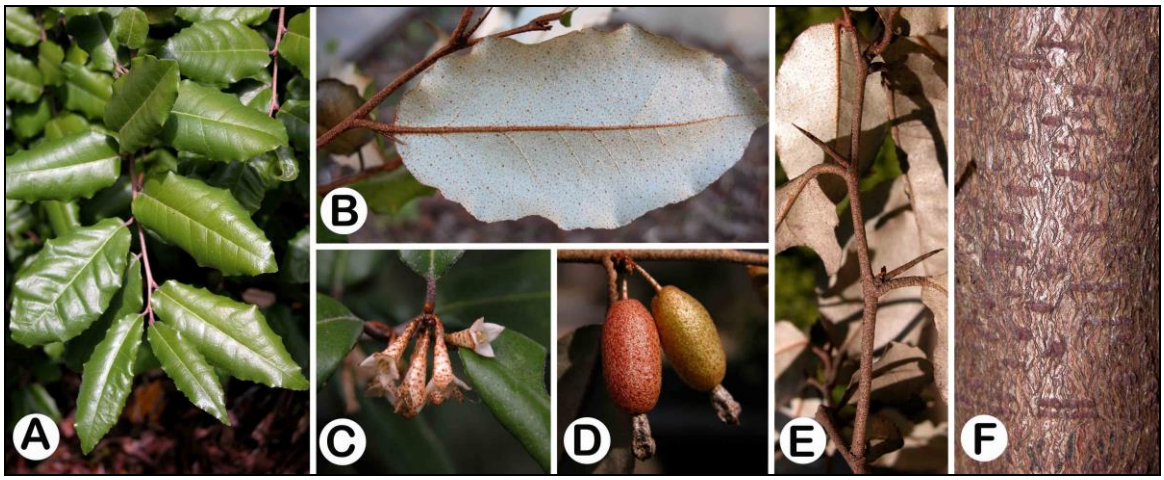
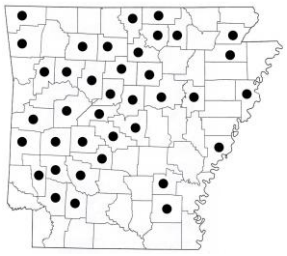


Figure 44. (A–F) *Elaeagnus pungens* plant and habit. (A–B) Leaves and stem (notice the abundant brown scales on the leaf lower surface in Fig. B). (C) Flowers. (D) Mature fruits. (E) Thorns and stem. (F) Bark.

Elaeagnus umbellata Thunb. (Fig. 45).

Elaeagnus umbellata (autumn olive) is a large, deciduous shrub or small tree to 5 m tall that is native to China and Japan (Quin & Gilbert 2007). It is well-naturalized in much of the USA, including Arkansas, occurring in most counties in the Ouachita and Ozark Mountain regions, along with a few eastern counties. This species is considered invasive in Arkansas (Gentry et al. 2013) into wooded, semi-wooded, and riparian habitats, but also will establish in prairie sites. *Elaeagnus umbellata* is ranked as a category-one noxious weed by the U.S. Forest Service, and is considered one of the most invasive species of woody plants in the country.



Similar to *E. angustifolia*, *E. umbellata* is reproductively mature within 3–5 years of age and also tends to form dense, often thorny thickets. Both species of *Elaeagnus* form mutualistic associations with actinomycete prokaryotes in the genus *Frankia* to fix nitrogen, and thus are capable of thriving on soils that are nitrogen deficient. Their roots produce nodules similar to those of nitrogen-fixing legumes. The fruits of *E. umbellata* may be used to make wine and preserves, and are attractive to a variety of wildlife species.

Elaeagnus umbellata somewhat resembles *E. pungens*, which is naturalized in the state (see comments section under *E. pungens* for distinguishing characteristics between the two species). It is, however, highly similar to *E. angustifolia*, but can be distinguished from it by the lack of stellate trichomes on the foliage (see generic description of *Elaeagnus* for more details). ***Habitat***: disturbed sites and waste places, including disturbed or open woods, woodland edges, prairies, roadsides, pastures, and fencerows.

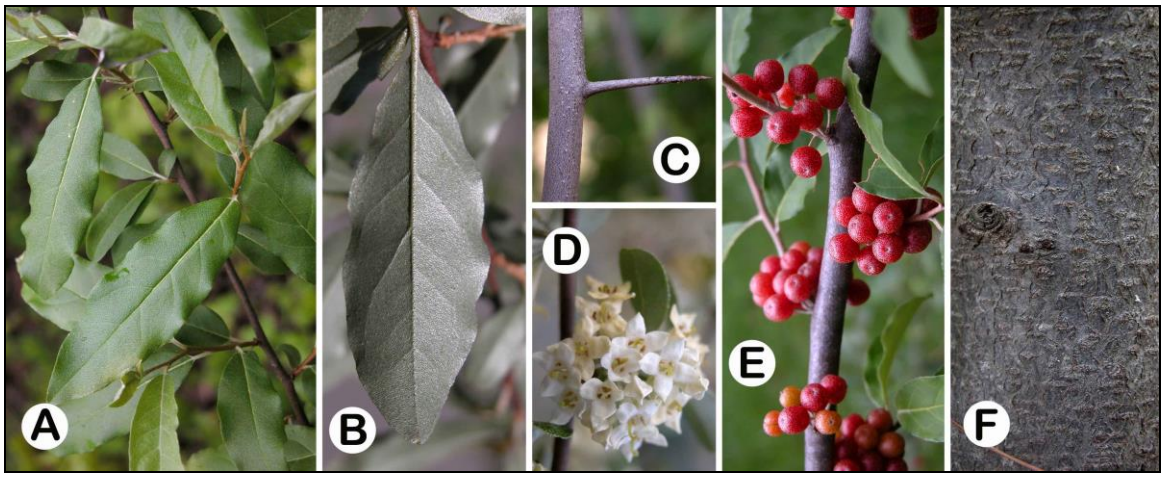


Figure 45. (A–F) *Elaeagnus umbellata* plant and habit. (A–B) Leaves and stem (notice the lack of brown scales on the leaf lower surface in Fig. B). (C) Thorn and stem. (D) Flowers. (E) Mature fruits. (F) Bark.

Eriobotrya, Loquat, Family Rosaceae

Eriobotrya is a genus of 30 species of evergreen trees and shrubs of eastern Asia (Gu & Spongberg 2003b; Phipps 2014a). A few species of *Eriobotrya*, including *E. japonica*, are cultivated for their edible fruits, and/or as ornamentals for their large leaves and fragrant flowers.

Eriobotrya japonica (Thunb.) Lindl. (Fig. 46).

Eriobotrya japonica (loquat) is a small, evergreen tree to 6 m tall, or sometimes more, that is native to China (Bailey & Bailey 1976; Krüssmann 1977; Gu & Spongberg 2003b). It is naturalized in a few southeastern states, including Florida and Louisiana, and currently is documented as escaped in Arkansas from Clark County (Thomas & Allen 1998; Hrusa et al. 2002; Judd 2003; Carter et al. 2009; Payne 2010; Wunderlin & Hansen 2011; Phipps 2014a; Kartesz 2015; Serviss & Serviss 2020b; USDA, NRCS 2021). Reproductively mature individuals of *E. japonica* often prolifically self-seed and it is not uncommon to encounter spontaneous juvenile plants in the vicinity of reproductive age plants.

Eriobotrya japonica produces large numbers of sweetly fragrant flowers in early to late

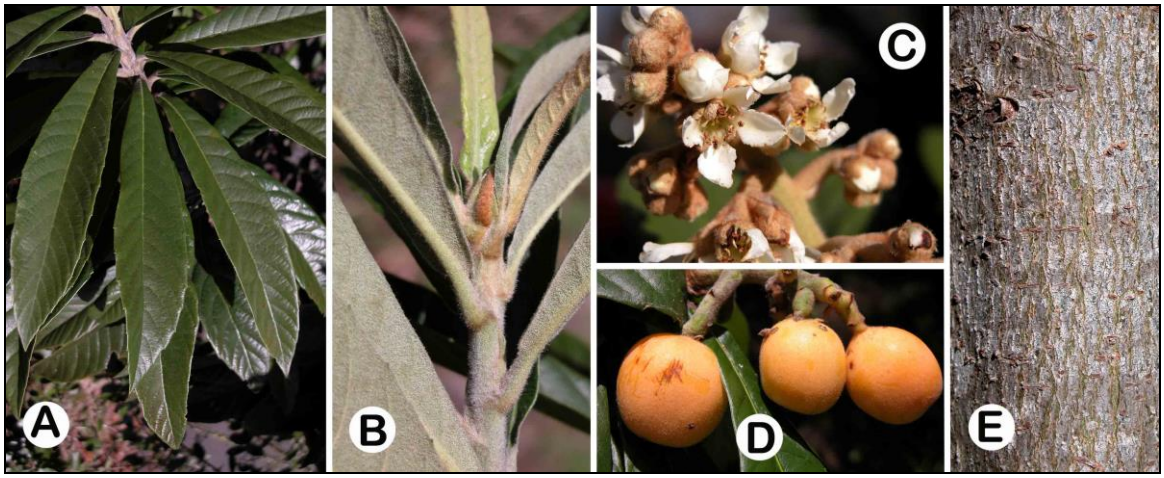


Figure 46. (A–E) *Eriobotrya japonica* plant and habit. (A–B) Leaves and stem (notice the dense indument of trichomes on the stem and leaf lower surface in Fig. B). (C) Flowers. (D) Mature fruits. (E) Bark.

winter, which typically are followed by fruit if hard or prolonged freezing temperatures are not experienced during or directly subsequent to flowering. It is cultivated in the southern USA and throughout southeastern Asia for its juicy, sweet fruits (Gu & Spongberg 2003b; Phipps 2014a). This species is self-fertile, but cross-pollination generally increases fruit set. Cultivation of *E. japonica* is restricted to warmer regions of the USA, as it has limited ability to withstand extreme or prolonged freezing temperatures, though it will tolerate short-term cold snaps to at least -12ºC.

In Arkansas, *E. japonica* potentially could be confused with *Castanea mollissima* (Chinese chestnut), *Photinia serratifolia* (Chinese photina), and *Magnolia grandiflora* (southern magnolia); however, it easily can be distinguished from *Castanea* by its perfect flowers and pome-type fruits, and from both *Magnolia* and *Photinia* by the dense indument of white to beige-colored trichomes that cover the young stems, twigs, leaves, and inflorescences. ***Habitat***: disturbed areas and waste places, especially in the vicinity of areas where plants of the species are cultivated.

Erythrostemon, Caesalpinia, Fabaceae

Erythrostemon is a genus of about 30 species of deciduous or evergreen trees, shrubs, and suffrutescent, perennial herbs distributed over the southern USA and Central and South America (Gagmon et al. 2016). One species, *E. gilliesii*, regularly is cultivated for its colorful, showy flowers.

Erythrostemon gilliesii (Wallich ex Hook.) Klotzsch; Syn.: *Caesalpinia gilliesii* (Wallich ex Hook.) Benth. (Fig. 47).

Erythrostemon gilliesii (bird-of-paradise shrub) is a deciduous shrub or small, open-canopy tree to 5 m tall that is native to Argentina and Uruguay (Krüssmann 1976; Isely 1998). Whereas, this species is not currently documented outside of cultivation in Arkansas, cultivated plants do occasionally self-seed, providing the potential for it to become escaped in the state's flora. *Erythrostemon gilliesii* is naturalized in several southwestern and south-central states, including Oklahoma and Texas (including Marion County in northeastern Texas), both of which border Arkansas (Isely 1998; Kartesz 2015; Weakley 2020).

Erythrostemon gilliesii is one of the most readily identifiable species of woody ornamentals when in flower. The two-toned flowers with red, long-exerted (up to 13 cm) stamens and golden-yellow petals are distinctive. The flowers are highly ornamental and also very attractive to hummingbirds and various species of hawkmoths. The seeds of *E. gilliesii* are reputedly toxic.

In Arkansas, *E. gilliesii* may be distinguished from most other woody species by its bipinnately (twice) compound leaves. It does, however, somewhat resemble *Albizia julibrissin* (mimosa) in that both species have bipinnately compound leaves. *Erythrostemon gilliesii* may be

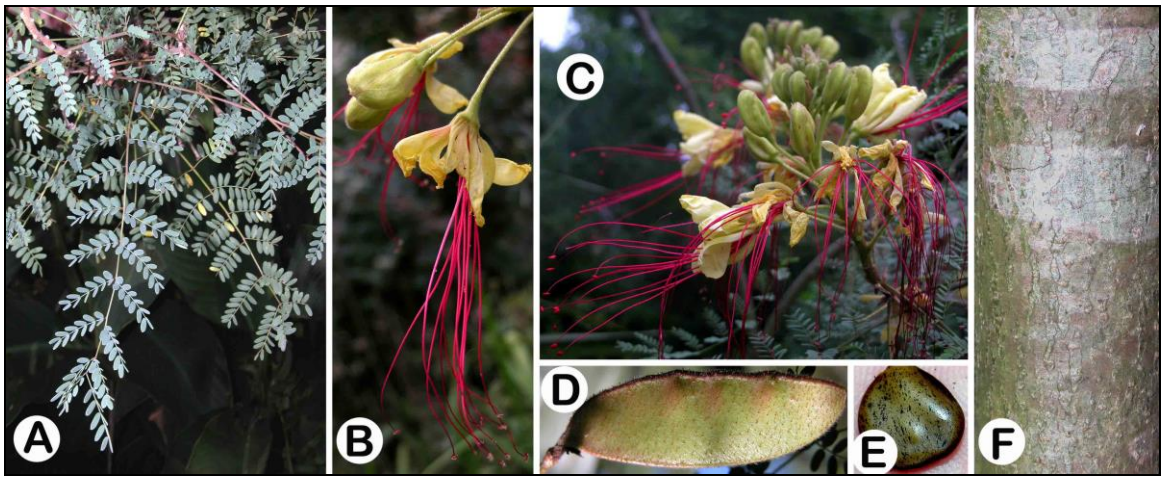


Figure 47. (A–F) *Erythrostemon gilliesii* plant and habit. (A) Leaves and stems. (B–C) Flowers and inflorescence. (D) Mature fruit. (E) Seed. (F) Bark.

distinguished from *A. julibrissin* by its densely glandular-pubescent young stems, inflorescences, and fruits, and leaves that have fewer leaflets per pinna (12–30). *Albizia julibrissin*, in contrast, has stems, inflorescences, and fruits that are not glandular-pubescent, and leaves with 40–50 leaflets per pinna. ***Habitat***: open, well-drained sites, particularly disturbed areas and waste places in the vicinity of where plants of the species are cultivated.

Euonymus, Burning Bush or Wahoo, Celastraceae

Euonymus is a genus of about 130 species of deciduous or evergreen trees and shrubs distributed primarily across Asia, Europe, and North America (Ma & Funston 2008; Ma & Levin 2016b). Many species are important as ornamentals for their attractive growth habit, brightly colored fruits and seeds, and attractive autumn foliage (Bailey & Bailey 1976; Krüssmann 1977). A number of highly invasive *Euonymus* species have been introduced from Asia into the USA and have subsequently naturalized in the flora, including Arkansas. Many of these exotic *Euonymus* species are shade-tolerant, and naturalized plants often are observed in the understory of semi-wooded and wooded habitats.

At present, three nonnative species of *Euonymus* are naturalized in the Arkansas flora; at least two are invasive. *Euonymus alatus* is well-established in northwestern Arkansas, but has been documented as far south in the state as Clark County, and *E. fortunei* occurs in several scattered locations across the state. *Euonymus japonicus* has been documented outside of cultivation in Arkansas from two counties. Two other nonnative and invasive species of *Euonymus*: *E. europaeus* and *E. maackii*, while currently not clearly documented from the Arkansas flora, are naturalized in neighboring states and should be expected in Arkansas outside of cultivation. Three native species of *Euonymus* also occur in the state.

Species of *Euonymus* have opposite, simple leaves with toothed margins — a useful distinguishing character from the vegetatively similar genera *Ligustrum* and *Lonicera*, and small, perfect (bisexual), greenish-yellow (or sometimes purplish-red) flowers arranged in cymose inflorescences. The fruit is a white, pink, red, or purple capsule that dehisces to reveal orange or red seeds (the seeds are covered in a brightly colored, fleshy aril, beneath which they are hard and white or pale brown); the seeds of *Euonymus* species are bird-dispersed, facilitating their invasive tendencies.

Key to *Euonymus* species:

1. Plants deciduous; young stems quadrangular in cross section, the angles often with corky wings ..... **Euonymus alatus**
1. Plants deciduous or evergreen (sometimes partially evergreen in *E. fortunei*); stems terete in cross section, or at least not winged.

2. Plants evergreen and liana-like or erect to ascending shrubs; leaves thickly chartaceous, often glossy.

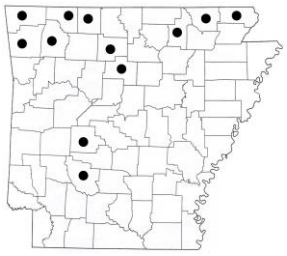
3. Plant liana-like ..... **Euonymus fortunei**
3. Plant a shrub.

4. Growth form with branches procumbent, sprawling, or ascending ..... **Euonymus fortunei**
4. Growth form erect..... **Euonymus japonicus**

2. Plants deciduous and shrubs or small trees, leaves chartaceous to membranous, not generally glossy.

5. Leaves generally long-acuminate or caudate at the apex, sometimes acute, smooth on both surfaces; anthers purple..... **Euonymus maackii**
5. Leaves acute to short-acuminate at the apex, rough or rugose based on raised venation; anthers white to cream..... **Euonymus europaeus**

Euonymus alatus (Thunb.) Sieb. (Fig. 48).



Euonymus alatus (winged burning bush) is a deciduous shrub or small tree to 5 m tall that is native to temperate eastern Asia (Ma & Funston 2008). In addition to much of the eastern USA and southern Canada (Kartesz 2015; Ma & Levin 2016b), this species is well-established and invasive in northwestern Arkansas, often invading into wooded areas where it can become a substantial component of the understory, sometimes forming dense stands. In the state, *E. alatus* has been documented as far south as Garland and Clark counties.

Euonymus alatus can be distinguished from other species of *Euonymus* (in Arkansas) by the corky, winged outgrowths that occur on the angles of the twigs. Both the production and length of the corky outgrowths is variable. While usually shrubby in growth form, *E. alatus* occasionally grows in a liana-like fashion, loosely climbing surrounding vegetation.

The leaves of *E. alatus* often turn bright red, maroon, purple, or pink in autumn. Combined with colorful, persistent fruits and seeds, this species provides an attractive display of color in late autumn. ***Habitat***: disturbed sites and waste places, fencerows, thickets, greenbelts, riparian zones, woodland edges, and as an understory shrub in urban wooded habitats and upland woods.

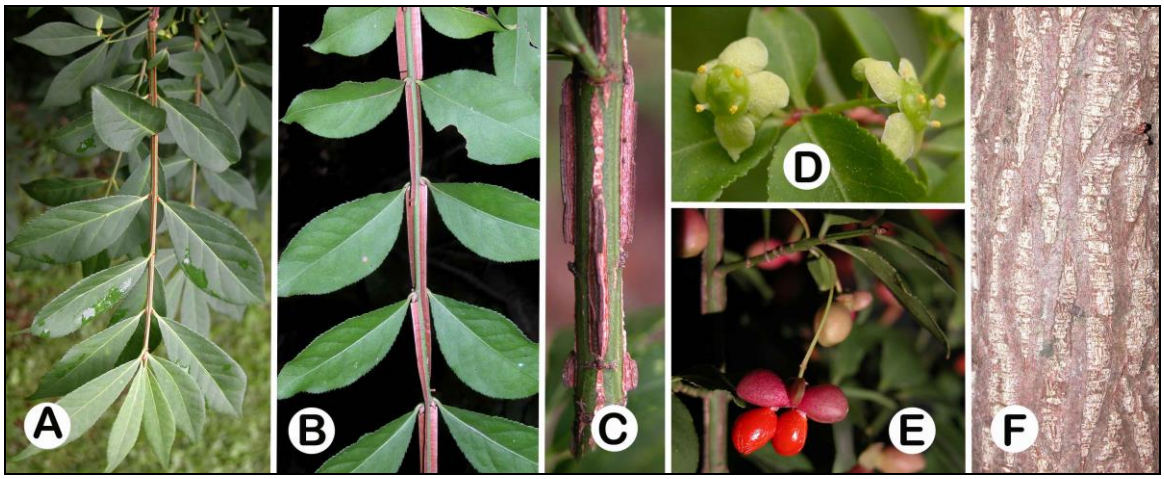


Figure 48. (A–F) *Euonymus alatus* plant and habit. (A–B) Leaves and stems (notice the variation in both the presence and development of the corky outgrowths or "wings"). (C) Close-up view of stem to show the corky outgrowths. (D) Flowers. (E) Mature fruits. (F) Bark.

Euonymus europaeus L. (Fig. 49).

Euonymus europaeus (spindle tree) is a large, deciduous, occasionally semi-evergreen shrub or small tree to 10 m tall that is native to Europe and western Asia (Bailey & Bailey 1976; Krüssmann 1977; Ma & Levin 2016b). This species is listed as occurring in Arkansas by Ma and Levin (2016b); however, it is not listed for Arkansas in Hunter (1995), Arkansas Vascular Flora Committee (2006), Gentry et al. (2013), Kartesz (2015), Ogle et al. (2020), or Weakley (2020). There is, however, a 1946 Demaree specimen (GH), collected from a cemetery in Ashley County. Whether or not this plant was in cultivation or present as an escape is not clear from the specimen data label, but it possibly may represent an occurrence of this species outside of cultivation in the state. No other Arkansas specimens or material of *E. europaeus* have been seen by the authors. This species is escaped or naturalized in several states in the eastern USA, including Mississippi, which borders Arkansas (Kartesz 2015; Ma & Levin 2016b; Weakley 2020). Weakley (2020) notes that it is

uncommon in cultivation and rarely naturalized in the region covered by his treatment. It is sometimes cultivated in Arkansas.

Euonymus europaeus has been cultivated (in the Old World) for centuries, and is used as a specimen tree or for a screen. It sometimes is used for dune stabilization in its native Europe (Bailey & Bailey 1976; Krüssmann 1977).

Euonymus europaeus morphologically resembles *E. maackii* (winterberry euonymus); however, it can be distinguished from it by its leaves with acute to short-acuminate apices and shorter petioles (0.6–1.25 cm), and pink to red fruits. Contrastingly, *E. maackii* has leaves with long-acuminate apices and longer petioles (1.25–2.5 cm), and yellowish-white fruits, though these can sometimes be tinged with pink coloration. *Euonymus europaeus* also vegetatively is similar to the native *E. atropurpureus* (eastern wahoo), but can be distinguished from it by its greenish white flowers, with 3–4 mm long petals, glabrous leaves, and prominently ridged and furrowed bark. The flowers of *E. atropurpureus* are dark purplish-red, with petals 1.5–2(–3) mm long, leaves that often are sparsely pubescent on the upper surface, and smooth bark. ***Habitat***: waste places and disturbed areas, urban woods and woodland edges, fencerows, and roadsides.

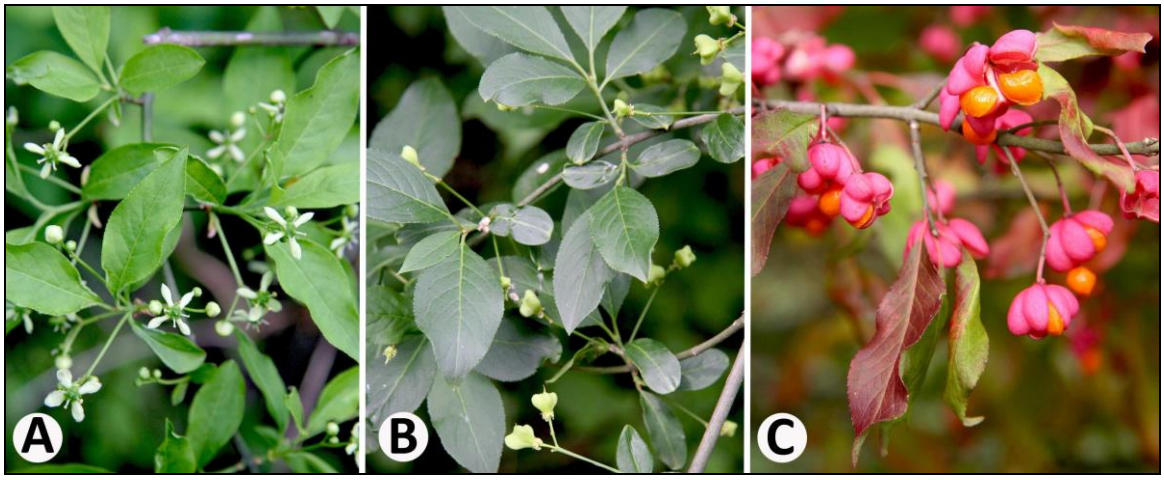
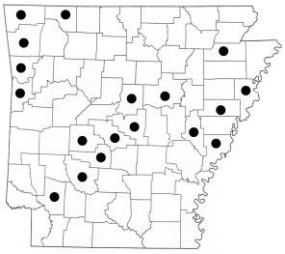


Figure 49. (A–C) *Euonymus europaeus* plant and habit. (A–B) Leaves, stems, and flowers. (C) Mature fruits. Bark (not shown) is prominently ridged and furrowed, with interlocking ridges. Photo credit: Robert Vidéki, Doronicum Kft., Bugwood.

Euonymus fortunei (Tursz.) Hand-Maz, including *E. kiautschovicus* Loes. (Fig. 50).



Euonymus fortunei (winter-creeper, climbing euonymus) is an evergreen shrub or more commonly a liana to 8 m or more in length that is native to China (Ma & Funston 2008). It is naturalized and invasive in much of the eastern USA, including Arkansas (Freeman & McGregor 1998; Miller 2003; Koul et al. 2006; Nesom 2010a; Kartesz 2015; Ma & Levin 2016b; Weakley 2020). It is variable in habit, ranging from an erect to ascending shrub to more typically a sprawling or climbing vine that will produce trailing stems along the ground and/or climb aggressively by means of adventitious roots. The liana-like form is most commonly encountered in Arkansas. This species is cultivated mostly as an evergreen groundcover, or sometimes as a hedge with shrub forms.

Euonymus fortunei is the most common and widespread species in the genus in its native Asia; it also is the most complex and morphologically variable species of *Euonymus*, with liana-like, shrub, and small tree forms, along with a highly variable and plastic leaf morphology (Ma & Funston 2008). This variation has led to considerable synonymy and some difficulty in delimiting species boundaries. One notable example of this problem is spreading euonymus, formerly classified as *E. kiautschovicus*, a generally shrubby form of *E. fortunei* with thick stems and round glossy leaves that

is commonly cultivated and occasionally found escaped in the USA. ***Habitat***: adaptable; disturbed areas and waste places, also wooded areas, woodland edges, thickets, and riparian zones, especially common in and along disturbed woods in proximity to urban environments.

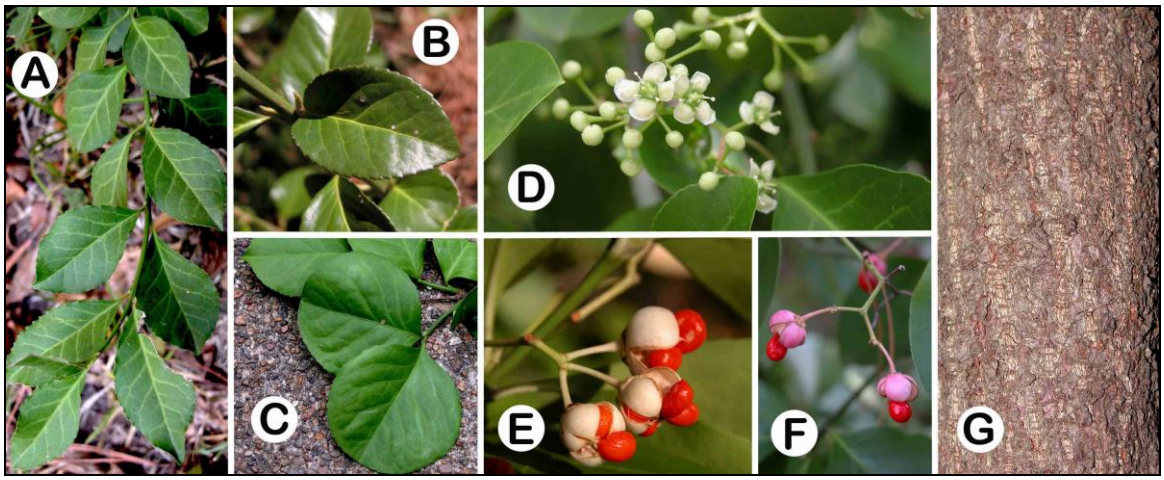
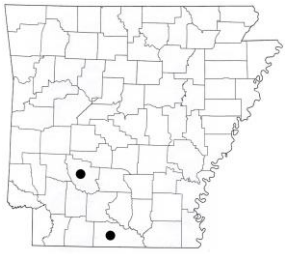


Figure 50. (A–G) *Euonymus fortunei* plant and habit. (A–C) Leaves and stems (notice the variation in leaf shape; Fig. B is the shrub form sometimes referred to as *E. kiautschovicus*). (D) Flowers. (E–F) Mature fruits. (G) Bark.

Euonymus japonicus Thunb. (Fig. 51).



Euonymus japonicus (Japanese spindle tree) is an evergreen shrub or small tree to 5 m tall, or sometimes more, that is native to Japan (Ma & Funston 2008). It has been documented outside of cultivation in Arkansas in Clark and Union counties (Serviss et al. 2017a). It also is escaped or naturalized in scattered locations in the eastern USA (Diamond 2013; Hannick et al. 2013; Kartesz 2015; Ma & Levin 2016b; Weakley 2020).

Euonymus japonicus can be distinguished from most other *Euonymus* species encountered in Arkansas by its evergreen habit, leathery, glossy, dark green leaves, and dark brown bark. The other species of *Euonymus*, with the exception of *E. fortunei*, are deciduous with thin membranous leaves and lighter gray, beige, or brown bark. The strictly erect form of *E. japonicus* distinguishes it from shrub forms

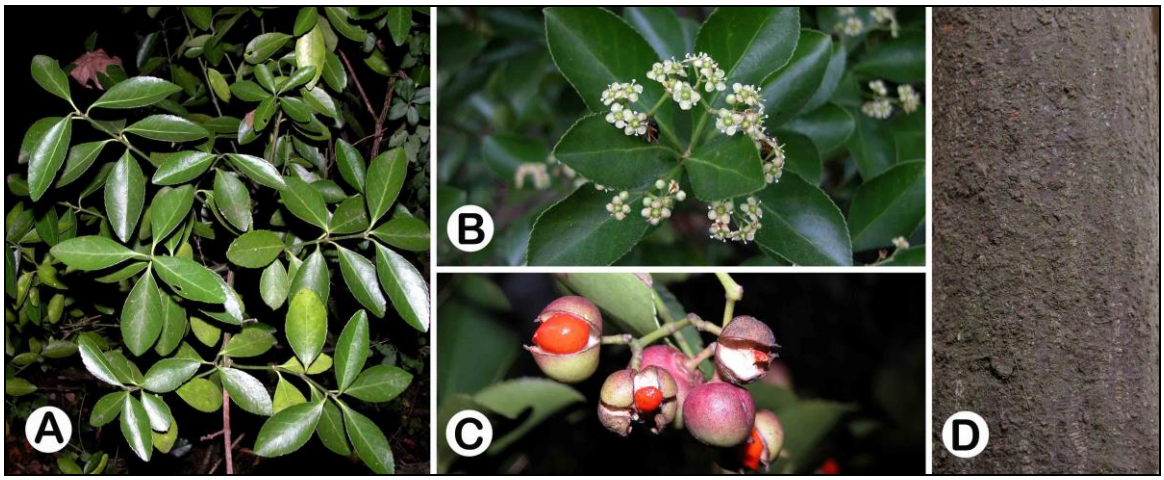


Figure 51. (A–D) *Euonymus japonicus* plant and habit. (A–B) Leaves and stem. (B) Flowers. (C) Mature fruits. (D) Bark.

of *E. fortunei* (see Serviss et al. 2017a).

Numerous horticultural varieties of *E. japonicus* exist, including decorative white, yellow, and pink-variegated forms, dwarf cultivars that are important for low level hedges and borders, and forms with a highly columnar or upright growth habit that can be used in narrow spaces (Bailey & Bailey 1976; Krüssmann 1977). It is highly conducive for use in topiary and as a hedge. Similar to *E. maackii*, *E. japonicus* is highly susceptible to euonymus scale. All portions of the plant are reputedly toxic, but apparently pose a serious threat only if consumed in large quantities. ***Habitat***: disturbed areas and waste places, riparian zones, mesic and low woods.

Euonymus maackii Ruprecht; Syn.: *Euonymus bungeanus* Maxim. (Fig. 52).

Euonymus maackii (winterberry euonymus) is a shrub or small, deciduous or tardily deciduous tree to about 5 m tall that is native to China (Ma & Funston 2008). Although not currently known from the Arkansas flora, it sometimes is cultivated in the state, and is naturalized in Colorado, Florida, Georgia, Illinois, and South Carolina (Ma & Levin 2016b; Weakley 2020). *Euonymus maackii* can spread locally through air layering of stems and vigorous production of root suckers. It also is adaptable to a wide range of soils. *Euonymus maackii* should be expected within the state's flora. *Euonymus maackii*, along with the similar *E. europaeus*, both mature reproductively at only a few years of age, and small plants less than one meter tall can produce flowers and fruits.

In Arkansas, *E. maackii* potentially could be confused with *Prunus mahaleb* (Mahaleb cherry), *Triadica sebifera* (Chinese tallow tree, popcorn tree), and young plants of both *Pyrus calleryana* (Bradford pear) and *P. communis* (common pear), because of its similarity in leaf shape and overall growth form to these species. *Euonymus maackii* can be distinguished from all of them, however, by its opposite leaves and distinctly ridged and furrowed bark, with interlocking ridges. All of the aforementioned species have alternately-arranged leaves and either smooth bark or bark consisting of narrow and elongate, or at least flattened, sometimes semi-exfoliating plates. In addition, the leaves of *T. sebifera* have entire margins, whereas those of *E. maackii* are toothed. ***Habitat***: waste places, disturbed sites, and woodland edges.

Euonymus scale (*Unaspis euonymi*) is a serious insect pest of both deciduous and evergreen *Euonymus* species. It is native to China and Japan, however, is now established and widespread in North America. It feeds on fluids from the plant body by means of piercing, sucking mouthparts. Light to moderate infestations of scale will cause chlorotic (yellowed) mottling of the foliage and leaf drop, and severe infestations will result in twig dieback and even death of the plant. Euonymus scale is difficult to control once mature because of the adult insect's stationary habit and protective waxy coating, making direct contact with pesticides more difficult.

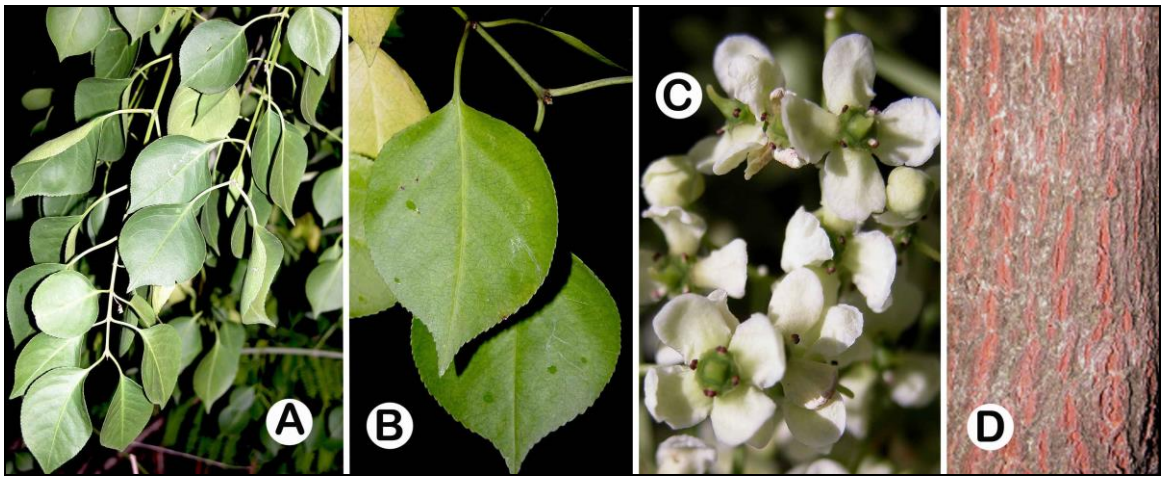


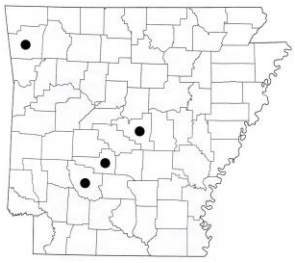
Figure 52. (A–D) *Euonymus maackii* plant and habit. (A–B) Leaves and stems. (C) Flowers (notice the purple anthers). (D) Young bark (older bark is prominently ridged and furrowed, with interlocking ridges).

Exochorda, Pearlbush, Rosaceae

Exochorda is a small genus of four species of deciduous shrubs of Asiatic origin (Gu & Alexander 2003; Haines 2014). Species of *Exochorda* are cultivated for their large and showy flowers. The genus is closely allied with *Spiraea*, with which it sometimes is confused.

Exochorda racemosa (Lindl.) Rehd. (Fig. 53).

Exochorda racemosa (pearlbush) is a large, deciduous shrub to 4 m tall that is native to China (Gu & Alexander 2003). It is naturalized in Arkansas, where it has been documented from Clark, Hot Spring, Pulaski, and Washington counties. It should, however, be expected elsewhere in the state outside of cultivation, as it readily self-seeds. It is not uncommon to observe seedlings and young plants in the vicinity of reproductive age individuals. In addition to Arkansas, *E. racemosa* is naturalized in several eastern states from Louisiana to the Carolinas and northward along the east coast to New York and Massachusetts (Horn & Hill 1997; Haines 2014; Diamond 2014; Weakley 2020).



Exochorda racemosa is cultivated as a specimen plant for its profuse display of white flowers in early spring. Culture and habit is similar to *Spiraea*, to which it is related.

In Arkansas, *E. racemosa* somewhat resembles *Spiraea* and shrub species of *Lonicera*. It can be differentiated from *Lonicera* by its alternate leaves (*Lonicera* species have opposite leaves), and from most species of *Spiraea* by its leaves with generally entire margins (occasionally, a few leaves may be serrately-toothed on the upper one-half, and juvenile plants of *E. racemosa* regularly have toothed leaves), and its large flowers between 2.5–3.5 cm in diameter (*Spiraea* species generally have toothed and/or lobed leaves, and flowers that are much less than 2.5 cm in diameter). ***Habitat***: disturbed areas and waste places, especially in the vicinity of cultivated plants of the species; also open woods, woodland edges, thickets, fields, and roadsides.

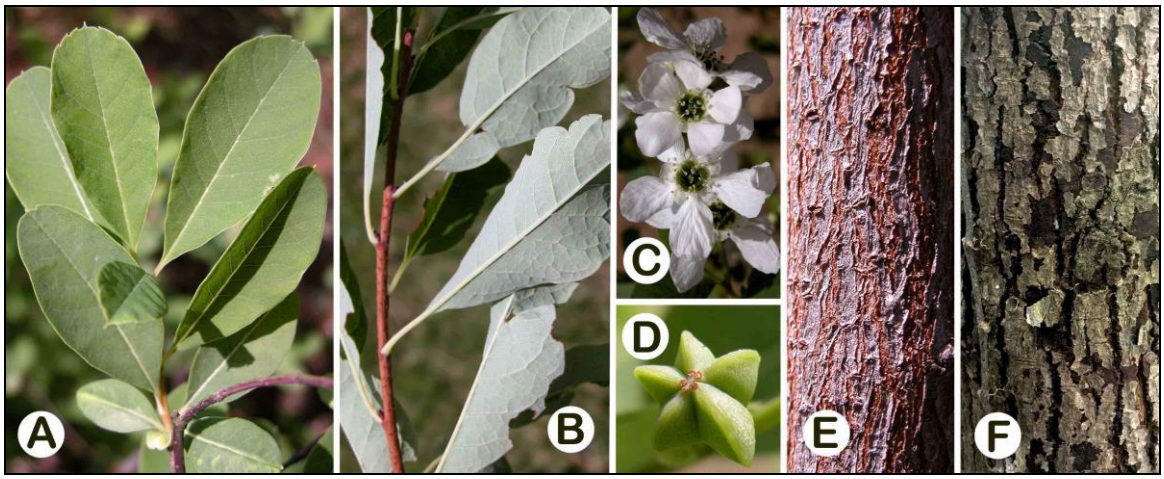


Figure 53. (A–F) *Exochorda racemosa* plant and habit. (A–B) Leaves and stems. (C) Flowers. (D) Mature fruit. (E) Young bark. (F) Older bark.

Ficus, Fig, Moraceae

Ficus is a large genus of 1,000–1,400 species of evergreen or deciduous trees, shrubs, and vines distributed over subtropical and tropical regions worldwide, with the highest level of diversity probably occurring in tropical Asia (Wunderlin 1997b; Wu et al. 2003b). Species of *Ficus* are cultivated, often as house-plants, for their large, tropical-looking foliage. A few species, most notably common fig (*F. carica*), also are grown locally and commercially for their high-quality edible fruits

(Wu et al. 2003b). The modified multiple fruit that characterizes *Ficus*, the syconium or "fig," distinguishes it from all other genera of woody plants in Arkansas.

Ficus carica L. (Fig. 54).

Ficus carica (common fig or edible fig) is a large, often multi-stemmed, deciduous shrub or small tree to 10 m tall that is native to the Mediterranean region (Wunderlin 1997b). While currently only documented outside of cultivation in Arkansas from Garland County, it commonly is cultivated in the state and sometimes encountered persisting long after such practices have ceased. *Ficus carica* also has been documented outside of cultivation in a number of other southeastern states (Wunderlin 1997b; Thomas & Allen 1998; Weakley 2020). Consequently, it should be expected elsewhere in Arkansas as escaped or persisting from cultivation. This species is the standard fig of commerce, which has been cultivated for its edible fruits in the Middle East for thousands of years.

Pollination of flowers occurs via fig wasps in a symbiotic, wasp-dependent pollination system, where the life cycle of the wasp is closely allied with the flowering and fruiting period of the fig (Wunderlin 1997b; Wu et al. 2003b). The larvae of the wasps feed on short-styled pistillate flowers, specialized sterile female flowers known as gall flowers that probably are produced for that purpose, or in staminate syconia of dioecious species of fig (Wunderlin 1997b; Wu et al. 2003b).

In Arkansas, *F. carica* vegetatively resembles both *Morus rubra* (red mulberry) and *M. alba* (white mulberry), along with *Broussonetia papyrifera* (paper mulberry); however, it may be distinguished from these species by its thick, deeply lobed leaves (juvenile mulberries also can have similarly lobed leaves), thick stems with stipules encircling a large, conical, terminal bud, flowers and fruits enclosed within a syconium, and mostly shrubby habit. *Morus* and *Broussonetia*, in contrast, have thinner leaves, many of which are unlobed or with only 1–2 lobes, thinner stems without the terminal bud surrounded by a pair of stipules, multiple fruits that are not modified into syconia, and are medium-sized to large trees at maturity. ***Habitat*:** disturbed areas and waste places, sometimes encountered persisting from cultivation.

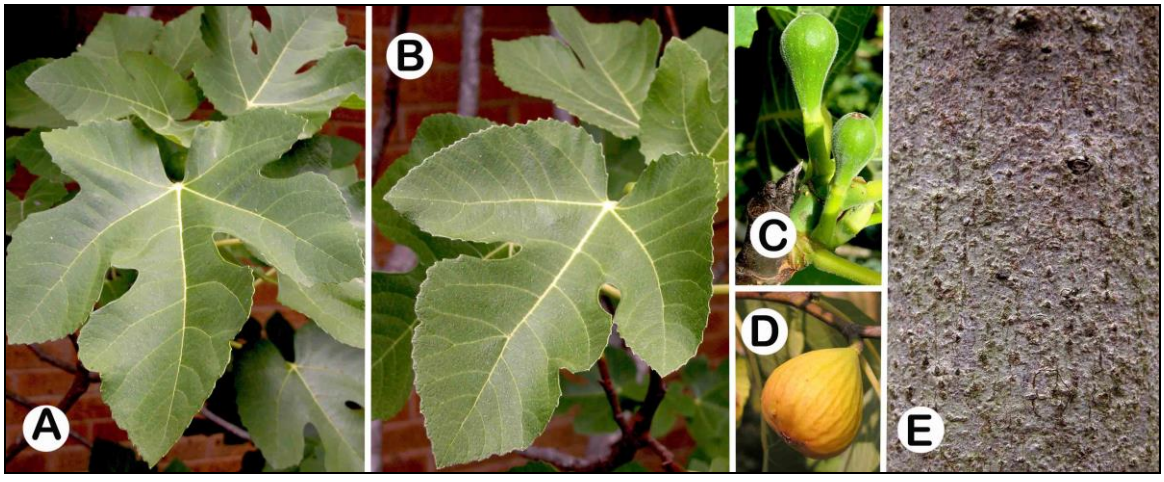


Figure 54. (A–E) *Ficus carica* plant and habit. (A–B) Leaves (the amount and degree of lobing is somewhat variable). (C) Flowers. (D) Mature fruit. (E) Bark.

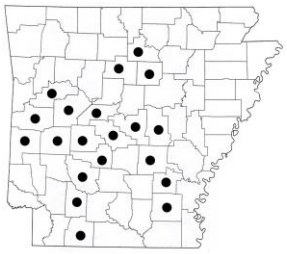
Firmiana, Parasol Tree, Malvaceae (formerly Sterculiaceae)

Firmiana is a small genus of about 16 species of deciduous shrubs and trees of Asiatic origin (Tang et al. 2007a; Dorr 2015). Species of *Firmiana* are cultivated for their large, tropical-looking

foliage. *Firmiana* and the Sterculiaceae family sometimes are classified within the closely allied Malvaceae.

Firmiana simplex is naturalized in scattered locations throughout the southeastern USA from eastern Texas to Florida, and north to Virginia and Maryland (Dorr 2015). It is naturalized and locally invasive in Arkansas, mostly in the southern and central areas of the state.

Firmiana simplex (L.) W. Wight (Fig. 55).



Firmiana simplex (Chinese parasol tree, varnish tree) is a small to medium-sized, deciduous tree, generally ranging from 6–15 m tall that is native to China and possibly Japan (Tang et al. 2007a). *Firmiana simplex* prolifically self-seeds, and thus a single, reproductive age tree can produce an entire colony — this is characteristic behavior for the species in Arkansas and elsewhere. This species is characterized by extremely rapid growth when young, tolerance of moist and dry soils, drought-tolerant once established, and reaches sexual maturity at less than 10 years of age. In China, the bark is used as a fiber source to produce cordage and cloth, and the wood is used to make furniture, coffins, and musical instruments (Tang et al. 2007a).

Morphologically, *F. simplex* is similar to *Vernicia fordii* (tungoil tree), which also is naturalized in Arkansas. It easily can be distinguished from *V. fordii* because it lacks the large, conspicuous red or brown glands that are present on the distal portion of the petioles of *V. fordii*. Small, juvenile plants of the two species can be particularly difficult to distinguish, especially when they occur together, unless the presence or absence of the petiolar glands is considered (compare Fig. 165E with Fig. 171B). ***Habitat*:** waste places, disturbed areas, woodland edges, disturbed woods, roadsides, old home sites, especially in the vicinity of where it is cultivated.

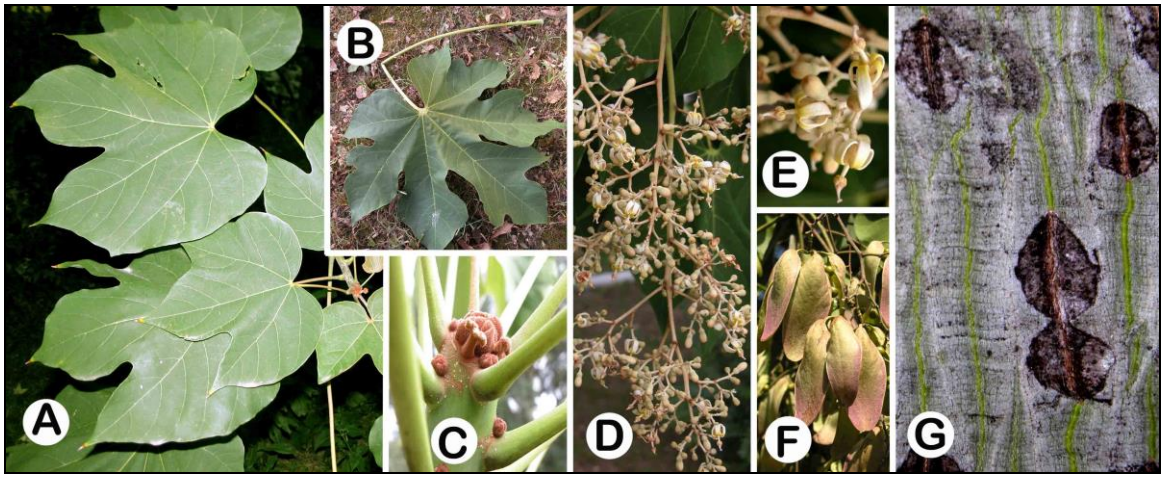


Figure 55. (A–G) *Firmiana simplex* plant and habit. (A–B) Leaves (three-lobed leaves are typical on mature growth, but leaves with five and seven lobes sometimes occur). (C) Stem and conspicuous, brown-pubescent buds. (D–E) Flowers and inflorescence. (F) Mature fruits. (G) Bark (the vertical green striping helps distinguish *F. simplex* from other, similar trees in Arkansas).

Forsythia, Forsythia or Golden Bells, Oleaceae

Forsythia is a genus of about 11 species of deciduous or semi-evergreen shrubs distributed primarily across Asia, with one species in Europe (Krüssmann 1977; Chang et al. 1996a). Most species are important as ornamentals for their colorful and profuse display of bright yellow flowers in early spring and ease of cultivation.

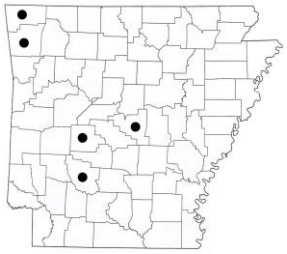
Two morphologically similar species, *F. suspensa* and *F. viridissima*, commonly are cultivated in Arkansas, and sometimes encountered in the flora outside of cultivation (Serviss et al.

2015, 2017b). Both also are naturalized in the eastern USA (Kartesz 2015; Weakley 2020). Naturalization and establishment of both *Forsythia* species appears to be accomplished mostly vegetatively via air layering of stems. Some establishment via seed production also may occur.

Species of *Forsythia* have opposite, simple, or rarely ternately compound leaves with coarsely toothed (in ours) margins, perfect (bisexual), yellow to golden-yellow flowers arranged in solitary or few-flowered axillary inflorescences. The fruit is a small, few-seeded capsule.

Forsythia suspensa (Thunb.) Vahl. (Fig. 56).

Forsythia suspensa (weeping forsythia) is a deciduous shrub to about 3 m tall that is native to China (Chang et al. 1996a). It has been documented outside of cultivation in Arkansas in Benton, Clark, Garland, Pulaski, and Washington counties (Serviss et al. 2015, 2017b). It readily spreads from established or cultivated plants via layering of stems, where the stems root when in contact with the ground. Whole colonies of plants can be produced in this manner. It should be expected outside of cultivation elsewhere in the state, and its occurrence in the Arkansas flora likely exceeds current documentation.



Many plants of *F. suspensa* (in Arkansas) have only simple leaves; however, sometimes individuals are encountered that have at least a few ternately compound leaves (Fig. 57). These plants can have some stems with simple leaves and others with ternately compound ones. Plants with at least some verticillate leaves also occasionally can be found (Fig. 57).

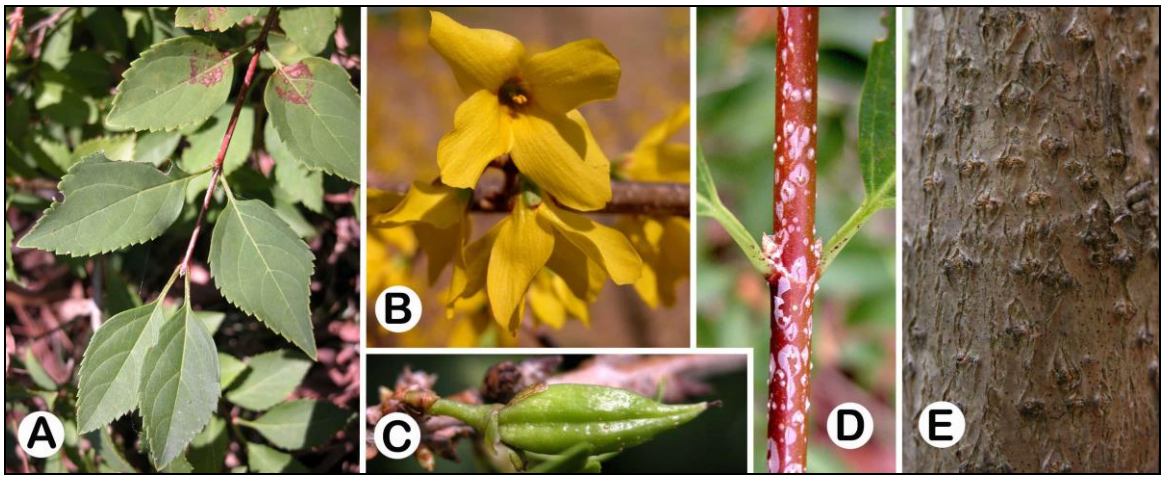


Figure 56. (A–E) *Forsythia suspensa* plant and habit. (A) Leaves. (B) Flowers. (C) Young fruit. (D) Stem. (E) Bark.

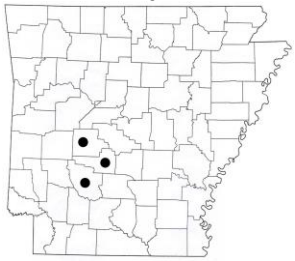
The occurrence and distribution of a number of nonnative taxa in the flora, such as *Forsythia*, probably is higher than current records indicate. Many of these species, especially when examined closely, demonstrate the ability for some type of reproduction, allowing for potential entry and subsequent establishment in the flora. In-depth investigation of urban environments in Arkansas has yielded records of many exotic woody species previously undocumented for the state, or additional occurrences of species known from only one or a few locations (Peck & Serviss 2011; Serviss et al. 2015, 2017b).

Forsythia suspensa morphologically resembles *F. viridissima* (greenstem forsythia) — see comments section for *F. viridissima* for distinguishing characteristics between the two species. ***Habitat***: disturbed areas and waste places, especially in the vicinity of cultivated plants of the species; also woodland edges, thickets, slopes, and roadsides.

Figure 57. *Forsythia suspensa* plants with ternately compound leaves (left) and verticillate leaves (right). Photo credit: plant with ternately compound leaves: Jennifer Ogle, University of Arkansas.

Forsythia viridissima Lindl. (Fig. 58).

Forsythia viridissima (greenstem forsythia) is a deciduous to semi-evergreen shrub to 3 m tall that is native to China (Chang et al. 1996a). It has been documented outside of cultivation in Arkansas from Clark, Garland, and Hot Spring counties (Serviss et al. 2015, 2017b). As with *F. suspensa* (weeping forsythia), this species should be expected elsewhere in the state outside of cultivation, as it spreads readily via air layering of stems from cultivated or established plants.



Forsythia viridissima morphologically is similar to *F. suspensa*; however, it can be distinguished from it by its longer, narrower leaves that are generally only toothed along the margins of the distal one-third to one-half of the lamina, flowers that generally are produced in clusters of 2–4 (rarely solitary), and lamellate (chambered) pith at the internodes. Contrastingly, *F. suspensa* has broader leaves that are serrate along most of the margin, flowers that are often solitary (can be 2 or more per axil), and hollow pith at the internodes.

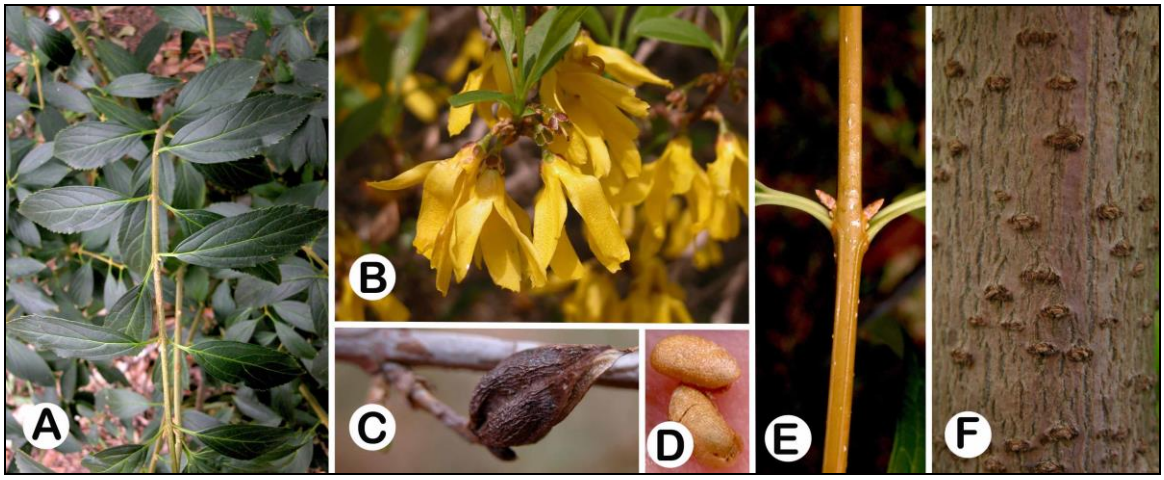


Figure 58. (A–F) *Forsythia viridissima* plant and habit. (A) Leaves. (B) Flowers. (C) Mature fruit. (D) Seeds. (E) Stem. (F) Bark.

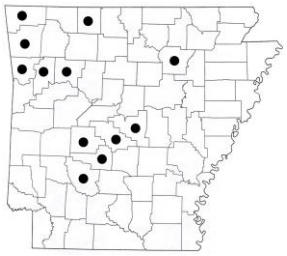
A naturally occurring, interspecific hybrid (between *F. suspensa* and *F. viridissima*), *F. × intermedia*, sometimes is cultivated in Arkansas, and potentially could be confused with either parental species. It is more or less intermediate in form between the two species but probably more closely resembles *F. suspensa*. It has the lamellate pith of *F. viridissima* and the more pendulant (weeping) growth form of *F. suspensa*. ***Habitat***: disturbed areas and waste places, especially in the vicinity of cultivated plants of the species; also woodland edges, thickets, riparian zones, and slopes.

Hedera, Ivy, Araliaceae

Hedera is a small genus of about 15 species of evergreen, high-climbing (via aerial rootlets) lianas distributed across Asia, Europe, and North Africa (Plunkett et al. 2018). Species of *Hedera* are cultivated for their evergreen, sometimes variegated foliage and vining habit.

Hedera helix L. (Fig. 59).

Hedera helix (English ivy, European ivy) is a large, evergreen liana that can climb to 30 m in length that is native to Europe (Bailey & Bailey 1976; Krüssmann 1977). It is well-naturalized over much of the USA (Kartesz 2015; Weakley 2020), including Arkansas, where it occurs in several counties. In Arkansas, it regularly invades into wooded and semi-wooded habitats, sometimes completely covering trees and ground. *Hedera helix* is capable of aggressive vegetative spread via stems, which climb and creep with the assistance of adventitious aerial roots. Plants are shade-tolerant, particularly during juvenility, although a wide-range of light regimes are tolerated, including full-sun. Fruit production seems to be highest under conditions that offer at least some direct sunlight. The fruits (seeds) are bird-dispersed. The distribution of *H. helix* in Arkansas is undoubtedly wider than current records indicate.



Hedera helix has been in cultivation for centuries, and probably over 100 different cultivars exist, including diminutive forms and forms with variegated leaves that possess pale green, white, or yellow coloration (Bailey & Bailey 1976; Krüssmann 1977). It is used as an ornamental for its attractive evergreen foliage and as a ground cover or foliage cover for fences, walls, and arbors.

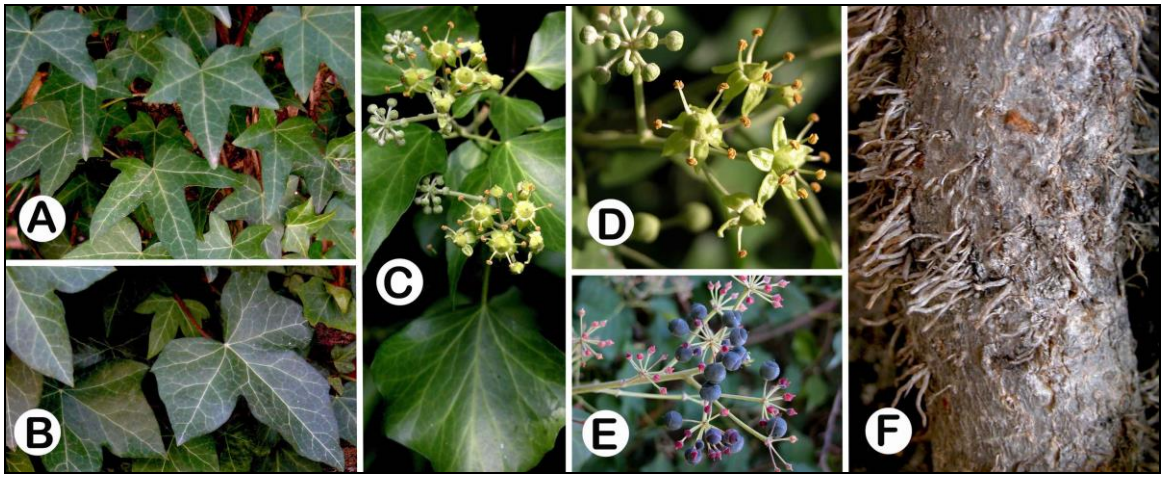


Figure 59. (A–F) *Hedera helix* plant and habit. (A–B) Leaves (the degree of lobe development and number of lobes is highly variable). (C–D) Flowers and inflorescence. (E) Mature fruit. (F) Bark and adventitious roots.

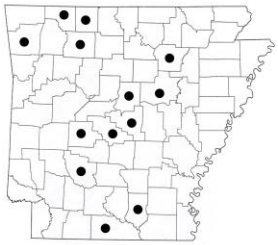
The leaf morphology of *H. helix* is highly variable. Leaves may be prominently and deeply lobed, shallowly lobed, or unlobed, and are dimorphic between vegetative and reproductive stems. The leaves of vegetative stems typically are broadly ovate, about as long as wide, and lobed, whereas the leaves of reproductive (flowering and fruiting) stems generally are smaller, narrower, and

unlobed. ***Habitat***: wooded and semi-wooded areas, riparian zones, and roadsides; often observed spreading from paces of cultivation.

Hibiscus, Mallow, Malvaceae

Hibiscus is a relatively large genus of about 200 species of evergreen or deciduous trees, shrubs, subshrubs, and herbs distributed across warm-temperate, subtropical, and tropical regions worldwide (Tang et al. 2007b; Blanchard 2015). *Hibiscus* is a horticulturally important genus, as many of its species produce large, colorful flowers, and are therefore frequently cultivated. *Hibiscus syriacus* is the only woody member of the genus in Arkansas.

Hibiscus syriacus L. (Fig. 60).



Hibiscus syriacus (Rose-of-Sharon, althea) is a large, deciduous shrub to 4 m tall that is native to China and India (Tang et al. 2007b). It is naturalized in the central and eastern USA (Blanchard 2015; Weakley 2020), including Arkansas, having been documented from a number of scattered counties across the state. It is important to note, however, that *H. syriacus* is extensively cultivated in Arkansas and prolifically self-seeds, and juvenile plants often are encountered in the vicinity of reproductive age individuals. It is therefore probably more common in the state's flora than current records indicate.

This species is one of only a handful of cold-hardy woody *Hibiscus*, and its flowers provide a "tropical" feel to temperate gardens, where other large-flowered, frost-tender *Hibiscus* (and related genera) cannot be grown because of seasonal freezing temperatures. *Hibiscus syriacus* prefers extended exposure to direct sun, but, will survive and grow under conditions of partial shade. Plants are extremely heat and drought-tolerant once established. Despite the specific epithet, *H. syriacus* originated in China but was taken into cultivation very early and was distributed to the Middle East along early trade routes (Tang et al. 2007b). Numerous cultivars of *H. syriacus* exist and a number of flower morphologies and color forms occur, including "double-flowered" forms that are rose-like in appearance with multiple petals, and color variants that range from reddish-pink to lilac, lavender, violet, purple, purplish-blue, or completely white. Some cultivars have flowers that lack the typical dark red coloration at the base of the petals. Naturalized plants typically have lavender to reddish-pink-colored flowers that often are smaller than those produced on cultivated individuals. The flowers of *H. syriacus* are highly attractive to bumblebees and carpenter bees.

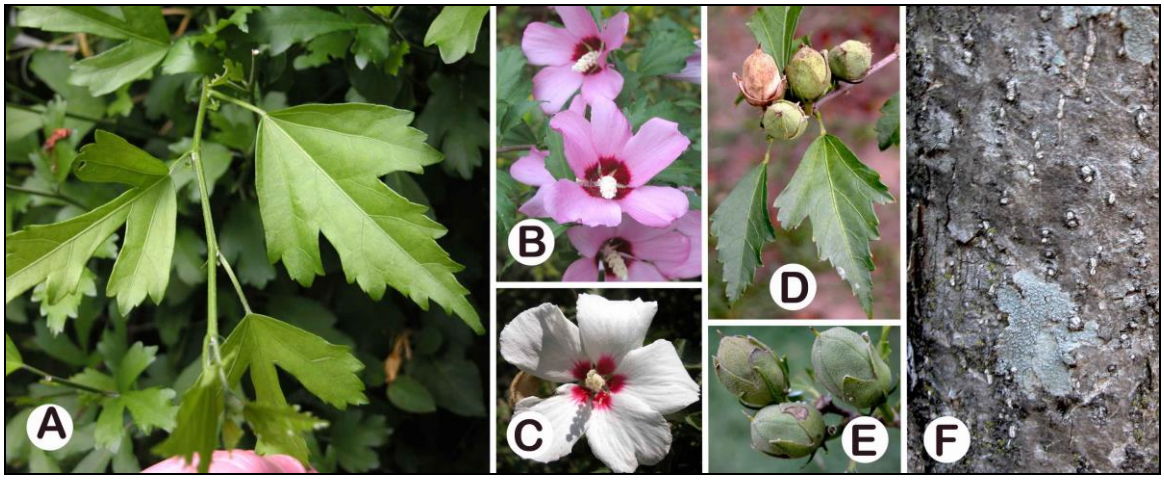


Figure 60. (A–F) *Hibiscus syriacus* plant and habit. (A) Leaves (the number and size of the lobes is highly variable, particularly when comparing sun versus shade leaves). (B–C) Flowers (a wide range of colors occurs). (D–E) Mature fruits. (F) Bark.

The combination of the prominently lobed, ovate-rhombic-shaped leaves, large stellate-pubescent capsules, and large, "hibiscus-type" flowers clearly distinguish *H. syriacus* from other shrubs in the state. ***Habitat***: disturbed sites and waste places; also open and disturbed urban woods, woodland edges, greenbelts, riparian zones, thickets, and roadsides.

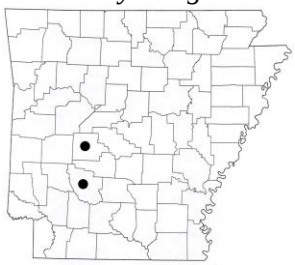
Hydrangea, Hydrangea, Hydrangeaceae

Hydrangea is a genus of 30–75 species of deciduous or evergreen trees, shrubs, and lianas occurring primarily in eastern Asia, with a few species also in North America (McClintock 1957; Krüssmann 1977; Wei & Bartholomew 2001; van Gelderen & van Gelderen 2004). Many are important as ornamentals for their large, showy, many-flowered inflorescences. Some species, such as *H. quercifolia*, also are cultivated for their colorful autumn foliage.

In Arkansas, there are perhaps five species of *Hydrangea*, with the native *H. arborescens* relatively widespread in the state. *Hydrangea macrophylla*, the only nonnative species in the flora, occurs as an occasional escape and can be long-persistent subsequent to cultivation practices.

Species of *Hydrangea* have large, opposite, simple, sometimes leathery leaves with entire or coarsely toothed margins, bisexual (perfect), white to cream-colored flowers (in ours) arranged in many-flowered cymose or paniculate inflorescences. Most species of *Hydrangea* produce two types of flowers in the inflorescence: large, sterile flowers toward the periphery and smaller, fertile flowers in the center. The sterile flowers are used to attract pollinators and are long-persistent, remaining attached through fruit development. Fertile flowers have 4 or 5 petals and 4 or 5 sepals. The fruit is a small, many-seeded capsule.

Hydrangea macrophylla (Thunb.) Ser. (Fig. 61).



Hydrangea macrophylla (big-leaf hydrangea, French hydrangea) is a deciduous shrub to 3 m tall that is native to Japan (Bailey & Bailey 1976; Krüssmann 1977). It commonly is cultivated in Arkansas and is long-persistent subsequent to cultivation. It occasionally is encountered as an escape in the state (Serviss et al. 2016a, 2017b), where it has been documented from Clark and Garland counties. It also is known from the floras of a few other states (Kartesz 2015; Jaster et al. 2016; Weakley 2020).

Hydrangea macrophylla commonly is cultivated in the southern USA, including Arkansas, and hundreds of horticultural varieties of it have been developed (Krüssmann 1977; Dirr 2002; van Gelderen & van Gelderen 2004). Two principal groups of *H. macrophylla* cultivars occur — the "hortensias" or "mopheads," which have large, rounded inflorescences with tightly clustered flowers, nearly all of which are sterile, and the "lacecaps," which have flattened inflorescences, where the outer flowers are showy and sterile and the centrally positioned flowers are small and fertile (Krüssmann 1977; Dirr 2004). Gradation between inflorescence types is observable across the range of cultivars (Dirr 2004). A few cultivars have variegated foliage.

In many cultivars, soil pH (aluminum availability, which is affected by soil pH) affects flower color, with strongly acidic (pH of 5.5 or lower) soils causing blue-colored flowers and mildly acidic to neutral to alkaline soils inducing pink-coloration. Lilac or purple flower coloration may occur in mildly acid soils. Flower color in some cultivars is unaffected by soil pH.

Hydrangea macrophylla may be distinguished from most other shrubs in the Arkansas flora by the combination of its large, coarsely-toothed, thick-membranous, sometimes semi-fleshy leaves that are oppositely-arranged, exfoliating bark, and large, showy pink, blue, purple, or occasionally white-colored flowers arranged in large, many-flowered inflorescences. It could possibly be confused with the native *H. arborescens* (wild hydrangea); however, it can be distinguished from it by its laminas (leaf blades) that are cuneate (tapering) at the base. Contrastingly, the bases of the laminas of *H. arborescens* are rounded to subcordate. ***Habitat***: disturbed sites and waste places, riparian zones, rubbish heaps, old home sites.

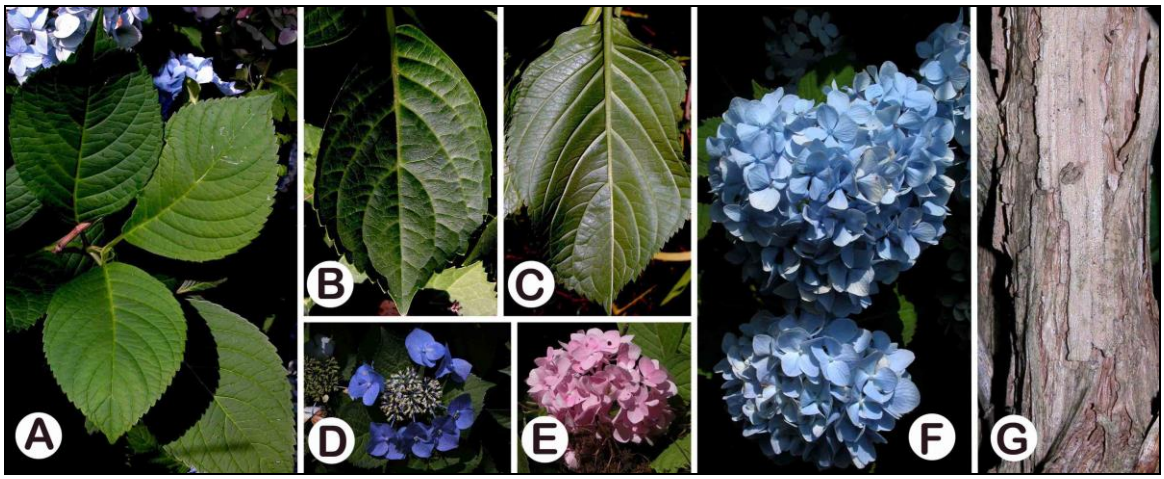


Figure 61. (A–G) *Hydrangea macrophylla* plant and habit. (A–C) Leaves. (D–F) Flowers (a wide range of colors exist). (G) Bark.

Ilex, Holly, Aquifoliaceae

Ilex is a large genus of about 400–500 species of deciduous or evergreen trees and shrubs distributed primarily over North America, South America, and Asia, and well-represented in both temperate and tropical regions (Chen et al. 2008). Many species are important as ornamentals for their colorful and profuse display of red fruits and attractive, often evergreen foliage.

In Arkansas, nine species of *Ilex* occur; all with the exception of *I aquifolium*, *I. cornuta*, and *I. crenata* are native. *Ilex decidua* is the most common and widely distributed species in the state.

Species of *Ilex* have alternate (rarely opposite), simple, generally leathery leaves with entire, coarsely toothed, or spinose margins, imperfect (unisexual — flowers are initially bisexual but become unisexual through abortion of the stamens or pistil), generally (in ours) white to cream-colored flowers arranged in solitary or few-flowered cymose or fascicled axillary inflorescences. Species of *Ilex* typically have flowers with four petals and four sepals, but a few species occasionally produce some flowers with five, six, or seven petals. The fruit is a small, one to few-seeded drupe.

Key to *Ilex* species:

1. Leaves without spines (a short tooth may be present at the apex) ..... **Ilex crenata**
1. At least some leaves with spines, sometimes reduced to only a single spine at the apex of the lamina.

2. Leaves ovate, elliptic, or oblong-lanceolate, margins undulate (may be nearly straight on older plants); spines usually more than 5 (may be nearly absent on the leaves of older plants); flowers white often tinged with pink or reddish-pink coloration..... **Ilex aquifolium**
2. Leaves generally more or less rectangular, sometimes oblong- elliptic or elliptic; spines 5 or less (the leaves of very young plants can have more than 5 spines); flowers green to yellow or cream .....**Ilex cornuta**

Ilex aquifolium L. (Fig. 62).

Ilex aquifolium (English holly, Christmas holly) is a large, evergreen shrub or small tree to 16 m tall, but often smaller, that is native to Eurasia and northern Africa (Krüssmann 1977). It is documented from the floras of a few states, including Alabama and Virginia in the eastern USA and California, Oregon, and Washington in the west (Kartesz 2015; Weakley 2020). It is known from Arkansas only in Benton County, based on a single naturalized population (Brent Baker, Pers. Comm., 2021; Theo Witsell, Pers. Comm., 2021). This species, however, is well-naturalized and invasive in the

western USA (Stokes et al. 2014; Kartesz 2015; California Invasive Plant Council 2021). Establishment and spread of *I. aquifolium* is via both vegetative colonization and long-distance dispersal of seeds (Stokes et al. 2014). This species should be expected elsewhere in Arkansas, particularly areas in proximity to where it is cultivated.

Ilex aquifolium is cultivated for its glossy, evergreen foliage and colorful fruits. It is the traditional holly used in Christmas and winter-themed decorations. Over 200 cultivars exist for the species, including weeping forms, white and yellow variegated cultivars with multiple patterns of variegation, and forms with white or yellow fruits (Krüssmann 1977; Oregon State University Landscape Plants 2021).

In Arkansas, *I. aquifolium* resembles both *I. cornuta* (Chinese holly) and the native *I. opaca* (American holly). It can be distinguished from *I. opaca* by its leaves with glossy upper surfaces and undulate margins with the spines oriented above and/or below the plane of the lamina, and from *I. cornuta* by its elliptic-shaped laminas and spines, when present, more than five in number. In contrast, the leaves of *I. opaca* have a dull (generally not glossy) upper surface and spines that are oriented in the same plane as the lamina, and *I. cornuta* has rectangular-shaped laminas generally with 1–5 spines. Individuals of all three species can be encountered that have at least some leaves with only a single spine at the apex of the blade. ***Habitat***: open or disturbed woods, including upland woods, woodland edges, and greenbelts.

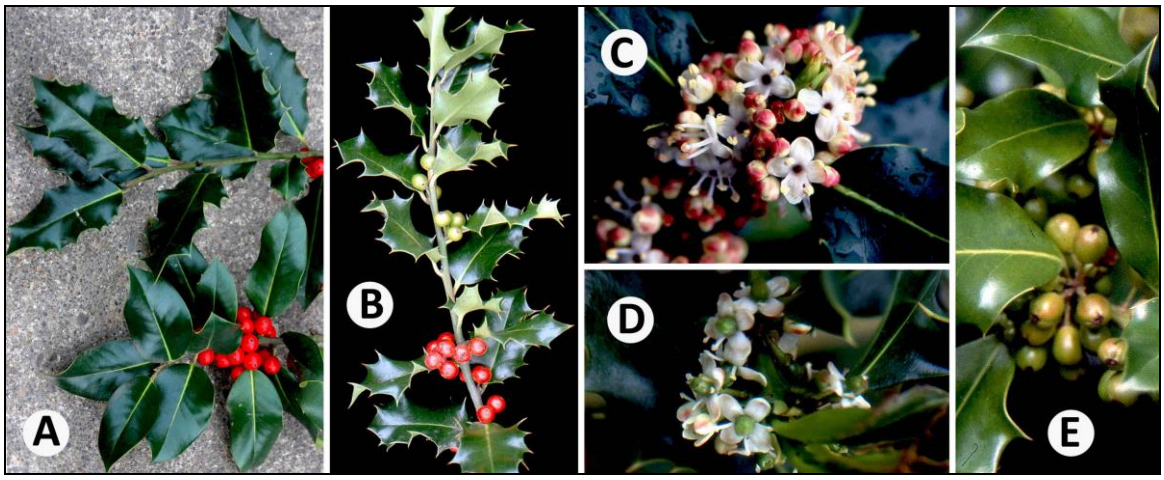
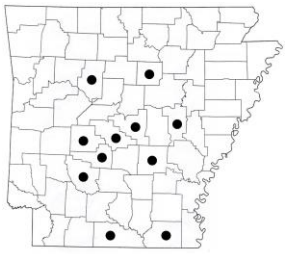


Figure 62. (A–E) *Ilex aquifolium* plant and habit. (A) Leaves (notice the variation in the degree of spine production from numerous marginal spines to some leaves with none). (B) Leaves and mature fruits (notice the undulate margins with spines oriented above and below the plane of the lamina). (C) Staminate flowers (the pink coloration is normal). (D) Pistillate flowers. (E) Close-up of leaves and immature fruits. Photo credit: Pat Breen, Oregon State University.

Ilex cornuta Lindl. and Paxt. (Fig. 63).



Ilex cornuta (Chinese holly) is a large, evergreen shrub or small tree to 5 m tall, or sometimes more, that is native to China and Korea (Chen et al. 2008). It is escaped to well-naturalized in many areas of the southeastern USA (Clark et al. 2005; Kartesz 2015; Weakley 2020), including Arkansas, where it is known from several counties. It is invasive into wooded, semi-wooded, and riparian areas that offer some level of disturbance. *Ilex cornuta* has been observed (in Arkansas) growing in areas where soils are consistently moist to periodically waterlogged. It also is shade-tolerant and will establish and reproduce in shade, such as the understory in open wooded habitats. The seeds of *I. cornuta* are bird-dispersed, and seedling and juvenile plants often are observed under areas where birds habitually forage or roost. This species is one of the most commonly cultivated

ornamental shrubs in the southern USA, especially variety *burfordii* (Burford holly) and probably is more common in the state's flora than current records indicate.

In Arkansas, it is possible to confuse *I. cornuta* with the native *I. opaca* (American holly). *Ilex cornuta*, however, can be distinguished from *I. opaca* by its generally rectangular-oblong leaves with dark green, glossy upper surfaces and five prominent marginal spines. In contrast, the leaves of *I. opaca* are elliptic to elliptic-oblong in shape, have a dull (generally not glossy), paler green upper surface, and generally have more than five spines. Both species have forms that bear leaves with only a single spine at the apex of the blade, but the dark green and glossy upper leaf surfaces clearly distinguish *I. cornuta* from *I. opaca*. ***Habitat***: open or disturbed woods, woodland edges, thickets, wetland margins, riparian zones, roadsides; will tolerate a wide range of soil moisture regimes from dry and well-drained to poorly drained, sometimes waterlogged soils.

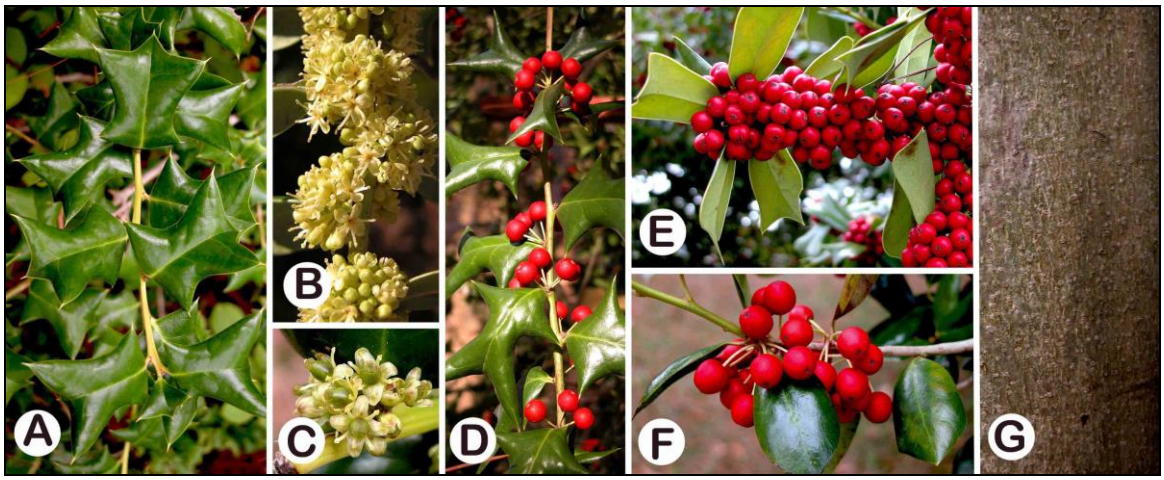


Figure 63. (A–G) *Ilex cornuta* plant and habit. (A) Leaves. (B) Staminate flowers. (C) Pistillate flowers. (D–F) Mature fruits (notice the lack of lobes on the leaves in Fig. F; this form occasionally is encountered, although the deeply lobed leaves are typical in wild *I. cornuta*). (G) Bark.

Ilex crenata Thunb. (Fig. 64).

Ilex crenata (Japanese holly, box-leaved holly) is an evergreen, multi-stemmed shrub or rarely a small tree to 10 m tall that is native to China, Japan, and Korea (Chen et al. 2008). In addition to Arkansas, where it has been documented from Garland County, *I. crenata* is naturalized in a few northeastern states, along with North Carolina and Louisiana (Pittillo & Brown 1988; McAvoy & Bennett 2001; Wilder & McCombs 2002; Haines 2011; Vincent et al. 2011; Serviss et al. 2016c; Weakley 2020).

This species frequently is cultivated as a hedge and border plant for its evergreen habit, compact growth form, dense foliage, and shade tolerance, and numerous horticultural forms exist (Bailey & Bailey 1976; Krüssmann 1977). It commonly is cultivated in Arkansas, and while presently only documented in the state from Garland County, it should be expected elsewhere as escaped or persisting from cultivation. ***Habitat***: disturbed urban woods, woodland edges, greenbelts, riparian zones, thickets, and fencerows.

In Arkansas, *I. crenata* very closely resembles the native *I. vomitoria* (yaupon holly) and is easily confused with it, particularly when examining sterile plants or specimens. Both species have similar foliage and growth forms, although *I. vomitoria* generally has a less tightly branched growth form and reaches a larger size at maturity. The conspicuous plate-shaped glands on the lower leaf surfaces of *I. crenata* are important for distinguishing it from *I. vomitoria* — the two species reliably can be distinguished by the following key (modified from Weakley 2020).

1. Leaf abaxial surface with scattered punctate glands (glands sometimes sparse or pale in color), apex of lamina obtuse to acute with a short, sharp tooth; fruits black ..... **Ilex crenata**
1. Leaf abaxial surface without scattered punctate glands, apex of blade retuse (notched) with a short mucronate projection; fruits red or yellow ..... **Ilex vomitoria**

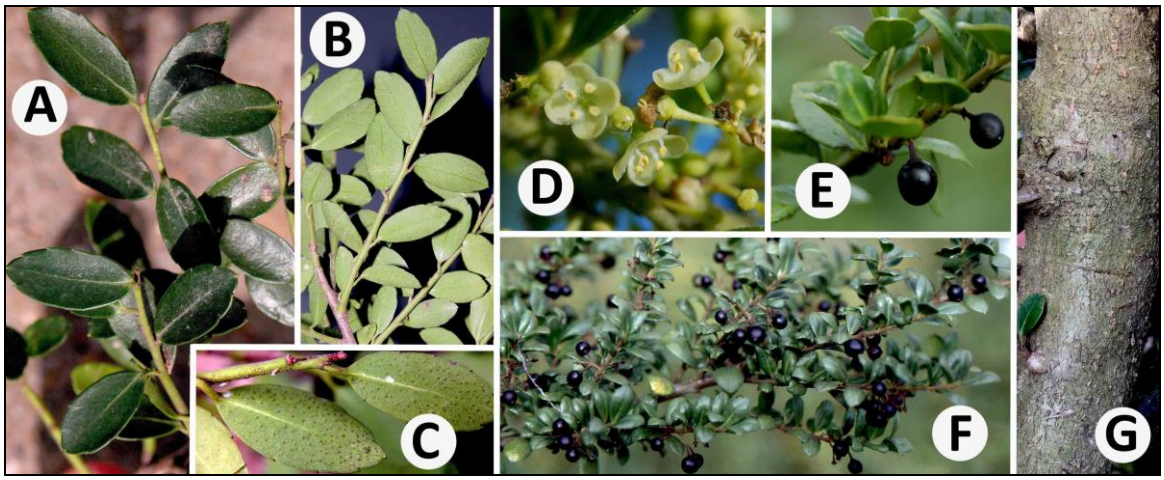


Figure 64. (A–G) *Ilex crenata* plant and habit. (A–C) Leaves (notice the conspicuous plate-shaped glands on the leaf lower surface in Fig. C). (D) Flowers. (E–F) Mature fruits. (G) Bark. Photo credit: D–F: Pat Breen, Oregon State University.

Jasminum, Jasmine, Oleaceae

Jasminum is a genus of 200–300 species of deciduous or evergreen, twining, climbing, or upright shrubs distributed mostly over subtropical and tropical regions of Africa, Asia, and Australia (Chang et al. 1996b). A number of species in the genus are important ornamentals for their showy, sometimes fragrant, white or yellow flowers and attractive foliage and growth forms.

Jasminum nudiflorum Lndl. (Fig. 65).

Jasminum nudiflorum (winter jasmine) is a deciduous, colonial shrub with pendulous stems, to 5 m tall that is native to China (Bailey 1949; Bailey & Bailey 1976; Krüssmann 1977; Chang et al. 1996b). It is naturalized in a number of eastern states, including Arkansas, where it has been documented from Hot Spring County (Diamond 2013; Yatskievych 2013; Kartesz 2015; Keener et al. 2018; Serviss et al. 2018d; Weakley 2020; USDA, NRCS 2021).

Naturalization and establishment (in Arkansas) of *J. nudiflorum* apparently is primarily or exclusively asexual by layering of stems, with the subsequent production of clonal offsets (apparently fruit production in the species is rare), and it should be expected elsewhere in the state, especially in the vicinity of where plants of the species are cultivated. Diamond (2013) observed similar establishment of *J. nudiflorum* in Alabama to what Serviss et al. (2018d) reported for Arkansas.

In Arkansas, *J. nudiflorum* could be confused with the two species of *Forsythia* naturalized in the flora, as its flowers and growth form overall is similar (see section under *J. mesnyi* for distinguishing traits between *Jasminum* and *Forsythia*). **Habitat**: disturbed sites and waste places, especially in the vicinity of cultivated plants of the species; also urban woods and edges, greenbelts, and roadsides.

Jasminum mesnyi Hance (Fig. 66).

Jasminum mesnyi (primrose jasmine) is a scandent, evergreen shrub to 5 m tall that is native to China (Chang et al. 1996b). It is cultivated in Arkansas and present in the naturalized floras of

several eastern states (Diamond 2013; Kartesz 2015; Weakley 2015; Keener et al. 2018; USDA, NRCS 2021). Although not currently documented from the Arkansas flora, it should be expected as escaped or naturalized, similar to *J. nudiflorum*. *Jasminum mesnyi* and *J. nudiflorum* are similar in form and habit and potentially could be confused (see subsequent key for distinguishing characteristics between the two species). ***Habitat***: disturbed sites and waste places, especially in the vicinity of where plants of the species are cultivated.

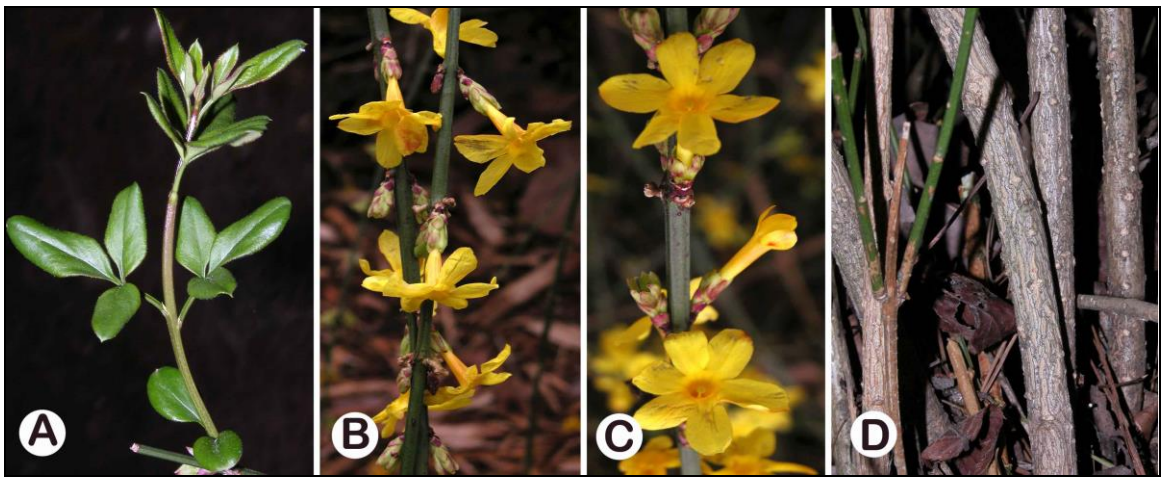


Figure 65. (A–D) *Jasminum nudiflorum* plant and habit. (A) Leaves and stem. (B–C) Flowers. (D) Bark.

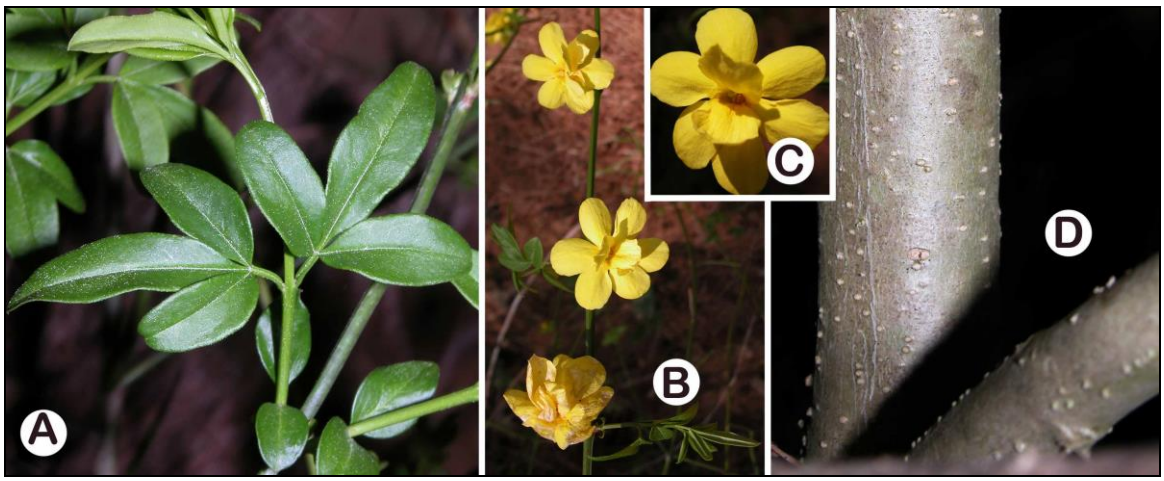


Figure 66. (A–D) *Jasminum mesnyi* plant and habit. (A) Leaves and stem. (B–C) Flowers. (D) Bark.

Both *Jasminum* species also resemble *Forsythia* in growth form and habit, especially during flowering when the leaves sometimes are absent. The following key can be used to reliably distinguish species of *Jasminum* and *Forsythia* present in the Arkansas flora.

1. Leaves ternately compound (sometimes a few leaves simple at the base of the branchlets), margins of leaflets entire and often pubescent; corolla lobes (4–)5–8(–11) in number; fruit a berry.

2. Terminal leaflet 1–3 cm long; corolla lobes shorter than the corolla tube; plant deciduous ..... **Jasminum nudiflorum**
2. Terminal leaflet 2.5–7 cm long; corolla lobes longer than the corolla tube; plant evergreen to semi-evergreen, sometimes with only a few leaves present in late winter .....**Jasminum mesnyi**

1. Leaves simple (occasionally some leaves ternately compound in *F. suspensa*), margins of leaves (or leaflets) prominently toothed; corolla lobes 4 in number; fruit a capsule.

3. Leaves oblong-elliptic, obovate-elliptic, or lanceolate, margins generally only serrate on the distal one-third to one-half of the lamina, otherwise entire; pith lamellate ..... **Forsythia viridissima**
3. Leaves ovate to ovate-elliptic, margins serrate along most to nearly all of the lamina; pith hollow ..... **Forsythia suspensa**

Kerria, Japanese Yellow Rose, Rosaceae

Kerria is a monotypic genus of suckering shrubs that is native to China and Japan (Li et al. 2003a; Henrickson & Weakley 2014). The single species, *Kerria japonica*, commonly is cultivated as an ornamental for its attractive flowers, shade tolerance, and ease of cultivation.

Kerria japonica (L.) DC. (Fig. 67).

Kerria japonica (Japanese yellow rose, Japanese kerria, Easter rose) is a deciduous shrub to 3 m tall that is native to China and Japan (Li et al. 2003a; Henrickson & Weakley 2014). It has been documented in the Arkansas flora from multiple locations in Garland County (Peck & Serviss 2016; Serviss et al. 2017b). It also is known from the floras of a few other eastern states (Kartesz 2015; Henrickson & Weakley 2014; Weakley 2020; Keener et al 2021).

Fruit production in North America is uncommon (Henrickson & Weakley 2014); however, *K. japonica* aggressively spreads via suckering, where whole populations may become established asexually. It also is highly shade-tolerant, which allows it to establish on semi-wooded and wooded sites. When in flower, *K. japonica* makes an attractive and striking ornamental and is an old-time favorite that still is present in many landscapes. The varieties with "doubled" flowers offer a rose-like appearance and provide the basis for the common names of Japanese yellow rose and Easter rose. The cultivar 'Pleniflora' is a sexually sterile form with "doubled" flowers that frequently is cultivated, especially in China, where apparently it is the most commonly grown cultivar of *K. japonica* (Bailey & Bailey 1976; Valder 1999). Forms with white flowers and variegated foliage also exist (Krüssmann 1977; Oregon State University Landscape Plants 2021).

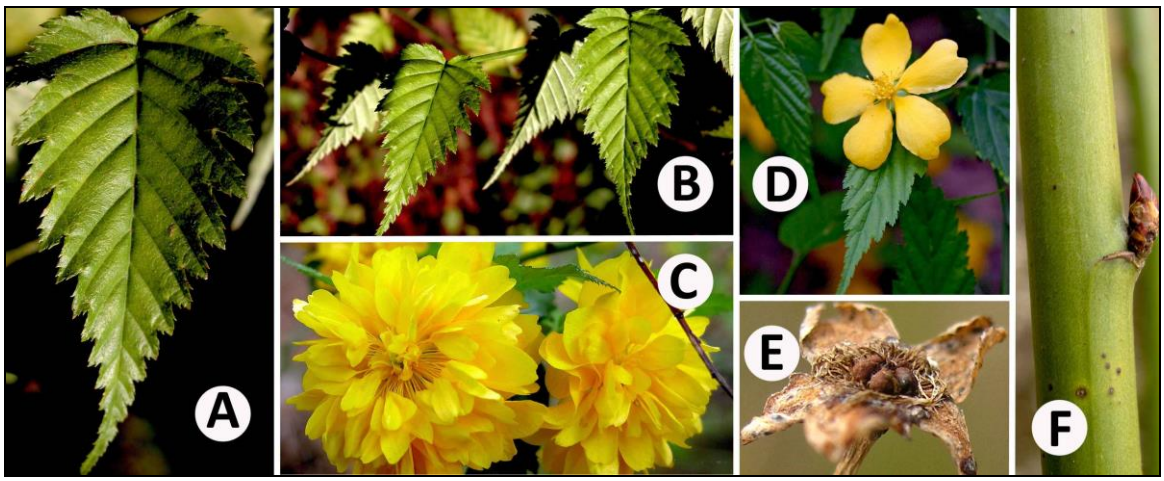


Figure 67. (A–F) *Kerria japonica* plant and habit. (A–B) Leaves and stem. (C–D) Flowers (Fig. C shows the "doubled" form). (E) Fruit. (F) Older stem with young bark. Photo credit: D–F: Bruce Patterson, Native Plant Trust, Go Botany.

In Arkansas, the large, solitary yellowish-orange-colored flowers, coarsely-toothed, ovate-lanceolate leaves with long-acuminate apices, and slender, strongly arching stems distinguish *K. japonica* from most other shrubs. Vegetatively, however, *K. japonica* does closely resemble the introduced and naturalized *Rhodotypos scandens* (black jetbead), which currently is known from Garland and Washington counties, and also the rare native shrub *Neviusia alabamensis* (Alabama snow wreath). *Kerria japonica* may be distinguished from both *Rhodotypos* and *Neviusia* by its yellowish-orange flowers and long-acuminate leaves, and further distinguished from *R. scandens* by its alternate leaf arrangement. *Rhodotypos* and *Neviusia*, in contrast, have white-colored flowers and acute leaves, and the leaves of *Rhodotypos* are oppositely-arranged. ***Habitat***: disturbed sites and waste areas, woodland edges, and disturbed woods.

Koelreuteria, Rain-Tree or Varnish Tree, Sapindaceae

Koelreuteria is a small genus of three species of deciduous or evergreen trees that is native to Asia (Xia & Gadek 2007). All species are important as ornamentals for their profuse display of brightly-colored flowers and unusual fruits. All also have been introduced into the USA and have become naturalized to various degrees in the flora; two of them, *K. bipinnata* and *K. paniculata*, are documented from Arkansas. *Koelreuteria elegans*, although morphologically similar to *K. bipinnata* and easily confused with it, is not as cold-tolerant and therefore restricted to the extreme southern USA. Species of *Koelreuteria*, in particular *K. bipinnata*, prolifically self-seed, often rapidly establishing naturalized populations of plants.

Species of *Koelreuteria* have alternate, once to twice pinnately compound leaves with leaflets that are variously toothed, lobed, or entire, and small, perfect (bisexual), yellow and orange-colored flowers in large, terminal, paniculate inflorescences. The fruit is a large, papery-inflated, few-seeded capsule. The seeds are distinct — spherical, lustrous, extremely hard, and dark brown to black. Fruits and seeds are wind and water-dispersed.

Key to *Koelreuteria* species:

1. Mature leaves bipinnately compound, leaflets entire or with a few, small teeth; fruits flattened and elliptic in shape ..... **Koelreuteria bipinnata**
1. Mature leaves once pinnately compound to occasionally weakly bipinnately compound toward the base of the lamina, leaflets deeply toothed to lobed; fruits conical ..... **Koelreuteria paniculata**

Koelreuteria bipinnata Franch. (Fig. 68).

Koelreuteria bipinnata (Chinese flame tree) is a small to medium-sized deciduous tree to 20 m tall that is native to China (Xia & Gadek 2007). This species in known from a few southeastern states, including Arkansas, where it is naturalized in the southwestern portion of the state (Serviss et al. 2006, 2020; Weakley 2020).

Koelreuteria bipinnata prolifically self-seeds and individual plants can give rise to entire populations. In Arkansas, this species has been observed invading into and establishing in open and wooded areas and appears to have the potential to become invasive.

Koelreuteria bipinnata is similar, especially during juvenility, to another species of *Koelreuteria* that is naturalized in Arkansas, *K. paniculata* (golden-rain tree). *Koelreuteria bipinnata* can be distinguished from *K. paniculata* by its bipinnately compound leaves with entire or finely toothed leaflets and pale yellow to reddish-pink, elliptic-shaped fruits. Contrastingly, *K. paniculata* has once pinnately to occasionally a few imperfectly bipinnately compound leaves with prominently toothed to lobed leaflets and green, conical-shaped fruits. It is important to note, however, that during juvenility both species have bipinnately compound leaves with prominently toothed to lobed leaflets and are difficult to distinguish (compare Fig. 165H with Fig. 165I).

Koelreuteria bipinnata also somewhat resembles *Melia azedarach* (Chinaberry), which is widespread in Arkansas and the native *Gymnocladus dioicus* (Kentucky coffee tree). It can be distinguished from *M. azedarach* by its mature leaves which have few pinnae, and leaflets that have entire or minutely toothed margins. The leaves of *M. azedarach*, in contrast, have more pinnae relative to those of *K. bipinnata* and leaflets that are coarsely toothed to shallowly lobed (the leaflets of juvenile *K. bipinnata* plants are coarsely/prominently toothed). In the juvenile stage, the two species easily are confused without careful examination (compare Fig. 165H with Fig. 167F). *Koelreuteria bipinnata* can be distinguished from *G. dioicus* by its leaflets with glossy upper surfaces, fruit that is an inflated capsule, and spherical seeds. *Gymnocladus dioicus* has leaflets with a dull (not glossy) upper surface, fruit that is a thick-walled legume, and round but flattened seeds. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, and riparian zones.

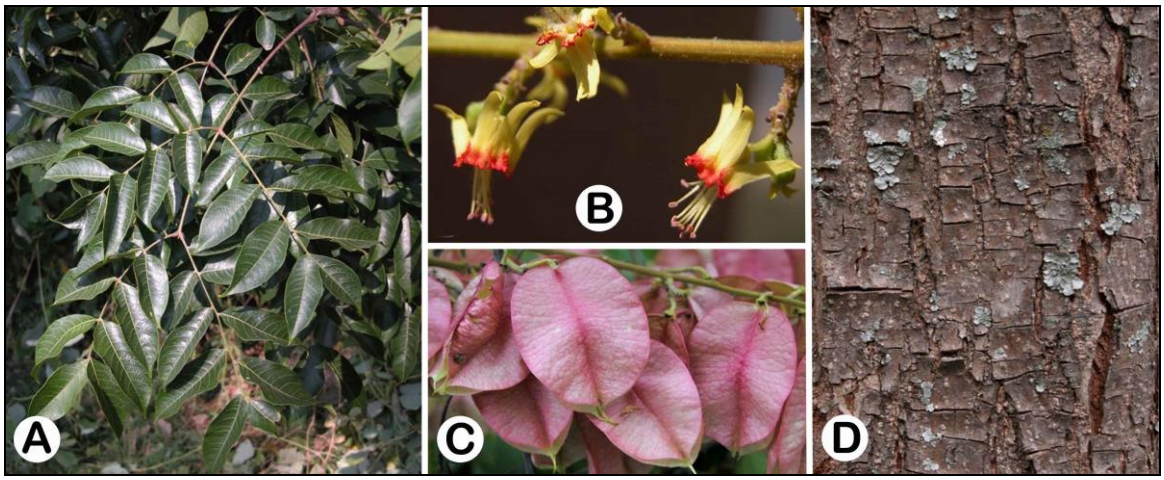
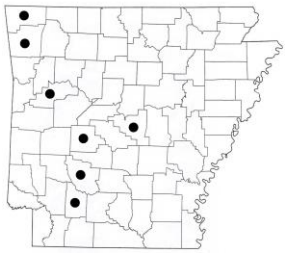


Figure 68. (A–D) *Koelreuteria bipinnata* plant and habit. (A) Leaves. (B) Flowers. (C) Mature fruits (fruit color can range from pale yellow tinged with pink to reddish-pink or purplish-red). (D) Bark.

Koelreuteria paniculata Lam. (Fig. 69).



Koelreuteria paniculata (golden-rain tree, varnish tree, flamegold) is a small to medium-sized deciduous tree to 15 m tall that is native to China and Korea (Xia & Gadek 2007). This species is naturalized in Arkansas, occurring in several scattered counties in the western one-half of the state. It also is naturalized in several eastern states, along with a few states west of the Mississippi River (Kartesz 2015; Weakley 2020; USDA, NRCS 2021).

Koelreuteria paniculata regularly is cultivated as a specimen tree for its showy display of flowers and unusual fruits. The flowers of *K. paniculata* (and other *Koelreuteria* species) are pollinated by insects, particularly forms of hymenoptera. Two scales are present on the limb of each petal that change from yellow to orange during anthesis, presumably as an additional means of attracting insect pollinators (Meyer 1976).

Koelreuteria paniculata will self-seed, but does not appear to recruit as prolifically as *K. bipinnata*. The fruits of *Koelreuteria* species primarily are wind-dispersed, giving them an unusual and unique appearance, which also aids in distinguishing the genus from other woody plants in the flora. The small, shiny, nutrient-rich seeds of *Koelreuteria* apparently attract animal dispersants, including birds (Lin et al. 2011; Wang et al. 2013); thus, birds probably also function in long-distance seed dispersal of *Koelreuteria* species. Gravity (in sites with slope) also may play a secondary role in dispersal, especially considering the spherical shape of the seeds.

In Arkansas, the combination of the papery, inflated pericarp (fruit wall), lustrous, spherical seeds, and large, showy inflorescences consisting of numerous bright yellow flowers, clearly

distinguish species of *Koelreuteria* from all other woody plants. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, slopes, and roadsides.

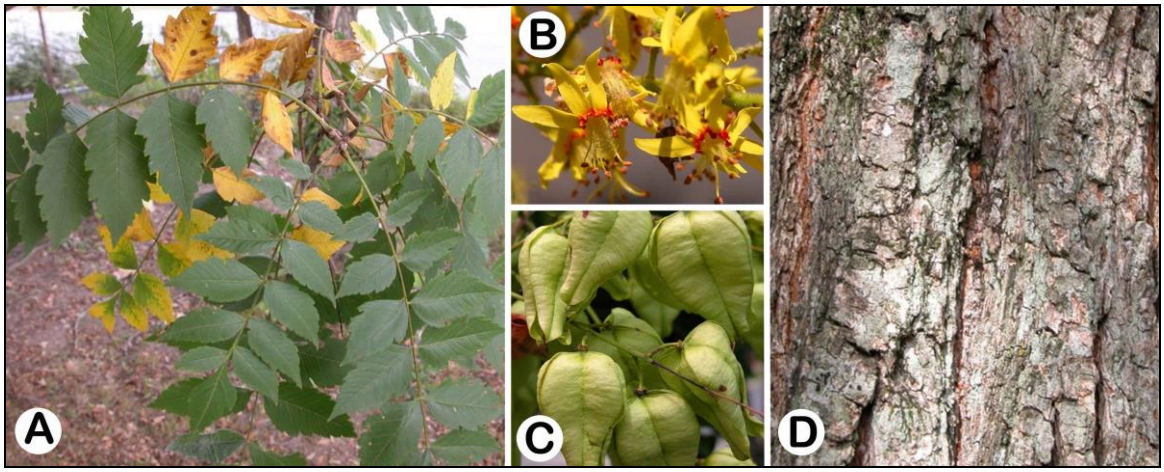
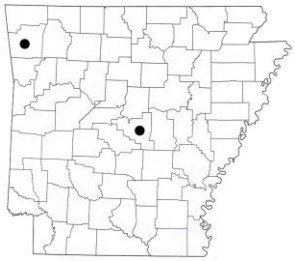


Figure 69. (A–D) *Koelreuteria paniculata* plant and habit. (A) Leaves. (B) Flowers. (C) Mature fruits (notice the green coloration as compared to those of *K. bipinnata*, Fig. 68C). (D) Bark.

Kolkwitzia, Beauty Bush, Caprifoliaceae

Kolkwitzia is a monotypic genus native to China (Yang et al. 2011). The single species, *K. amabilis*, is used as an ornamental for its showy flowers and attractive growth form.

Kolkwitzia amabilis Graebn. (Fig. 70).



Kolkwitzia amabilis (beauty bush) is a deciduous shrub to 3 m tall that is native to China (Bailey & Bailey 1976; Krüssmann 1976; Yang et al. 2011). It is cultivated in Arkansas and the southern USA, and has been documented from the naturalized floras of a number of states (Kartesz 2015; Weakley 2020; USDA, NRCS 2021). In Arkansas, *K. amabilis* is known from Pulaski and Washington counties (Ogle et al. 2020). The Pulaski County plants possibly were escaped, although long-persistence from cultivation is suspected; regardless, the plants had the appearance of naturalization. As this species is a component of the floras of other southern states, it should

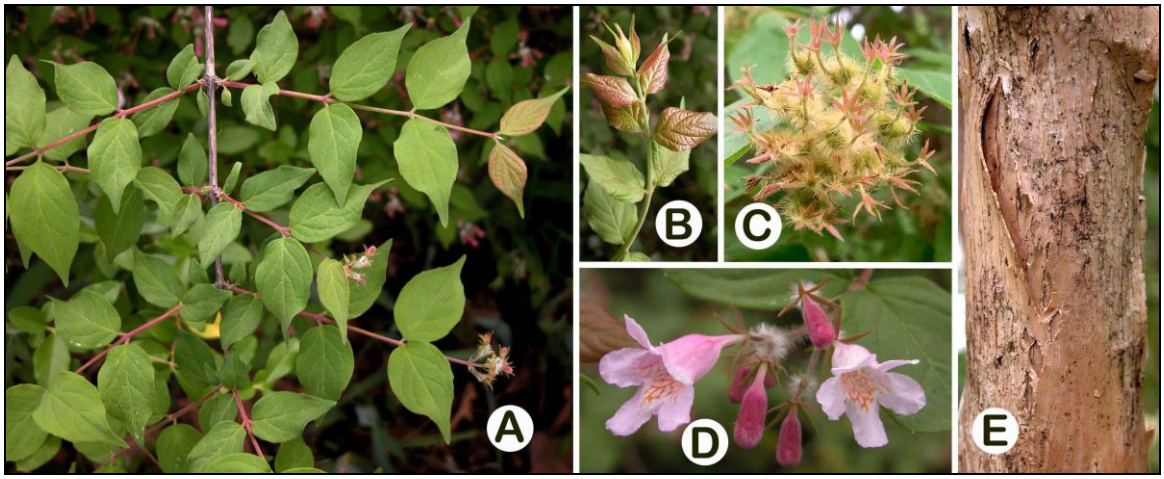


Figure 70. (A–E) *Kolkwitzia amabilis* plant and habit. (A–B) Leaves and stems. (C) Fruits. (D) Flowers (flowers can range in color from pink to almost white). (E) Bark.

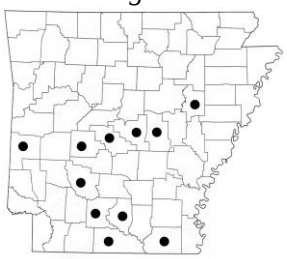
be expected outside of cultivation elsewhere in Arkansas.

In Arkansas, *K. amabilis* could be confused with the morphologically similar *Abelia ×grandiflora* (glossy abelia — see entry for *A. ×grandiflora* for distinguishing characteristics between the two species). ***Habitat***: disturbed sites and waste places, thickets, greenbelts, and roadsides.

Lagerstroemia, Crepe Myrtle, Lythraceae

Lagerstroemia is a genus of about 55 species of evergreen trees distributed over subtropical and tropical regions of Asia and Australia (Quin & Graham 2007a). Some species in the genus, such as *L. indica* and *L. speciosa*, are prized as ornamentals for their profuse displays of showy flowers. Flowers in a wide range of colors, drought, heat, and cold tolerance once established, and an extended flowering period that occurs over a duration of several weeks have contributed to *L. indica* being one of the most widely used woody ornamental species in the southern USA.

Lagerstroemia indica L. (Fig. 71).



Lagerstroemia indica (crepe myrtle) is a large shrub to medium-sized, deciduous tree to 12 m tall that is native to and widespread in Asia (Quin & Graham 2007a). It is naturalized across the southeastern USA (Kartesz 2015; Weakley 2020), including Arkansas, where it occurs in several counties in the south-central portion of the state. Based on its frequency of cultivation, suckering habit, and prolific seed production, it should be expected outside of cultivation elsewhere in the state. *Lagerstroemia indica* produces large numbers of small, winged, wind-dispersed seeds that may be transported long distances from fruit-bearing plants.

Numerous horticultural varieties and forms exist based on mature plant size, flower color, and disease resistance (Bailey & Bailey 1976; Krüssmann 1977; Griffiths 1992). Plants may range in size from dwarf forms only 1–2 m tall to trees of several meters height. A tremendous range of flower colors exist within cultivated material, including red, purple, lavender, magenta, pink, pearl, and white. *Lagerstroemia indica* is extremely heat and drought-tolerant once established. The foliage of *L. indica* is malodorous when bruised or crushed.

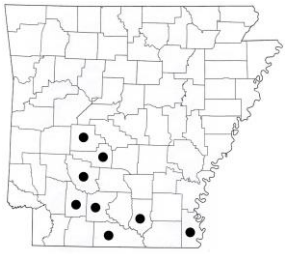
In Arkansas, *L. indica* may be confused with some species of privet (*Ligustrum*); however, can be distinguished from them by the presence of at least some alternate leaves, young stems with longitudinal ridges, and multicolored, exfoliating bark. Contrastingly, species of *Ligustrum* have opposite leaves, smooth stems, and bark that does not exfoliate. ***Habitat***: disturbed sites and waste places, woodland edges, thickets, riparian zones, and roadsides.

Figure 71. (A–J) *Lagerstroemia indica* plant and habit. (A–C) Leaves and stems (leaf shape is variable). (D–G) Flowers (much variation in color exists). (H) Fruits. (I–J) Bark.

Lantana, Shrubverbena, Verbenaceae

Lantana is a genus of about 150 species of herbs and evergreen shrubs distributed mostly over subtropical and tropical regions of the Americas, with some species in southern Africa (Bailey & Bailey 1976; Krüssmann 1977; Griffiths 1992). Species, such as *L. camara*, *L. montevidensis*, and *L. strigocamara* are important as ornamentals in warm-temperate, subtropical, and tropical regions for their showy flowers. *Lantana strigocamara* is invasive.

Lantana strigocamara Sanders (Fig. 72).



Lantana strigocamara (shrubverbena, lantana) is a small, evergreen shrub to 3 m tall (Sanders 2012). It is an allopolyploid, interspecific hybrid of horticultural origin and frequently is cultivated in warm-temperate, subtropical, and tropical regions for its showy flowers, and is now naturalized (and often invasive) in the subtropics and tropics worldwide (Sanders 2006; Sanders 2012). It also is naturalized in a number of southern states (Kartesz 2015; Weakley 2020), including Arkansas, where it is known from eight southern counties. Seedlings and escaped plants regularly are encountered in the vicinity of where plants of the species are cultivated, and its distribution in the state likely is wider than current records indicate.

Much of the material in the horticultural trade considered previously as *L. camara* actually is *L. strigocamara* (Sanders 2006; Sanders 2012). The flowers of *L. strigocamara* are highly attractive to butterflies, hummingbird sphinx moths, and hummingbirds, and change color from yellow to orange, red, or pink with age probably as a means of catering to a larger variety of pollinators. The foliage gives off a distinctive lemon or citrus-like scent when bruised or crushed. ***Habitat***: disturbed sites and waste places, fields, roadsides and sand dunes; soils must be well-drained.

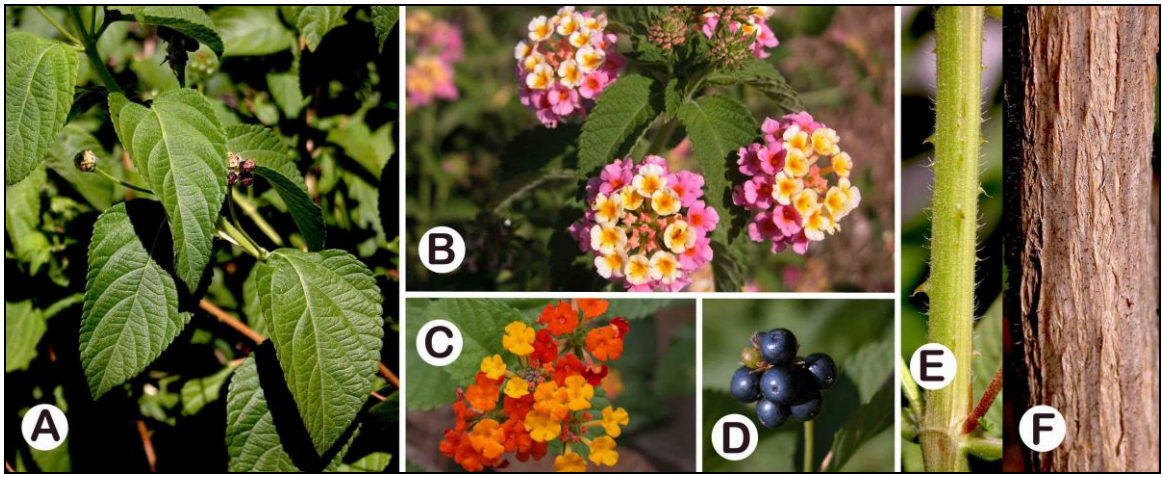


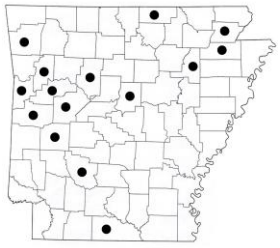
Figure 72. (A–F) *Lantana strigocamara* plant and habit. (A) Leaves. (B–C) Flowers (much variation in flower color occurs). (D) Mature fruits. (E) Stem with prickles (the amount of pubescence and prickles is variable). (F) Bark.

Lespedeza, Bushclover, Fabaceae

Lespedeza is a genus of about 60 species of herbs, subshrubs, and shrubs distributed primarily over Asia and North America (Isely 1998; Huang et al. 2010). Many species of *Lespedeza* can tolerate arid soils, thus they are good for soil conservation and sand stabilization. They also are used as honey plants and for nitrogen fixation (Huang et al. 2010). The young shoots and leaves are used as forage for livestock and as green manure (Huang et al. 2010). Some species, such as *L. cuneata*, are highly invasive.

Most species of *Lespedeza* in Arkansas are herbaceous or subshrubs. Two shrubby, nonnative species, *L. bicolor* and *L. thunbergii*, are naturalized or escaped in the state.

Lespedeza bicolor Turcz. (Fig. 73).



Lespedeza bicolor (bicolor lespedeza, bicolor bushclover, shrub lespedeza) is a shrub to about 3 m tall that is native to Japan (Isely 1998; Huang et al. 2010). It is naturalized in the central and eastern USA (Kartesz 2015; Weakley 2020), including Arkansas, where it occurs in several scattered counties. This species regularly is planted for wildlife use (Isely 1998), which may contribute to its establishment in the flora.

The seed oil of *L. bicolor* is used as a lubricant, the leaves as a tea substitute, and the branchlets for making baskets (Huang et al. 2010). Because this species tolerates arid soils, it is grown as a windbreak and for sand stabilization and soil conservation (Huang et al. 2010). Although the leaves of *L. bicolor* typically have only three leaflets, a few leaves on a given plant may have four or five leaflets.

In Arkansas, *L. bicolor* could be confused with the morphologically similar *L. thunbergii* (Thunberg's bush clover); however, it can be distinguished from *L. thunbergii* by its more erect habit and by the calyx, where the lobes are shorter than the calyx tube. In contrast, *L. thunbergii* has a more spreading growth form and calyx lobes that are as long as or longer than the tube. ***Habitat***: open, well-drained areas, especially rocky soils and habitats.

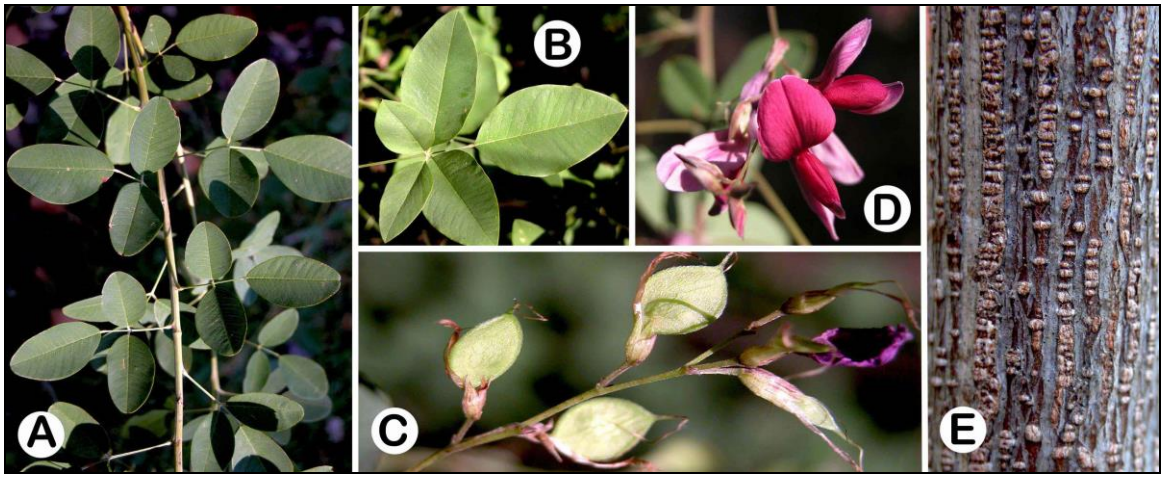


Figure 73. (A–E) *Lespedeza bicolor* plant and habit. (A–B) Leaves and stem (leaves can range in the number of leaflets from 3–5, although 3 is typical). (C) Mature fruits. (D) Flowers. (E) Bark.

Lespedeza thunbergii (DC) Nakai (Fig. 74).

Lespedeza thunbergii (Thunberg's bush clover) is a subshrub or shrub to about 3 m tall that is native to China, India, Japan, and Korea (Isely 1998; Huang et al. 2010). It is naturalized in the central and eastern USA (Kartesz 2015; Weakley 2020), including Arkansas, where it is known from Drew County (Gentry et al. 2013).

This species overall is very similar to *L. bicolor* (see entry for *L. bicolor* for distinguishing traits between the two species). ***Habitat***: disturbed sites and waste places.

Lespedeza cuneata (Dum.-Cours) G. Don (sericea lespedeza, Chinese lespedeza) is a perennial herb or subshrub to about 1–1.5 m tall that is native to China (Isely 1998; Huang et al. 2010). It is naturalized and widespread in Arkansas and elsewhere in the USA (Isely 1998; Kartesz 2015; Weakley 2020). Although often encountered in the herbaceous condition,

it can become suffrutescent late in the growing season. It can be distinguished from both *L. bicolor* and *L. thunbergii* by its overall smaller size (1.5 m or less), narrower (terminal) leaflets (0.2–0.7 cm), and white to cream-colored flowers. Both *L. bicolor* and *L. thunbergii* have a larger overall size (to ca. 3 m), wider (terminal) leaflets (1–3.5 cm), and pink-colored flowers.

Figure 74. (A–C) *Lespedeza thunbergii* plant and habit. (A) Plant showing growth form. (B–C) Flowers. Photo credit: Missouri Botanical Garden.

Ligustrum, Privet, Oleaceae

Ligustrum is a genus of about 50 species of evergreen (mostly) to semi-evergreen or deciduous shrubs and small trees; mostly Asiatic, with one species in Europe and North Africa (Krüssmann 1977; Chang et al. 1996c). Many species are (or have been) important as ornamentals in the horticultural trade, and as a result, were introduced into the USA for such purpose. Several of these species have subsequently naturalized in the flora, including Arkansas — many are highly invasive (Nesom 2009; Maddox et al. 2010; Gentry et al. 2013). *Ligustrum* species tend to be shade-tolerant, and naturalized plants often are observed in the understory of semi-wooded and wooded habitats.

Species of *Ligustrum* are characterized by opposite leaves with entire margins, a useful distinguishing feature from the morphologically similar genus *Euonymus* — species of *Euonymus* have opposite leaves but with toothed margins. At present, six species of *Ligustrum* are naturalized to various extents in the Arkansas flora; most are invasive. *Ligustrum sinense* is so common and widespread in the state that it provides the impression of being native. The seeds of *Ligustrum* species are bird-dispersed, facilitating their invasive tendencies.

Species of *Ligustrum* have small, perfect (bisexual), white to cream-colored, often fragrant flowers arranged in paniculate inflorescences. The fruit is a small reddish-purple, blue, gray, or black drupe.

Key to *Ligustrum* species:

1. Plants with stems (branchlets) glabrous, stems rarely minutely pubescent; leaves generally 4–15 cm long and 2.2–6 cm wide, some leaves on *L. japonicum* can be smaller.

2. Plants to 10 m tall; leaves generally with prominent venation on adaxial surface, abaxial surface blue-green, primary lateral veins usually 6–8 pairs, rarely 5 pairs ..... **Ligustrum lucidum**
2. Plants generally 5 m or less tall; leaves generally with at least somewhat obscured venation on the adaxial surface, abaxial surface pale to lime green, primary lateral veins 5 or less ..... **Ligustrum japonicum**

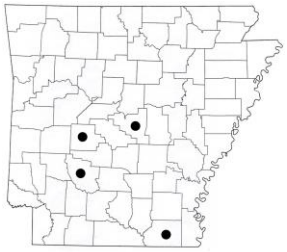
1. Plants with stems (branchlets) pubescent, sometimes glabrous in *L. vulgare*; leaves usually 1.5–6 cm long and usually 2.5 cm or less wide, shade leaves in *L. sinense* sometimes can be larger, but stems are clearly pubescent.

3. Plants at least with some degree of conspicuous dichotomous branching; lamina usually broadest slightly above the middle; inflorescences and infructescences tight and narrowly cylindrical to cylindric-pyramidal in shape..... **Ligustrum quihoui**
3. Plants not conspicuously dichotomously branched; laminas general widest at about the middle or below it; inflorescences and infructescences more open and spreading, broadly cyclindic to pyramidal and paniculate.

4. Branchlets often glabrous, sometimes minutely pubescent; fruits lustrous and black at maturity ..... **Ligustrum vulgare**
4. Branchlets pubescent; fruits dull and blue to bluish-black at maturity.

5. Plants often with a conspicuously erect growth form (when compared to *L. sinense*); inflorescences generally only terminal and absent from lateral branches; corolla tube equal to or longer than the lobes and clearly exerted from the calyx tube..... **Ligustrum obtusifolium**
5. Plants more spreading in growth form; inflorescences terminal and on lateral branches; corolla tube shorter than the lobes and only slightly exerted from the calyx tube..... **Ligustrum sinense**

Ligustrum japonicum Thunb. (Fig. 75).



Ligustrum japonicum (Japanese privet) is an evergreen shrub or small tree to 5 m tall or sometimes larger that is native to Korea and Japan (Krüssmann 1977; Chang et al. 1996c). In addition to scattered naturalization in the eastern USA (Nesom 2009; Weakley 2020), *L. japonicum* is naturalized and invasive in Arkansas, frequently observed invading into wooded habitats, particularly woods with some level of disturbance or when in proximity to areas where plants of the species are cultivated. *Ligustrum japonicum* is highly shade-tolerant, growing and reproducing under canopy cover. As with other species of *Ligustrum*, the seeds are bird-dispersed.

This species is a long-time and important staple landscape plant in many areas for its attractive, glossy, evergreen foliage, aesthetic growth form, and ease of cultivation. In addition to a specimen or accent plant, it sometimes is used as a hedge or border.

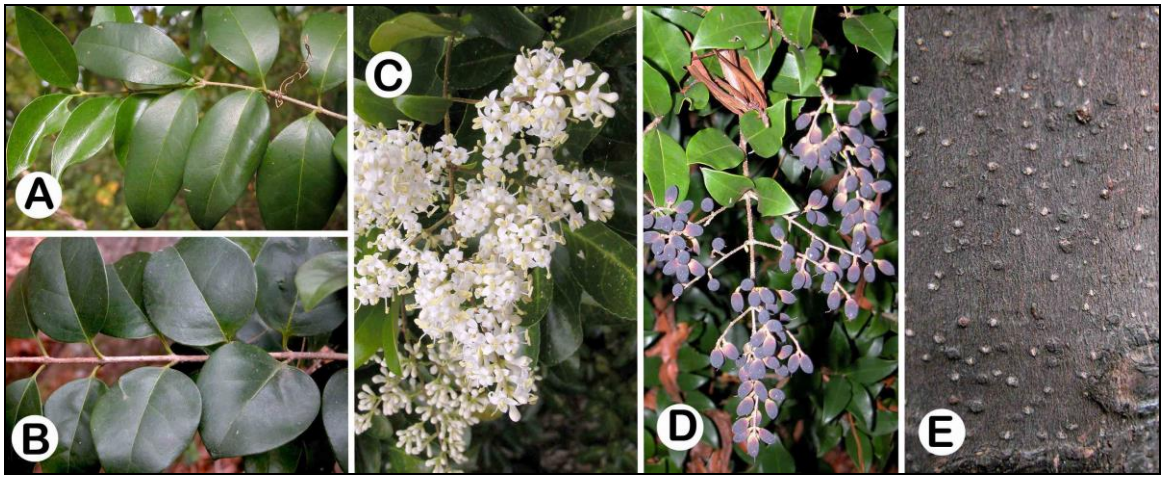
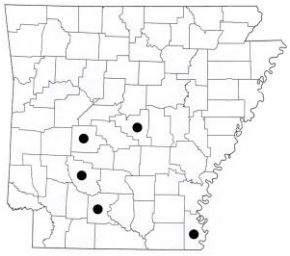


Figure 75. (A–E) *Ligustrum japonicum* plant and habit. (A–B) Leaves and stems. (C) Flowers and inflorescences. (D) Mature fruits. (E) Bark.

Morphologically, *L. japonicum* is very similar to and easily confused with another naturalized species of *Ligustrum* in Arkansas, *L. lucidum* (glossy privet). *Ligustrum japonicum* can be distinguished from *L. lucidum* by its thicker, more coriaceous, generally smaller leaves with less pronounced (as compared to *L. lucidum*) venation on the upper surface and pale, lime-green lower surfaces, smaller inflorescences, dark bluish-black fruits, and generally smaller mature size. In contrast, *L. lucidum* has larger (generally) leaves with prominent venation on the upper surface and lower surfaces that are blue-green, larger inflorescences, medium to pale blue fruits, and a larger size, to 10 m or more. ***Habitat***: waste places and disturbed sites, especially in the vicinity of where plants are cultivated, riparian zones, woodland edges, and open or disturbed woods.

Ligustrum lucidum Ait. (Fig. 76).



Ligustrum lucidum (glossy privet) is a large shrub to small, evergreen tree to 10 m tall, or sometimes more, that is native to Korea and China (Krüssmann 1977; Chang et al. 1996c). This species is naturalized in the southeastern USA (Nesom 2009; Weakley 2020), including Arkansas, where it has been documented from several counties. It is highly invasive, especially in habitats with some level of disturbance and/or in proximity to areas where plants of the species are cultivated. *Ligustrum lucidum* prolifically self-seeds, with large numbers of seedlings and juveniles often observed in areas where reproductive age plants are present. In addition to mesic environments, *L. lucidum* will establish in wet habitats, particularly riparian zones along streams and in moist soils, where it can aggressively establish. It also is shade-tolerant, growing to a large size in wooded or open habitats. In its native China, *L. lucidum* is used to cultivate wax insects for the production of white wax and the fruits are used to prepare a tonic (Chang et al. 1996c).

In Arkansas, *L. lucidum* is very similar to, and easily confused with, *L. japonicum* (Japanese privet), which also is naturalized in the state (see description for *L. japonicum* for distinguishing characteristics between the two species). The similarity of the two species is even more striking when they occur in understory conditions, where the leaves of *L. japonicum* can approach those of *L. lucidum* in overall size and appearance, or when they are encountered as juveniles (compare Fig. 166B with Fig. 166A). ***Habitat***: waste places and disturbed sites, especially in the vicinity of where plants are cultivated, riparian zones, wet places, woodland edges, open or disturbed urban woods, greenbelts, and roadsides.

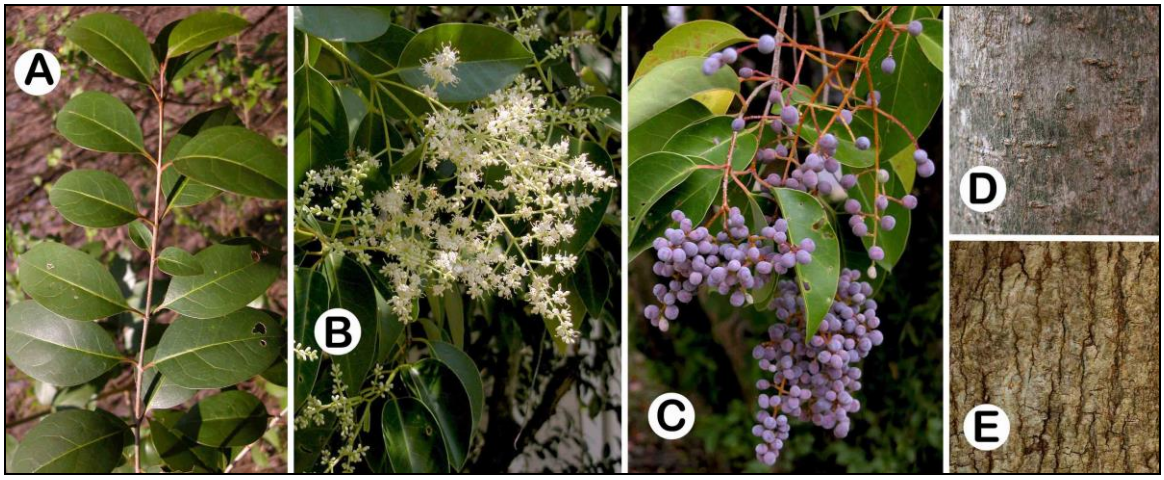


Figure 76. (A–E) *Ligustrum lucidum* plant and habit. (A) Leaves and stem (notice the pronounced venation as compared to *L. japonicum* in Fig. 75). (B) Flowers and inflorescence. (C) Mature fruits. (D) Young bark. (E) Older bark.

Ligustrum obtusifolium Sieb. and Zucc. var. **amurense** Carr.; Syn.: *Ligustrum amurense* Carr. (Fig. 77).

Ligustrum obtusifolium (amur privet, border privet) is a deciduous shrub to about 3 m tall that is native to China, Korea, and Japan (Krüssmann 1977; Chang et al. 1996c). It is naturalized over much of the eastern USA, including Mississippi, Missouri, Tennessee, and Texas, all of which border Arkansas (Nesom 2009; Kartesz 2015; Weakley 2020). At present, *L. obtusifolium* is known in Arkansas only from Washington County (Brent Baker, Pers. Comm., 2021). It previously has been reported for Arkansas (Nesom 2009; Ogle et al. 2020). It is cultivated in the state and should be expected elsewhere in the flora, especially in northern Arkansas. The overall morphological similarity of *L. obtusifolium* to *L. sinense* (Chinese privet); however, may have contributed to it being "overlooked" in the state, based on misidentification as *L. sinense*.

Though the two species are extremely similar in appearance and easily confused, *L. obtusifolium* can be distinguished from *L. sinense* by its more erect growth form, shorter petioles (only 1–2 mm long), and flowers where the corolla tube generally is 1.5–2.5 times longer than the lobes (the entire corolla is 5–10 mm long). In contrast, *L. sinense* often has a more spreading growth form (this is apparent if the two species are viewed together), petioles that are 2–8 mm long, and corollas where the tube is shorter than the lobes (in some instances, the tube may possibly be nearly equal in length to the lobes, but never longer; the entire corolla is 3.5–5.5 mm long).

Ligustrum obtusifolium is extremely cold-hardy and is an important staple landscape plant in the northern USA, where it often is used for a living hedge. ***Habitat***: waste places and other disturbed sites, woodland edges, riparian zones, and fencerows.

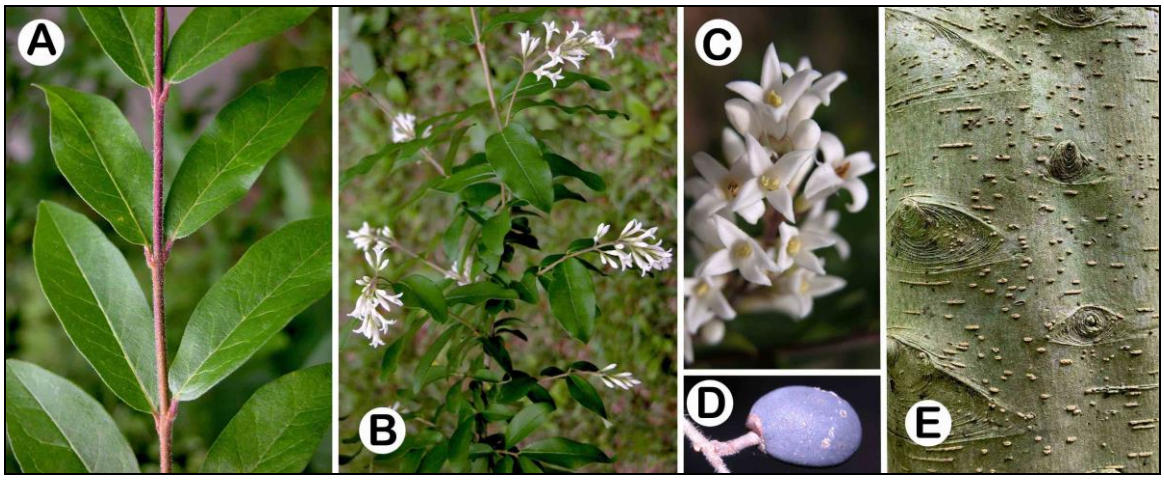
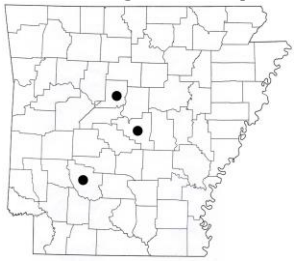


Figure 77 (A–E) *Ligustrum obtusifolium* plant and habit. (A) Leaves and stem. (B) Plant and inflorescences. (C) Flowers. (D) Mature fruit. (E) Bark.

Ligustrum quihoui Carr. (Fig. 78).



Ligustrum quihoui (waxy-leaf privet, Quihou privet) is a deciduous to semi-evergreen or evergreen shrub to 3 m tall that is native to China (Krüssmann 1977; Chang et al. 1996c). It is naturalized in several eastern states (Nesom 2009; Weakley 2020), including Arkansas, having been documented from Clark, Conway, and Pulaski counties.

In Arkansas, *L. quihoui* is considered invasive (Gentry et al. 2013), especially in urban environments, where it typically is encountered in disturbed woods, semi-wooded, and greenbelt habitats. It often is abundant when encountered. It appears to be a good competitor with the

aggressive and invasive *L. sinense* (Chinese privet), and in areas where *L. quihoui* is present, the two species often are observed growing together.

Ligustrum quihoui probably is more widespread in Arkansas than currently documented, especially considering its invasive nature and possible confusion with the morphologically similar *L. sinense*. Although the overall growth form and appearance of *L. quihoui* is similar to *L. sinense*, it can be distinguished from it by its narrower leaves, highly divaricate branching habit, and narrower inflorescences and infructescences. Small, juvenile plants of the two species are extremely similar (compare Fig. 166D and Figs. 166E–F), particularly when the level of development is not enough to show the characteristic dichotomous branching pattern of *L. quihoui*. However, the wider, more rounded leaves that typically are widest at about the middle of the lamina of *L. sinense* help to distinguish it from *L. quihoui*, which even when very young, has a more narrow leaf with a lamina that often is widest toward the distal portion — note that the leaves of *L. sinense* in the juvenile stage can be quite variable as to shape and size, even on the same plant; observe closely the plant in Fig. 166F). ***Habitat***: waste places and disturbed sites, especially in the vicinity of where plants of the species are cultivated; also slopes, escarpments, riparian zones, woodland edges, and open or disturbed, urban woods and greenbelts.

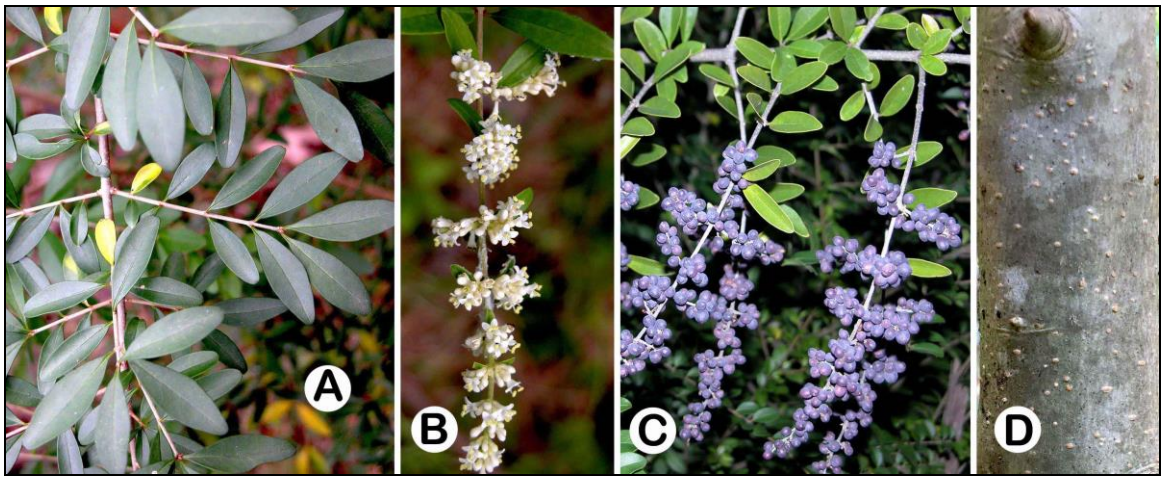
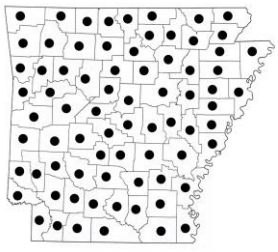


Figure 78. (A–D) *Ligustrum quihoui* plant and habit. (A) Leaves and stems (notice the divaricate branching patter as compared to that of *L. sinense* in Fig. 79). (B) Flowers and inflorescence. (C) Mature fruits. (D) Bark.

Ligustrum sinense Lour. (Fig. 79).



Ligustrum sinense (Chinese privet) is a deciduous to semi-evergreen shrub or small tree to 5 m tall that is native to China (Krüssmann 1977; Chang et al. 1996c). This species is well-naturalized in Arkansas and throughout much of the eastern USA (Nesom 2009; Kartesz 2015; Weakley 2020). It is highly invasive in Arkansas (and elsewhere), and is tolerant of a wide array of light, moisture, and soil regimes.

In low-quality, urban habitats, such as waste places, disturbed riparian zones, greenbelts, open woods, and fields, *L. sinense* frequently is one of the most abundant woody species encountered. In these habitats it is as or more abundant than many of the native woody species. *Ligustrum sinense* also regularly occurs in more pristine environments. Like many other *Ligustrum* species, *L. sinense* frequently is used as an ornamental for its profuse display of flowers in late spring and as a hedge plant, which helps to maintain a large source pool for dissemination of seeds.

Ligustrum sinense morphologically resembles a few other *Ligustrum* species present in the Arkansas flora, including *L. obtusifolium* (amur privet), *L. quihoui* (waxy-leaf privet), and *L. vulgare*

(common privet). Careful examination of plants or specimens must occur to ensure proper identification of *Ligustrum* species, particularly when viewing sterile material or juvenile plants, where variation in leaf size and shape, along with presence/absence and type of pubescence on leaves and stems, can further enhance difficulty with species determinations (see key to *Ligustrum* species and text under each species for distinguishing characters from *L. sinense*, where applicable).

The juvenile stages of *L. sinense* and *L. obtusifolium* (compare Fig. 166C and Figs. 166E–F) are quite similar and particularly difficult to distinguish. The leaves of *L. sinense* typically have 3–5 pairs of primary lateral veins and petioles that are 2–8 mm long, whereas the leaves of *L. obtusifolium* have 4–7 pairs of primary lateral veins and petioles that are 1–2(–4) mm long, although there is some overlap between the two species in regard to these characteristics. Additionally, petiole lengths in very young plants may be less than that stated above because of the relative smaller body size, and venation patterns of the leaves also may not be clearly evident. The generally more erect growth form of *L. obtusifolium* can be apparent, even with young plants. ***Habitat***: waste places and disturbed sites, riparian zones, river floodplains and terraces, woodland edges, and open or disturbed woods, greenbelts, and roadsides.

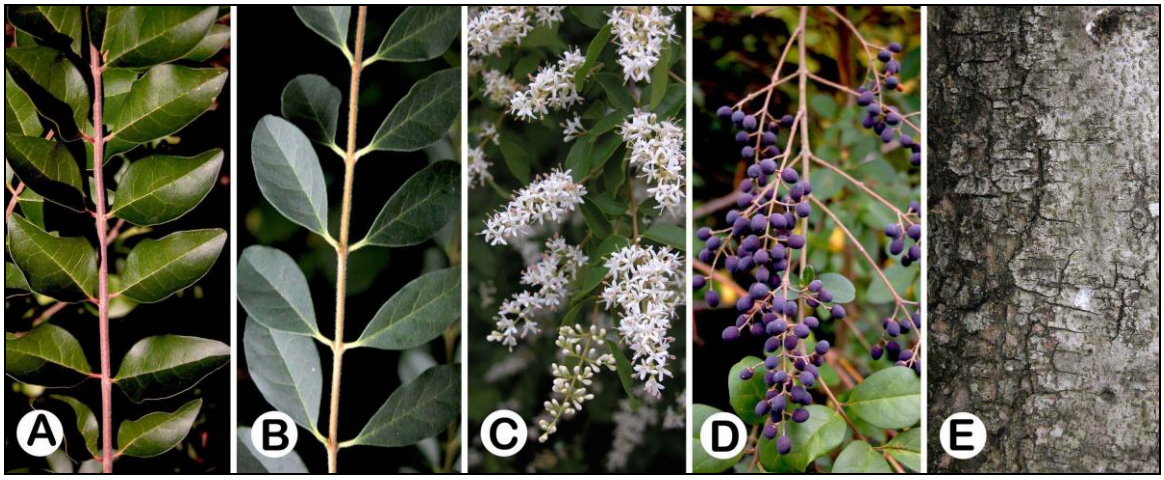
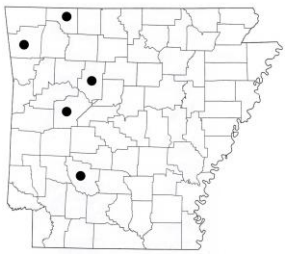


Figure 79. (A–E) *Ligustrum sinense* plant and habit. (A–B) Leaves and stems. (C) Flowers and inflorescences. (D) Mature fruits. (E) Bark.

Ligustrum vulgare L. (Fig. 80).



Ligustrum vulgare (common privet) is a deciduous (possibly semi-evergreen in milder climates) shrub or small tree to 5 m tall that is native to Europe, western Asia, and northern Africa (Krüssmann 1977). It is naturalized in numerous states (Nesom 2009; Kartesz 2015; Weakley 2020), including Arkansas, where it occurs mostly in the northern one-half of the state. *Ligustrum vulgare* self-seeds, allowing isolated plants to establish populations. This species has been cultivated for centuries, and thus numerous horticultural varieties and forms exist; these are separated primarily on the basis of flower and fruit coloration, leaf size, and growth habit (Krüssmann 1977).

Ligustrum vulgare is somewhat similar to the more widespread *L. sinense* (Chinese privet). *Ligustrum vulgare* can be distinguished from *L. sinense* by its generally glabrous foliage (sometimes stems and leaves can be minutely pubescent) and by its black, glossy/lustrous fruits — it is the only *Ligustrum* species in Arkansas with lustrous, black-colored fruits. Contrastingly, *L. sinense* has young stems that generally are pubescent, often densely so (sometimes stems can be nearly glabrous), leaves that are pubescent at least along the midvein on the lower surface, and fruits that are blue or blue-purple and dull (not glossy). ***Habitat***: waste places and disturbed sites, especially in the vicinity of where plants are cultivated, riparian zones, woodland edges, and open or disturbed woods.

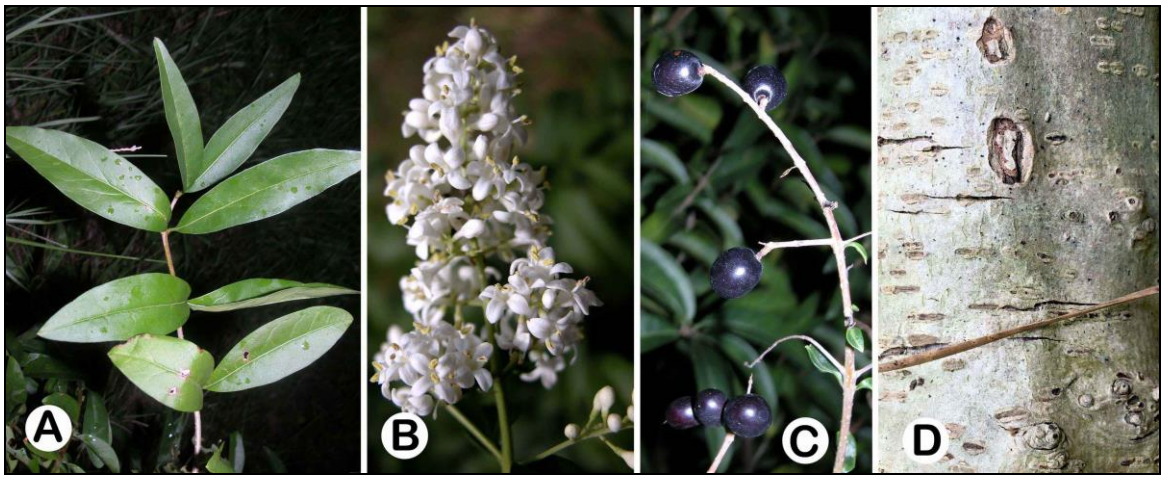


Figure 80. (A–D) *Ligustrum vulgare* plant and habit. (A) Leaves and stem. (B) Flowers and inflorescence. (C) Mature fruits (notice the glossy black coloration which aids in distinguishing *L. vulgare* from other Arkansas *Ligustrum* species). (D) Bark.

Lonicera, Honeysuckle, Caprifoliaceae

Lonicera is a genus of about 180 species of evergreen (mostly) to semi-evergreen or deciduous lianas, shrubs, and small trees distributed across much of the northern hemisphere (Krüssmann 1977; Yang et al. 2011b). Many species are important as ornamentals for their showy, sometimes fragrant flowers and attractive foliage. A number of *Lonicera* species were introduced into the USA from Asia, many of which have subsequently naturalized and become invasive in the flora, including Arkansas. Many nonnative *Lonicera* species are shade-tolerant and escaped or naturalized plants often are observed in the understory of semi-wooded and wooded habitats.

Currently, five nonnative species of *Lonicera* are naturalized to various degrees in the Arkansas flora; all are considered invasive (Gentry et al. 2013; Ogle et al. 2020). *Lonicera japonica* occurs statewide, and *L. fragrantissima* and *L. maackii* are well-established and invasive in some portions of Arkansas. The state has three native species of *Lonicera*: *L. flava*, *L. reticulata*, and *L. sempervirens*.

Species of *Lonicera* have opposite, simple leaves and small, perfect (bisexual), often paired flowers with inferior ovaries arranged in axillary cymose inflorescences. The flowers often change color with age. The fruit is a small red or black berry; the seeds of *Ligustrum* species are bird-dispersed, facilitating their invasive tendencies. The stems of many of the shrub honeysuckles are hollow.

Key to *Lonicera* species:

1. Plant a liana-like shrub, clearly climbing by twining and sprawling; mature fruits black ..... **Lonicera japonica**
1. Plant an erect or ascending shrub, not liana-like and climbing; mature fruits red or orange.

2. Foliage glabrous (young leaves and stems may be pubescent); flowers usually bright to pale pink, very rarely white; mature fruits red or orange ..... **Lonicera tatarica**
2. Foliage at least slightly pubescent, sometimes pubescence restricted to the abaxial surfaces of the leaves; flowers white to cream, usually pale pink in *L* × *bella*; mature fruits red.

3. Internodes of stems solid, stems yellow-brown to purple, glabrous or nearly so or with long, hirsute trichomes; leaves subcoriaceous, often broadly ovate or rounded, sometimes elliptic, midvein on abaxial surface bristly-pubescent; flowers often produced before or with leaf emergence, strongly fragrant ..... **Lonicera fragrantissima**

3. Internodes of stems hollow, stems gray to brownish-gray, generally pubescent but never with long hirsute trichomes; leaves chartaceous to membranous, generally not broadly ovate to rounded, abaxial surfaces generally pubescent but without bristly trichomes; flowers produced clearly after leaf emergence, fragrant or not.

4. Leaves 5–8 cm long, apices generally acuminate, adaxial surfaces of leaves often with sunken veins, giving the leaf a semi-rugose appearance; peduncles of inflorescences and infructescences shorter than the leaf petioles; flowers white to cream .....**Lonicera maackii**
4. Leaves 3–5.5 cm long, apices acute to obtuse, adaxial surfaces of leaves without sunken veins, without rugose appearance; peduncles of inflorescences and infructescences as long as or longer than the leaf petioles; flowers white to cream or pink.

5. Leaves densely pubescent on the abaxial surface; flowers white to cream.....**Lonicera morrowii**
5. Leaves sparsely pubescent on the abaxial surface; flowers generally with some pink coloration, occasionally white.....**Lonicera x bella**

Lonicera x bella Zab. (Fig. 81).

Lonicera x bella (showy fly honeysuckle) is a deciduous shrub to 4 m tall; it is a fertile, interspecific hybrid (between *L. morrowii and L. tatarica*) of horticultural origin (Krüssmann 1977). *Lonicera x bella* is well-naturalized in the central and eastern USA (Kartesz 2015; Weakley 2020) and has been documented in Arkansas from Washington County (Ogle et al. 2020). It is invasive and it should be expected elsewhere in the state, especially in the northern portion.

This species is cultivated for its showy flowers and fruits and attractive growth form. Whereas *L. x bella* typically has pink-colored flowers that fade to yellow as they age, at least one cultivar has white flowers, making it easily confused with *L. morrowii* (Asian fly honeysuckle), and some forms have flowers that do not fade to yellow with age (Yang et al. 2011b). The sparse pubescence on the lower surfaces of the leaves of *L. x bella* aid in distinguishing it from *L. morrowii* (the lower surfaces of the leaves of *L. morrowii* are densely pubescent).

Many of the Eurasian shrub honeysuckles are readily capable of interspecific hybridization (some of these hybrids are of horticultural origin, whereas others occur naturally), which creates a

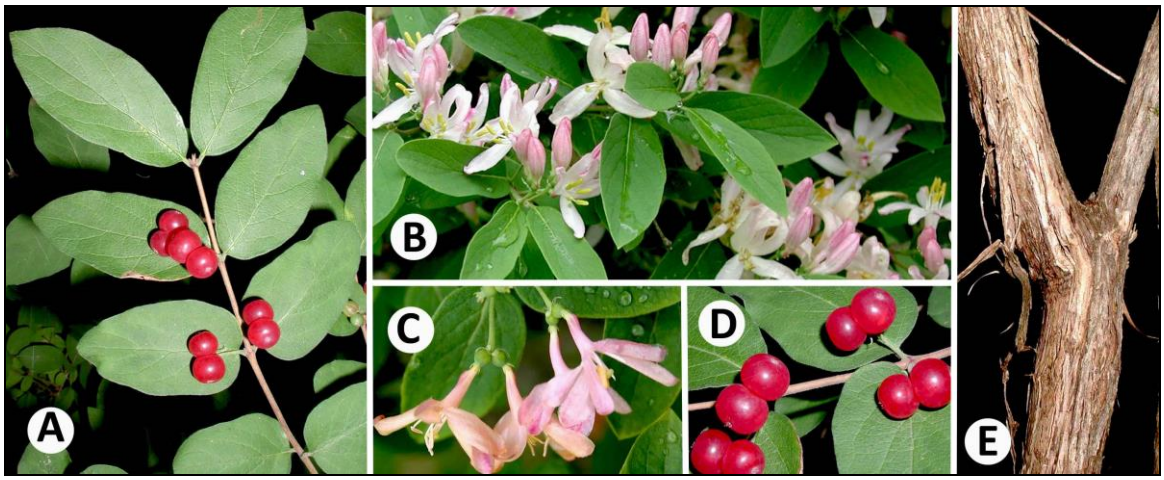
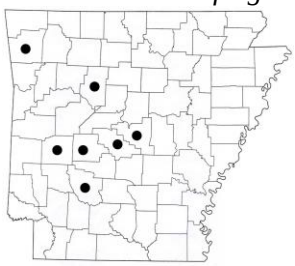


Figure 81. (A–E) *Lonicera x bella* plant and habit. (A) Leaves, stem, and fruits. (B–C) Flowers. (D) Mature fruits. (E) Bark. Photo credit: Leslie J. Mehrhoff, University of Connecticut, Bugwood.

variety of hybrid taxa that possess characteristics of both parents, often making identification of an individual plant challenging. These hybrids frequently are cultivated and also sometimes encountered escaped or naturalized in the USA (at present, *L. ×bella* is the only one known to occur outside of cultivation in Arkansas). *Lonicera ruprechtiana* (Manchurian honeysuckle) is a parental species for many of these hybrids.

Lonicera ×bella is particularly interesting in that it not only is fertile, but apparently capable of backcrossing with either parental species, which can produce hybrid swarms of plants in a local area (see entry for *L. morrowii* for further discussion). ***Habitat***: disturbed areas and waste places, mesic upland woods, riparian zones, fencerows, and roadsides.

Lonicera fragrantissima Lindl. ex Paxt. (Fig. 82).



Lonicera fragrantissima (fragrant bush honeysuckle) is a deciduous to semi-evergreen shrub to 2.5 m tall that is native to China (Krüssmann 1977; Yang et al. 2011b). This species is naturalized over much of the southern and eastern USA, from Texas to Georgia, Virginia, New York, and Ohio (Kartesz 2015; Weakley 2020), including Arkansas, where it occurs in several counties. It is invasive and generally encountered along woodland edges, greenbelts, and within disturbed, urban wooded habitats.

Flowering occurs very early in spring, prior to or with leaf emergence (some older leaves from the previous season also may be present). *Lonicera fragrantissima* flowers earlier than most of the other nonnative shrub honeysuckles. The flowers are strongly and sweetly fragrant, giving rise to the common name of fragrant bush honeysuckle.

Most plants of *L. fragrantissima* (in Arkansas) have only opposite leaves; however, sometimes individuals are encountered that have at least a few verticillately-arranged leaves (Fig. 83). These plants can have some to most stems with opposite leaves and a few with at least some verticillate leaves.

Two varieties of *L. fragrantissima* are recognized and are separated primarily based on vegetative differences. Variety *lancifolia* (*L. standishii*, Standish's honeysuckle), has leaves (lower surface) and stems that are covered in long, prominent, bristly trichomes. Variety *fragrantissima* lacks these prominent trichomes (they sometimes are present along the midvein on the lower leaf surface). Variety *fragrantissima* also can be distinguished from variety *lancifolia* by its wider, elliptic, ovate, or nearly rotund leaves, in addition to its glabrous or nearly glabrous foliage. The

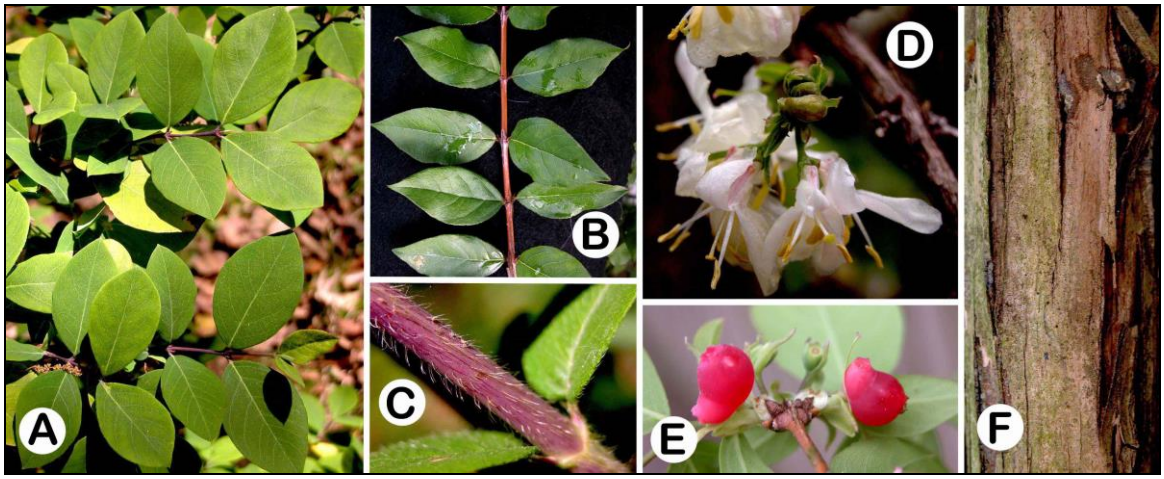
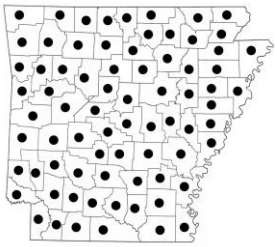


Figure 82. (A–F) *Lonicera fragrantissima* plant and habit. (A–B) Leaves and stems (the leaves in var. *fragrantissima* often are broadly elliptic or rounded to nearly orbicular, especially on larger stems). (C) Stem of var. *lancifolia* (notice the long, bristly trichomes). (D) Flowers. (E) Mature fruits. (F) Bark.

leaves of variety *lancifolia*, contrastingly, are elliptic, ovate-oblong, or lanceolate. Both varieties of *L. fragrantissima* occur in the state's flora. ***Habitat***: waste areas and disturbed sites, woodland edges and urban wooded and greenbelt habitats, sometimes along slopes and hilly areas.

Figure 83. *Lonicera fragrantissima* plant from Clark County, Arkansas, with verticillate leaves.

Lonicera japonica Thunb. (Fig. 84).



Lonicera japonica (Japanese honeysuckle) is a deciduous to semi-evergreen, lianitic shrub to 6 m or more in length that is native to Korea, China, and Japan (Krüssmann 1977; Yang et al. 2011b). It frequently is cultivated and is well-naturalized over much of the continental USA (Kartesz 2015; Weakley 2020), including Arkansas, where it occurs statewide. It is considered invasive in the state (Gentry et al. 2013). It is, perhaps, the most widespread and abundant nonnative woody species in Arkansas; its abundance in the flora and presence in a large number of habitats provides an impression of being native. *Lonicera japonica* occurs commonly in open, edge, and wooded habitats, regardless of disturbance level. It will cover vegetation and climb large trees via twining, often to several meters. *Lonicera japonica* reproduces via seeds, air layering of stems where they root adventitiously where in contact with soil, and via a suckering root system.

Lonicera japonica is planted widely as an ornamental for its showy, fragrant flowers and vining habit. In addition to white flowers that fade to yellow, some cultivars produce pink flowers. Sweet tasting nectar often is consumed by children, giving rise to the "honey suckle" designation. It is used by a variety of wildlife — browsed extensively by deer, flowers are visited by hummingbirds, and a variety of birds eat the fruits (Hunter 1995).

Juvenile leaves or leaves that are produced on ground running stems sometimes are deeply pinnately lobed. It is the only species of honeysuckle in Arkansas with black-colored fruits.

When growing in open areas, *L. japonica* will rotate its stems in a clockwise fashion to contact substrate for climbing. ***Habitat***: disturbed places, fence rows, pastures, riparian zones, greenbelts, woodland edges, and urban wooded areas; prefers full sun, but is tolerant of shade conditions.

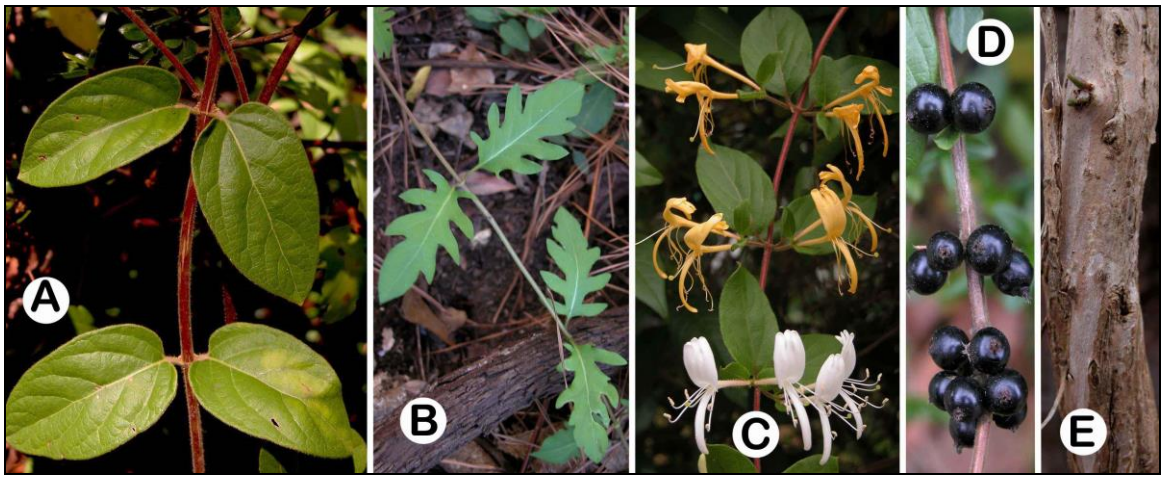
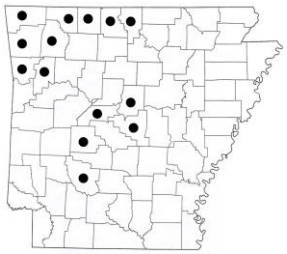


Figure 84. (A–E) *Lonicera japonica* plant and habit. (A–B) Leaves and stems (notice the deeply lobed leaves in Fig. B, which sometimes are encountered on trailing stems or juvenile growth). (C) Flowers. (D) Mature fruits. (E) Bark.

Lonicera maackii (Rupr.) Maxim. (Fig. 85).



Lonicera maackii (amur honeysuckle) is a large, semi-evergreen shrub or small tree to 6 m tall that is native to China (Krüssmann 1977; Yang et al. 2011b). This species is naturalized in the central and eastern USA (Kartesz 2015; Weakley 2020), including Arkansas, where it is well-established in the northwestern portion of the state and sporadically elsewhere. It is invasive in Arkansas (Gentry et al. 2013) and often abundant in open, semi-wooded, or wooded habitats in urban areas. Spontaneous seedlings are common in areas where reproductively mature plants are present. This species sometimes is cultivated, as fruiting plants are attractive because of a profuse display of small, red, tightly clustered fruits.

In Arkansas, *L. maackii* somewhat resembles *L. fragrantissima* (fragrant bush honeysuckle) and *L. morrowii* (Asian fly honeysuckle) in overall form and appearance. Although the characteristic is somewhat variable, *L. maackii* can be distinguished from both species by its leaves with prominently sunken venation on the upper surfaces, which gives the leaves a semi-rugose (wrinkled)

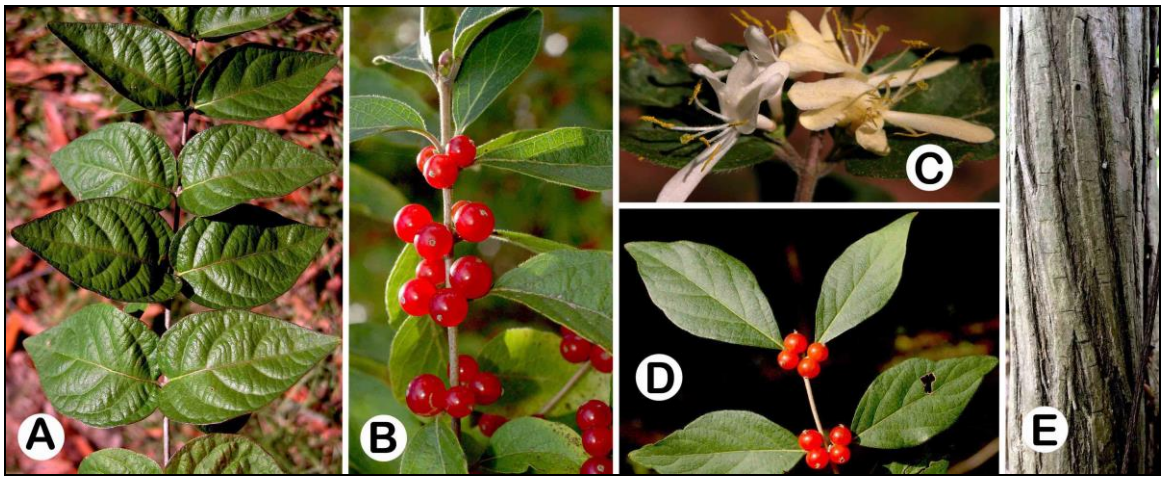


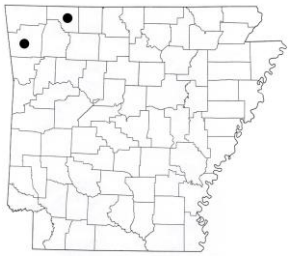
Figure 85. (A–E) *Lonicera maackii* plant and habit. (A, D) Leaves and stems (notice the prominent, sunken veins shown in Fig. A that give the upper surfaces of the leaves a wrinkled appearance). (B, D) Mature fruits. (C) Flowers. (E) Bark.

appearance. This trait is especially pronounced on stems produced from robust, vigorous growth. It further can be distinguished from *L. morrowii* by its generally larger and broader, more ovate leaves (the leaves of *L. maackii* typically are 5–8 cm long, whereas those of *L. morrowii* typically are only 3–5 cm long), slightly larger flowers, later flowering time, and length of peduncles relative to petioles (*L. maackii* has peduncles that are shorter than its petioles, whereas the peduncles of *L. morrowii* are longer than its petioles).

All species of shrub honeysuckle naturalized in Arkansas are native to Asia and are invasive. The seeds of *Lonicera* species are bird-dispersed, but establishment also occurs by suckering. The seeds of shrub honeysuckles can persist for extended periods of time in the soil, potentially making eradication of these plants a long-term and difficult process. ***Habitat***: disturbed areas and waste places, fencerows, pastures, greenbelts, woodland edges, urban wooded areas, and roadsides.

Lonicera morrowii A. Gray (Fig. 86).

Lonicera morrowii (Asian fly honeysuckle) is a deciduous shrub to 3 m tall that is native to Japan (Krüssmann 1977; Yang et al. 2011b). This species is naturalized in northwestern Arkansas, occurring in Carroll and Washington counties; however, it is abundant and invasive in many other areas of the USA (Kartesz 2015; Weakley 2020), especially in the northeast, invading into wooded and open habitats, and should be expected in this capacity in Arkansas. *Lonicera morrowii* sometimes is cultivated for its profuse display of flowers and showy, red-colored fruits.



Vegetatively, *L. morrowii* is similar to *L. japonica* (Japanese honeysuckle), which is common and well-naturalized in Arkansas. *Lonicera morrowii* is distinguished from *L. japonica* by its strictly shrubby habit and red-colored fruits (*L. japonica* has a vining habit and black fruits). *Lonicera morrowii* also resembles *L. maackii* (amur honeysuckle — see entry for *L. maackii* for distinguishing characteristics between the two species). It also can be confused with *L. ×bella* (showy fly honeysuckle); however, generally can be distinguished from it by its white flowers that fade to yellow (*L. ×bella* usually has pink flowers) and dense pubescence on the lower surfaces of the leaves (the leaves of *L. ×bella* are sparsely pubescent abaxially).

Yang et al. (2011b) treated *L. morrowii* as a variety of *L. tatarica*: *L. tatarica* var. *morrowii*. This inclusion is logical and important, as the interspecific hybrid between the species, *L. ×bella*, is intermediate in morphology between the two parental taxa (*L. morrowii* and *L. tatarica*), is fertile, and capable of backcrossing successfully with either parent.

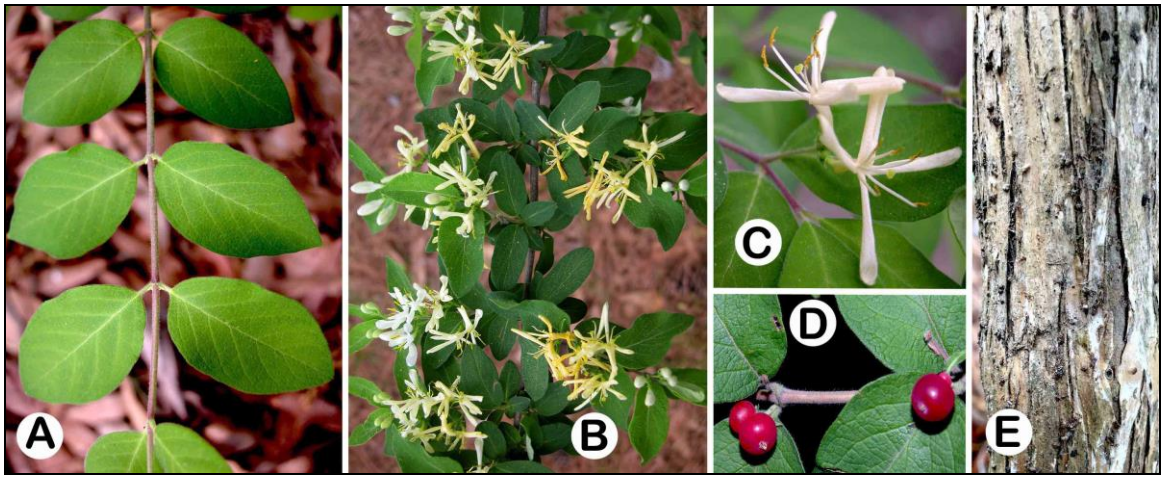


Figure 86. (A–E) *Lonicera morrowii* plant and habit. (A) Leaves and stem. (B–C) Flowers. (D) Mature fruits. (E) Bark.

Lonicera morrowii can be extremely difficult to eradicate once established because of a long-lived soil seed bank, vigorous suckering habit, and an ability to regrow after removal of the above ground portion of the plant. ***Habitat***: open disturbed sites, fencerows, woodland edges and wooded habitats; prefers mesic soils, but will tolerate well-drained and calcareous soil conditions.

Lonicera tatarica L. (Fig. 87).

Lonicera tatarica (Tatarian honeysuckle) is a large, deciduous shrub to slightly over 3 m tall that is native to Asia (Krüssmann 1977; Yang et al. 2011b). While currently not known from the Arkansas flora, it is widely cultivated and naturalized over much of the USA (Kartesz 2015), including Texas, which borders Arkansas. *Lonicera tatarica* is invasive and should be expected outside of cultivation in the state, particularly in the northern and western portions.

Lonicera tatarica in form and habit is similar to the other naturalized species of shrub honeysuckles that occur in the state; however, it can be distinguished from most of them by the combination of its pink to crimson flowers (occasionally flowers are white), often orange-colored fruits, and glabrous stems and leaves (new foliage can be pubescent). The other species of shrub honeysuckle (*L. fragrantissima*, *L. maackii*, *L. morrowii*) all have pubescent leaves and/or stems, red fruits, and white flowers (the flowers of *L. fragrantissima* sometimes are tinged with pink). *Lonicera* × *bella* (showy fly honeysuckle), however, easily is confused with *L. tatarica*, but can be distinguished from it by its leaves and stems that have at least some amount of pubescence. ***Habitat***: highly adaptable, open and wooded habitats, slopes, riparian zones, and moist areas, also prominent in waste areas and disturbed sites; is tolerant of sun or shade, but does better in full sun.

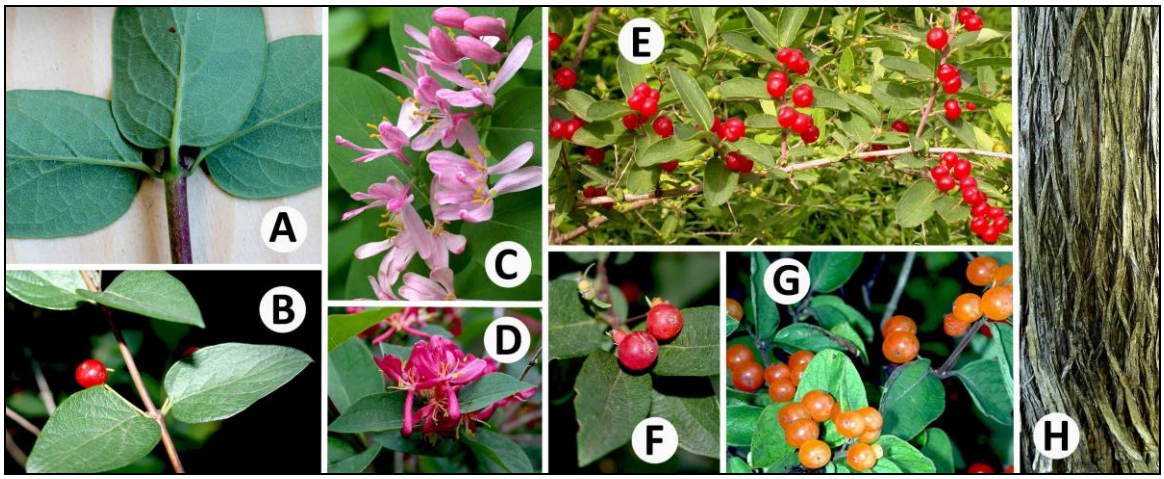


Figure 87. (A–H) *Lonicera tatarica* plant and habit. (A–B) Leaves and stem (notice that the stem shown in Fig. B is glabrous). (C–D) Flowers (flower color can vary from white to various shades of pink). (E–G) Mature fruits (notice the fruits in Fig. G are orange rather than red; orange-colored fruits sometimes are encountered for this species). (H) Bark. Photo credits: A: Rob Routledge, Sault College, Bugwood; B, D, F: Leslie J. Mehrhoff, University of Connecticut, Bugwood; C, E, H: Peter M. Dziuk and Katy Chayka, Minnesota Wildflowers; G: Chris Evans, University of Illinois, Bugwood.

Loropetalum, Fringe-flower, Hamamelidaceae

Loropetalum is a small genus of three species of semi-evergreen to evergreen shrubs or small trees native to China, India, and Japan (Zhang et al. 2003). *Loropetalum chinense* is an important ornamental species in warm-temperate regions.

Loropetalum chinense R. Br. (Fig. 88).

Loropetalum chinense (fringe-flower, Chinese loropetalum) is a large, evergreen to semi-evergreen shrub or small tree to 4 m tall that is native to India and China (Krüssmann 1977; Zhang et

al. 2003). This species commonly is cultivated in Arkansas, and spontaneous seedlings sometimes occur in the vicinity of reproductive age plants (spontaneous seedlings and juvenile plants of both green and purple foliage varieties have been observed in Clark County — Serviss & Peck 2008; Figs. 166J, 167A). *Loropetalum chinense* sometimes produces root suckers, allowing for localized vegetative spread. It also is shade-tolerant. Based on the combination of these attributes, along with its frequency of cultivation, it should be expected elsewhere in the flora.

Loropetalum chinense has two recognized varieties: *L. chinense* var. *chinense* and *L. chinense* var. *rubrum* (Zhang et al. 2003). Variety *chinense* has green foliage and white to yellow-colored flowers, whereas variety *rubrum* has green to purple foliage and pink, magenta, or red-colored flowers. Variety *rubrum* often is planted for ornamental purposes, and numerous cultivars of it exist, including forms with deep magenta or purple-colored foliage and dwarf forms one meter or less tall. When in flower, many cultivars of var. *rubrum* are quite showy, where the combination of deep purple to maroon foliage intensely contrasts with the bright pink or magenta flowers.

In Arkansas, the overall leaf shape and growth form of *L. chinense* somewhat resembles that of *Vaccinium arboreum* (tree sparkleberry, farkleberry); however, *L. chinense* readily can be distinguished from *V. arboreum* by the dense indument of stellate trichomes covering young stems and the lower surfaces of leaves. Contrastingly, the stems and leaves of *V. arboreum* lack stellate trichomes. ***Habitat***: disturbed sites and waste places, especially in the vicinity of cultivated plants of the species.

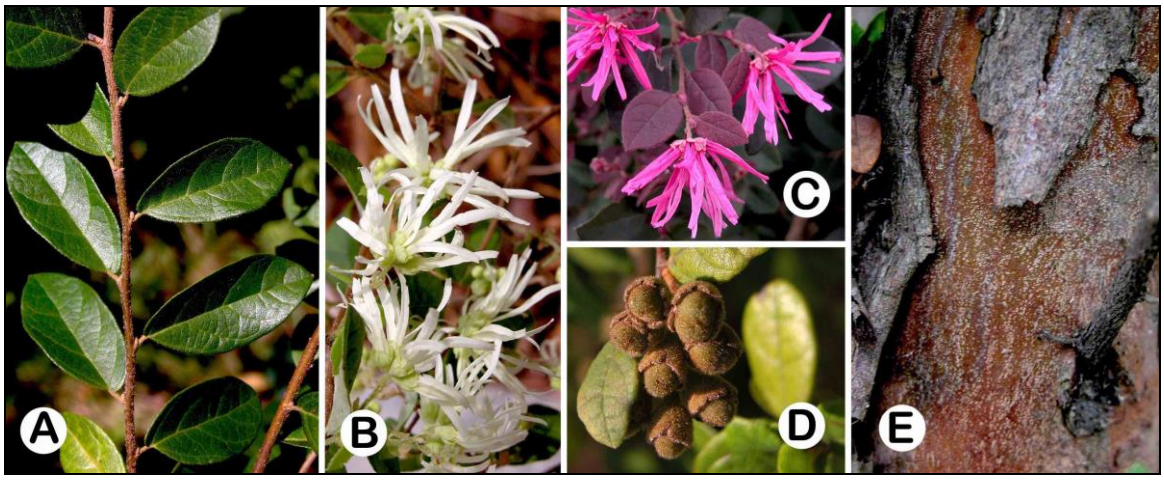


Figure 88. (A–E) *Loropetalum chinense* plant and habit. (A) Leaves and stem. (B–C) Flowers. (D) Mature fruits. (E) Bark.

Lycium, Goji Berry or Wolf Berry, Solanaceae

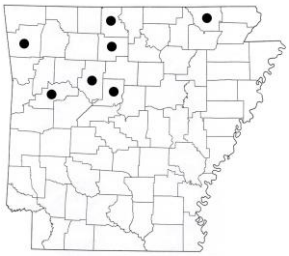
Lycium is a genus of 90–100 species of deciduous, usually thorny shrubs distributed over Asia, Europe, southern Africa, and South America (Zhang et al. 1994).

Lycium barbarum L. (Fig. 89).

Lycium barbarum (wolfberry, matrimony vine, goji berry) is a sprawling to semi-vining, deciduous shrub to 2.5 m tall that is native to China (Zhang et al. 1994). It is naturalized over much of the USA (Kartesz 2015; Weakley 2020), including Arkansas, where it is known from seven scattered counties in the northern one-half of the state.

Lycium barbarum commonly is cultivated in its native China and the USA for its edible fruits

that are used to make (or flavor) a variety of beverages and eaten fresh or dried. The fruits also have been used extensively in traditional Chinese medicine (Zhang et al. 1994). The seeds of *L. barbarum* undoubtedly are bird-dispersed.



In Arkansas, the combination of purple flowers that fade to pink or pale yellowish-brown with age, bright reddish-orange to red-colored, ellipsoid to ovoid-shaped fruits, glabrous foliage, and stems with slender thorns clearly distinguish this species from other shrubs in the state. ***Habitat***: disturbed areas and waste places, thickets, riparian zones and stream sides, and roadsides.

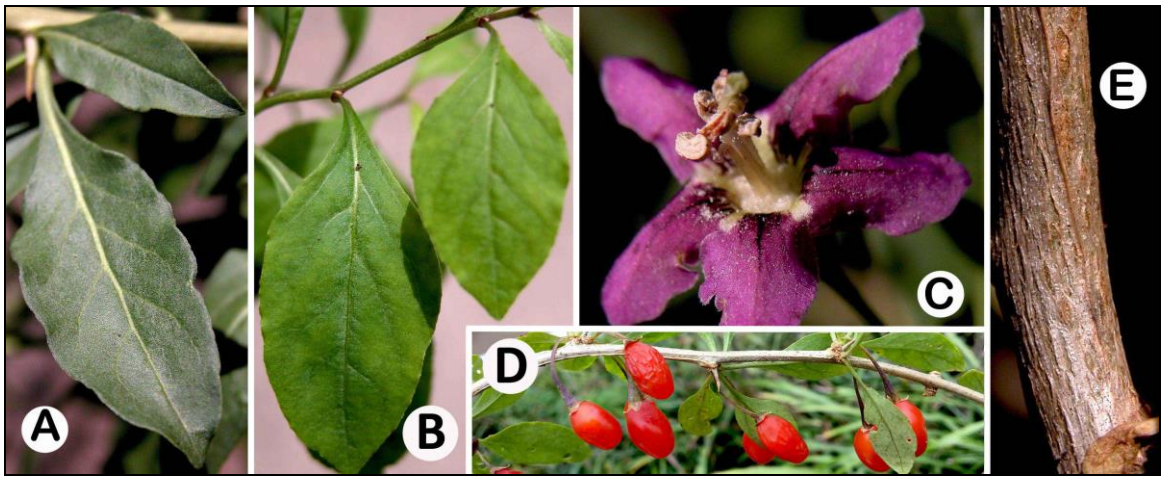


Figure 89. (A–E) *Lycium barbarum* plant and habit. (A–B) Leaves and stem (notice the thorns in Figs. A and D). (C) Flowers. (D) Mature fruits. (E) Bark.

Magnolia, Magnolia, Magnoliaceae

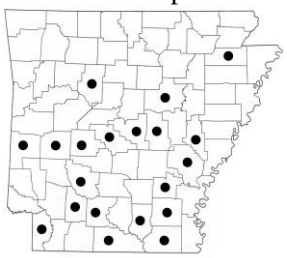
Magnolia is a genus of about 120 species of deciduous or evergreen trees and shrubs distributed primarily over North America and Asia (Meyer 1997). Many species are important as ornamentals for their large, attractive, often fragrant flowers, unusual fruits, and large leaves. Some species, such as *M. grandiflora*, also are cultivated for shade.

In Arkansas, five species of *Magnolia* occur; all with the possible exception of *M. grandiflora* are native. Most species are deciduous; however, *M. grandiflora* and *M. virginiana* are evergreen. Japanese magnolia (*M. liliflora*), saucer magnolia (*M. × soulangeana*), and star magnolia (*M. stellata*) sometimes are cultivated in Arkansas and may be encountered persisting from cultivation; however, are not known to occur outside of cultivation in the state.

Species of *Magnolia* have alternate, simple, generally large leaves with entire margins, large, perfect (bisexual) white, cream, yellowish-orange, pink, or purple-colored flowers arranged in solitary, axillary inflorescences. Flowers have 6–15 tepals (perianth segments that are more or less similar and not easily differentiated into distinct sepals and petals) that gradually transition from calyx to corolla. The fruit is an aggregate of follicles that dehisce to release a seed with a bright red, orange-red, orange, or pink-colored aril. The seeds are bird-dispersed.

Magnolia grandiflora L. (Fig. 90).

Magnolia grandiflora (southern magnolia) is a medium-sized to large, evergreen tree to 37 m tall, but often smaller (Meyer 1997). It probably is not native to Arkansas (Ogle et al. 2020), but is well-naturalized in the state, with initial establishment presumably from cultivated *M. grandiflora* plants. *Magnolia grandiflora* is common in cultivation, and in addition to Arkansas, has naturalized in other states outside of its native range, including Kentucky, Tennessee, and Virginia (Meyer 1997). It also is cultivated outside of the USA.



This species is one of the most frequently cultivated trees in the southern USA, and through its long-term popularity has become an iconic symbol of the south. It is the state tree of both Louisiana and Mississippi.

While *M. grandiflora* produces most of its flowers in late spring and early summer, some flowering also may occur during autumn. *Magnolia grandiflora* is shade-tolerant, and often is encountered in disturbed urban woods and along woodland edges, often in close proximity to where it is cultivated. The seeds of *M. grandiflora* are bird-dispersed, however, so plants also may be encountered in remote areas.

In Arkansas, *M. grandiflora* possibly can be confused with *M. virginiana* (sweetbay magnolia), *Persea borbonia* (red bay), *Eriobotrya japonica* (loquat), or *Photinia serratifolia* (Chinese photina). In similar fashion *to M. grandiflora*, all of these species produce elongate, coriaceous, evergreen leaves. *Magnolia grandiflora*, however, may be distinguished from each species by the following: from *M. virginiana* by its leaves that are green to reddish-orange on the lower surface (leaves of *M. virginiana* are white to silvery-white on the lower surface); from *P. borbonia* by its wider leaves (4.5–12.5 cm wide) and larger, solitary flowers (*P. borbonia* has narrower leaves, 2–6 cm wide and smaller flowers, less than 1 cm wide, arranged in compound cymes); and from *E. japonica* and *P. serratifolia* by its leaves with entire margins (leaves of both *E. japonica* and *P. serratifolia* are prominently toothed). ***Habitat***: moist or well-drained sites; urban woods and woodland edges; also in bottomlands, floodplain forests, and along riparian zones.

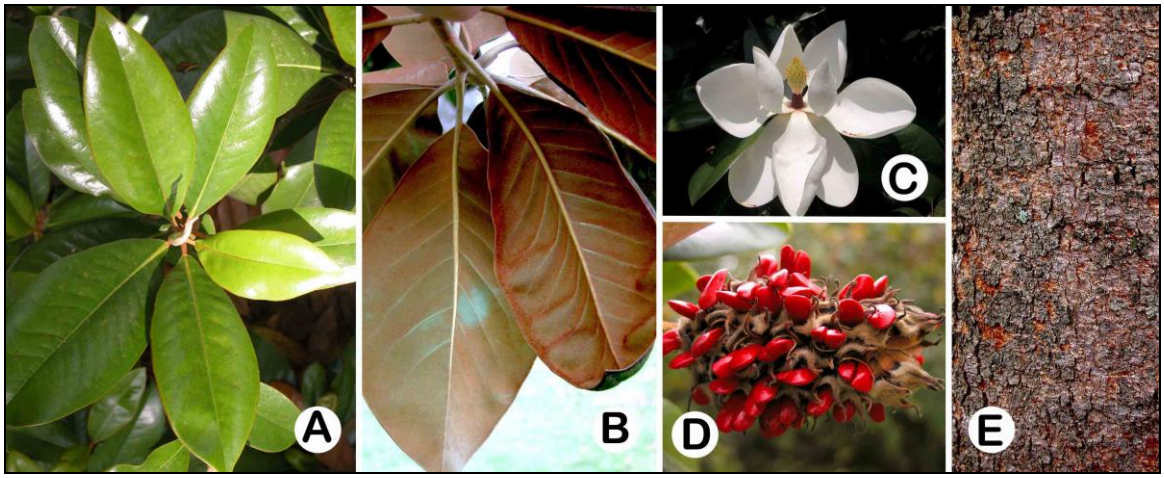


Figure 90. (A–E) *Magnolia grandiflora* plant and habit. (A–B) Leaves (notice the rust-colored trichomes on the leaf lower surface in Fig. B). (C) Flowers. (D) Mature fruits and infructescence. (E) Bark.

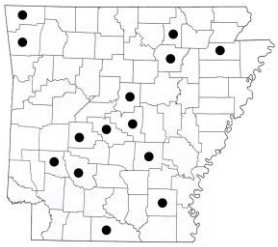
Mahonia, Mahonia, Berberidaceae

Mahonia is a genus of about 60 species of evergreen shrubs distributed over Asia and the Americas (Ying et al. 2011a). Several species are important as ornamentals for their attractive growth form, evergreen foliage, general shade tolerance, and showy flowers and fruits. Species of the genus *Mahonia* often are included within the more comprehensive *Berberis* (Whittemore 1997).

Mahonia bealei (Fort.) Carr.; Syn.: *Berberis bealei* Fort. (Fig. 91).

Mahonia bealei (leatherleaf mahonia, Oregon grape) is an evergreen shrub that can reach an eventual height of 4 m tall (usually much shorter) that is native to China (Ying et al. 2011a). This species is naturalized in the eastern USA (Whittemore 1997; Kartesz 2015; Weakley 2020), including Arkansas, where it is known from several scattered counties. In Arkansas, it is generally observed invading into wooded areas, particularly those with some level of disturbance. Occasionally large,

dense populations of hundreds of plants may be encountered — these usually in disturbed, urban woods adjacent to residential areas where *M. bealei* is cultivated.



Mahonia bealei is extremely shade-tolerant, and will grow to maturity and reproduce successfully in shade conditions. Seedlings often are observed in the vicinity of reproductive age plants. The seeds of *M. bealei* are bird-dispersed, and it is not uncommon to find seedlings and juveniles of this species in areas where birds roost and leave large numbers of droppings.

Mahonia bealei is the only shrub in the Arkansas flora that has once pinnately compound leaves with rigid-leathery, spiny leaflets, and prominent, foliaceous, spiny stipules. The wood of *M. bealei* is bright lemon-yellow in color. ***Habitat***: disturbed or open urban woods, woodland edges, greenbelts, thickets, roadsides, and riparian zones.

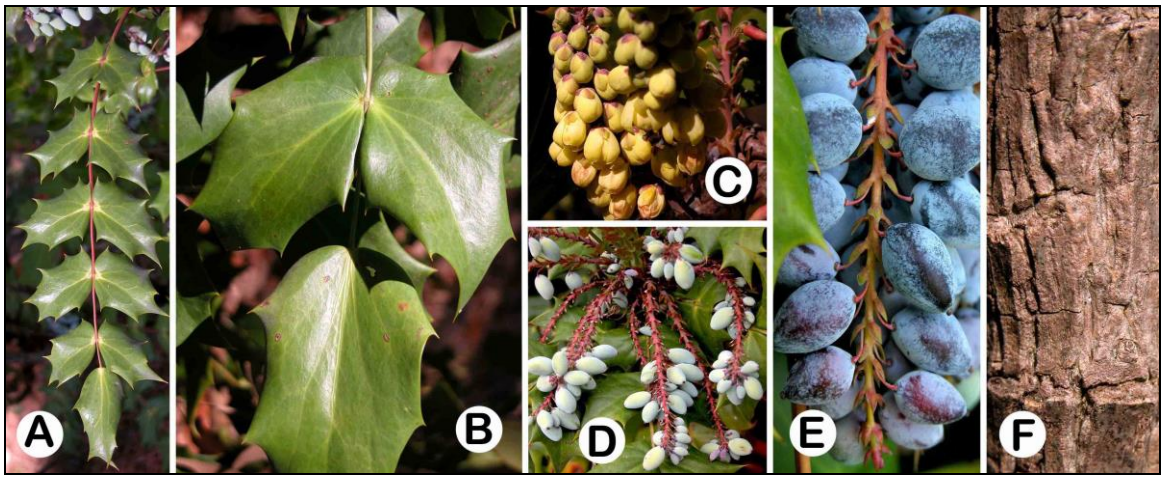


Figure 91. (A–F) *Mahonia bealei* plant and habit. (A–B) Leaves and leaflets. (C) Flowers. (D–E) Mature fruits. (F) Bark.

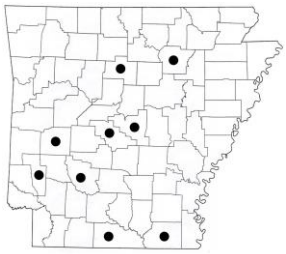
Malus, Apple or Crabapple, Rosaceae

Malus is a genus of about 55 species of deciduous or semi-evergreen trees distributed across Asia, Europe, and North America (Gu & Spongberg 2003c; Dickson 2014). The common apple (*M. pumila*) is prized as a fruit commodity worldwide and is the most economically important species in the genus. A number of *Malus* species and interspecific hybrids are grown in temperate regions as fruit crops, or strictly as ornamentals for their colorful flowers and fruits (Dickson 2014). One important ornamental species, Siberian crabapple (*M. baccata*), frequently is cultivated for its showy flowers and yellow or red fruits. This species also is used as a rootstock for grafting other *Malus* cultivars and is a possible genetic source of disease resistance and cold hardiness (Dickson 2014). It occasionally escapes cultivation and is known from the floras of a number of states (Yatskievych 2013; Dickson 2014), including Missouri and Tennessee, both of which border Arkansas. Although not currently documented from the state's flora, it potentially could be encountered as escaped.

Three species of *Malus* occur in the Arkansas flora; all but *M. pumila* are native. Species in the genus *Malus* morphologically are similar to, and often have been included within, the closely related genus *Pyrus*. *Malus* differs from *Pyrus* primarily on the basis of its fruits which lack brachysclereids (stone cells), the classic "grit" encountered in many pear fruits, generally pubescent leaves and winter buds, and by the hypanthium (united calyx) that is open and not enclosed about the styles of the pistils. In contrast, species of *Pyrus* generally have fruits with brachysclereids, have glabrous (or mostly so) leaves and buds, and a hypanthium that is enclosed around the styles in the flower.

Species of *Malus* have alternate, simple leaves and small, perfect (bisexual), often showy flowers with inferior ovaries arranged in simple (unbranched) umbellate or corymbose inflorescences. The flower buds of *Malus* species often are bright magenta-pink and contrast attractively with opened flowers that are white or pale pink. The fruit is a small to large, multi-seeded pome.

Malus pumila P. Mill.; Syn.: *Malus domestica* (Suckow) Borkh. (Fig. 92).



Malus pumila (common apple) is a small to medium-sized, deciduous tree to 15 m tall that is native to southern Europe and much of temperate Asia (Gu & Spongberg 2003c; Dickson 2014). In the USA, it is escaped or naturalized in many states (Kartesz 2015; Weakley 2020), including Arkansas, where it has been documented in the flora from nine scattered counties.

The fruits of *M. pumila* are eaten by a variety of bird and mammal species (Dickson 2014). Wild *M. pumila* plants generated from seeds often have fruits that are considerably smaller and more bitter or sour than cultivated plants (Hilty 2002; Dickson 2014).

This species is the apple of commerce, and an important food commodity that is grown in temperate regions worldwide. Frequent cultivation and use of *M. pumila* as a food source in the USA undoubtedly has contributed to its naturalization. Numerous horticultural varieties and forms exist (Krüssmann 1977; Griffiths 1992), and cultivation is both local and commercial. Mature fruits vary as to color (including green, yellow, pink, red, and two-toned forms), texture of flesh, and sugar content; these attributes ultimately affect usage. Fruits are eaten raw, used for baking, or in making preserves, applesauce, cider, and vinegar. ***Habitat***: disturbed sites and waste places, woodland edges, riparian zones, old fields, and roadsides.

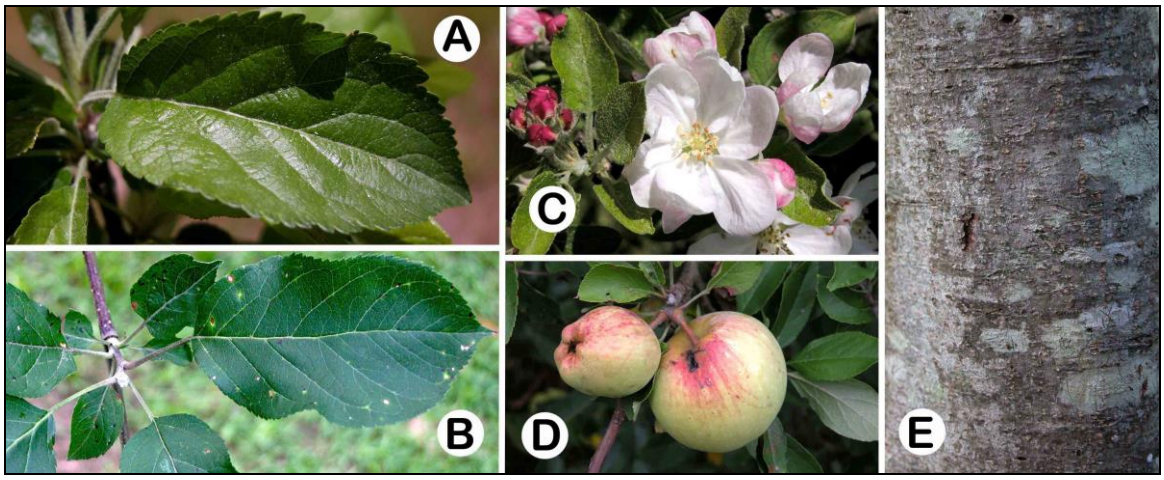


Figure 92. (A–E) *Malus pumila* plant and habit. (A–B) Leaves and stem. (C) Flowers. (D) Mature fruits. (E) Bark.

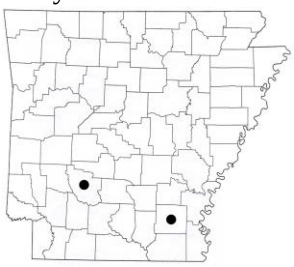
Malvaviscus, Wax Mallow, Malvaceae

Malvaviscus is a small genus of three species of herbs or shrubs that is native to warm-temperate and tropical regions of the Americas (Bailey & Bailey 1976; Krüssmann 1977). The fruit is unusual as a fleshy or papery, berry-like schizocarp.

Malvaviscus arboreus Dill. ex Cav. var. **drummondii** (Torr. ex Gray) Schery (Fig. 93).

Malvaviscus arboreus Dill. ex Cav. (wax mallow) is a small, evergreen shrub (semi-woody subshrub in Arkansas) to ca. 3 m tall that is native to Mexico and Texas, and naturalized in a few southeastern states (Bailey & Bailey 1976; Krüssmann 1977; Diggs et al. 1999; Weakley 2020). *Malvaviscus arboreus* currently is known from Clark and Drew counties in Arkansas, although it is

likely more common in the flora than records indicate (Serviss et al. 2017b). It prolifically self-seeds under the correct conditions and the fruits/seeds are eaten and readily dispersed by birds.



Malvaviscus arboreus is cultivated for its showy, red-colored flowers that attract hummingbirds and butterflies. The fruits also are ornamental at maturity, with a vibrant reddish-orange to deep red coloration; fruits are edible. Two botanical varieties of this species are recognized; however, only *Malvaviscus arboreus* var. *drummondii* is documented from Arkansas.

In subtropical and tropical regions, *M. arboreus* is a shrub; however, in Arkansas, where annual freezing temperatures are encountered, it occurs as a perennial subshrub that dies back to the crown during winter. *Malvaviscus arboreus* is tolerant of both sun and shade conditions, as well as moist or dry soils. ***Habitat***: disturbed areas and waste places, especially in the vicinity of where plants of the species are cultivated.

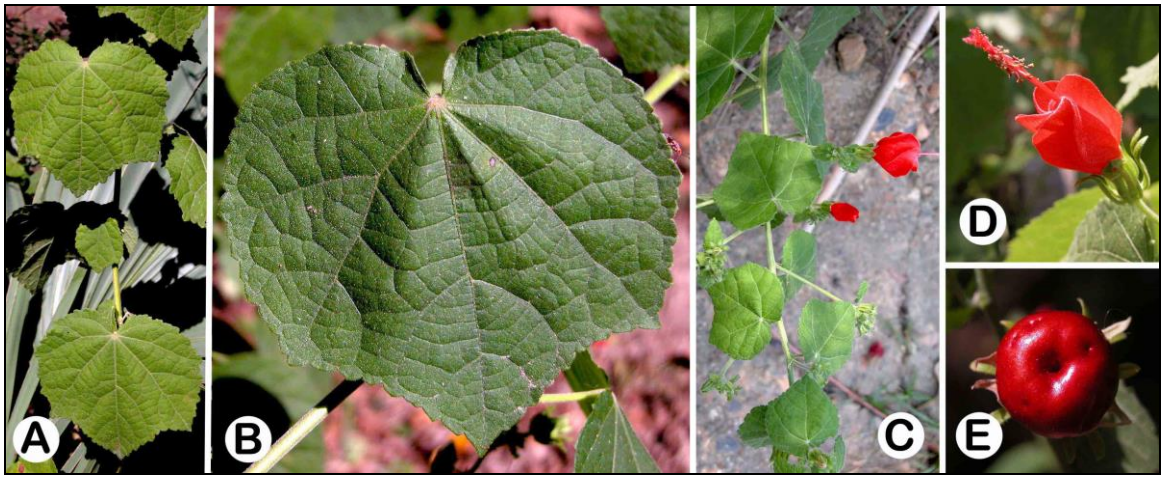


Figure 93. (A–E) *Malvaviscus arboreus* plant and habit. (A–B) Leaves and stem. (C–D) Flowers. (E) Mature fruit.

Manihot, Cassava, Euphorbiaceae

Manihot is a genus of about 100 species of herbs and evergreen shrubs and trees native to the Americas, mostly Brazil (Krüssmann 1977; Hayden 2016). *Manihot esculenta* is grown in tropical regions worldwide as a staple food crop for its starch-rich roots that yield tapioca and cassava starch (Hayden 2016). *Manihot grahamii*, the most cold-tolerant member of the genus, is cultivated in tropical and warm-temperate areas for its unusual foliage.

Manihot grahamii Hook. (Fig. 94).

Manihot grahamii (hardy tapioca, Graham's Cassava) is a shrub or small tree to 5 m tall, or sometimes more, that is native to South America (Hayden 2016). It is naturalized in several southeastern states (Hayden 2016; Weakley 2020), including Arkansas, where currently it is documented from Clark and Union counties.

This species is a prolific seed producer with explosively dehiscent capsules that can project seeds up to several meters from the parent plant. Spontaneous seedlings and juveniles often are observed in the vicinity of cultivated plants, and a single plant can readily give rise to an entire population via self-seeding. Removal of established plants appears to induce the germination of large numbers of its seeds from the soil seed bank, indicating that *M. grahamii* could be autoallelopathic.

As its namesake "hardy tapioca" implies, *M. grahamii* is considerably more cold-tolerant than other species in the genus, and in southern Arkansas is more or less hardy, eventually developing into a small, multi-stemmed tree. It is important to note, however, that prolonged temperatures below freezing can kill above ground portions of the plant. In more northern areas, cold winters cause the death of the stems, but plants re-sprout from the crown and grow quickly once warmer weather returns (Hayden 2016), sometimes reaching a height of up to 2.5 m by the end of the growing season. The flowers of *M. grahamii* are highly attractive to bees.

The large, deeply palmately lobed leaves with numerous, slender lobes easily distinguish *M. grahamii* from all other woody plants in the Arkansas flora. ***Habitat***: disturbed areas and waste places, especially in the vicinity of where plants of the species are cultivated.

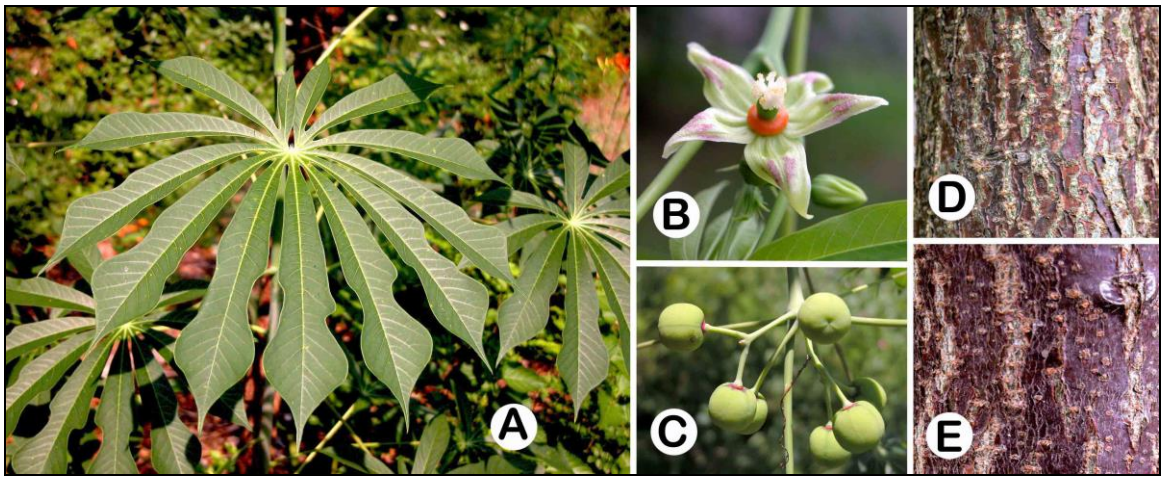
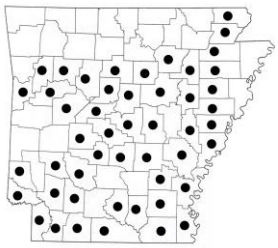


Figure 94. (A–E) *Manihot grahamii* plant and habit. (A) Leaves. (B) Pistillate flower. (C) Nearly mature fruits. (D–E) Bark.

Melia, Mahogany, Meliaceae

Melia is a small genus of three species of usually deciduous trees native to temperate and tropical Asia (Peng & Mabberley 2008).

Melia azedarach L. (Fig. 95).



Melia azedarach (Chinaberry, bead tree) is a medium-sized, deciduous (semi-evergreen in milder climates) tree to 20 m tall, or sometimes more, that is native and widespread in Asia (Krüssmann 1977; Peng & Mabberley 2008). It is well-established and invasive in the eastern USA, including Arkansas (Kartesz 2015; Weakley 2020). It is considered invasive in Arkansas (Gentry et al. 2013). *Melia azedarach* occurs in a variety of habitats, such as bottomlands, floodplain forests, riverbanks, riparian habitats, woodland edges, and fencerows, as well as highly disturbed sites. Because of its value as an ornamental, *M. azedarach* has been introduced in many warm-temperate to tropical regions of the world and is now widespread and naturalized in many of these areas (Peng & Mabberley 2008).

This species is cultivated for its "feathery-looking" foliage and attractive display of colorful, fragrant flowers. In its native China, it is important for timber and it commonly is used as a source of fuel in India (Peng & Mabberley 2008). Extracts from *M. azedarach* have antiviral activity and the seeds sometimes are used for rosary beads.

Melia azedarach is highly invasive, and seedlings often are observed in areas where reproductive age trees occur. It also reproduces asexually by means of aggressive suckering from the

roots. The fruits of *M. azedarach* are poisonous to mammals and humans, but are dispersed by birds, allowing long-distance dispersal and subsequent establishment of the species in remote areas.

In Arkansas, *M. azedarach* vegetatively resembles *Koelreuteria bipinnata* (Chinese flame tree); however, it can be distinguished from *K. bipinnata* by its smaller, coarsely toothed to shallowly lobed leaflets (occasionally some leaflets may be entire or nearly so), flowers with lilac petals and purple stamens and pistils, and drupaceous fruits. Contrastingly, *K. bipinnata* has mature leaves with larger leaflets that have entire or minutely toothed margins, flowers that are bright yellow with small but conspicuous orange scales at the base of the perianth, and fruits that are papery-inflated capsules. Juvenile stages of the two species are very similar and easily confused (compare Fig. 167F and Fig. 165H); however, juveniles of *M. azedarach* can be distinguished from those of *K. bipinnata* by comparison of the terminal and lateral leaflets of the pinnae. The terminal leaflets of the pinnae in *M. azedarach* are about the same size to only slightly larger than the lateral leaflets, whereas the terminal leaflets of the pinnae of *K. bipinnata* generally are much larger than the lateral leaflets. ***Habitat***: disturbed areas and waste places, roadsides, fencerows, woodland edges, floodplain forests, bottomlands, riverbanks, and riparian zones.

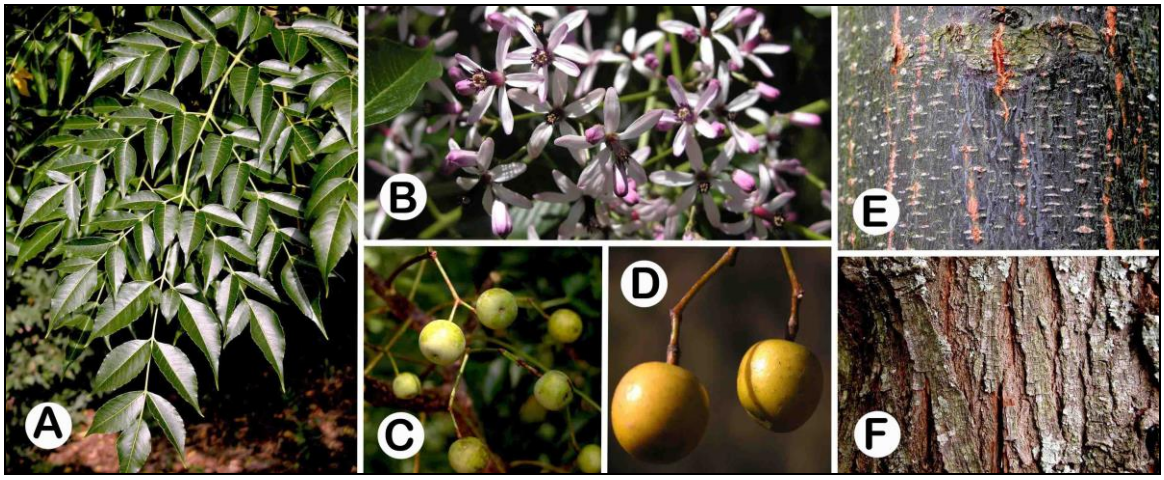


Figure 95. (A–F) *Melia azedarach* plant and habit. (A) Leaves. (B) Flowers. (C–D) Mature fruits. (E) Young bark. (F) Older bark.

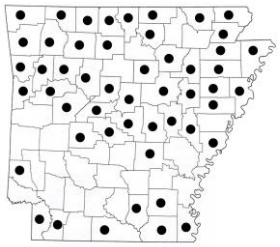
Morus, Mulberry, Moraceae

Morus is a genus of about 16 species of deciduous trees, distributed mostly in temperate regions of Asia, Europe, and North America (Wunderlin 1997c; Wu & Gilbert 2003c). Some species of *Morus* are cultivated for their edible fruits and for use as shade trees (Bailey & Bailey 1976; Wunderlin 1997c). The fruits can be eaten raw or used to make juices, jellies, and preserves, and are rich in a number of important compounds, including antioxidant polyphenols (Zhang et al. 2018). The leaves of a few species, such as *M. alba*, are used as a food source for silkworms, which are the source for commercial silk production (Wu & Gilbert 2003c). Two species of *Morus* occur in the Arkansas flora.

Species of *Morus* have alternate, simple, toothed, often lobed leaves (leaves may have one, two, or three lobes, or may be unlobed). Leaf morphology is highly variable, particularly in juvenile plants, where the number and shape of the lobes and overall shape of the leaf is often markedly different than that found in mature individuals. A characteristic white-milky sap is exuded when the foliage is damaged, which aids in distinguishing *Morus* and other Moraceous taxa, such as *Broussonetia papyrifera* and the native *Maclura pomifera*, form other woody plants in the flora.

Morus species are monoecious or dioecious with small, green or greenish-yellow, unisexual (staminate or pistillate) flowers. The fruit is a small, fleshy, white, red, or black syncarp (multiple fruit).

Morus alba L. (Fig. 96).



Morus alba (white mulberry) is a large shrub to medium-sized, deciduous tree to 15 m tall that is native to and widespread in Asia (Krüssmann 1977; Wunderlin 1997c; Wu & Gilbert 2003c). It is well-naturalized in much of the continental USA (Wunderlin 1997c; Kartesz 2015; Weakley 2020), including Arkansas, where it occurs mostly in the northern one-half of the state. It probably is more abundant in the state's flora than current records indicate, as it morphologically is similar to and easily confused with the native *M. rubra* (red mulberry). *Morus alba* generally is observed in disturbed areas, but also can occur in rocky soils, upland sites, pastures, and elsewhere; it often is weedy. A variety of bird and mammal species feed on the fruits, and the many-seeded syncarps of *Morus* species typically are bird-dispersed (Hunter 1995). In areas where it occurs, spontaneous juvenile plants of *M. alba* frequently are observed in areas where birds commonly roost.

This species originally was introduced into the USA in an attempt to establish a silkworm industry (Hilty 2002). The larvae of the silkworm moth (*Bombyx mori*), the species from which commercially valuable silk is produced, feed on the leaves.

In Arkansas, *M. alba* can be confused with *M. rubra* and *Broussonetia papyrifera* (paper mulberry). It can be distinguished from *B. papyrifera* by the absence of hirsute trichomes covering the stems and leaves (the foliage of *B. papyrifera* is densely hirsute-pubescent). *Morus alba* can be distinguished from *M. rubra* by its smaller, generally glabrous to mostly glabrous leaves (leaves are essentially glabrous, but the lower surface sometimes has trichomes present on the major veins or as tufts in the axils of major veins), whereas *M. rubra* has leaves that are larger, scabrous-pubescent on the upper surfaces, and scattered pubescence on the lower surface (sometimes the leaves of *M. alba* can be somewhat scabrous on the upper surfaces). Apparently, the two species sometimes hybridize when growing together, enhancing the difficulty of precise species identification (Wunderlin 1997c).

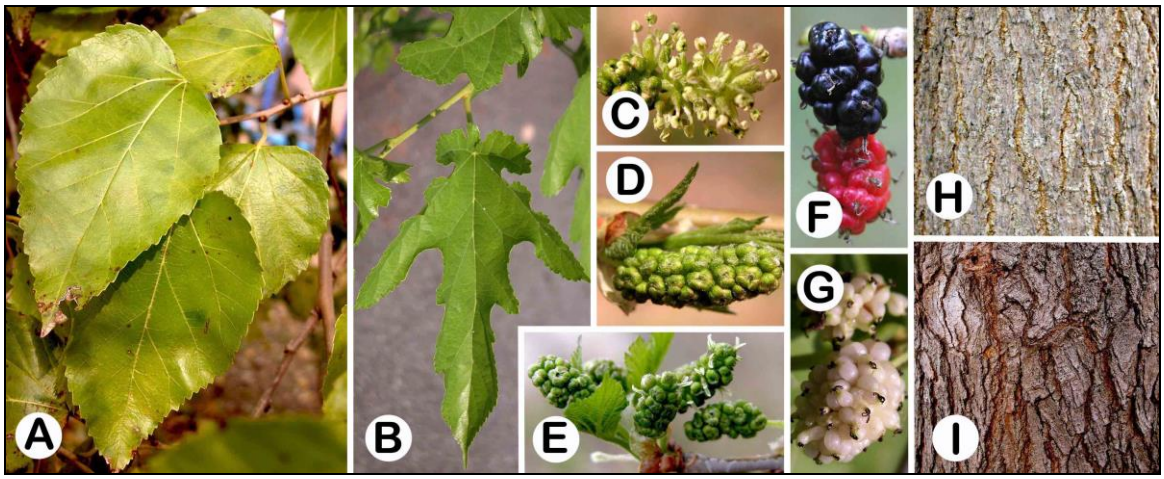


Figure 96. (A–I) *Morus alba* plant and habit. (A–B) Leaves (the amount and degree of lobing is highly variable, especially in juvenile plants). (C) Young staminate flowers and inflorescence. (D–E) Pistillate flowers and inflorescence. (F–G) Mature fruits (depending on form, mature fruit color can be black, pale pink, or white). (H) Young bark. (I) Older bark.

Habitat: disturbed areas and waste places, especially in urban environments where plants of the species are cultivated, open areas, fencerows, pastures, woodland edges, greenbelts, riparian zones, and roadsides.

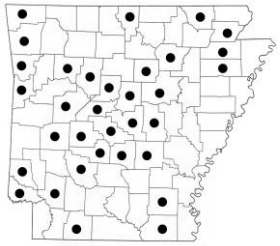
Two distinct varieties of white mulberry exist; both are naturalized in the flora. The two varieties can be distinguished using the following key.

1. Fruits greenish-white, white, or pale purple, cylindric in shape; leaves wide (to 30 cm), often unlobed ..... **Morus alba** var. **multicaulis**
1. Fruits red, turning to a dark blackish-purple when mature, ovoid to ellipsoid in shape; leaves more narrow (5–15 cm), often deeply lobed ..... **Morus alba** var. **alba**

Nandina, Family Berberidaceae

Nandina is a monotypic genus native to Asia (Whittemore et al. 1997; Ying et al. 2011b). The single species, *N. domestica*, is frequently grown in temperate regions for its ease of cultivation, ornamental foliage, and colorful fruits. Sometimes *Nandina* is placed in its own family, the Nandinaceae (Takhtajan 1986).

Nandina domestica Thunb. (Fig. 97).



Nandina domestica (nandina, heavenly bamboo) is a small, evergreen shrub to about 2.5 m tall that is native to China, India, and Japan (Whittemore et al. 1997; Ying et al. 2011b). *Nandina domestica* is well-naturalized over much of the southeastern USA (Whittemore et al. 1997; Weakley 2020), including Arkansas. In Arkansas (and elsewhere), it frequently is encountered invading into wooded, semi-wooded, and edge habitats, especially in areas that are adjacent to places where cultivated plants occur. Sometimes wild plants are observed far from areas of cultivation.

Nandina domestica is one of the most frequently cultivated shrubs in the southern USA, which provides a large source pool of propagules (seeds) for naturalization. Once established, it is drought-tolerant and able to compete with the root systems of large trees for available water (Bailey & Bailey 1976). It is extremely shade-tolerant and will reproduce successfully under shaded conditions. It also is flexible in regard to soil type and moisture regime. The seeds of *N. domestica* are bird-dispersed, and plants can reproduce at a relatively small size (as small as 0.5 m) and young age. Plants also readily form root suckers and regrow rapidly after being cut back, and plants are difficult to eradicate once established. The combination of these attributes facilitates its highly invasive character.

Nandina domestica is the only shrub in the Arkansas flora that has 2–4 times decompound leaves, with leaflets conspicuously arranged ternately (in groups of 3). The wood is bright lemon-yellow. Numerous horticultural forms of *N. domestica* exist, including dwarf varieties and forms with pale green, bronze-tinted, or variegated foliage (Bailey & Bailey 1976; Krüssmann 1977)). Variety

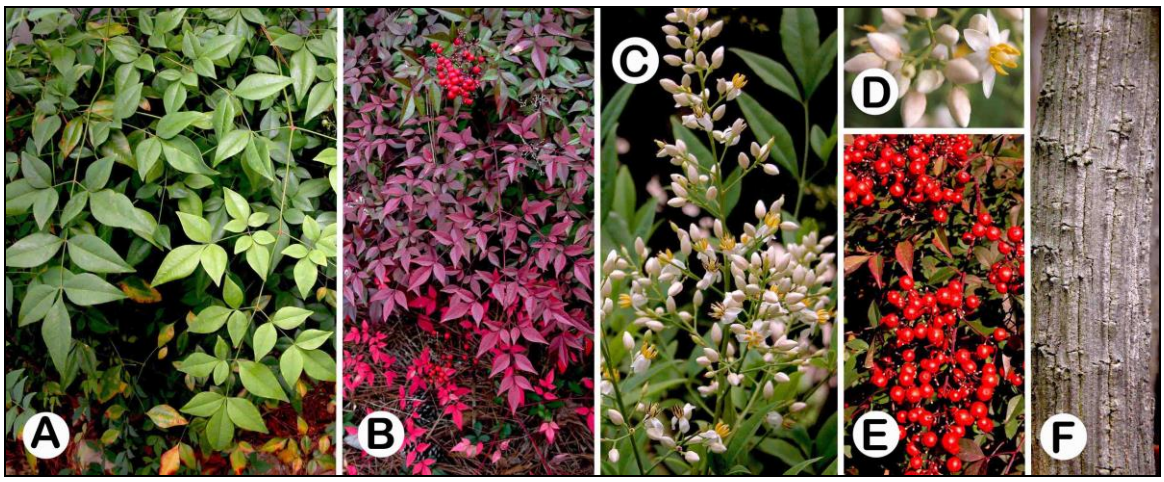


Figure 97. (A–F) *Nandina domestica* plant and habit. (A) Leaves. (B) Plant with autumn color. (C–D) Flowers and inflorescence. (E) Mature fruits. (F) Bark.

leucocarpa has off white to pale yellow fruits and light green foliage and is occasionally encountered outside of cultivation in the state. ***Habitat***: disturbed sites, urban woods and greenbelts, bottomlands, floodplain forests, river terraces, stream sides, riparian zones, thickets, fencerows, pastures, and roadsides.

Nerium, Oleander, Apocynaceae

Nerium is a small genus of evergreen shrubs distributed over the Mediterranean region, Asia, and Japan (Krüssmann 1977; Li et al. 1995a). One species, *N. oleander*, frequently is cultivated in subtropical and tropical regions for its showy and profuse display of flowers and drought tolerance.

Nerium oleander L. (Fig. 98).

Nerium oleander (oleander) is a large, evergreen shrub or small tree to 6 m tall that is native to Asia the Mediterranean region (Krüssmann 1977; Griffiths 1992; Li et al. 1995a). It has been documented escaped in Arkansas from Pulaski County (Peck 2003; Peck & Serviss 2016). It is naturalized in several Gulf-coastal states, from Texas to Florida, including northern Louisiana (Thomas & Allen 1996; Hrusa et al. 2002; Wunderlin & Hansen 2011; Kartesz 2015; Weakley 2020). *Nerium oleander* should be expected outside of cultivation elsewhere in Arkansas, especially in the southern portion of the state.

Although currently not well-established outside of cultivation in Arkansas, *N. oleander* is a species that deserves special attention, as all portions of the plant are extremely poisonous to humans and domestic animals. Toxicity is owed to a series of glycosidic cardenolides of various toxicities (Burrows & Tyrl 2001). Poisoning is via ingestion and some symptoms include depression, excess salivation, nausea, vomiting, stomach pain, diarrhea, slowed pulse, irregular heartbeat, dizziness, and in some cases, death (Burrows & Tyrl 2001). Contact with the sap causes skin irritation in some people. Inhalation of smoke from burning the plant also may cause poisoning.

Although *N. oleander* is not particularly cold-tolerant (hardy to zone 8), in southern Arkansas plants are hardy above ground at least during some winters, with some varieties hardy enough to persist even through colder winters when temperatures fall well below freezing. This has been observed in Cark County, where shrubs of oleander have persisted for many consecutive years without death of the larger stems. *Nerium oleander* is highly tolerant of heat and drought once established.

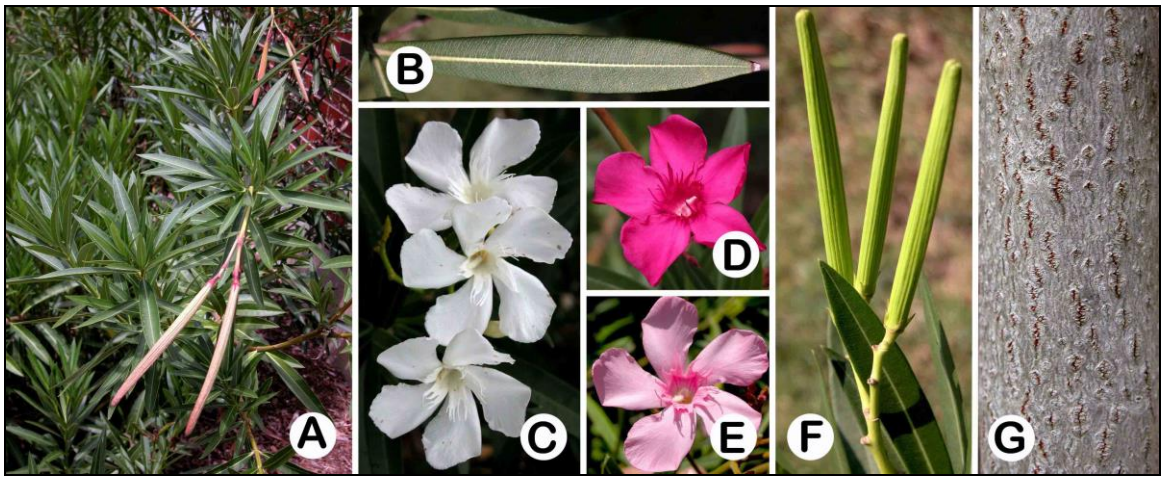


Figure 98. (A–G) *Nerium oleander* plant and habit. (A) Plant. (B) Leaf. (C–E) Flowers. (F) Mature fruits. (G) Bark.

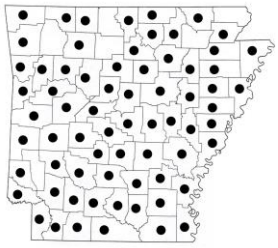
In Arkansas, *N. oleander* may be distinguished from other shrubs by the combination of its verticillate, thick-leathery, linear-lanceolate to oblong-lanceolate leaves, bright white, pink, or magenta-colored flowers, and elongate, cylindrical, striate fruits with pubescent seeds. Accurate identification of this species is critical, as only small amounts of it, if ingested, may be fatal. ***Habitat***: disturbed sites and waste places, open woods, woodland edges, and roadsides, especially on open, sandy, or well-drained sites.

Paulownia, Princess Tree, Paulowniaceae (formerly Scrophulariaceae)

Paulownia is a small genus of about seven species of deciduous trees distributed across warm-temperate Asia (Krüssmann 1977; Hong et al. 1998).

Paulownia tomentosa (Thunb.) Sieb. and Zucc. ex Steud. (Fig. 99).

Paulownia tomentosa (princess tree, royal paulownia) is a medium-sized to large, deciduous tree to 20 m tall that is native to China (Krüssmann 1977; Hong et al. 1998) It is cultivated and well-naturalized in the eastern USA (Kartesz 2015; Weakley 2020), including Arkansas, where it has been recorded from most counties.



This species is cultivated mostly for ornamental purposes for its showy, fragrant flowers, unusual inflorescences, and large leaves (Bailey & Bailey 1976; Krüssmann 1977; Yatskievych 2013). It also is used as a shade tree and the wood is used to make cabinets and a variety of other items (Bailey & Bailey 1976; Yatskievych 2013).

Paulownia tomentosa prefers well-drained and rocky soils, particularly in upland or hilly habitats. It prolifically self-seeds, producing thousands of seeds or more on a large plant, and it is common to observe spontaneous seedlings in the vicinity of reproductive age plants. The seeds are small and winged, and easily dispersed long distances by wind or water. Under the correct conditions, *P. tomentosa* is weedy and invasive.

Paulownia tomentosa has one of the fastest growth rates (during juvenility) of any tree in the flora — it can grow to three meters tall (or sometimes more) in a single growing season. The leaves of juvenile plants also sometimes are two to three times larger than that of mature trees, giving young trees a "tropical look" to their foliage. When in flower, *P. tomentosa* is one of the most attractive and

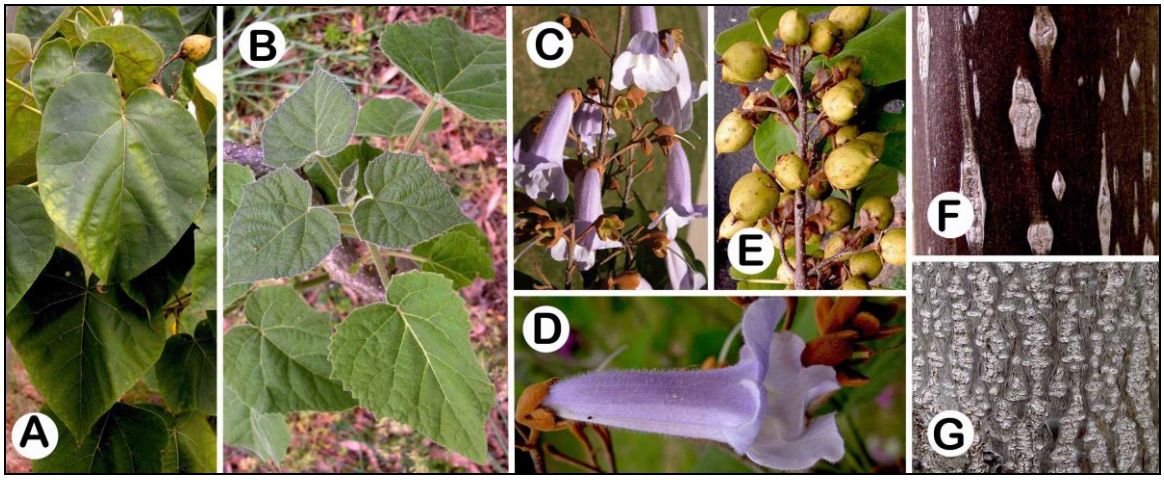


Figure 99. (A–G) *Paulownia tomentosa* plant and habit. (A–B) Leaves (Fig. B shows leaves of a juvenile plant that are coarsely toothed; the teeth become less prominent to absent on mature foliage). (C–D) Flowers. (E) Mature fruits and infructescence. (F) Young bark. (G) Older bark.

distinctive ornamental trees. Purple or lilac-colored flowers are typical; however, forms with nearly white flowers sometimes are encountered.

Morphologically, it closely resembles the Arkansas species of *Catalpa* (*C. bignonioides* and *C. speciosa*); however, it easily can be distinguished from them by the dense, stellate-tomentose pubescence covering leaves, young stems, and flowers, short conical fruits that are about as long as wide, generally opposite leaves, and pale gray or grayish-tan bark. In contrast, *Catalpa* species, though pubescent, are not densely stellate-tomentose, have glabrous flowers, fruits that are linear and many times longer than wide, generally verticillate leaves, and brown to gray-brown bark. ***Habitat***: upland and hilly areas, open woods, woodland edges, riparian zones and along mountain streams, roadsides, fencerows, and disturbed areas, especially in the vicinity of where cultivated plants are present.

Philadelphus, Mock Orange, Hydrangeaceae

Philadelphus is a genus of about 65–70 species of deciduous or rarely evergreen shrubs and lianas that are distributed mostly across temperate regions of the northern hemisphere (Weakley & Henrickson 2016). Currently, three species of *Philadelphus* occur in the Arkansas flora; with two native and one, *P. inodorus*, apparently introduced. *Philadelphus coronarius*, which is native to Eurasia, sometimes is cultivated and while currently not documented from the state's flora, should be expected outside of cultivation. Many species are important as ornamentals in temperate climates for their profuse display of flowers in spring.

Species of *Philadelphus* have opposite, simple leaves with toothed or entire margins (sometimes both on the same plant). Flowers are perfect (bisexual), sometimes fragrant, with four, large, white to cream-colored petals and pale to bright yellow or orange stamens and pistils. Flowers are produced mostly in few-flowered cymose, racemose, or paniculate inflorescences. The fruit is a small many-seeded capsule.

Philadelphus morphologically is similar to the closely allied genus *Deutzia*, represented in Arkansas by *Deutzia scabra*. However, Arkansas species of *Philadelphus* may be distinguished from *D. scabra* by their flowers with four petals and foliage that lacks stellate (star-shaped) trichomes (*D. scabra* has flowers with five petals and stellate-pubescent leaves and stems).

Philadelphus coronarius L. (Fig. 100).

Philadelphus coronarius (sweet mock orange, European mock orange, English dogwood) is a multi-stemmed, deciduous shrub to 4 m tall that is native to Europe and southwestern Asia (Krüssmann 1977; Weakley & Henrickson 2016). While not currently documented outside of cultivation in the state, it should be expected in the flora. It is known from the floras of several states in the eastern USA, from Missouri and Minnesota eastward to Maine, Virginia, and Georgia (Yatskievych 2013; Kartesz 2015; Weakley & Henrickson 2016; Weakley 2020).

This species is cultivated for its showy, fragrant flowers. *Philadelphus coronarius* plants spread vegetatively via air-layering, where stems root and form new plants when in contact with soil.

In Arkansas, the combination of opposite leaves, reddish-brown arching stems, exfoliating bark, large flowers with contrasting white to cream-colored petals and numerous, yellow to orange stamens aid in distinguishing *P. coronarius* from most other shrubs in the flora. However, in addition to *Deutzia scabra* (discussed above), *P. coronarius* closely resembles the three species of *Philadelphus* currently known from the state: *P. hirsutus* (hairy mock orange), *P. inodorus* (Appalachian mock orange), and *P. pubescens* (Ozark mock orange). The combination of the axillary buds obscured by pouches (enclosures of epidermal and cortical tissue at the base of the petioles) and pistils with four styles distinguish it from the other *Philadelphus* species, with the exception of *P. inodorus*. *Philadelphus coronarius* may be distinguished from *P. inodorus* by its racemes generally with 5–7 flowers and flowers with 20–50 stamens (*P. inodorus* has few-flowered cymes, generally with 1–3 flowers and flowers with 60–90 stamens). ***Habitat***: disturbed sites and waste places, woodland edges, thickets, riparian zones, and roadsides.

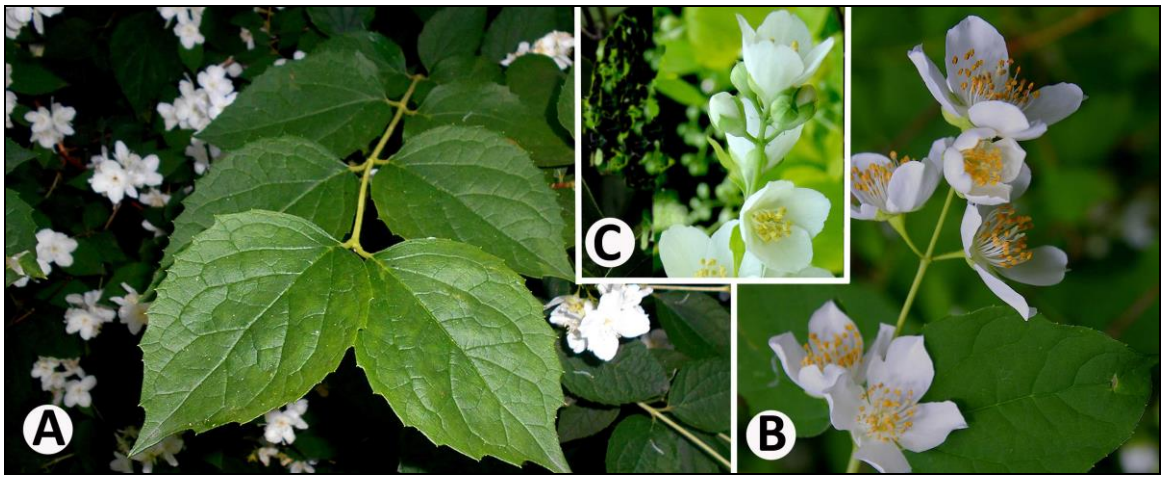
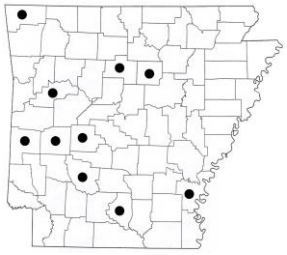


Figure 100. (A–C) *Philadelphus coronarius* plant and habit. (A) Leaves (can be toothed or entire). (B–C) Flowers and inflorescence (notice the inflorescence is a raceme and the flowers have less than 60 stamens). Photo credits: A: Salicyna; B: Dan Mullen; C: Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo.

Philadelphus inodorus L. (Fig. 101).



Philadelphus inodorus (Appalachian mock orange; scentless mock orange) is a multi-stemmed, deciduous shrub to about 4 m tall (Weakley & Henrickson 2016). It is native to the USA, east of Arkansas (Weakley & Henrickson 2016; Ogle et al. 2020); however, is naturalized in the state in scattered counties mostly in the Ouachita and Ozark mountain regions.

As with other *Philadelphus* species, *P. inodorus* readily spreads vegetatively via air-layering of stems and asexual colonies of plants sometimes are produced. This characteristic also allows for easy propagation, and when combined with the attractive flowers and relative ease of cultivation, makes *Philadelphus* species desirable as ornamentals. *Philadelphus inodorus* is tolerant of a wide range of soil moisture regimes, and thus can occur in a wide range of habitat types that vary considerably in their moisture regimes.

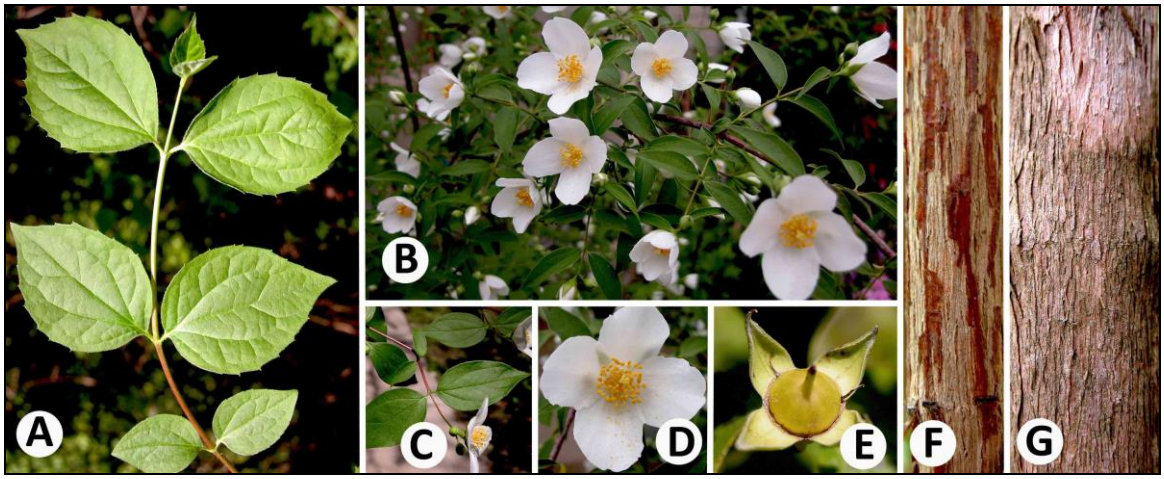


Figure 101. (A–G) *Philadelphus inodorus* plant and habit. (A, C) Leaves (notice some of the leaves in Fig. A are toothed, whereas the lower ones, along with the leaves in Fig. C, have entire to mostly entire margins — the degree of teeth on the leaves is variable). (B, D) Flowers. (E) Mature fruit. (F) Young bark (notice the contrasting pattern of rusty-brown and beige coloration). (G) Older bark.

In Arkansas, the few-flowered, cymose inflorescences of 1–3(–9) flowers and flowers with 60–90 stamens distinguish it from the two native species, *P. hirsutus* and *P. pubescens*. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, slopes, riparian zones, and streambeds.

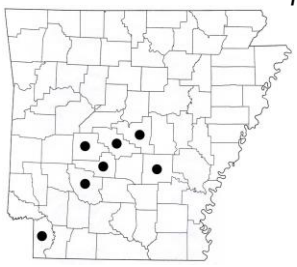
Photinia, Chokeberry or Photina, Rosaceae

Photinia is a genus of about 60 species of evergreen or deciduous shrubs and small trees distributed over Asia and North America (Lu & Spongberg 2003; Nesom 2014b). A few of the Asiatic evergreen species are important ornamentals in the horticultural trade, and as a result, were introduced into the USA for such purpose.

One of these species, *P. serratifolia*, has become well-naturalized in the flora, including Arkansas, and is invasive. Arkansas has two native species of *Photinia* (these sometimes are placed within the genus *Aronia*), which are small, deciduous, colonial shrubs with small, rounded to elliptic leaves. As a result of these traits, the native species easily are distinguished from the nonnative *P. serratifolia*. The wood of *Photinia* species is hard and durable and is sometimes used for furniture and to produce various types of wooden artifacts (Nesom 2014).

Species of *Photinia* have alternate, simple leaves and small, perfect (bisexual), white, pink, or cream-colored, often malodorous flowers arranged in compact, many-flowered umbellate or corymbose inflorescences. The fruit is a small red, blue, or black-colored pome.

Photinia serratifolia (Desf.) Kalkm.; Syn.: *P. serrulata* Lindl. (Fig. 102).



Photinia serratifolia (Chinese photina, Taiwanese redtip) is a large, evergreen shrub or a small tree to about 12 m tall that is native to China (Lu & Spongberg 2003; Nesom 2014b). It commonly is cultivated, and is naturalized in a few southeastern states, in addition to Arkansas, where it has been documented from several counties. This species is invasive into a wide range of habitats, including dry upland sites, mesic habitats, and disturbed areas. It also tolerates a wide range of soil types and light regimes, including high shade conditions. It is likely more abundant in the flora than current records indicate.

Photinia serratifolia is an important and staple ornamental for use as an accent specimen or hedge, and/or for its attractive spring foliage that is reddish-orange to orange in color and large, showy displays of flowers and colorful fruits. In cultivation, it commonly is confused with another introduced and frequently cultivated species of *Photinia*, *P. glabra* (Japanese photina, Japanese redtip). *Photinia serratifolia* can be distinguished from *P. glabra* by its petioles that are 2–4 cm long and pubescent on the upper surface (the petioles of *P. glabra* are 1.5 cm or less long and glabrous). *Photinia × fraseri* is an interspecific hybrid between *P. glabra* and *P. serratifolia* that is frequent in cultivation. It is more or less intermediate in form between the parental species. It has petioles that are pubescent (at least when young) and 1–1.5(–2.3) cm long.

Juvenile plants of *P. serratifolia* have coarsely toothed leaves; the teeth bearing small, stiff, bristle-like spines. Mature foliage leaves also are coarsely serrate, but the teeth generally are much smaller and not always spine-tipped, giving the plant a markedly different appearance from the juvenile stage. Juvenile leaves also can range in shape from obovate or elliptic to oblong, whereas mature leaves are essentially oblong. At least one form of *P. serratifolia* has short, obovate leaves.

In Arkansas, *P. serratifolia* vegetatively is similar to *Prunus caroliniana* (Carolina laurel cherry), especially when comparing juvenile phases of the two species (compare Fig. 167K with Fig. 168C). *Photinia serratifolia* can be distinguished from *P. caroliniana*, however, by its larger, more elongate, more coriaceous leaves that have numerous, closely spaced, usually spinose teeth. In contrast, the leaves of *P. caroliniana* are smaller and more membranous, with generally only a few, widely spaced teeth, or with entire margins. ***Habitat***: disturbed areas and waste places, urban woods, woodland edges, slopes and bluffs, riparian zones, often encountered as a component of the understory in disturbed woods or wooded areas in proximity to where it is cultivated.

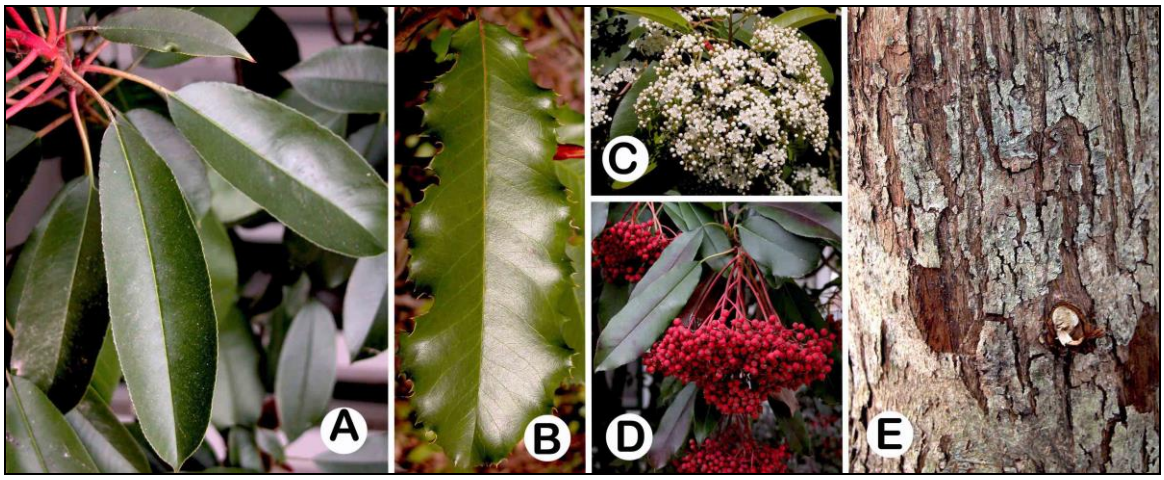


Figure 102. (A–E) *Photinia serratifolia* plant and habit. (A–B) Leaves (notice the leaf in Fig. B has teeth with prominent spinose tips). (C) Flowers and inflorescence. (D) Mature fruits and infructescence. (E) Bark.

Pinus, Pine, Pinaceae

Pinus is a north-temperate genus of about 100 species of aromatic, evergreen shrubs and trees (Kral 1993). Six species of *Pinus* currently are known from the Arkansas flora. *Pinus taeda* and *P. echinata* are native and widespread in the state. *Pinus glabra* is known from a single population in Dallas County (Ogle et al. 2020). *Pinus palustris*, *P. strobus*, and *P. virginiana* all are introduced, although native elsewhere in the USA. *Pinus* species are economically important for wood and paper production, and also many species are sold and cultivated for ornamental purposes. Some species also are used in erosion control or as Christmas trees, windbreaks, and wildlife habitat (Yatskievych 1999).

Species of *Pinus* produce two types of shoots: typical long shoots/branches and short, determinate branches or fascicles that contain spirally arranged foliage leaves (needles) surrounded by a basal covering of scale-like, nonphotosynthetic leaves. *Pinus* are monoecious, producing both microsporangiate and megasporangiate or ovulate strobili on the same plant. Based on its leaves, cones, and growth form, *Pinus* easily is distinguished from all other woody general in Arkansas.

Pinus palustris Mill (Fig. 103).

Pinus palustris (longleaf pine) is a large tree to 47 m tall that is native to the southeastern USA (Kral 1993). It is known only from Union County in Arkansas, based on two specimens collected in the 1980s and 2000s (Serviss & Peck 2013). The Arkansas plants likely occurred as escapes from planted trees. Shepherd and Amason first documented this species from Arkansas in Union County in 1983 (Serviss & Peck 2013). It subsequently was rediscovered in Union County (from a different location than the Shepherd and Amason record) by Peck in 2013 (Serviss & Peck 2013). Whether or not it is native or introduced to Arkansas is uncertain.

In addition to North America, *P. palustris* sometimes is cultivated in Europe, where it is referred to as pitch pine (Krüssmann 1983). *Pinus palustris* is a fire successional species, with a deep taproot and a definite grass stage (Kral 1993). It is a valued for lumber and pulpwood production and was once important for naval stores as a source of turpentine, pine oil, tar, and pitch (Bailey & Bailey 1976; Kral 1993). ***Habitat***: sandy, dry soils of upland sites, sandhills, flatwoods, and roadsides.

In Arkansas, the long needles (20–45 cm — usually two per fascicle) of *P. palustris* clearly distinguish it from other *Pinus* species. *Pinus taeda* (loblolly pine) can have needles up to 23 cm long (generally only 12–18 cm), but typically has three needles per fascicle.

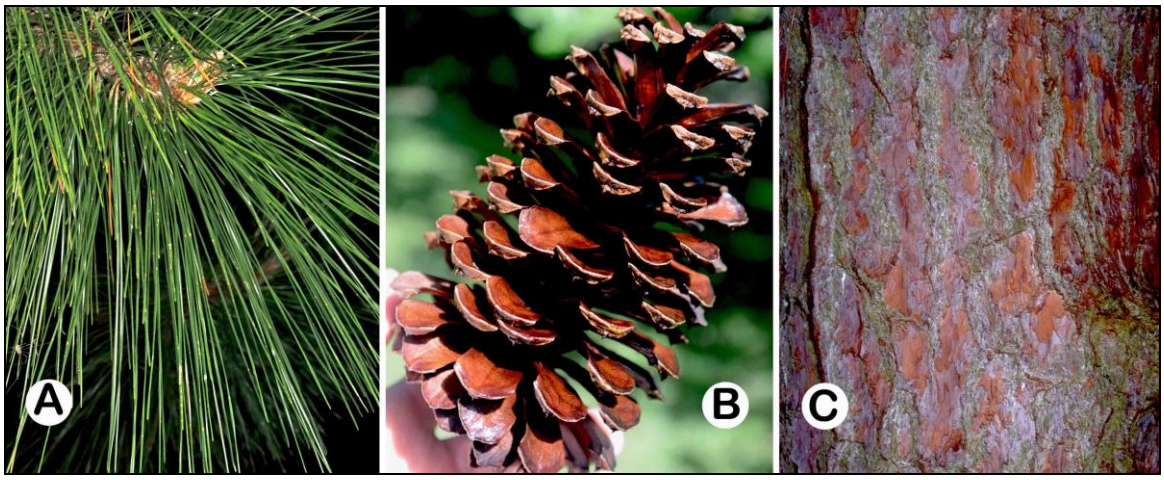
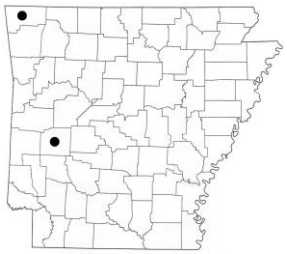


Figure 103. (A–C) *Pinus palustris* plant and habit. (A) Leaves and fascicles. (B) Mature ovulate cone. (C) Bark. Photo credit: John Seiler, Virginia Tech University.

Pinus strobus L. (Fig. 104).

Pinus strobus (eastern white pine, northern white pine) is a large tree to 67 m tall that is native to much of the northern and eastern USA (Kral 1993). It is naturalized in Benton and Montgomery counties in Arkansas.



This species is an important timber tree; however, because of extensive logging few uncut stands of it remain (Kral 1993). It was once prized as a source for ship masts, and large tracts of it were reserved for the Royal Navy during colonial times (Kral 1993). It also is planted for wildlife use, as a windbreak, and for ornamental purposes (Yatskievych 1999).

In Arkansas, the combination of five needles per fascicle and whitish-green stomatal grooves on the upper surface of the needles clearly distinguish *P. strobus* from other *Pinus* species. ***Habitat***: upland woods, fields, and roadsides of dry and mesic sites.

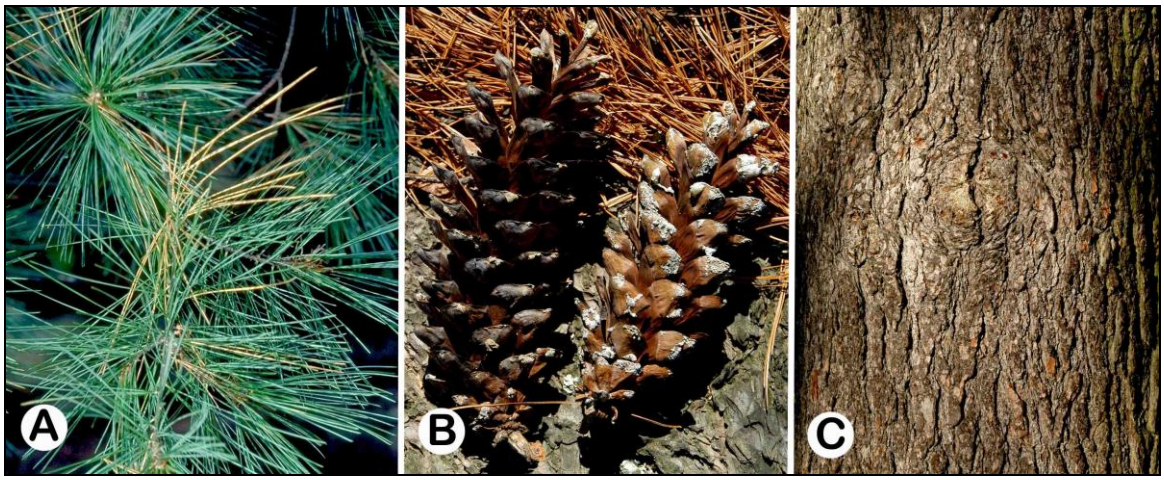
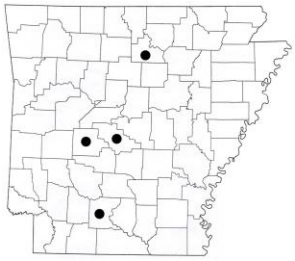


Figure 104. (A–C) *Pinus strobus* plant and habit. (A) Leaves and fascicles (the whitish-green lines on the upper surfaces of the needles are somewhat noticeable on the needles in the lower-right portion). (B) Mature ovulate cones. (C) Bark. Photo credit: John Seiler, Virginia Tech University.

Pinus virginiana Mill. (Fig. 105).



Pinus virginiana (Virginia pine, scrub pine) is a small to medium-sized tree to 18 m tall that is native to the eastern USA (Kral 1993). It is naturalized in Arkansas and occurs in a few, scattered counties. Although it can be weedy, and will establish naturalized populations, most occurrences of naturalized *P. virginiana* in Arkansas probably originated from cultivated plants (Kral 1993; Ogle et al. 2020).

Pinus virginiana sometimes is used as a source of pulp for paper production and grown for wildlife use, as a windbreak, or ornamental purposes (Kral 1993; Yatskievych 1999). This species grows well on barren, poor nutrient soils (Bailey & Bailey 1976; Kral 1993).

The strongly twisted, 2–8–centimeter long needles of *P. virginiana* clearly distinguish it from other Arkansas species of *Pinus*. ***Habitat***: dry, well-drained sites of disturbed areas, uplands, fields, and roadsides.

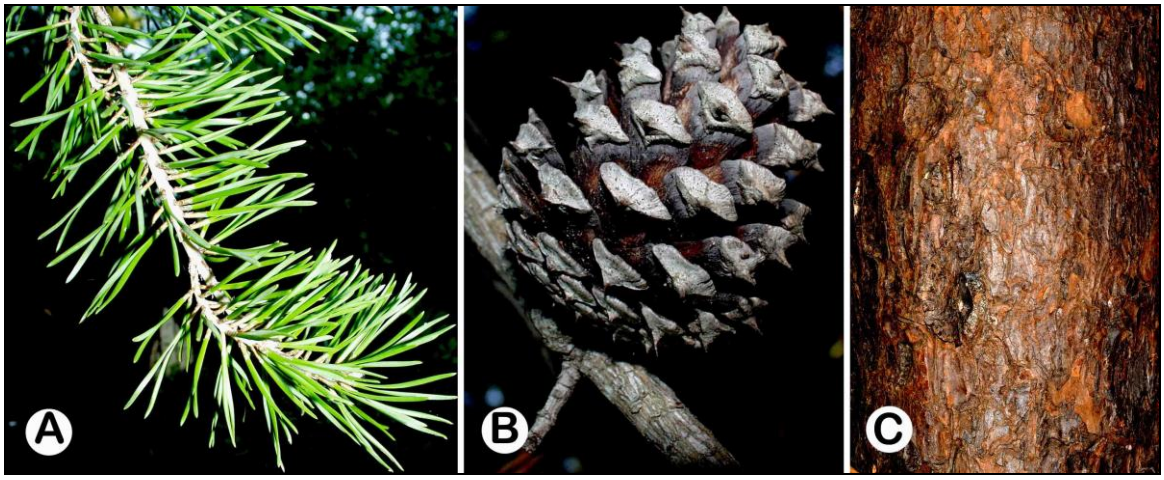
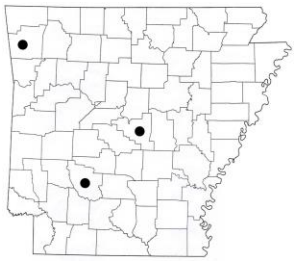


Figure 105. (A–C) *Pinus virginiana* plant and habit. (A) Leaves and fascicles (notice the prominent twisting of the needles). (B) Mature ovulate cone. (C) Bark. Photo credit: John Seiler, Virginia Tech University.

Pistacia, Pistachio, Anacardiaceae

Pistacia is a small genus of about 10 species of deciduous shrubs and trees native to the Mediterranean, East Asia, and the Americas (Bailey & Bailey 1976; Krüssmann 1977; Min & Barfod 2008). The genus includes the pistachio of commerce, *P. vera*, which is grown in warm regions for its high-quality, flavorful seeds or "pistachio nuts."

Pistacia chinensis Bunge (Fig. 106).



Pistacia chinensis (Chinese pistachio) is a medium-sized, deciduous tree to 20 m tall that is native to China, Taiwan, and the Philippines (Krüssmann 1977; Min & Barfod 2008). It has been documented outside of cultivation in Arkansas from Clark, Pulaski, and Washington counties (Peck & Serviss 2011; Serviss & Serviss 2020a). Although currently uncommon in Arkansas, *P. chinensis* is naturalized in several western states, including Oklahoma and Texas, and should be expected elsewhere in the state (Krings 2011; Kartesz 2015; Invaders of Texas/Texas Invasives 2020; USDA, NRCS 2021).

This species mostly is used as an ornamental for its showy fruits, colorful autumn foliage (yellow, orange or scarlet), and drought tolerance. In its native Asia, the wood is used in furniture making and to produce a yellow-colored dye (Min & Barfod 2008).

The foliage of *P. chinensis* is strongly aromatic when bruised or damaged, similar to that of the native *Cotinus obovatus* (American smoketree) giving a characteristic "anacardiaceous" odor. *Pistacia chinensis* is highly drought-tolerant once established. Its seeds are bird-dispersed. ***Habitat***: disturbed areas and waste places, woodland edges, urban greenbelts, and roadsides.

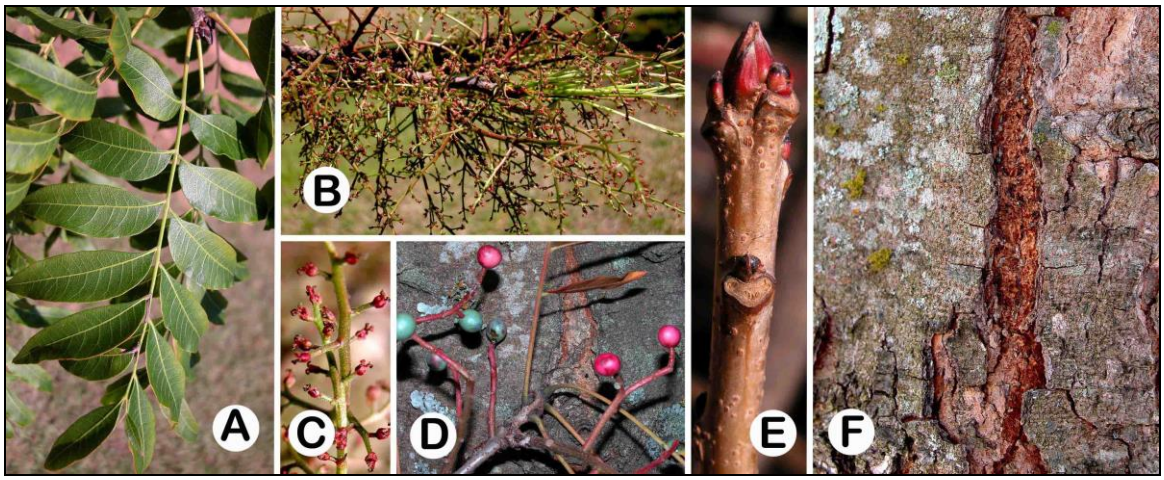


Figure 106. (A–F) *Pistacia chinensis* plant and habit. (A) Leaves and leaflets. (B–C) Flowers and inflorescence. (D) Fruits. (E) Twig showing prominent buds. (F) Bark.

Morphologically, *P. chinensis* closely resembles several other species of woody angiosperms in the Arkansas flora, including *Ailanthus altissima* (tree-of-heaven), *Sapindus drummondii* (western soapberry), and the three arborescent species of *Rhus*: *R. copallinum* (winged sumac), *R. glabra* (smooth sumac), and *R. typhina* (staghorn sumac) — see subsequent key for distinguishing characteristics between these species. Juvenile stages of *P. chinensis* (Fig. 167L), *R. copallinum*, and *S. drummondii* can be particularly difficult to distinguish. In the juvenile stage, *Pistacia chinensis* can be distinguished from *S. drummondii* by its anacardiaceous odor (*S. drummondii* lacks this odor) and from *R. copallinum* by the presence of terminal buds, and on somewhat older individuals, a combination of parapinnate and imparapinnate leaves (*R. copallinum* lacks terminal buds and has mostly to exclusively imparapinnate leaves).

1. Leaflets entire except for a few large teeth at the base, each tooth on its abaxial surface with a large, plate-shaped gland at the apex; fruit a samara .....**Ailanthus altissima**
1. Leaflets entire or toothed, but if toothed, teeth lacking a large, plate-shaped gland at the apex; fruit a drupe.

    2. Rachis of leaf prominently winged ..... **Rhus copallinum**
    2. Rachis of leaf without wings or wings very narrow and obscure (sometimes present in *Sapindus* or in juvenile plants of *Pistacia*).

        3. Leaflets entire (*Sapindus* occasionally with a few toothed leaflets).

            4. Foliage strongly (anacardiaceous) aromatic, adaxial surfaces of leaflets semi-glossy; twigs with a large, brownish-black or sometimes red, conical-shaped terminal bud; flowers red to reddish-green; drupes red at maturity, eventually turning dark blue, not translucent .....**Pistacia chinensis**
            4. Foliage without strong, aromatic odor, adaxial surfaces of leaflets dull; twigs without a terminal bud; flowers yellowish-white; drupes golden-yellow and translucent at maturity ..... **Sapindus drummondii**

3. Leaflets prominently toothed.

5. Stems, rachis, and abaxial surfaces of leaflets glabrous or nearly so..... **Rhus glabra**
5. Stems, rachis, and abaxial surfaces of leaflets densely velutinous-pubescent ..... **Rhus typhina**

Podocarpus, Podocarp, Podocarpaceae

Podocarpus is a genus of about 100 species of dioecious or rarely monoecious, evergreen shrubs and trees widely distributed over subtropical and tropical regions worldwide, with a few species also occurring in warm-temperate zones (Bailey & Bailey 1976; Krüssmann 1977; Fu et al. 1999; Byng 2015). A number of *Podocarpus* species are cultivated; however, relatively few are cold–hardy, which limits their use as ornamentals in much of the USA (Bailey & Bailey 1976; Krüssmann 1976).

Species of *Podocarpus* are characterized by their alternate, spirally arranged or sometimes subopposite to opposite, usually linear-lanceolate or linear-elliptic, simple leaves, typically solitary ovulate cones, which often have the basal bracts fused to form a "receptacle" that becomes swollen, fleshy, and brightly colored at maturity, and seeds that are enclosed in an epimatium that sometimes is fleshy.

Podocarpus macrophyllus (Thunb.) Sweet (Fig. 107).

Podocarpus macrophyllus (big–leaf podocarp, yew plum pine) is a large, evergreen shrub or occasionally (in Arkansas) a small tree to 20 m tall that is native to China and Japan (Bailey & Bailey 1976; Krüssmann 1976; Fu et al. 1999). This species is rare in the USA flora and only has been documented outside of cultivation from a few southeastern states (Alabama and Florida), in addition to Arkansas, where it is known only from Clark County (Wunderlin & Hansen 2011; Barger et al. 2012; Kartesz 2015; Serviss et al. 2016b; Weakley 2020; USDA, NRCS 2021).

Podocarpus macrophyllus is grown in the southern USA, including Arkansas, as an ornamental for its glossy, tightly-clustered, evergreen foliage, conspicuous blue to blue-green-colored ovulate cones that at maturity become red to purplish-red in color with a purplish-black–colored seed at the apex, attractive growth form, and ease of cultivation. It prefers well-drained, acidic soil in full sun to partial shade, but it also is tolerant of high shade conditions.

The fleshy, fruit-like megasporangiate cones, including the seeds, probably are attractive to birds. The seeds of *Podocarpus* species, in general, are animal-dispersed (Buchholz & Gray 1948;

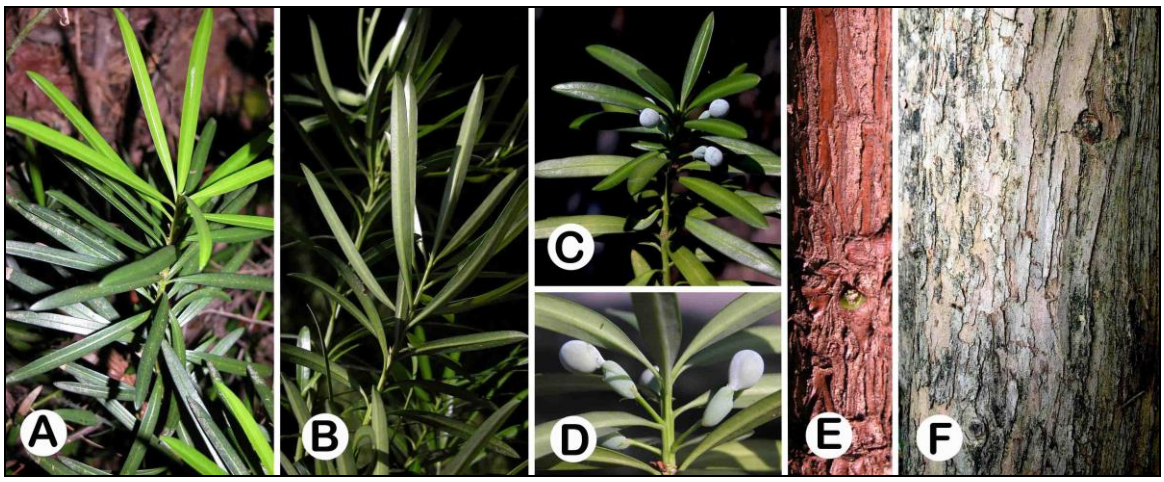


Figure 107. (A–F) *Podocarpus macrophyllus* plant and habit. (A–B) Leaves and stem. (C–D) Mature seeds with sarcotestas. (E) Young bark. (F) Older bark.

Givnish 1980; Geldenhuys 1993).

The combination of flattened, linear-lanceolate to linear-elliptic, spirally arranged leaves, horizontally arranged branches, and fleshy, colorful megasporangiate cones clearly distinguishes *P. macrophyllus* from all other woody species in the state. ***Habitat***: disturbed sites, urban woods and greenbelts, and riparian zones.

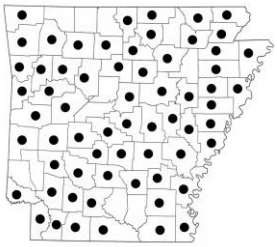
Populus, Poplar or Cottonwood, Salicaceae

Populus is a genus of about 30 species of deciduous trees, distributed mostly over the northern hemisphere in Asia, Europe, and North America, with a few species in North Africa (Eckenwalder 2010). A number of species are important for timber production and wood products, or used for shelterbelts or as ornamentals (Eckenwalder 2010). Many species develop into very large trees or form extensive vegetative colonies via a clonal, and sometimes aggressive, suckering root system. The most widespread tree in North America and one of the largest organisms ever to exist is *P. tremuloides*. Some clones of *P. tremuloides* consist of tens of thousands of stems produced from a single, interconnected root system and cover several hectares. Three species of *Populus* occur in Arkansas; one species, *P. alba*, is nonnative but well-established in the flora.

Species of *Populus* have alternate, simple, often large leaves with coarsely-toothed margins, and small, nondescript, imperfect (unisexual) flowers arranged in few to many-flowered, racemose inflorescences. The fruit is a small, many-seeded capsule.

Populus alba L. (Fig. 108).

Populus alba (white poplar) is a large, deciduous, colonial tree to 40 m tall that is native to Europe, Asia, and North Africa (Eckenwalder 2010). It is well-naturalized over much of the USA, including Arkansas, occurring in most counties. This species is cultivated as an ornamental for its highly contrasting (white and green) foliage and whitish-gray and black bark. It also is planted for a border or as a wind break because of its rapid rate of growth and suckering habit.



Most spread and establishment of *P. alba* probably occurs vegetatively via the production of suckers from an expansive and invasive root system. Large clonal stands of plants often are formed in this manner. The prolific suckering habit also makes eradication difficult, as the root system readily suckers even after removal of the principal trunks. *Populus alba* also is extremely tolerant of a wide array of soil types and moisture regimes.

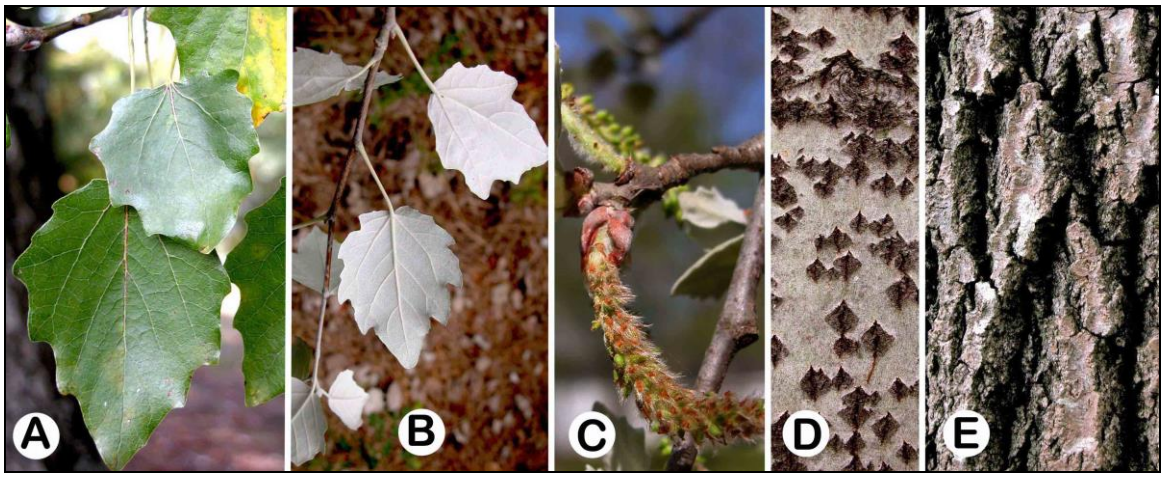


Figure 108. (A–E) *Populus alba* plant and habit. (A–B) Leaves and stem. (C) Staminate flowers and catkin. (D) Young bark (notice the black, diamond-shaped areas). (E) Older bark.

In Arkansas, *P. alba* is distinctive and immediately recognizable by its bright white young stems and leaf lower surfaces, and pale whitish-gray to greenish-gray young bark with brownish-black, diamond-shaped areas; the combination of these characteristics clearly distinguish it from all other trees in the flora. ***Habitat***: disturbed sites and waste places, often encountered spreading vegetatively from areas of cultivation; also in bottomland woods, woodland edges, thickest, riverbanks, riparian zones, prairies, fields, and roadsides.

Prosopis, Mesquite, Fabaceae

Prosopis is a genus of perhaps 35 species of deciduous, often spiny shrubs and small trees native mostly to warm-temperate and subtropical regions of the Americas (Isely 1998).

Prosopis glandulosa Torr. var. **glandulosa** (Fig. 109).

Prosopis glandulosa (honey mesquite) is a shrub or small tree to 20 m tall that is native to the central and western USA and Mexico (McGregor 1986; Isely 1998). Although not native to Arkansas, it has been introduced into the state, presumably accidentally and has been documented as escaped in Pulaski County (Tucker 1976; Peck 2003; Serviss & Peck 2013).

This species produces a large, extensive taproot. It is considered a range weed and invasive, as cattle will feed on the fruits and disperse the seeds, allowing spread and establishment into new areas (McGregor 1986). Two varieties of this species are recognized (Isely 1998); however, only *Prosopis glandulosa* var. *glandulosa* is documented from Arkansas.

Tucker (1976) reported this species from Pulaski County in Arkansas based on collections by Moore in 1954 and 1955, noting that it was a "true inventive" of potentially long duration that was collected along the railroad tracks on the southern edge of Little Rock, apparently brought in with livestock. Smith (1978; 1988; 1994) excluded this species from the Arkansas flora, considering it to be only a waif, and not "part of the normal flora;" however, Peck (2003) reinstated *P. glandulosa* as a component of the Arkansas flora based on the Moore vouchers. Naturalized plants of *Prosopis glandulosa* were rediscovered in Arkansas in 2013 (Serviss & Peck 2013).

In Arkansas, the combination of bipinnately compound leaves often clustered in short lateral spurs, stout stipular spines, and linear-cylindrical fruits with constrictions between the seeds distinguish *P. glandulosa* from most other species of shrubs and trees. It can, however, potentially be confused with the native *Gleditsia triacanthos* (honey locust). *Prosopis glandulosa* can be

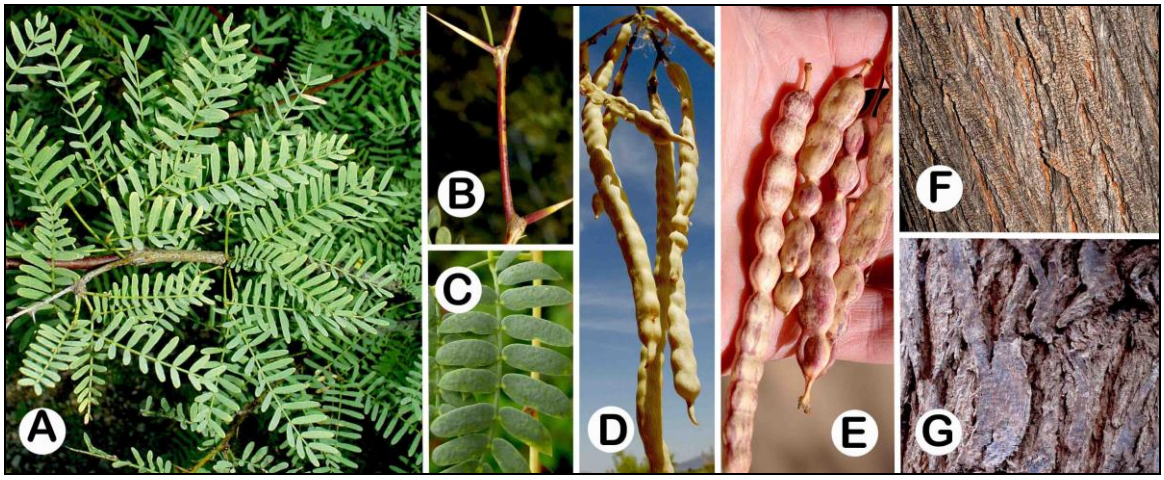


Figure 109. (A–G) *Prosopis glandulosa* plant and habit. (A, C) Leaves, leaflets, and stem. (B) Stem with thorn-like stipular spines (there can be one or two per node). (D–E) Mature fruits. (F–G) Bark. Photo credit: John Seiler, Virginia Tech University.

distinguished from *G. triacanthos* by the presence of unbranched stipular spines and cylindrical fruits with constrictions between the seeds. In contrast, *G. triacanthos* has thorns that typically are branched (some forms lack thorns) and flattened fruits. ***Habitat***: disturbed sites and waste places.

Prunus, Plum, Rosaceae

Prunus is a genus of about 200 species of evergreen or deciduous shrubs and small trees distributed primarily over Asia, Europe, and North America, with the greatest diversity in north-temperate regions (Gu & Bartholomew 2003; Rohrer 2014). Several species of high economic importance are grown commercially and locally for their highly desirable fruits and seeds, including: almond (*P. dulcis*), apricot (*P. armeniaca*), cherry (both sweet and sour cherries: *P. avium* and *P. cerasus*), peach and nectarine (*P. persica*; nectarine sometimes is considered a distinct species from peach, *P. nucipersica*), common or European plum (*P. domestica*, which includes prunes), and oriental/Japanese plum (*P. salicina*). Many native species of *Prunus*, though not grown commercially, are themselves locally important for the production of jellies and preserves, or for hybridization with commercially important species, such as *P. domestica* and *P. salicina*, in order to produce hybrids that may be grown for fruit production over a wider area in the USA (Okie 2001; Rohrer 2014). A few species of *Prunus* are cultivated exclusively as ornamentals for their attractive flowers.

The fruits of some *Prunus* species go through a progression of color changes as they mature (Rohrer 2014). Often, an individual tree where the fruits would be nearly black when fully ripe has its fruits removed by birds when they are still red or purple. These same fruits, which may be highly astringent when at this stage, often are more palatable to humans when dark purple or black (Rohrer 2014).

About 13 species of *Prunus* are native or naturalized in Arkansas, including three Eurasian species and the quasi-native, *P. caroliniana*, which may have been introduced from its putative native range farther south and east of the state. Four native species: *P. americana*, *P. gracilis*, *P. pumila*, and *P. rivularis* are rare in Arkansas and designated as species of conservation concern (Gentry et al. 2013; Ogle et al. 2020; Brent Baker, Pers. Comm., 2021).

Species of *Prunus* have alternate, simple, toothed leaves and small, perfect (bisexual), white or occasionally pink-colored, often malodorous flowers arranged in compact, few to many-flowered fasciculate, corymbose, or racemose inflorescences. The fruit is a small red, purplish-red, blue, yellow, or black-colored drupe.

Prunus avium (L.) L. (Fig. 110A).

Prunus avium (sweet cherry, bird cherry) is a large, deciduous tree to 30 m tall, but often much smaller, that is native to Eurasia (Krüssmann 1978; Rohrer 2014). While not presently known from Arkansas in the wild condition, *P. avium* sometimes is cultivated in the state and also naturalized across much of the eastern USA (Rohrer 2014; Weakley 2020), including Tennessee, which borders Arkansas. The fruits of *P. avium*, which sometimes are produced in large numbers, are consumed readily by birds, providing a high probability of seed dispersal into the flora. Plants also sometimes produce root suckers, offering a mode for vegetative spread, and although apparently not typical behavior for the species (Rohrer 2014), suckering has been observed with some Arkansas *P. avium* material (possibly induced because of disturbances to the root system through mowing, cultivating, or digging). Based on the combination of the aforementioned factors, the species should be expected outside of cultivation in the state.

Prunus avium has been cultivated for centuries and is one of two species grown commercially for cherries. Cultivars of *P. avium* are grown in North America both for their attractive flowers, especially where the Japanese ornamental cherries are not hardy, and for their sweet fruits (Rohrer 2014).

The combination of the large (6–15 cm long) leaves with gland-tipped teeth and the two large, red, plate-shaped glands on the petiole, large (2.5 cm in diameter), solitary to few-fascicled

flowers, and small, lustrous, bright scarlet-red to purplish-red fruits are useful characteristics for distinguishing *P. avium* from native species of *Prunus*. ***Habitat***: disturbed sites and waste places, woods, woodland edges, and thickets.

Prunus avium resembles the morphologically similar species, *P. cerasus* L. (sour cherry, pie cherry; Fig. 110B); *P. cerasus* is a small, deciduous tree to 10 m that is native to Eurasia (Krüssmann 1978; Rohrer 2014). *Prunus cerasus* is the other important cherry of commerce (often used for cooking). It is cultivated and well-naturalized in the USA, although currently not known from the Arkansas flora.

Prunus cerasus sometimes is cultivated in Arkansas, and could occur in the flora, especially considering that it is self-fertile (Rohrer 2014) and has been documented from Missouri (Yatskievych 2013), which borders Arkansas. *Prunus avium* may be distinguished from *P. cerasus* by its leaves with prominent, large, red, flattened glands on the petioles, pubescent lower surfaces, and more than eight pairs of secondary veins. In contrast, the leaves of *P. cerasus* usually lack the large petiolar glands, have a glabrous lower surface, and generally have eight or fewer pairs of secondary veins.

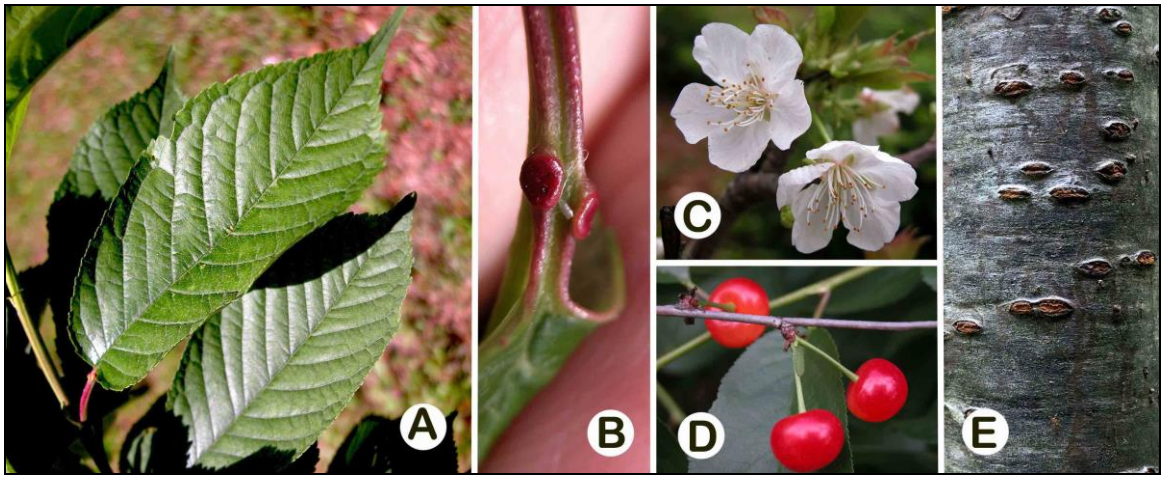
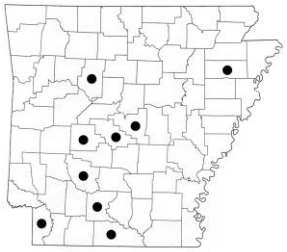


Figure 110A. (A–E) *Prunus avium* plant and habit. (A) Leaves and stem. (B) Prominent petiolar glands. (C) Flowers. (D) Mature fruits. (E) Bark.

Figure 110B. (A–C) *Prunus cerasus* plant and habit. (A) Leaves and stem. (B) Flowers. (C) Mature fruits (can range in color from bright to dark red). Photo credit: C: Howard F. Schwartz, Colorado State University, Bugwood.

Prunus caroliniana Mill. (Fig. 111).



Prunus caroliniana (Carolina laurel cherry) is a small to medium-sized, evergreen tree to about 12 m tall, or occasionally more, that is native to the southern and eastern USA, mostly along the Gulf and East coasts (Rohrer 2014; Weakley 2020). *Prunus caroliniana* is well-established in several counties in southern Arkansas, but it is unclear as to whether or not Arkansas is part of its original native range. Rohrer (2014) notes that *P. caroliniana* is a popular ornamental for screens and trimmed hedges and is widely planted in the southeastern USA because of its lustrous, evergreen foliage. It probably was common as a native plant on the southeastern barrier islands; however, most inland occurrences probably represent escapes from cultivation (Rohrer 2014).

Prunus caroliniana is the only evergreen species of *Prunus* in Arkansas. It is weedy and invasive, particularly into disturbed, semi-wooded areas and greenbelts, and woodland edges in urban environments. It is shade-tolerant, but also will grow well in full sun. It often is found in association with several of the invasive, woody, Asiatic ornamental species that are naturalized in Arkansas, including *Ilex cornuta* (Chinese holly), *Photinia serratifolia* (Chinese photina), *Ligustrum lucidum* (glossy privet), *Ligustrum japonicum* (Japanese privet), *Nandina domestica* (nandina), and *Elaeagnus pungens* (thorny olive).

The leaves of *P. caroliniana* are highly variable in shape and production of marginal teeth. Leaves may be broadly elliptic to lanceolate-elliptic or oblong-elliptic and with the apex rounded, acute, or slightly acuminate. Leaf margins may be entire or mostly entire with only a few teeth, or coarsely toothed with numerous, well-developed spinose teeth.

Young or juvenile plants of *P. caroliniana* closely resemble young plants of both *Photinia serratifolia* and the native *Ilex opaca* (American holly); however, *P. caroliniana* can be distinguished from them by its leaves with flexible, spinose teeth that generally are widely spaced and often few in number. Both *P. serratifolia* and *Ilex opaca*, in contrast, have leaves with stiffer teeth, and in the case of *P. serratifolia*, more teeth that are spaced closely together. Juvenile stages of *P. caroliniana* and *P. serratifolia*, in particular, are very similar and easily confused (compare Fig. 168C and Fig. 167K). With these, the number of teeth and spacing between teeth are important for species determination. ***Habitat***: disturbed sites and waste places, open woods, woodland edges, greenbelts, thickets, riparian zones, fencerows, and roadsides.

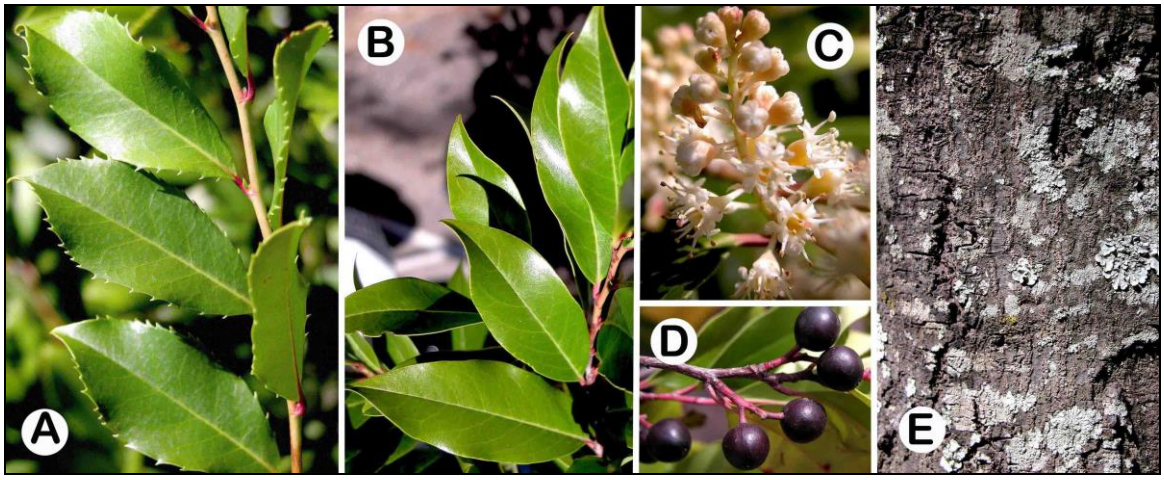
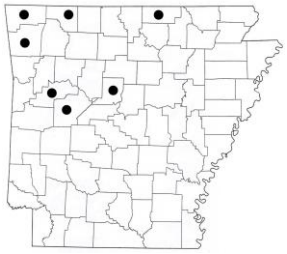


Figure 111. (A–E) *Prunus caroliniana* plant and habit. (A–B) Leaves and stem (notice the toothed margins on the leaves in Fig. A versus the entire margins in Fig. B). (C) Flowers and inflorescence. (D) Mature fruits. (E) Bark.

Prunus mahaleb L. (Fig. 112).



Prunus mahaleb (perfumed cherry, Mahaleb cherry) is a small, deciduous tree to 15 m tall that is native to Europe and western Asia (Krüssmann 1978; Rohrer 2014). It is naturalized in several states (McGregor 1986; Rohrer 2014), including Arkansas, where it is known from seven scattered counties, mostly in the northern one-half of the state.

This species sometimes is observed in large colonies, presumably formed from seeds as it does not generally produce root suckers. The stones of *P. mahaleb* are ground to make the aromatic, bitter-tasting spice, mahleb or mahlab that has been used for centuries as a flavoring agent for cookies, pastries, breads, and cheeses in the Middle East and North Africa. The rootstocks of *P. mahaleb* have been used to graft scions of commercial varieties of cherry (Rohrer 2014).

Prunus mahaleb can be distinguished from most other *Prunus* species in the Arkansas flora by the combination of its small (2.5–5 cm long), usually light green, broadly ovate to rotund leaves, extremely sweet-fragrant flowers, and small, lustrous, dark red or purplish-black to black fruits (ca. 6 mm long). It can, however, be confused with sterile specimens of both nonnative *Pyrus* species that occur in the state: *P. calleryana* and *P. communis*. *Prunus mahaleb* can be distinguished from them by its leaves with small glands that occur between the teeth (sometimes the glands are absent). The leaves of *Pyrus* lack these glands. ***Habitat***: disturbed sites and waste places, woods, woodland edges, greenbelts, thickets, riparian zones, fencerows, and roadsides.

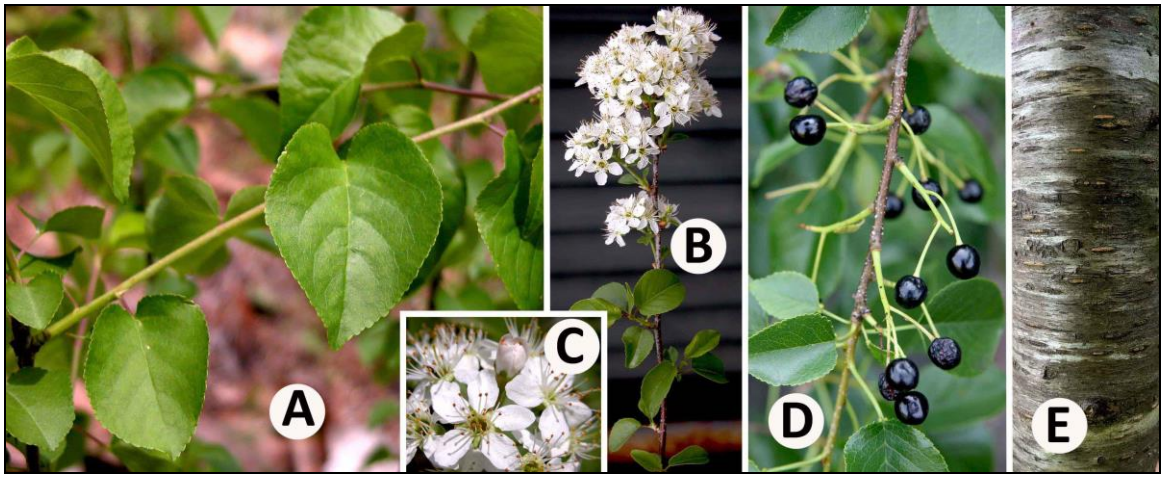
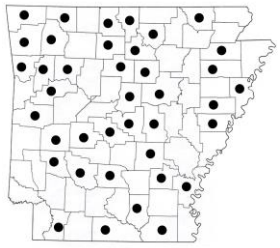


Figure 112. (A–E) *Prunus mahaleb* plant and habit. (A) Leaves and stem. (B–C) Flowers and inflorescence. (D) Mature fruits. (E) Bark. Photo credit: D: Robert Vidéki, Doronicum Kft., Bugwood.

Prunus persica (L.) Batsch; Syn.: *Amygdalus persica* L. (Fig. 113).



Prunus persica (peach, nectarine) is a small, deciduous tree to 10 m tall that is native to China (Lu & Bartholomew 2003; Rohrer 2014). It is naturalized in the eastern USA (Rohrer 2014; Weakley 2020), including Arkansas, where it has been documented from numerous, scattered counties across the state.

This species is the common peach of commerce and frequently is cultivated in temperate regions worldwide. The fruits are used for fresh-eating, canning, preserves, jellies, baking, and as flavoring agents for foods and liquors. The frequent cultivation and use of *P. persica* as a food commodity has undoubtedly contributed to its spread and naturalization in Arkansas and elsewhere.

Anthocyanic forms of *P. persica*, with deep reddish-purple foliage and fruits, occasionally are cultivated as ornamentals for their colorful foliage and sometimes escape cultivation. The nectarine

of commerce generally is considered a variety of peach (*P. persica* var. *nucipersica*), and is similar to standard *P. persica* in most respects, with the exception that the fruit is glabrous instead of pubescent (Rohrer 2014). It has, in times past, been classified as a separate species, *P. nucipersica*.

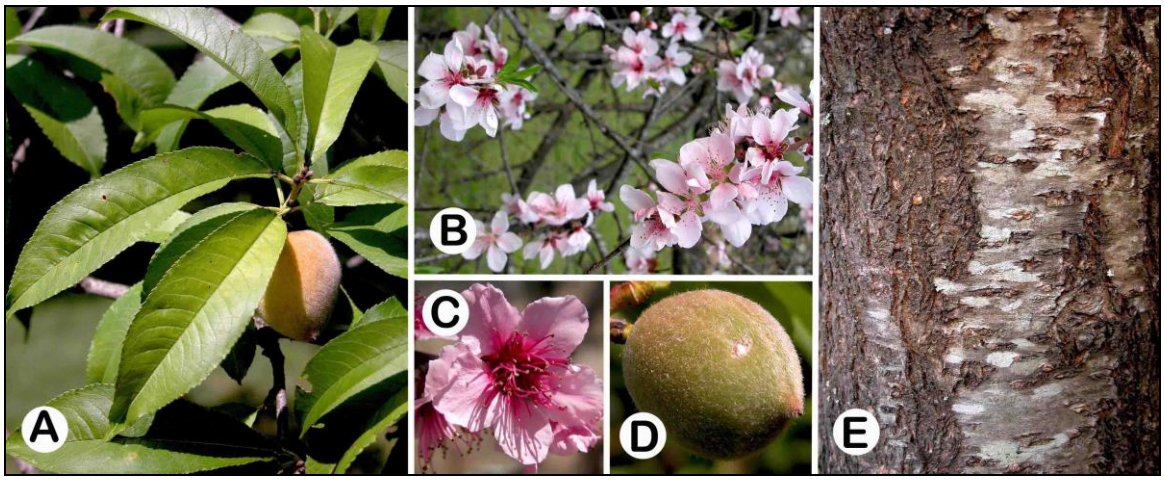


Figure 113. (A–E) *Prunus persica* plant and habit. (A) Leaves and stem. (B–C) Flowers. (D) Fruit. (E) Bark.

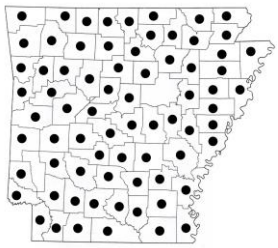
In Arkansas, naturalized *P. persica* plants may be observed as isolated individuals or as groves or thickets of multiple plants that arise from seeds. This species prolifically self-seeds and a single plant may give rise to an entire population. Wild plants tend to produce fruits that are smaller and colored differently than cultivated forms.

The combination of the densely pubescent ovaries and fruits, pink-colored flowers, and narrow, lanceolate-elliptic leaves clearly distinguish *P. persica* from other species of *Prunus*, along with most other woody species, that occur in Arkansas. ***Habitat***: disturbed sites and waste places, woodland edges, riparian zones, hill sides, and roadsides, especially in the vicinity of where plants of the species are cultivated or where fruit discards are deposited.

Pueraria, Kudzu, Fabaceae

Pueraria is a genus of about 35 species of twining perennial herbs or lianas native to tropical Asia, Japan, and New Guinea (Isely 1998; Wu & Thulin 2010).

Pueraria montana Lour. var. **lobata** (Willd.) Maes. and Almeid. ex Sandjap. and Predeep (Fig. 114).



Pueraria montana (kudzu) is a large, deciduous, twining liana to 30 m in length that is native to China and Japan (Isely 1998; Wu & Thulin 2010). It is well-naturalized in the southeastern USA (Isely 1998; Kartesz 2015; Weakley 2020), including Arkansas, where it occurs essentially statewide. It is considered invasive in Arkansas (Gentry et al. 2013). Weakley (2020) notes that although *P. montana* is widespread and "weedy" in the south, it may not be significant ecologically as an invasive species because of its low production of viable seeds and relative absence from high-quality natural areas.

Pueraria montana aggressively climbs trees and other substrates by twining and also trails along the ground, sometimes adventitiously rooting along its stems. Spread is both via seeds and adventitious rooting of stems, although as noted by Weakley (2020) seeds may not be a major contributor overall to naturalization. Once established, plants of *P. montana* often cover all existing substrate and vegetation. In areas where it occurs, it is an aggressive competitor with other plants for available light, including large trees, where in addition to shading, may cause breakage from its weight or death via eventual constriction by its twining stems. This species is

extremely difficult to eradicate once established because of its massive, tuberous root system and rapid regeneration and subsequent growth of new stems if cut back.

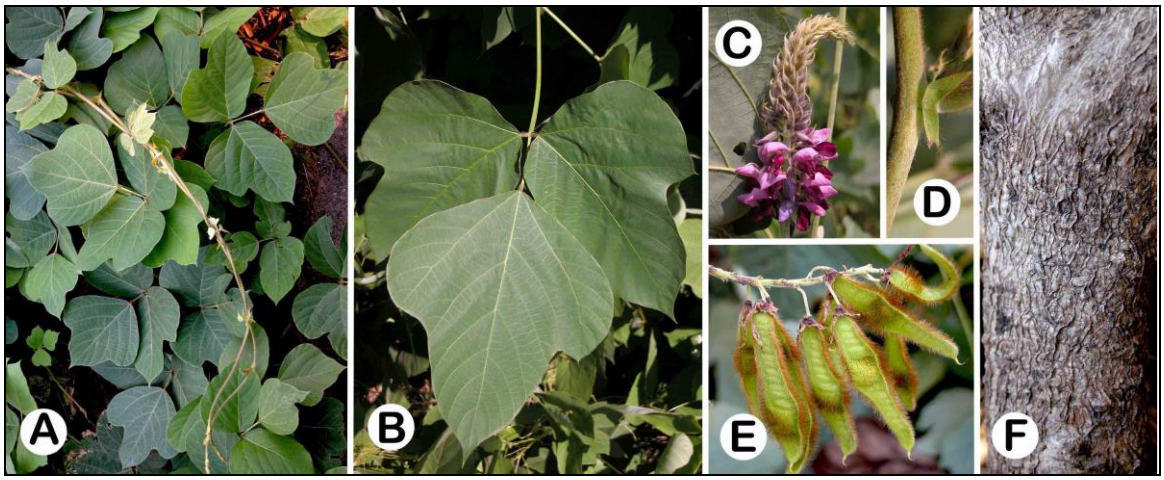


Figure 114. (A–F) *Pueraria montana* plant and habit. (A–B) Leaves and stem. (C) Flowers and inflorescence. (D) Stem with stipules and hirsute trichomes. (E) Mature fruits. (F) Bark.

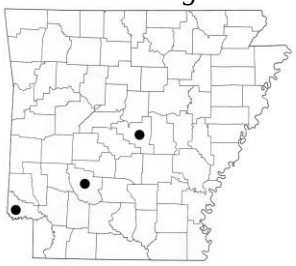
In its native China and Japan, the tubers and young leaves sometimes are used as a food source; plants also are used as a cover crop and for fodder (Wu & Thulin 2010). *Pueraria montana* intentionally was introduced into the USA as a forage crop for livestock and to control erosion on roadside cuts (Isely 1998). The flowers produce a fragrance that is highly reminiscent of artificially-flavored grape soda. ***Habitat***: woods, woodland edges, greenbelts, thickets, riparian zones, fields, and roadsides, often in dense stands that completely cover existing vegetation.

In Arkansas, *P. montana* readily is distinguished from other lianas by the combination of its large, ternately compound leaves, twining stems, and dense indument of yellow, long-hirsute trichomes on stems and fruits. It is possible, however, to confuse *P. montana* with the native, suffrutescent vine *Dioclea multiflora* (cluster pea). Although *D. multiflora* is not truly woody, its leaves are highly reminiscent of those of *P. montana*. *Pueraria montana* may be distinguished from *D. multiflora* by its much larger overall size and by its leaflets, which generally are lobed (*D. multiflora* is a smaller vine, generally only 3–5 m in length, and its leaflets generally are unlobed).

Punica, Pomegranate, Lythraceae (formerly Punicaceae)

Punica is a small genus of two species of Asiatic origin (Krüssmann 1978; Qin & Graham 2007b). *Punica granatum* is the pomegranate of commerce and is cultivated in warm-temperate and subtropical regions worldwide for its edible fruits and attractive flowers.

Punica granatum L. (Fig. 115).



Punica granatum (pomegranate) is a large, thorny, deciduous shrub or small tree to 6 m tall that is native to central and western Asia and perhaps Europe (Bailey & Bailey 1976; Krüssmann 1978; Qin & Graham 2007b). It is naturalized in a number of southern states, including Arkansas, and escaped/naturalized plants have been documented from Clark, Little River, and Pulaski counties (Kartesz 2015; Serviss & Peck 2016b; Weakley 2020). *Punica granatum* initially was documented for the Arkansas flora by Peck (2003), based on specimens from Little River and Pulaski counties. A subsequent escaped occurrence of the species was reported by Serviss and Peck (2016b).

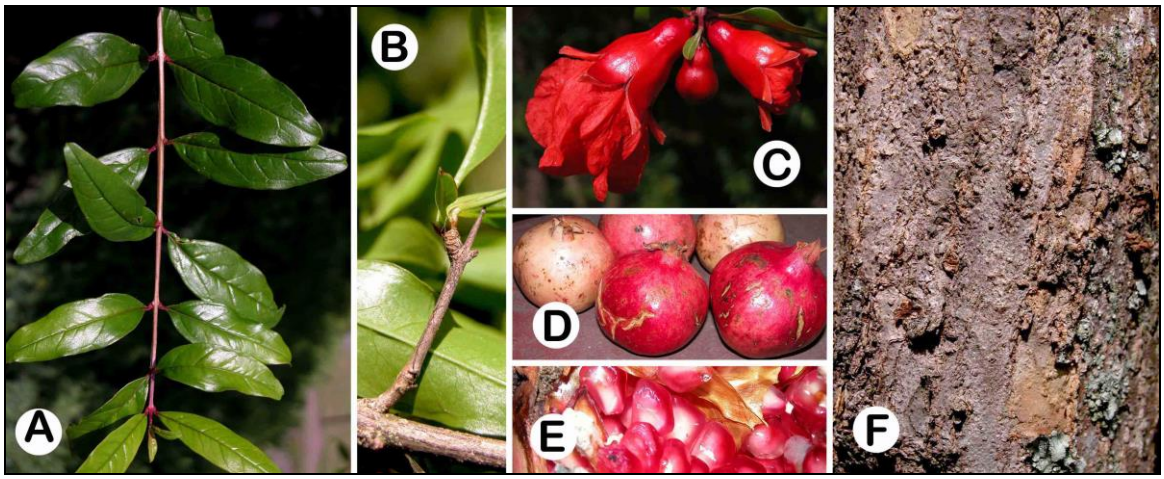


Figure 115. (A–F) *Punica granatum* plant and habit. (A) Leaves and stem. (B) Stem and thorn. (C) Flowers. (D) Mature fruits showing some of the variation in fruit color that can be encountered. (E) Seeds with sarcotestas. (F) Bark.

This species sometimes is cultivated in Arkansas. Some plants readily produce fruits, whereas others do not; this discrepancy may be owed to the fact that some cultivars of pomegranate apparently require cross-pollination for successful fruit set. The growing season in southern Arkansas generally is long enough for fruits to mature and ripen. The fruits are edible and similar in form and quality to commercially available pomegranates, and in some instances the seeds are viable. Plants also are easy to cultivate, long-persistent, and may increase vegetatively via root suckers once established.

Punica granatum is the pomegranate of commerce, and it frequently is cultivated in warm regions as an ornamental for its attractive flowers and foliage and for its edible fruits (Bailey & Bailey 1976; Krüssmann 1978). It has been cultivated in the Middle East for millennia. The edible, juicy portion surrounding individual seeds is a fleshy portion of the seed coat referred to as a sarcotesta.

In Arkansas, it is possible with sterile material to confuse *P. granatum* with *Pyracantha koidzumii* (Formosa firethorn), *Pyracantha fortuneana* (Chinese firethorn), and smaller specimens of the native *Sideroxylon lanuginosum* (gum bumelia). *Punica granatum* easily can be distinguished from these species by its glabrous foliage, petioles that typically are red in color, large (ca. 3–6 cm long by 2–4 cm wide, sometimes wider in forms with "doubled" flowers), solitary or 2–5–clustered, red to orange-red–colored flowers with thick, coriaceous calyces, and large (ca. 5–13 cm in diameter), solitary, yellow, yellowish-pink, pink, or red-colored fruits. *Pyracantha* and *Sideroxylon* (at least on new growth) have densely pubescent foliage, particularly the stems and lower surfaces of the leaves, and small, white to off-white-colored flowers that are densely clustered in the inflorescences, and considerably smaller fruits. ***Habitat***: open, well-drained sites, waste places, roadsides and other disturbed areas.

Pyracantha, Firethorn, Rosaceae

Pyracantha is a genus of about 10 species of evergreen shrubs and small trees distributed over Europe and Asia (Gu & Spongberg 2003d; Nesom 2010b; Lance & Zika 2014). Several species are important as ornamentals for their glossy, evergreen foliage, and profuse and long-lasting display of colorful fruits. Three principal species of *Pyracantha*: *P. coccinea, P. fortuneana, P. koidzumii* have become established outside of cultivation to various degrees in the USA flora (Nesom 2010b; Lance & Zika 2014). *Pyracantha fortuneana* and *P. koidzumii* regularly are cultivated in Arkansas and have been documented outside of cultivation in the state.

Pyracantha coccinea probably is the most frequently cultivated *Pyracantha* species in the USA and is naturalized in a number of states, mostly outside of the southeast. The warm environment of the southeastern USA may preclude extensive naturalization of this species in that region (Ron Lance, Pers. Comm., 2018). At present, it is known in Arkansas outside of cultivation only from Benton County in the extreme northwestern portion of the state.

In Arkansas, *Pyracantha* species somewhat resemble *Sideroxylon lanuginosum* and a few species of *Crataegus*. *Pyracantha* can be distinguished from *S. lanuginosum* by their smaller leaves that generally are toothed, and red, orange, or yellow fruits (the leaves of *S. lanuginosum* are larger with entire margins and the fruits are black). *Pyracantha* can be distinguished from morphologically similar *Crataegus* species by their evergreen habit and leafy thorns (*Crataegus* generally are deciduous and normally produce thorns that are devoid of leaves). *Pyracantha* species also resemble *Punica granatum*, but can be distinguished from it by their pubescent foliage (at least when young) and numerous small flowers and fruits (the foliage of *P. granatum* is glabrous and the flowers and fruits are large and solitary or in small clusters of 2–5).

Species of *Pyracantha* have alternate, simple leaves, short, stout, often leafy thorns, and small, perfect (bisexual), white to cream-colored flowers arranged in compact, many-flowered corymbose inflorescences. The fruit is a small orange, reddish-orange, or red (rarely yellow-colored) pome. The seeds are primarily bird-dispersed, though water may play a secondary dispersive role.

Key to *Pyracantha* species:

1. Leaves elliptic or ovate to lanceolate or oblanceolate, generally widest at or below the middle of the lamina; apex of lamina acute or rarely obtuse ..... **Pyracantha coccinea**
1. Leaves oblanceolate to obovate, generally widest above the middle of the lamina (sometimes about the middle of the lamina in *P. koidzumii*); apex of lamina obtuse, rounded, or truncate, sometimes retuse/emarginate and/or apiculate.

2. Leaf margins on most or all leaves conspicuously toothed, leaves generally widest toward apex .....**Pyracantha fortuneana**
2. Leaf margins entire, a few leaves may have a few widely spaced teeth (juvenile plants of *P. koidzumii* often will have toothed leaves), leaves generally widest more toward the middle .....**Pyracantha koidzumii**

Pyracantha coccinea Roem. (Fig. 116).

Pyracantha coccinea (scarlet firethorn) is an evergreen shrub to 5 m tall that is native to Eurasia (Krüssmann 1978). It frequently is cultivated and also naturalized in many states (Nesom 2010b; Lance & Zika 2014). It is known in the Arkansas flora from Benton County (Theo Witsell, Pers. Comm., 2021), but should be expected outside of cultivation in other areas in the northern portion of the state.

This species is cultivated for its evergreen habit and profuse display of colorful fruits. Numerous cultivars of *P. coccinea* exist, and these vary based on fruit color (can range from almost yellow through various shades of orange to red), growth form, and overall size.

In Arkansas, *P. coccinea* could be confused with the other two naturalized species of *Pyracantha*: *P. fortuneana* (Chinese firethorn) and *P. koidzumii* (Formosa firethorn); however, it can be distinguished from them by its generally elliptic leaves with acute apices. Contrastingly, *P. fortuneana* and *P. koidzumii* have obovate to oblanceolate leaves that are obtuse, rounded, or truncate at the apex and also sometimes retuse or emarginate. ***Habitat***: disturbed sites and waste places, upland or open woods, woodland edges, thickets, and roadsides; also on rocky soils.

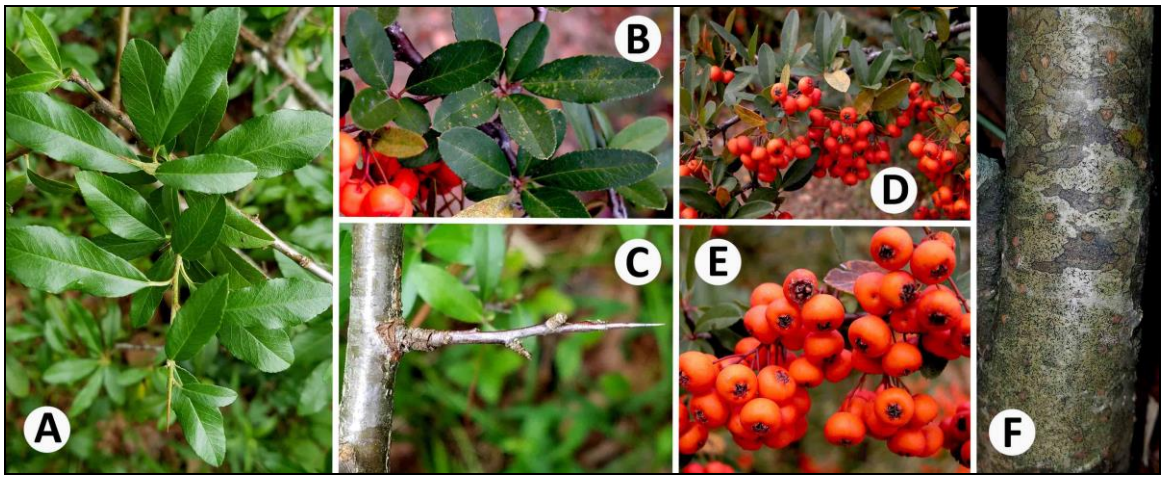


Figure 116. (A–F) *Pyracantha coccinea* plant and habit. (A–B) Leaves and stem. (C) Thorn. (D–E) Mature fruits and infructescences. (F) Bark.

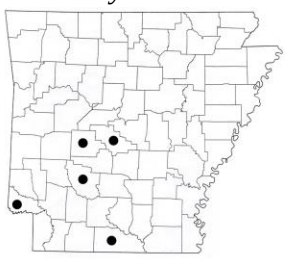
Pyracantha fortuneana (Maxim.) Li; Syn.: *P. crenatoserrata* (Hance) Rehd. (Fig. 117).

Pyracantha fortuneana (Chinese firethorn) is a large, thorny, evergreen shrub to about 3 m tall that is native to China (Gu & Spongberg 2003d; Nesom 2010b; Lance & Zika 2014). It has been documented escaped in Arkansas from Clark County (Serviss et al. 2018c). In addition to Arkansas, *P. fortuneana* is present in the floras of a few other southern states, including Alabama, California, Florida, South Carolina, and Texas (Nesom 2010b; Lance & Zika 2014). Based on its frequency of cultivation and prolific seed production, *P. fortuneana* should be expected outside of cultivation elsewhere in the state.

Pyracantha fortuneana sometimes self-seeds and it is not uncommon to find numerous spontaneous juveniles in the immediate vicinity of reproductive age plants. Seedlings appear to be somewhat shade-tolerant, but grow quickly if and when exposed to sunlight.

This species morphologically is very similar to *P. koidzumii* (Formosa firethorn), which is naturalized in Arkansas. Precise species determination requires careful examination of leaves and reproductive structures (see text with P. *koidzumii* for distinguishing characteristics between the two species). ***Habitat***: disturbed areas, woodland edges, thickets, and riparian zones.

Pyracantha koidzumii (Hayata) Rehd. (Fig. 118).



Pyracantha koidzumii (Formosa firethorn) is a large, thorny, evergreen shrub to about 4 m tall that is native to China and Taiwan (Gu & Spongberg 2003d; Nesom 2010b; Lance & Zika 2014). It is naturalized in the southern USA, from Arizona, Oklahoma and Texas eastward to Florida and South Carolina, including Arkansas, where it has been documented from Clark, Garland, Little River, Saline, and Union counties (Serviss 2009; Nesom 2010b; Lance & Zika 2014; Serviss et al. 2016b, 2018c). Based on its frequency of cultivation and prolific seed production, *P. koidzumii* should be expected elsewhere in the state.

In Arkansas, *P. fortuneana* usually can be distinguished from *P. koidzumii* by its leaves with serrulate or crenulate-serrate margins (the leaves of *P. koidzumii* generally have entire to mostly entire margins). However, distinguishing the two species may at times be more difficult, especially among juvenile plants. Some individuals of *P. koidzumii* will produce some leaves with teeth toward the apex (generally five or fewer per margin), and occasionally plants of *P. fortuneana* will have at least some leaves that are sparsely toothed. Additionally, juvenile plants of both *P. fortuneana* and *P.*

koidzumii have toothed leaf margins. ***Habitat***: bluffs, slopes, hillsides, rocky areas, woodland edges, thickets, and riparian zones.

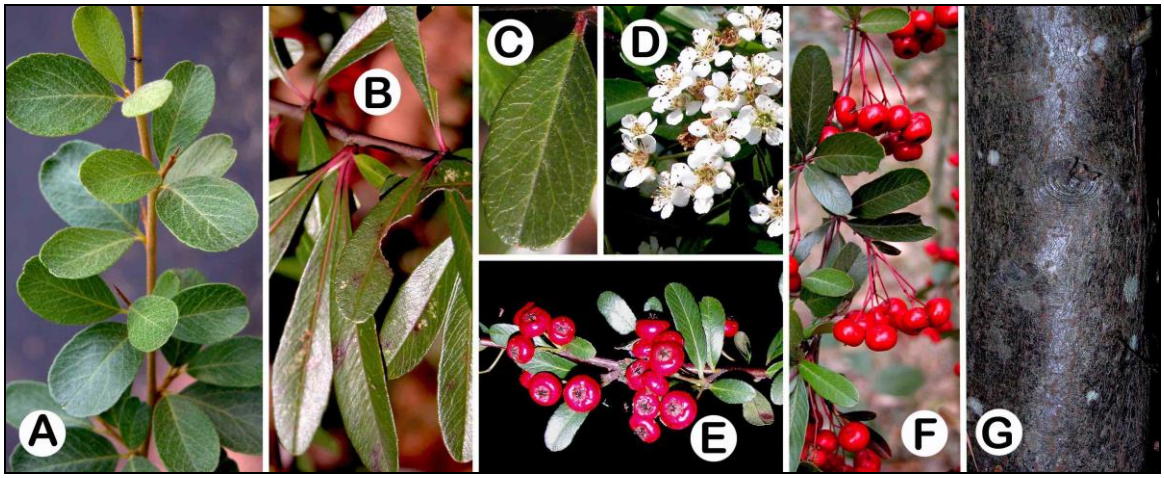


Figure 117. (A–G) *Pyracantha fortuneana* plant and habit. (A–C) Leaves and stem. (D) Flowers. (E–F) Mature fruits. (G) Bark.

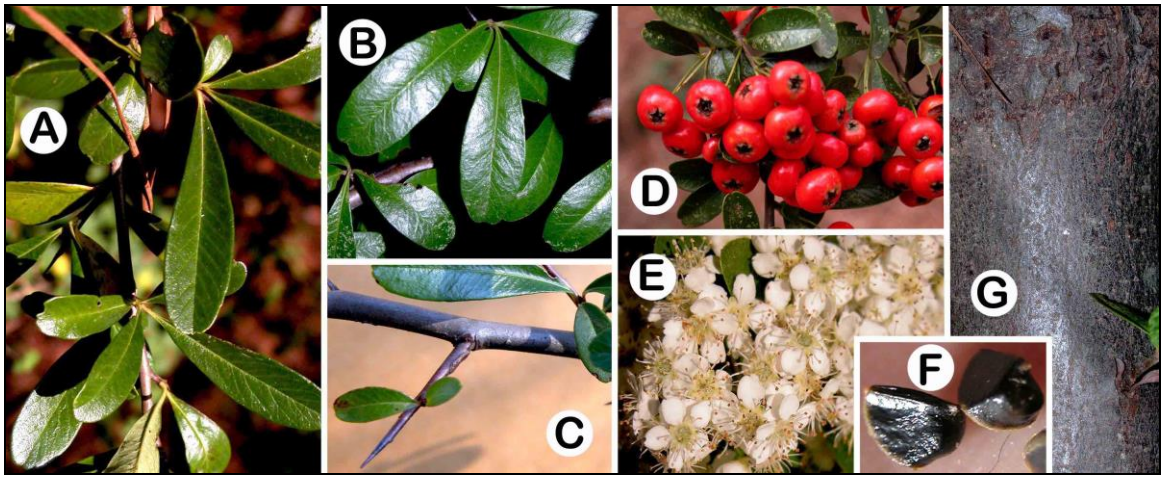


Figure 118. (A–G) *Pyracantha koidzumii* plant and habit. (A–B) Leaves and stem. (C) Stem and thorn. (D) Mature fruits. (E) Flowers. (F) Seeds. (G) Bark.

Difficulty in determining species identifications with escaped and naturalized *Pyracantha* plants also may arise from the fact that numerous cultivars and hybrids of both species exist, many of which are cultivated in the southeastern USA (Bailey 1949; Bailey & Bailey 1976; Krüssmann 1978; Meyer et al. 1994; Egolf & Andrick 1995; Nesom 2010b). Additionally, spontaneous intermediates occasionally are encountered where cultivated species or hybrids are grown in proximity; no barrier to hybridization is apparent (Lance & Zika 2014).

Pyrus, Pear, Rosaceae

Pyrus is a genus of about 25 species of deciduous trees distributed across Asia, Europe, and North Africa (Krüssmann 1978; Gu & Spongberg 2003e; Catling & Mitrow 2014). Species are important as ornamentals for their showy flowers and/or edible fruits. The common or European pear (*P. communis*) is prized as a fruit commodity worldwide and the most economically important species in the genus. A number of other *Pyrus* species and interspecific hybrids also are grown in temperate regions as fruit crops. *Pyrus pyrifolia*, also known as Asian pear, Korean pear, Nashi pear, or pear-

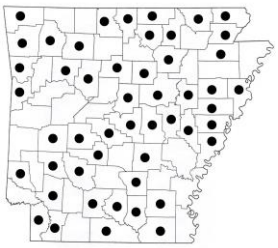
apple, is the Asian pear of commerce, and is the predominant species of pear grown for fruit in Asia. The Asian pear sometimes is considered a hybrid between a pear and an apple, hence the name "pear-apple," but rather it is a series of horticultural forms of *P. pyrifolia*, some of which may have their origins from hybridization of *P. pyrifolia* with *P. ussuriensis*.

Two species of *Pyrus* are naturalized in the Arkansas flora, with *P. calleryana* being highly invasive. Species in the genus *Pyrus* are allied closely with *Malus* (apples), and species of both genera often have been treated as congeneric (see genus description of *Malus* for distinguishing characteristics between the two genera).

Species of *Pyrus* have alternate, simple leaves and small, perfect (bisexual), often showy flowers with inferior ovaries arranged in compound (branched) corymbose inflorescences. The fruit is a small to large, few to multi-seeded pome.

Pyrus calleryana Decne. (Fig. 119).

Pyrus calleryana (Callery pear, Bradford pear) is a small to medium-sized, deciduous tree to 15 m tall that is native to China (Gu & Spongberg 2003e). It is well-naturalized and invasive in the central and eastern USA, including Arkansas (Gentry et al. 2013; Catling & Mitrow 2014b; Weakley 2020), where it occurs essentially statewide. *Pyrus calleryana* is tolerant of a variety of habitats (excluding wetlands), including upland, rocky sites and calcareous (alkaline) soils. This species typically bears large, leafy thorns, which pose a hazard to people and domestic animals.



It frequently is used as an ornamental for its profuse display of flowers in early spring and attractive red or multi-colored autumn foliage. It also is used as rootstock for grafting other *Pyrus* species, such as *P. pyrifolia*, that are used for fruit production (Catling & Mitrow 2014b). The wood of *P. calleryana* is hard and durable and sometimes is used to make furniture and tools (Catling & Mitrow 2014b).

The fruits of *P. calleryana* are important forage for a number of bird and mammal species, and vary somewhat in size and color among naturalized individuals. They often persist on the plant well into winter, sometimes even rotting while still attached. *Pyrus calleryana* and its putative hybrids are well suited to invasive behavior, having broad ecologic tolerance, relatively few pests, rapid growth, and early sexual maturity, in as little as three years (Catling & Mitrow 2014b).

The hard, close-grained wood of *Pyrus calleryana* has been used for making furniture and tools. Four botanical varieties of *P. calleryana* are recognized that are separated predominately based on leaf shape (Gu & Spongberg 2003e); all four occur in the North American flora (Catling & Mitrow

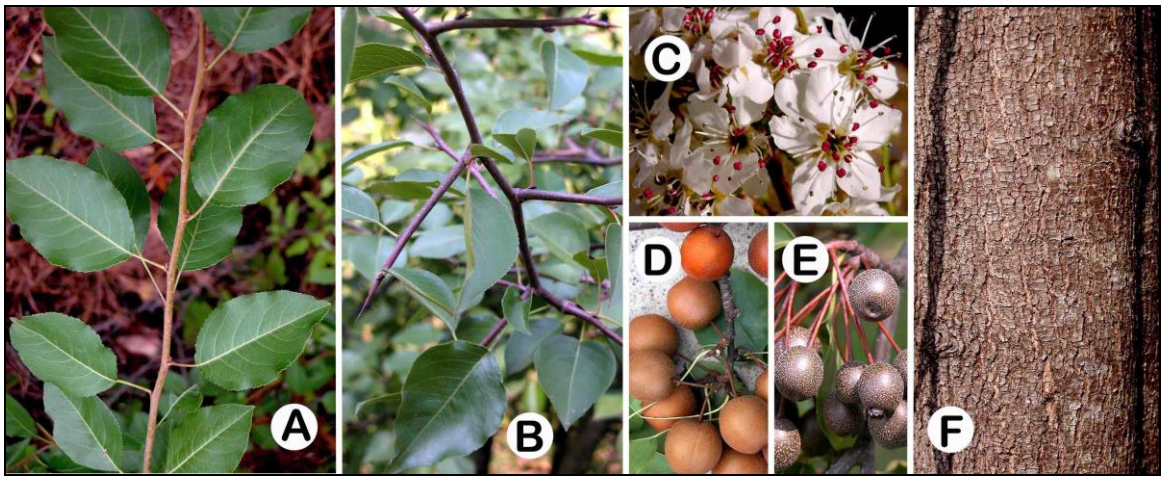
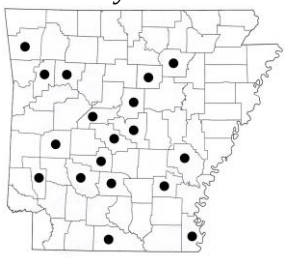


Figure 119. (A–F) *Pyrus calleryana* plant and habit. (A) Leaves and stem. (B) Thorns. (C) Flowers. (D–E) Mature fruits (fruit color and size is somewhat variable). (F) Bark.

2014b). In Arkansas, *P. calleryana* is similar to *P. communis* (common or European pear), which also is naturalized in Arkansas; however, it may be distinguished from *P. communis* by its large thorns (usually present), and by its smaller fruits that lack a calyx (*P. communis* sometimes lacks thorns and has larger fruits with a persistent calyx).

The horticultural selection known as 'Bradford' (Bradford pear) commonly is planted as an ornamental in Arkansas and elsewhere. It looks similar to wild *P. calleryana*, but has a tighter, pyramidal-shaped crown, thicker, more coriaceous leaves, and no thorns. It probably is the original source of naturalized plants of the species in the USA. ***Habitat***: disturbed areas and waste places, open woods, woodland edges, riparian zones, slopes and bluffs, urban greenbelts, thickets, fencerows, roadsides, and old fields.

Pyrus communis L. (Fig. 120).



Pyrus communis (common pear, European pear) is a small to medium-sized, deciduous tree to 15 m tall, or occasionally more, that is native to Europe and Asia (Krüssmann 1978; Gu & Spongberg 2003e; Catling & Mitrow 2014b). It is naturalized in the central and eastern USA (Catling & Mitrow 2014b), including Arkansas, where it occurs in several scattered counties across the state.

Pyrus communis frequently is cultivated and grown both locally and commercially as a fruit commodity; over 1,000 cultivars exist (Catling & Mitrow 2014b). This practice has undoubtedly contributed to its widespread occurrence outside of cultivation in Arkansas and elsewhere. A number of the important fruit-bearing cultivars, such as 'Kieffer' and 'Le Conte', actually are interspecific hybrids between *P. communis* and *P. pyrifolia* (Japanese pear).

Naturalized plants sometimes produce fruits that are considerably smaller than plants in cultivation, which often are bitter and mostly inedible (Yatskievych 2013; Catling & Mitrow 2014b). The fruits are fed on by a variety of bird and mammal species. The wood of *P. communis* is hard and sometimes used to make furniture and handles for tools.

In Arkansas, *P. communis* is similar to and easily confused with its congener, *P. calleryana* (see comments section under *P. calleryana* for distinguishing characteristics between the two species). ***Habitat***: disturbed areas and waste places, degraded woods, woodland edges, riparian zones, thickets, roadsides; sometimes persistent post-cultivation.

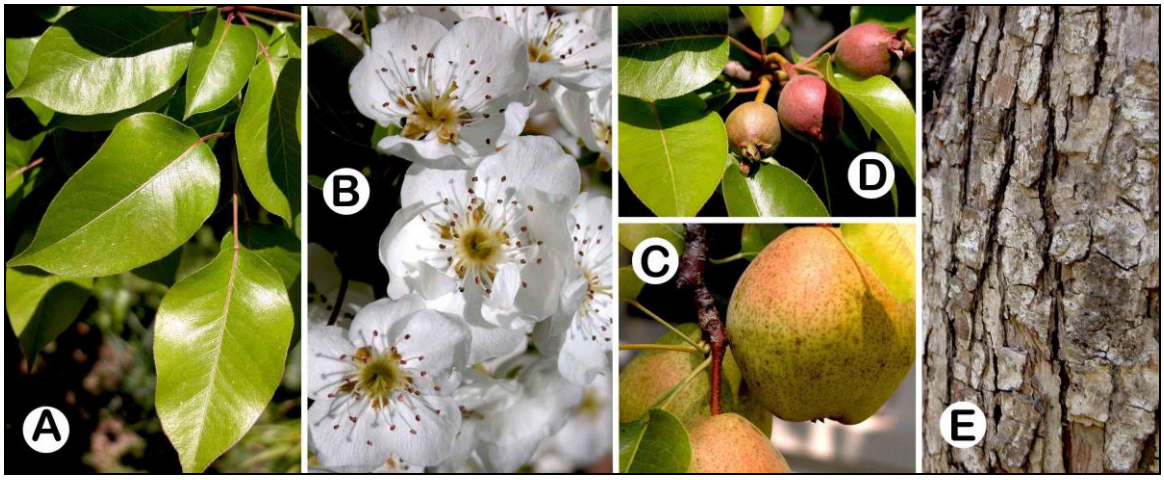


Figure 120. (A–E) *Pyrus communis* plant and habit. (A) Leaves. (B) Flowers. (C) Mature fruits. (D) Young fruits and leaves. (E) Bark.

Quercus, Oak, Fagaceae

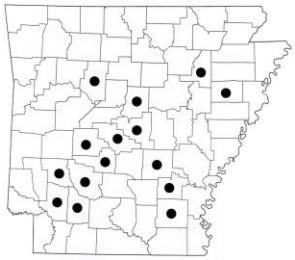
Quercus is a genus of about 400 species of deciduous, semi-evergreen, and evergreen shrubs and trees distributed throughout much of the northern hemisphere, with the greatest diversity in the Americas (Nixon 1997b; Huang et al. 1999b). Species of *Quercus* are valuable for ornament, timber, tannins and dyes, wildlife use, and shade (Hunter 1995; Nixon 1997b; Huang et al. 1999b). Many species of red oaks also are cultivated for their attractive red to reddish-orange autumn foliage.

The character of acorn maturation in the first year (annual maturation) or second year (biennial maturation) after pollination commonly is used to differentiate major groups within the genus (Nixon 1997b). North American white oaks have annual maturation, whereas the vast majority of red oaks have biennial maturation. In the field, this character can be observed throughout the growing season by examining a sample of twigs from the same tree (Nixon 1997b). If developing fruits exhibit a single size class and are found only on the current year's growth, maturation is annual; if the developing fruits exhibit two size classes with small pistillate flowers on new growth and larger developing fruit on the previous year's twigs, maturation is biennial (Nixon 1997b).

Thirty-two species of *Quercus* are known from the Arkansas flora. All with the exception of *Q. acutissima* and *Q. virginiana* are native.

Species of *Quercus* have alternate, simple, often pinnately lobed and/or toothed leaves and imperfect, small, green to yellow or beige-colored, wind-pollinated flowers. The fruit is a nut partially to completely (rarely) enclosed by a set of united bracts. The characteristic of two or more buds clustered at the apex of twigs aids in distinguishing *Quercus* from other woody taxa in the state.

Quercus acutissima Carruth (Fig. 121).



Quercus acutissima (sawtooth oak) is a small to medium-sized tree to 30 m tall that is native to Korea, China, and Japan, and elsewhere in Asia (Krüssmann 1978; Huang et al. 1999b). It is naturalized in several eastern states in the USA (Whittemore 2004; Kartesz 2015; Weakley 2020), including Arkansas, where it occurs in several counties mostly in the central portion of the state.

Quercus acutissima sometimes is cultivated as an ornamental and also planted for wildlife use (Whittemore 2004), which undoubtedly has contributed to its naturalization in the state and elsewhere. This species has the potential to become well-established in the flora because of the high rate of fruit production (the seeds of which are highly viable and readily germinate with subsequent seedling emergence) and potential for dispersal by seed-eating mammals, such as squirrels. Additionally, *Q. acutissima* will

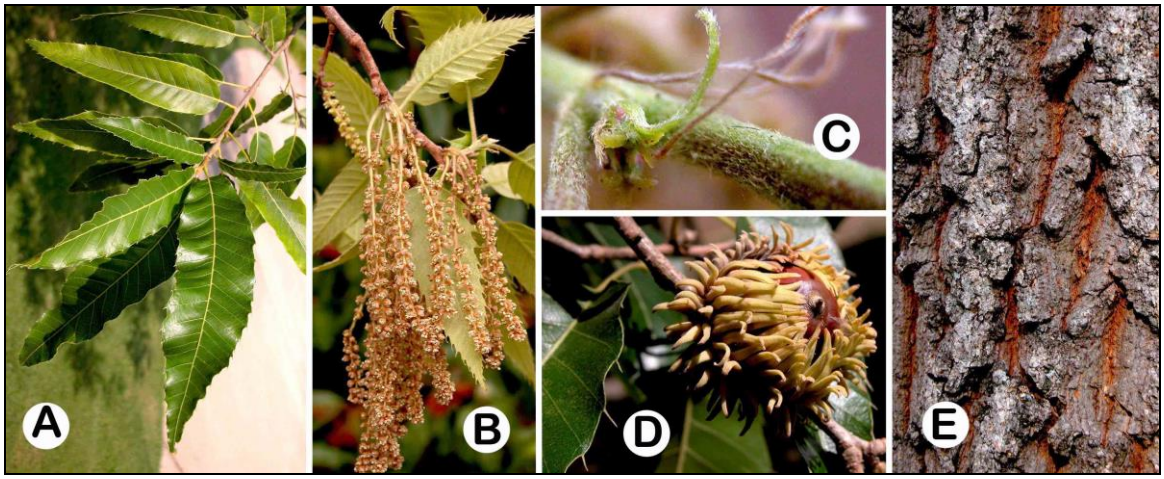
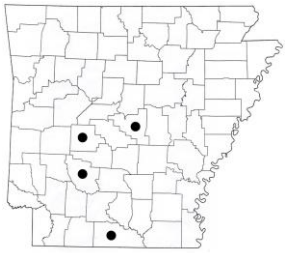


Figure 121. (A–E) *Quercus acutissima* plant and habit. (A) Leaves and stem. (B) Staminate flowers and catkins. (C) Pistillate flower. (D) Mature fruit. (E) Bark.

reproduce at a relatively young age.

In Arkansas, *Q. acutissima* vegetatively resembles *Castanea* (chestnut) and narrower-leaf forms of *Q. muehlenbergii* (chinquapin/chestnut oak), and the fruits of *Q. acutissima* somewhat resemble those of *Q. macrocarpa* (bur oak). *Quercus acutissima* can be distinguished from *Castanea* by the presence of the two or more clustered buds at the tips of the twigs (*Castanea* species generally do not have clustered buds at their branch tips) and from *Q. muehlenbergii* by its leaves with green lower surfaces (the leaves of *Q. muehlenbergii* are glaucous on the lower surface). It can be distinguished from *Q. macrocarpa* by its smaller acorns that have caps with long, reflexed scales (at most, its acorns are about half the size of those of *Q. macrocarpa*) and by its prominently toothed leaves with elongate bristle tips at the apex of the lobes (the leaves of *Q. macrocarpa* are deeply pinnately lobed and the lobes lack an elongated bristle tip). ***Habitat***: disturbed sites and waste places, hilly areas and slopes, fields, pastures, and riparian zones.

Quercus virginiana Mill. (Fig. 122).



Quercus virginiana (live oak) is a medium-sized to large, evergreen tree to 35 m tall that is native to the Gulf and East coasts of the USA, from Louisiana and Texas to North Carolina and Virginia (Nixon 1997b). It apparently is not native to Arkansas (Nixon 1997b). This species has been documented as escaped in Arkansas from four counties in the southern one-half of the state. It should be expected elsewhere in the flora.

The small, thick, coriaceous and evergreen leaves of *Q. virginiana* distinguish it from other Arkansas oaks, with the exception of *Q. hemispherica* (laurel oak). *Quercus virginiana* can be distinguished from *Q. hemispherica* by its completely evergreen habit and leaves that are tomentose-pubescent on the lower surface (except shade leaves) and with at least a few stellate trichomes on the upper surface (*Q. hemispherica* is semi-evergreen to deciduous and its leaves are nearly glabrous to completely glabrous, sometimes with a few tufts of trichomes in the axils of the veins on the lower surface). ***Habitat***: disturbed sites and waste places, especially in the vicinity of cultivated individuals of the species; also riparian zones and roadsides.

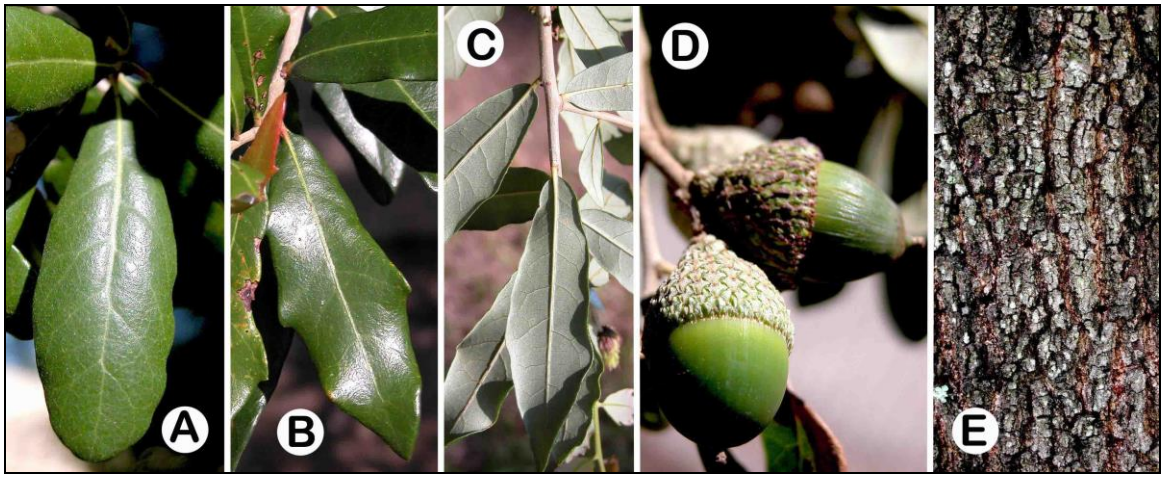


Figure 122. (A–E) *Quercus virginiana* plant and habit. (A–C) Leaves and stems. (D) Mature fruits. (E) Bark.

Rhamnus, Buckthorn, Rhamnaceae

Rhamnus is a genus of about 150 species of deciduous to occasionally semi-evergreen shrubs and trees distributed mostly over the Americas and Asia, with some species in Europe and Africa (Chen & Schirarend 2007a; Nesom & Sawyer 2016). The seeds of many species contain protein and oils and are used for the manufacture of lubricating oil, printing ink, and soap (Chen & Schirarend

2007a). Some species of *Rhamnus*, such as *R. cathartica* and *R. davurica*, are highly invasive in the USA; the production of large numbers of bird-dispersed fruits and high seedling recruitment contribute to their invasiveness.

Rhamnus cathartica L. (Fig. 124).

Rhamnus cathartica (European buckthorn, common buckthorn) is a deciduous, thorny shrub or small tree to 8 m tall that is native to Europe, Asia and northwestern Africa (Chen & Schirarend 2007a; Nesom & Sawyer 2016). It is naturalized and invasive in several states (Steury 2011; Nesom & Sawyer 2016; Weakley 2020). While presently not widespread in Arkansas, it has been documented from Washington County (Ogle et al. 2020), and should be expected elsewhere in the state, based on its invasive character.

Rhamnus cathartica was introduced to North America as an ornamental shrub and was originally used for hedges, farm shelterbelts, and wildlife habitat; it is an aggressive invader of woods and prairies and is able to completely displace native vegetation (Nesom & Sawyer 2016).

In Arkansas, the combination of thorns, particularly at the apex of most twigs, and opposite to mostly opposite leaves with sunken veins on the upper surface, distinguish *R. cathartica* from most other trees and shrubs. It, however, can be confused with its naturalized congener, *R. davurica* (Dahurian buckthorn). *Rhamnus cathartica* may be distinguished from *R. davurica* by its laminas that usually are 1–2 times as long as wide and typically widest at or below the middle, and fruits with 3–4 seeds (*R. davurica* has laminas usually 2–3 time as long as wide and widest at or above the middle, and fruits with only two seeds). ***Habitat***: disturbed sites and waste places, woodland edges, greenbelts, riparian zones and riverbanks, floodplains, ravines, fields, fencerows, and roadsides.

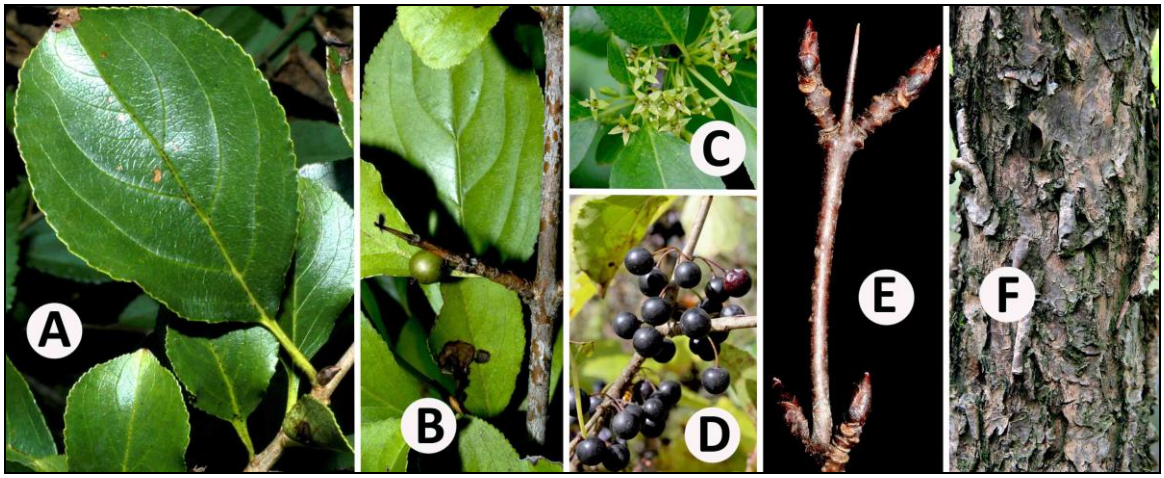


Figure 124. (A–F) *Rhamnus cathartica* plant and habit. (A) Leaves. (B) Thorn. (C) Flowers. (D) Mature fruits. (E) Twig with thorn (notice the position of the thorn at the shoot apex). (F) Bark. Photo credits: A–B, E: John Seiler, Virginia Tech University; C, F: Robert Vidéki, Doronicum Kft., Bugwood; D: Chris Evans, University of Illinois, Bugwood.

Rhamnus davurica Pallas subsp. **davurica** (Fig. 125).

Rhamnus davurica (Dahurian buckthorn) is a deciduous, thorny shrub or small tree to 10 m tall that is native to China, Korea, Mongolia, and Russia (Chen & Schirarend 2007a; Nesom & Sawyer 2016). It is naturalized in several eastern states (Hauenschild et al. 2016; Nesom & Sawyer 2016; Weakley 2020), including Arkansas, where it has been documented from Washington County (Ogle et al. 2020). Based on its invasive habit, *R. davurica* should be expected elsewhere in the state.

Plants of *R. davurica* from the USA flora sometimes have been identified as

subsp. *nipponica*; the type from Japan; however, it is not clear whether they are correctly identified or even whether they are outside the range of variability in subsp. *davurica* (Nesom & Sawyer 2016).

In Arkansas, as with *R. cathartica*, the combination of thorns and opposite to mostly opposite leaves with sunken veins on the upper surface distinguish *R. davurica* from most other shrubs and trees. However, the native *Frangula caroliniana* (Carolina buckthorn) and *Rhamnus lanceolata* (lanceleaf buckthorn) morphologically are similar to *R. davurica*, particularly the leaves and overall growth form. *Rhamnus davurica* can be distinguished from *F. caroliniana* and *R. lanceolata* by its oppositely-arranged leaves (the phyllotaxy of both *F. caroliniana* and *R. lanceolata* is alternate). ***Habitat***: disturbed sites and waste places, woodland edges, urban greenbelts, riparian zones, and floodplains.

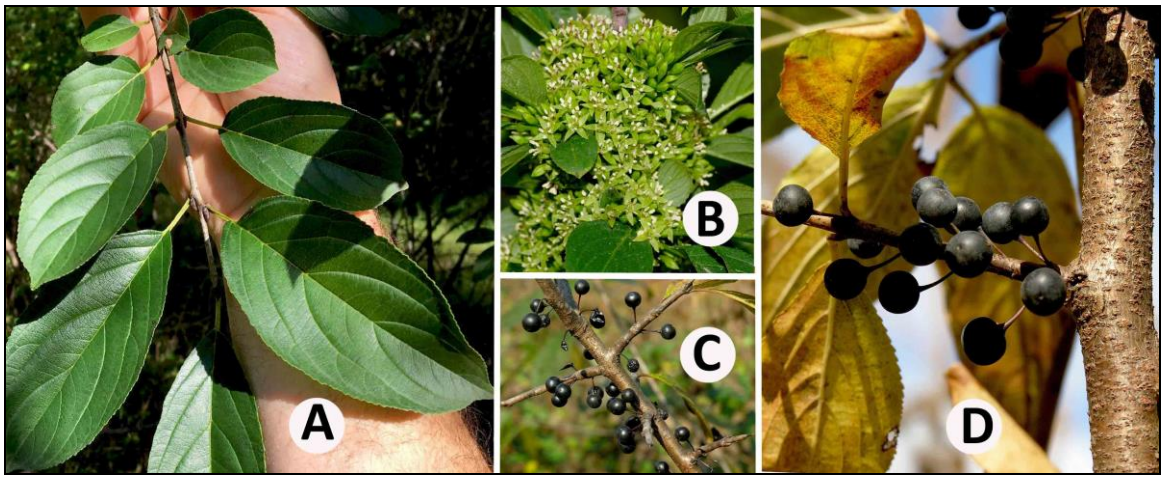


Figure 125. (A–D) *Rhamnus davurica* plant and habit. (A) Leaves. (B) Flowers. (C) Thorn spur branches and mature fruits. (D) Young bark and mature fruits. Photo credits: A: Samual Royer, SEINet; B–D: Will Cook, Carolina Nature.

Rhaphiolepis, Indian or Yedda Hawthorn, Rosaceae

Rhaphiolepis is a small genus of about 15 species of evergreen shrubs of Asiatic origin (Bailey & Bailey 1976; Gu & Spongberg 2003). Two species: *R. indica* and *R. umbellata*, along with their interspecific hybrid *R. ×delacourii*, are used as ornamentals in warm-temperate areas for their showy flowers and glossy, evergreen foliage.

Rhaphiolepis indica (L.) Lindl. (Fig. 123).

Rhaphiolepis indica (Indian hawthorn) is a medium-sized, evergreen shrub or occasionally a small tree to 4 m tall that is native to Asia (Bailey & Bailey 1976; Griffiths 1992; Gu & Spongberg 2003). It has been documented as escaped in Arkansas from Clark County via the presence of numerous seedlings and small plants in the vicinity of cultivated plants of the species (Fig. 169D–E). Although presently not an established component in the flora, it should be expected elsewhere in the state outside of cultivation, based on its regular use as an ornamental and production of large numbers of seeds that are at least in part bird-dispersed.

In warm-temperate regions, this species sometimes is cultivated as an ornamental for its showy flowers and evergreen habit. *Rhaphiolepis indica* is not treated in Phipps (2014) or Weakley (2020), and it is not attributed to the USA flora by Kartesz (2015) or USDA, NRCS (2021). Keener

et al. (2021) lists it for Alabama. Kartesz (2015) and Weakley (2020) list *R. umbellata*, a morphologically similar species, for a few southeastern states.

In Arkansas, *R. indica* could be confused with *Crataegus brachyacantha*) (blueberry hawthorn); however, it can be distinguished by the absence of thorns (*C. brachyacantha* has short, curved thorns on its stems). *Rhaphiolepis indica* also potentially could be confused with some of the larger species of *Vaccinium* (blueberry). It may be distinguished from most species of *Vaccinium* by its larger, thick-leathery, coarsely toothed leaves, and flowers with petals that mostly are separate. *Vaccinium* species, contrastingly, have smaller, more membranous leaves (*V. arboreum* has coriaceous leaves) with mostly entire margins or with smaller, less prominent teeth, and flowers with clearly united petals that form a vase-shaped corolla tube. ***Habitat***: disturbed sites and waste places, especially in the vicinity of cultivated plants of the species.

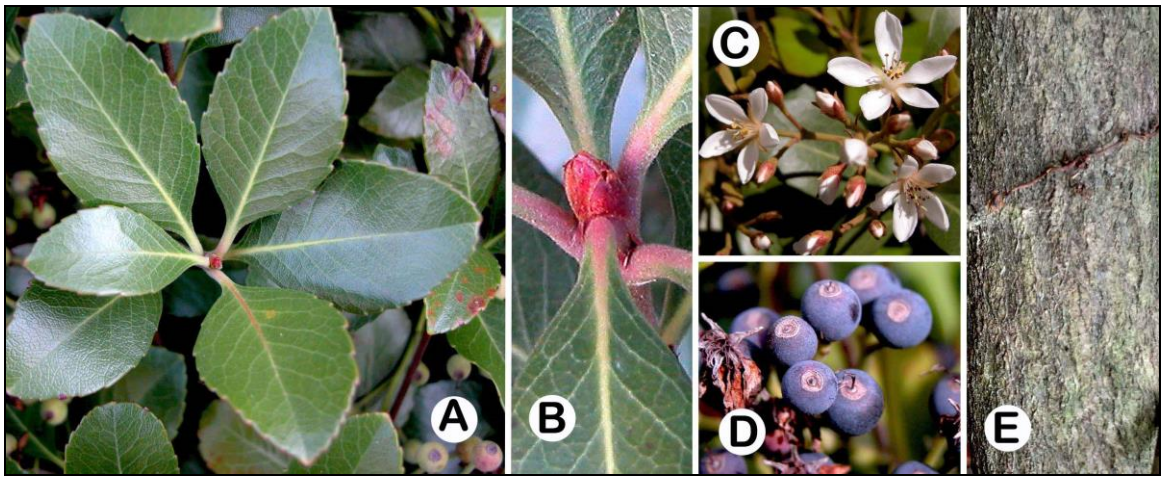


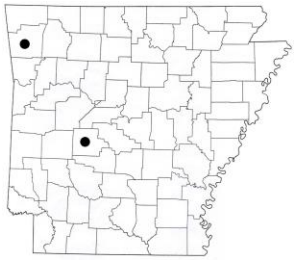
Figure 123. (A–E) *Rhaphiolepis indica* plant and habit. (A) Leaves. (B) Leaves and buds. (C) Flowers. (D) Mature fruits. (E) Bark.

Rhodotypos, Jetbead, Rosaceae

Rhodotypos is a monotypic genus native to East Asia (Li et al. 2003; Henrickson 2014). The single species, *R. scandens*, is used as an ornamental and in Asia for medicinal purposes (Li et al. 2003b).

Rhodotypos scandens (Thunb.) Makino (Fig. 126).

Rhodotypos scandens (black jetbead) is a deciduous shrub to 3 m tall that is native to China, Japan, and Korea (Krüssmann 1978; Li et al. 2003b; Henrickson 2014). It has been documented from a number of eastern states in the USA, including Arkansas (Gentry et al. 2013; Henrickson 2014; Serviss et al. 2015; Weakley 2020), where it is known from Garland and Washington counties. It is used occasionally as an ornamental for its large, showy flowers and unusual clusters of pea-sized, lustrous, black fruits. It is an attractive, easily cultivated shrub in a moist, semi-shade environment.



This species reproduces via both seed production and air layering of stems, the latter of which results in the production of clonal offsets, to establish naturalized populations. The unusual fruit of *R. scandens* is drupe-like during development, but dries at maturity while retaining a shiny, smooth exocarp; it can be considered a modified drupelet (Henrickson 2014).

In Arkansas, vegetatively, *R. scandens* closely resembles the rare native shrub *Neviusia alabamensis* (Alabama snow wreath); however, it can be distinguished from *N. alabamensis* by its opposite leaves, solitary flowers with four, large petals, and black fruits. In contrast, *N. alabamensis* has alternate leaves, flowers that lack petals and are generally clustered in groups of 3–8, and fruits

that are not black. ***Habitat***: disturbed areas, but often an understory species of moist slopes and stream sides.

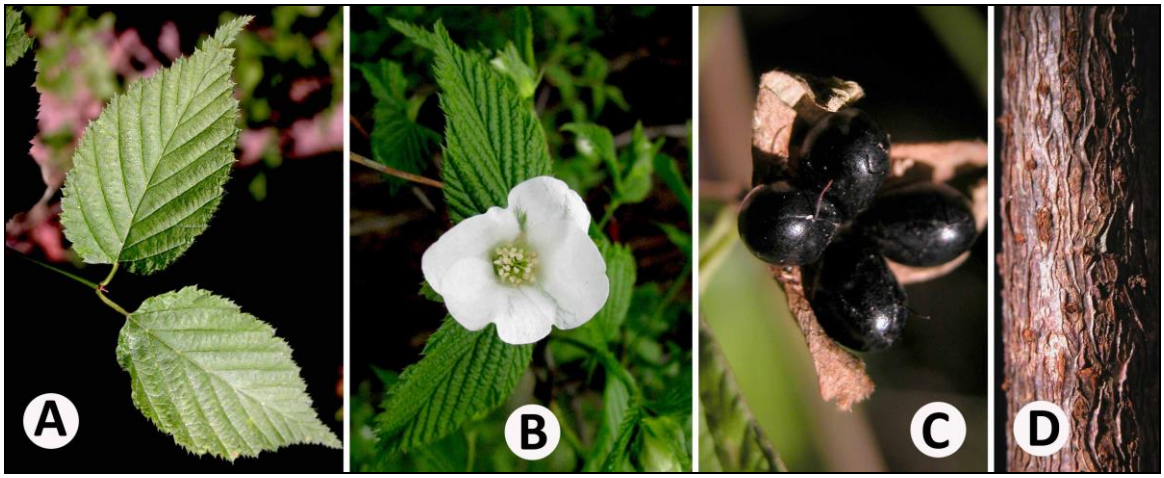


Figure 126. (A–D) *Rhodotypos scandens* plant and habit. (A) Leaves. (B) Flower. (C) Fruit and seeds. (D) Bark. Photo credit: B: Leslie J. Mehrhoff, University of Connecticut, Bugwood.

Rhus, Sumac, Anacardiaceae

Rhus is a genus of about 35 species of aromatic, deciduous shrubs and small trees distributed primarily over warm-temperate regions of Eurasia and the Americas (Miller et al. 2001). Some species of *Rhus* occasionally are cultivated for their colorful, intense red, orange, and yellow autumn foliage.

There are five species of *Rhus* in Arkansas; all, with the possible exception of *R. typhina*, are native. The native *R. trilobata*, along with *R. typhina*, are rare (in Arkansas), each only having been documented from a single county (Peck & Serviss 2011; Ogle et al. 2020). The remaining three species are relatively widespread in the state.

The flowers of *Rhus* species are highly attractive to several species of bees, wasps, and flies (Hilty 2002), and the persistent fruits are eaten by several types of birds (Hunter 1995). The foliage is browsed by rabbits and deer (Hunter 1995). Many species of *Rhus* form extensive thickets or colonies of plants via an invasive, suckering root system, and as a consequence, are sometimes used for soil stabilization and erosion control, although they are somewhat difficult to eradicate once established.

Species of *Rhus* have alternate, ternately compound or once pinnately compound leaves with lobed, toothed, or entire leaflets and imperfect (unisexual) and usually some perfect (bisexual) flowers on the same plant (*Rhus* are polygamodioecious — individual plants mostly have only staminate or pistillate flowers present, but also with a few that are perfect) arranged in terminal, often many-flowered, paniculate inflorescences. The fruit is a small, dry, pubescent, drupe.

Rhus typhina L.; Syn.: *R. hirta* (L.) Sudw. (Fig. 127).

Rhus typhina (staghorn sumac) is a colonial, deciduous shrub or small tree to 10 m tall that is native to the central and eastern USA (Hardin & Phillips 1985; Yatskievych 2006; Kartesz 2015; Weakley 2020). Its status as native or introduced to Arkansas is unclear; regardless, it is rare, having only been documented from Pulaski County (Peck & Serviss 2011). *Rhus typhina* also occasionally is cultivated in Arkansas, and plants can spread from sites of cultivation via an invasive, suckering root system; it should be expected elsewhere in the state.

Two morphologically distinct and highly ornamental forms of *R.*

typhina: 'dissecta' and 'laciniata' sometimes are cultivated and occasionally escape (currently not documented from the flora in Arkansas). They are similar in most respects to wild-type *R. typhina*, with the exception of the leaves that are 1–2 times compound with pinnatisect leaflets that give the plant a "fern-like" appearance. Variety 'laciniata' differs from var. 'dissecta' by having deeply incised bracts in the inflorescence (Krüssmann 1978; Yatskievych 2006).

Rhus typhina may be distinguished from the native *Rhus* species, and other morphologically similar woody species, such as *Ailanthus altissima* (tree-of-heaven), *Pistacia chinensis* (Chinese pistachio), and *Sapindus drummondii* (western soapberry) that occur in Arkansas, by the dense indument of long-pilose trichomes that cover its stems, leaves (petiole and rachis), and inflorescences. The trichomes give the thick stems a "velvety" appearance that is reminiscent of developing antlers in deer and elk — hence, the common name of staghorn sumac. ***Habitat***: disturbed sites and waste places, greenbelts, and riparian zones.

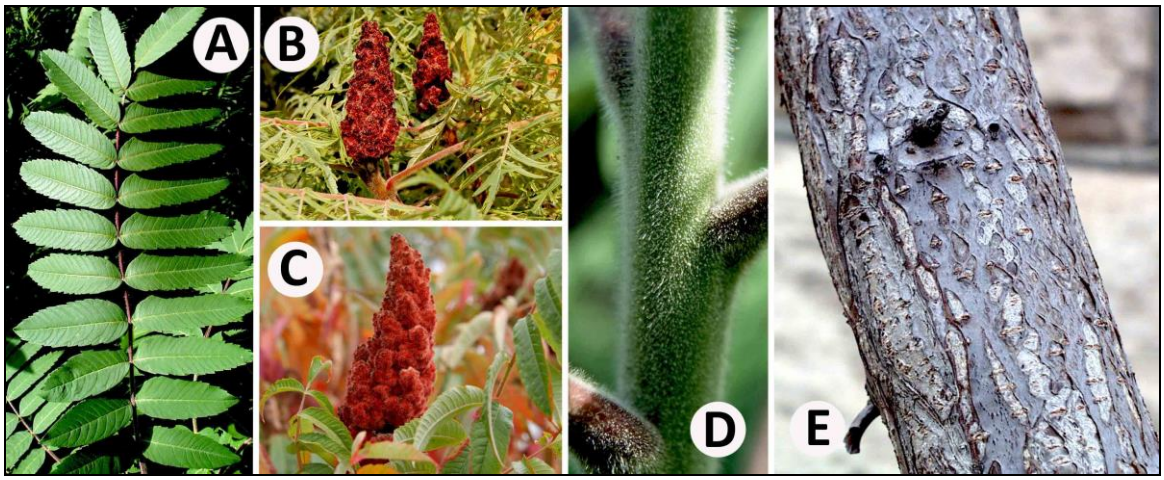


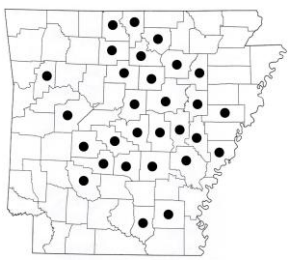
Figure 127. (A–E) *Rhus typhina* plant and habit. (A) Leaves and leaflets. (B–C) Mature fruits. (D) Stem with long, pilose trichomes. (E) Bark. Photo credits: A, E: Paul Wray, Iowa State University, Bugwood; B: Dow Gardens, Bugwood; C: Robert Vidéki, Doronicum Kft., Bugwood; D: T. Davis Sydnor, The Ohio State University, Bugwood.

Ricinus, Castor Bean, Euphorbiaceae

Ricinus is a monotypic genus native to tropical Africa (Krüssmann 1978; Gillespie 2016). The single species, *R. communis*, is cultivated and naturalized in subtropical and tropical regions worldwide.

In tropical regions (mainly Brazil and India), the species is widely cultivated for its seed oil. Castor oil is used in cosmetics, medicines, paints, plastics, and lubricants (Moshkin 1986a, 1986b; Gillespie 2016). The use of castor oil in traditional medicine dates at least from ancient Egyptian times (Frohne & Pfander 1984). Castor oil also is used worldwide for a variety of medicinal purposes, most commonly as a laxative and for skin ailments (Moshkin 1986a; Gillespie 2016).

Ricinus communis L. (Fig. 128).



Ricinus communis (castor bean, castor oil plant) is a small, evergreen tree to 12 m tall (Krüssmann 1978; Gillespie 2016a). It is cultivated and well-naturalized in the southeastern USA (Gillespie 2016a), including Arkansas, where it has been documented from several counties.

It is cultivated as an ornamental for its showy, "tropical-looking" foliage, and a number of horticultural forms exist for the species. Anthocyanic plants sometimes are encountered that have leaves, stems, flowers, and fruits that are maroon or reddish-purple in coloration. As *R.*

communis is not cold-tolerant, it only occurs as an annual in Arkansas, reaching heights of 1.5–4 m, but dying with the onset of freezing periods incurred during fall or winter months (plants possibly could perennate in southern Arkansas during extremely mild winters). Persistence in the flora from year to year is via seeds. Regular cultivation of *R. communis* has undoubtedly contributed to its naturalization in Arkansas and elsewhere.

Ricinus communis is highly toxic to people, animals, and even insects. The seeds contain particularly high levels of a protein known as ricin (Burrows & Tyrl 2001; Gillespie 2016a), which is poisonous, and small doses can be highly toxic to humans and animals (Burrows & Tyrl 2001). Symptoms of ricin poisoning usually include abdominal pain, vomiting, diarrhea, dehydration, and in some instances, death (Burrows & Tyrl 2001). The seeds of *R. communis* are beige-brown to reddish-orange and mottled with darker black, brown, or reddish coloration. They somewhat resemble pinto beans in size and coloration. The shape and overall appearance of the seeds also is reminiscent of engorged ticks after feeding.

In Arkansas, the combination of large, deeply palmately lobed leaves with prominent petiolar glands, nodes with prominent ring-shaped stipular scars, and red to purple bristly capsules distinguish *R. communis* from all other woody plants in Arkansas. ***Habitat***: disturbed sites and waste places, woodland edges, riparian zones, urban greenbelts, and roadsides.

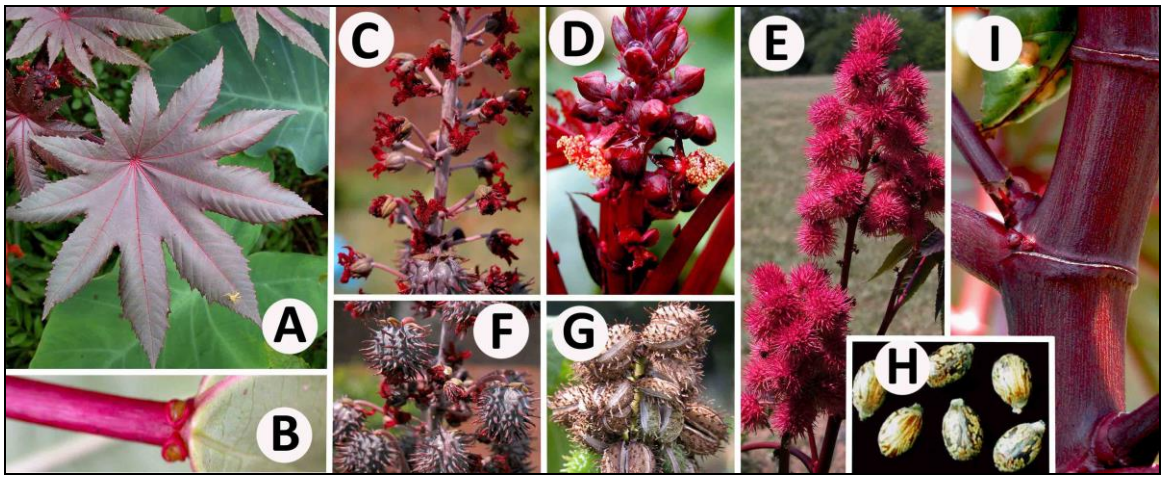


Figure 128. (A–I) *Ricinus communis* plant and habit. (A) Leaves. (B) Petiolar glands. (C) Pistillate flowers and inflorescence. (D) Staminate flowers and inflorescence. (E–G) Mature fruits. H. Seeds (notice the resemblance to pinto beans). (I) Stem.

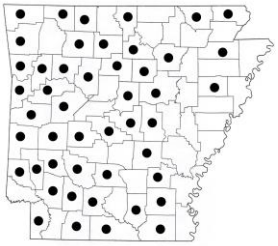
Robinia, Locust, Fabaceae

Robinia is a small, North American genus of about 5–8 species (and additional hybrid taxa) of large, deciduous shrubs and trees (Krüssmann 1978; Isely & Peabody 1984; Isely 1998; Weakley 2020). The Southern Appalachians are a center of diversity of the genus, with active hybridization, introgression, and formation of local (sterile) races involved (Weakley 2020). All species are cultivated for ornamental purposes for their showy and sometimes highly fragrant flowers, and for erosion control because of their ability to form dense colonies via an invasive, suckering root system. As a result, their ranges in the USA have increased substantially, particularly westward. Most of the species (if not all) also have been introduced, with some subsequent naturalization, in Europe and Asia (Isely 1998; Sun & Bartholomew 2010; Yatskievych 2013). Four species of *Robinia* occur in the Arkansas flora, but it is unclear as to whether or not *R. hispida*, *R. hartwigii*, and *R. viscosa* are native to the state or have been introduced from their presumed native ranges east of the Mississippi River.

Species of *Robinia* have alternate, once pinnately compound leaves with numerous leaflets, and perfect (bisexual), showy, white or variously pink-colored flowers that are produced in elongate, pendent or sub-erect axillary inflorescences. The fruit is a dry, flattened, few-seeded legume. The

stems of *Robinia* species generally are characterized by stout, paired stipular spines that subtend the leaves; the combination of stipular spines and once pinnately compound leaves distinguish *Robinia* from other woody genera in Arkansas.

Robinia hispida L. var. **hispida** (Fig. 129).



Robinia hispida (bristly locust) is a deciduous, colonial shrub or small tree to 4 m tall or possibly more (Isely 1998). It is native to the eastern USA, probably east of the Mississippi River (Isely 1998), but is well-naturalized in Arkansas, occurring in all but a few counties. Originally, it likely was brought into the state for ornamental purposes, and subsequent naturalization probably was mostly via vegetative colonization. *Robinia hispida* has an aggressive habit of suckering from the roots, and large colonies of plants may be produced over time.

This species is variable and polymorphic and is separated into about five morphologically distinct varieties that differ primarily on the basis of density and presence or distribution of trichomes, leaflet size, and ability to produce fruits (plants are either fertile or essentially sterile, reproducing mostly or exclusively vegetatively; Isely & Peabody 1984; Isely 1998). The mostly sterile triploid forms of *Robinia hispida* var. *hispida* are the most widespread for the species in the USA (Isely 1998). Only var. *hispida* currently is known from Arkansas. If it ever occurs, fruit production in Arkansas material of *R. hispida* is rare.

The flowers of *R. hispida* and other species of *Robinia* are highly attractive to many species of bees (Hunter 1995; Hilty 2002). The dense indument of hispid trichomes may be used to deter insect herbivory and inhibit the ability of ants to access (steal) nectar, as the calyx and pedicels of the inflorescences also are densely hispid.

Robinia hispida may be distinguished from the other *Robinia* species in the state by the dense indument of long-hispid, trichomes that cover its stems, leaves (except the leaflets), peduncles and branches of inflorescences, and fruits (if produced). The other *Robinia* species lack these trichomes. ***Habitat***: waste places and disturbed sites, open woods, woodland edges, thickets, pastures, fencerows, prairies, bluffs and hillsides, and roadsides.

Robinia viscosa (clammy locust; Fig. 130) and *R. hartwigii* (Hartwig's locust) both are documented in Arkansas from multiple counties in the Ouachita Mountains (Brent Baker, Pers. Comm., 2021). Both species are native to the Appalachian region of Tennessee and the Carolinas, but

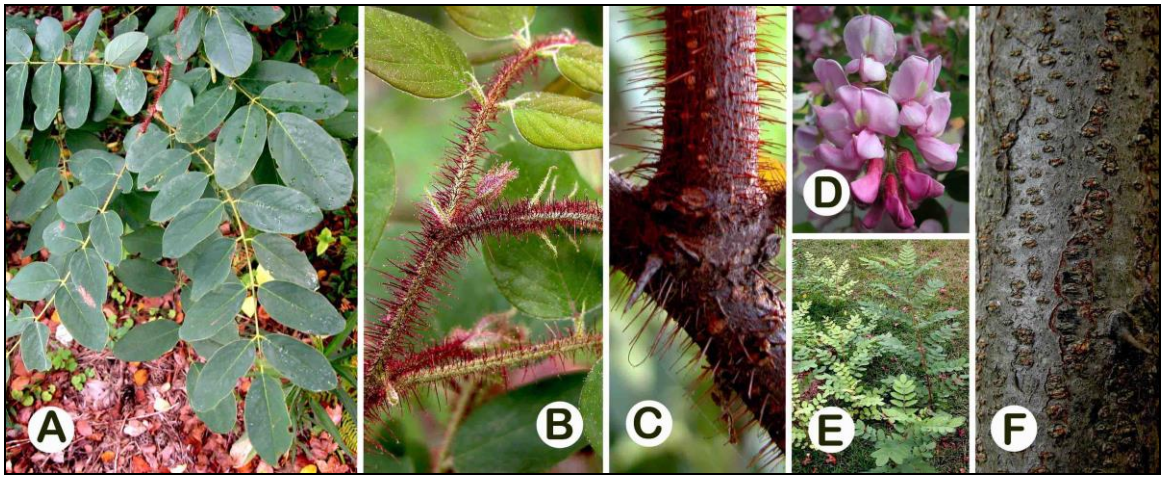


Figure 129. (A–F) *Robinia hispida* plant and habit. (A) Leaves and leaflets. (B–C) Young and older stems with long, hispid trichomes (notice the prominent stipular spines in Fig. C). (D) Flowers and inflorescence. (E) Root suckers. (F) Bark.

possibly have been introduced sporadically westward (Isely & Peabody 1984; Isely 1998; Weakley 2020). It is plausible that one or both species, however, also may be native to western Arkansas, representing disjunct occurrences from their larger ranges farther east (Ogle et al. 2020; Weakley 2020).

Robinia viscosa and *R. hartwigii* are similar to *R. hispida* in many respects; however, may be distinguished from *R. hispida*, in addition to lacking the long-hispid trichomes, by their often larger mature size, densely glandular-viscid (*R. viscosa*) or glandular pubescent stems, petioles, and peduncles, and leaves generally with (13–)15–21(–25) leaflets. *Robinia hispida*, in contrast, is a shrub or small tree (to 4 m tall), not glandular, and generally has leaves with 9–13(–15) leaflets).

Several interspecific hybrid taxa, of both natural and horticultural origin, exist between various combinations of the four *Robinia* species, and these may be encountered in cultivation or persisting from it. All have pink-colored flowers and vary as to mature size, precise shade of flower color, and degree of pubescence and glands, making identification somewhat difficult. At present, none of these hybrids have been documented outside of cultivation in Arkansas, although they are present in the floras of several other states.

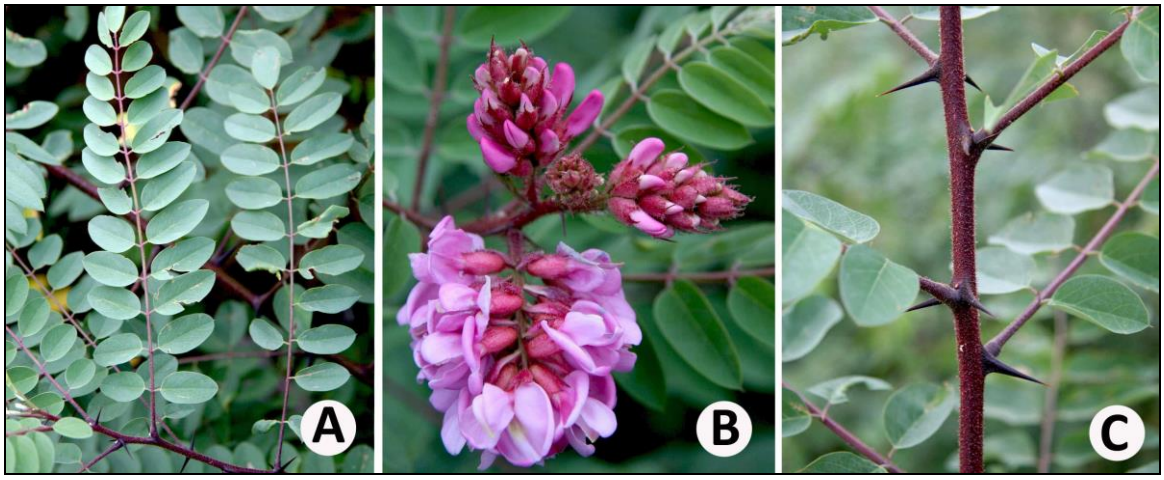


Figure 130. (A–C) *Robinia viscosa* plant and habit. (A) Leaves, leaflets, and stem (notice the leaves have more than 15 leaflets). (B) Flowers and inflorescences. (C) Stem with stipular spines and glandular trichomes (notice the lack of long, hispid trichomes — compare to *Robinia hispida*, Fig. 129B–C). Photo credit: Robert Vidéki, Doronicum Kft., Bugwood.

Rosa, Rose, Rosaceae

Rosa is a genus of about 140–200 species of deciduous or evergreen shrubs and lianas that are distributed mostly over cool-temperate regions of the northern hemisphere (Gu & Robertson 2003; Lewis et al. 2015). Many species and hybrid taxa of *Rosa* are important as ornamentals for their showy, sometimes large and/or fragrant flowers (Krüssmann 1978: Phipps 2014b; Lewis et al. 2015). The genus also is well known for its extensive ability to hybridize, and both native and cultivated *Rosa* species are important in horticulture (Lewis 2008; Lewis et al. 2015; Lewis & Elvin-Lewis 2017). The fruits of several species are edible and eaten raw or used to make jellies, jams, and preserves (Lewis et al. 2015).

Arkansas species of *Rosa* generally are armed with prickles, helping to distinguish them from most other shrubs and vines in the flora; however, it is important to note that on a given plant, some or even most stems may be mostly to completely devoid of prickles. Species of *Rosa* easily are distinguished from other shrubs and vines in the state by the combination of their large, showy, sometimes fragrant flowers, imparapinnate compound leaves, and foliaceous stipules that are fused to the petiole, in addition to the armature of prickles on stems, leaves, and sometimes sepals. Numerous

types of prickles occur on *Rosa*, including pricklets, which are diminutive prickles present on petioles and rachises of leaves (Lewis 2015); more than one type often occurs on a single plant.

About 10 species of *Rosa* currently are known from the Arkansas flora, several of which are exotic. *Rosa multiflora* probably is the most widespread of the nonnative *Rosa* species in the state. It, along with *R. bracteata* and *R. lucieae*, are invasive.

Key to *Rosa* species:

1. Stipules mostly free from the petiole, united to the petiole only at their base.

2. Leaflets usually 3, rarely 5; stems glabrous ..... **Rosa laevigata**
2. Leaflets 5–11; stems tomentose-pubescent ..... **Rosa bracteata**

1. Stipules adnate to the petiole for one-half or more of their length.

3. Plant a shrub, more or less erect (some stems may be scandent or liana-like in *R. multiflora*); leaves membranous or coriaceous, dull or semi-lustrous; pedicels of flowers 0.5–1.2 cm, except *R. chinensis*, which has pedicels 2.5–6 cm.

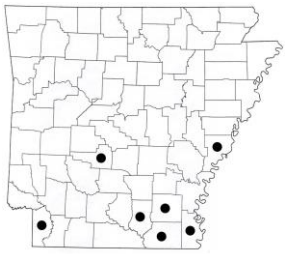
4. Leaflets pubescent with a dense indument of glands on the veins of the abaxial surface, sticky to the touch..... **Rosa rubiginosa**
4. Leaflets eglandular or sometimes with glands but then not sticky to the touch.

5. Leaflets 3–5; stipules linear, ciliate and glandular; flowers usually red or pink (rarely white); pedicels 2.5–6 cm..... **Rosa chinensis**
5. Leaflets 5–11, often 9; stipules not as above, pectinate; flowers white or rarely pink; pedicels 0.5–1.2 cm..... **Rosa multiflora**

3. Plant scandent and liana-like, climbing or prostrate along the ground; leaves coriaceous, lustrous on the adaxial surface; pedicels 1.8–2.5 cm..... **Rosa lucieae**

Rosa bracteata J.C. Wndl. (Fig. 131).

Rosa bracteata (McCartney rose) is an evergreen shrub to 3 m tall that is native to China and Taiwan (Gu & Robertson 2003). This species is well-naturalized and invasive in the southeastern USA (Lewis et al. 2015; Weakley 2020), including Arkansas, where it occurs in seven southern counties.



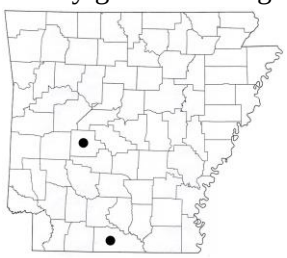
In addition to its overall invasive tendency, *R. bracteata* tends to form dense thickets where established (Lewis et al. 2015). *Rosa bracteata* has large, solitary or clustered 2–3, white flowers that are 5–7.5 cm in diameter that are subtended by 6–8 laciniate, imbricate bracts, pubescent foliage (stems and leaves), leaves with five to nine leaflets, and large prickles that often are paired.

In Arkansas, the combination of multiple, imbricate bracts, stipules that attach to the petiole only at the base, and tomentose-pubescent stems with large, small bristle-like, and glandular prickles help to distinguish *R. bracteata* from other species of *Rosa*. ***Habitat***: disturbed sites and waste places, woodland edges, fencerows, pastures, ditches, and roadsides; also sometimes in wet soils.

Rosa laevigata Michx. (Fig. 132).

Rosa laevigata (Cherokee rose) is a scandent, climbing, liana-like shrub that is native to China and Taiwan (Gu & Robertson 2003). It is naturalized across the southeastern USA (Lewis et al. 2015; Weakley 2020) and known in Arkansas from Garland and Union counties. This species has large, white, solitary (or rarely paired) flowers (about 7 cm in diameter), generally large prickles, and

usually glabrous foliage. The fruits are orange and pear-shaped with elongate, bristle-like trichomes. The leaves typically have three leaflets, though occasionally may have five.



In addition to climbing trees and other vegetation, *R. laevigata* sometimes forms dense, rhizomatous thickets. Its stems can reach a length of at least 10 m (Lewis et al. 2015).

The combination of leaves with only three leaflets and dense indument of prickles covering the pedicel and hypanthium aids in distinguishing *R. laevigata* from other species of *Rosa* in Arkansas. ***Habitat***: disturbed sites and waste places, woodland edges, pastures, fencerows, and roadsides.

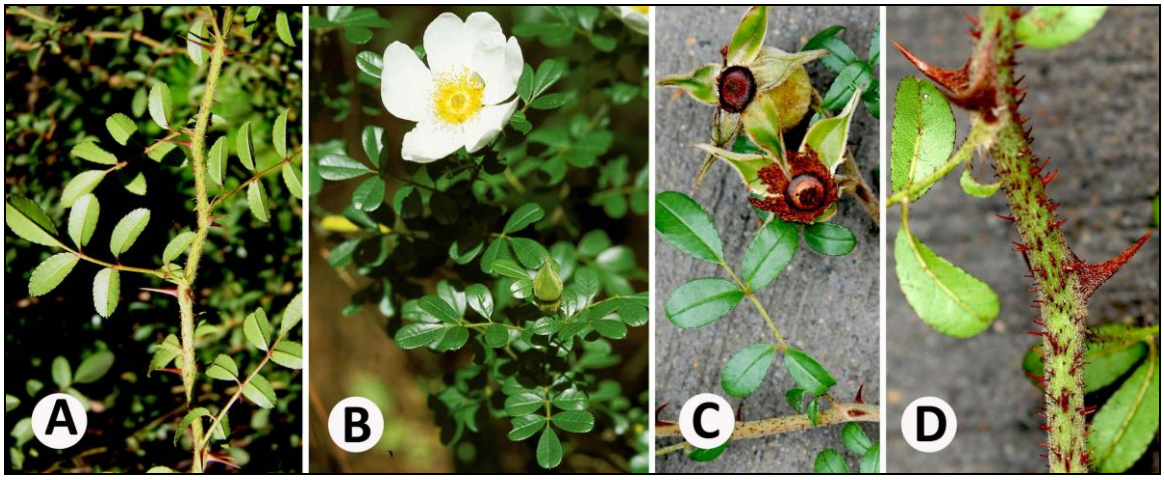


Figure 131. (A–D) *Rosa bracteata* plant and habit. (A) Leaves and stem. (B) Flower. (C) Fruits and leaf. (D) Stem with prickles (notice the combination of both large and smaller, bristle-like prickles). Photo credits: A: Karan A. Rawlins, University of Georgia, Bugwood; B–D: James H. Miller, USDA Forest Service, Bugwood.

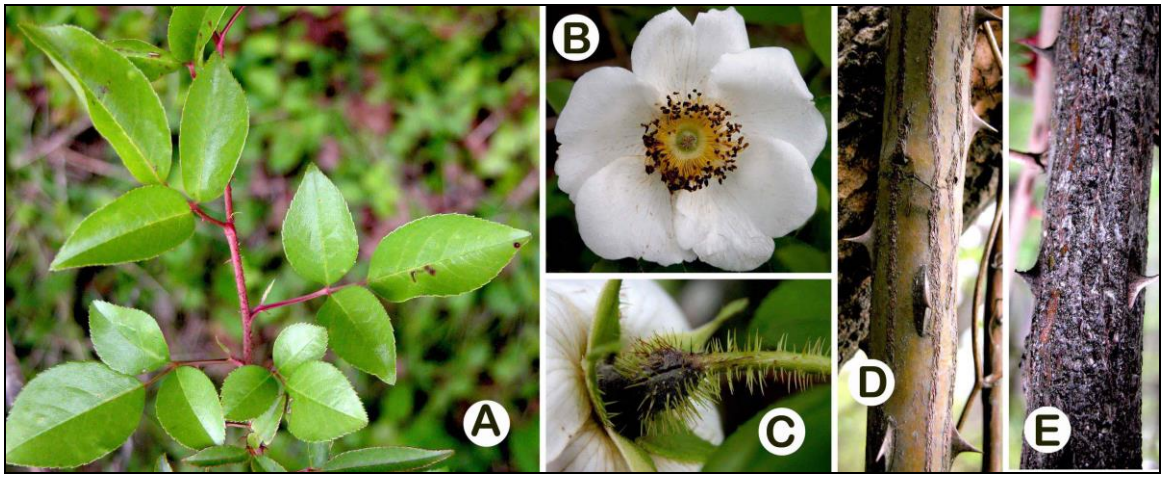
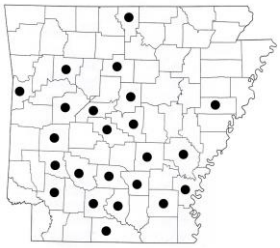


Figure 132. (A–E) *Rosa laevigata* plant and habit. (A) Leaves and stem (notice the leaves are ternately compound). (B) Flower. (C) Ovary and pedicel (notice the prominent, bristle-like prickles on the pedicel and ovary; this, along with the mostly ternately compound leaves, aids in distinguishing *R. laevigata* from most other *Rosa* species in the state). (D) Stem with prickles. (E) Bark.

Rosa lucieae Franch. and Rocheb. ex Crépin; Syn. *R. wichuraiana* Crépin (Fig. 133).

Rosa lucieae (memorial rose) is a semi-evergreen, trailing or climbing liana from 2.5–5 m in length that is native to Korea, China, and Japan (Krüssmann 1978; Gu & Robertson 2003). It is

naturalized in several states in the eastern USA (Lewis et al. 2015; Weakley 2020), including Arkansas, where it occurs in several counties.



Naturalized plants of *R. lucieae* often occur as the "double-flowered" form, with more than five petals; however single and double flower forms occur and flower color can range from white to pale or dark pink. *Rosa lucieae* cultivars and hybrids have been used widely in breeding rambler and climbing roses. Its creeping stems extend to six meters in length and root readily, forming a white- or pink-petaled ground cover for gardens and cemeteries, and along highways where it serves to stabilize verges (Lewis et al. 2015).

Rosa lucieae is distinct from the native *Rosa* species in Arkansas by its lianitic habit. The one exception is *R. palustris* (swamp rose), which is a shrub that sometimes produces long, scandent or trailing, liana-like stems. *Rosa lucieae* can be distinguished from *R. palustris* by its glossy, thick, semi-evergreen foliage and dark red prickles (at times, the prickles also can be pale yellow-green in color). *Rosa palustris*, in contrast, has pale, dull green leaves and generally tawny or grayish-colored prickles. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, woodland edges, flood plains and bottomlands, prairies, pastures, fields, fencerows, and roadsides.

Rosa chinensis Jacq. (Chinese rose) has been attributed to the Arkansas flora previously (Gentry et al. 2013), although much of the Arkansas material considered *R. chinensis* probably is rather *R. lucieae* (Ogle et al. 2020). *Rosa chinensis* is a small, erect, evergreen shrub to 2 m tall that is native to China (Gu & Robertson 2003). This species has reddish-pink to pink or rarely white flowers that are about 5 cm in diameter. The flowers often have more than five petals, which gives rise to the "doubled" flowers condition commonly seen in many cultivated types of roses. This species has glabrous foliage, leaves with three to five leaflets, and stems that are generally armed with only a few prickles; sometimes prickles are absent.

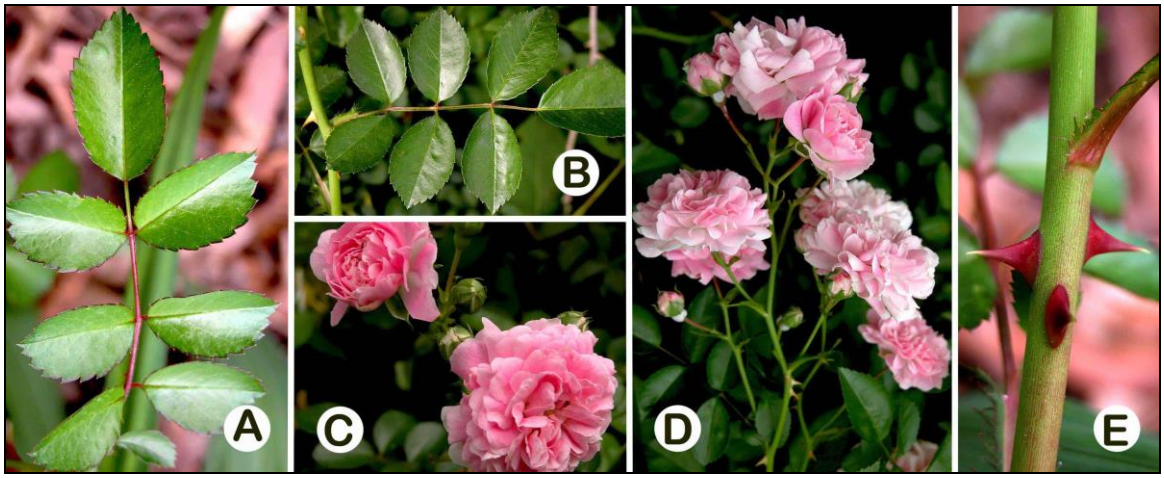
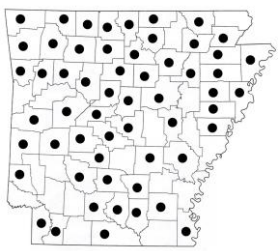


Figure 133. (A–E) *Rosa lucieae* plant and habit. (A–B) Leaves and stem. (C–D) Flowers and inflorescence (flowers can range in color from white to dark, reddish-pink). (E) Stem with prickles.

Rosa multiflora Thunb. (Fig. 134).

Rosa multiflora (multiflora rose, Japanese rose) is a large shrub, often climbing via scandent stems to 10 m in length that is native to Korea and Japan (Gu & Robertson 2003). *Rosa multiflora* is naturalized and invasive over much of the continental USA (Lewis et al. 2015; Weakley 2020), including Arkansas (Gentry et al. 2013), where it occurs essentially statewide. It commonly is observed along woodland edges, greenbelts, fencerows, and disturbed sites. It also is frequent in cultivation.



The presence of prickles is variable with this species; stems can range from being moderately prickly to having prickles essentially absent. Flower color also is somewhat variable, ranging from white (typical) to shades of pink. The USDA Forest Service has indicated that *R. multiflora* is a major conservation issue in 31 states (Banasiak & Meiners 2009).

Rosa multiflora can be distinguished from the native *Rosa* species by its multi-flowered inflorescences and laciniate stipules. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, thickets, riparian zones, stream sides, prairies, pastures, fields, fencerows, and roadsides.

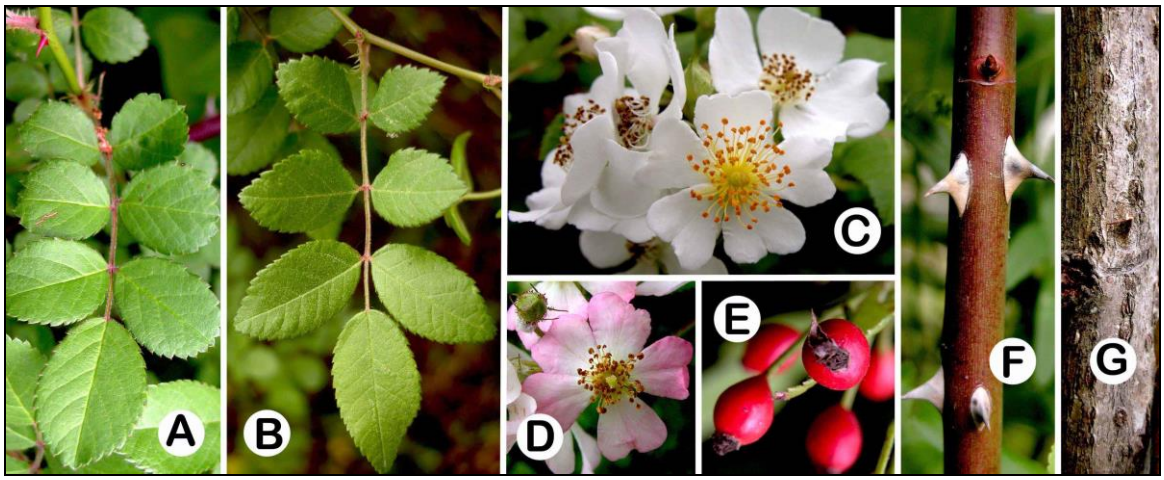


Figure 134. (A–G) *Rosa multiflora* plant and habit. (A–B) Leaves, stipules, and stem (notice the pectinate stipules in Fig. B). (C–D) Flowers. (E) Mature fruits. (F) Stem with prickles. (G) Bark.

Rosa rubiginosa L.; Syn. *R. eglanteria* L. (Fig. 135).

Rosa rubiginosa (sweetbrier rose, eglantine rose) is a shrub to 3 m tall that is native to Europe and Asia (Lewis et al. 2015; Weakley 2020). It is naturalized across much of the continental USA (Lewis et al. 2015; Weakley 2020), including Arkansas, where it is known from several scattered counties. This species has bright pink flowers (to about 5 cm in diameter) in clusters of one to three, pubescent and glandular leaves with three to nine leaflets, and scarlet-red fruits that are round to ovoid in shape.

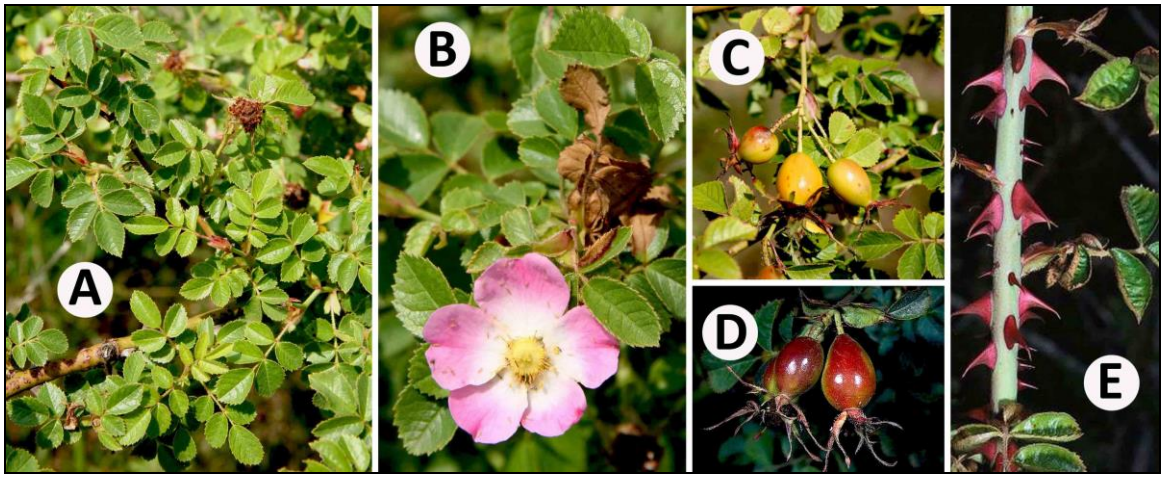
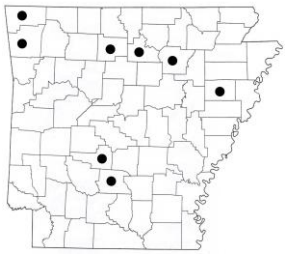


Figure 135. (A–E) *Rosa rubiginosa* plant and habit. (A) Leaves. (B) Flower. (C–D) Fruits. (E) Stem with prickles (notice that more than one kind of prickle is present and that many of the larger prickles are arranged in pairs). Photo credits: A–C: Robert Vidéki, Doronicum Kft., Bugwood; D–E: Joseph M. DiTomaso, University of California, Davis, Bugwood.

Rosa rubiginosa plants are compact, upright shrubs without rhizomes that have a somewhat unique combination of characteristics: including stems with stout, falcate infrastipular prickles mixed with internodal prickles, aciculi, and glandular setae, and leaflet blades that are densely viscid-glandular with margins that are biserrate of multi-serrate with stipitate glands (Lewis et al. 2015).



In Arkansas, the aforementioned combination of characteristics, along with the pattern of conspicuously paired prickles on the stems and apple-scented, densely viscid-glandular leaflets, aid in distinguishing *R. rubiginosa* from most other species of *Rosa*. Sometimes prickles are produced on the fruits. ***Habitat***: disturbed sites and waste places, woodland edges, thickets, fencerows, and roadsides.

Salix, Willow, Salicaceae

Salix is a large genus of about 450 species of deciduous shrubs and trees distributed mostly over temperate and boreal regions worldwide (Argus 2010). Nine species of *Salix* occur in the Arkansas flora, all of which, with the exception of *S. alba* and *S. babylonica*, are native. Morphologically, many of these species are similar and careful examination of plants, especially dried specimens, is essential for proper identification.

Salix species have simple, alternate, toothed, generally narrow leaves, and small, imperfect, yellow-colored flowers. The fruit is a narrow capsule and the seeds have a coma of trichomes allowing for effective wind dispersal.

Salix alba L. (Fig. 136).

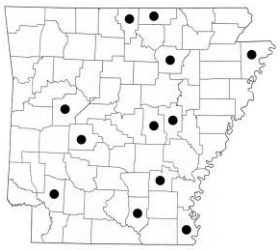
Salix alba (white willow) is a large tree to 25 m tall that is native to Europe (Krüssmann 1978; Fang et al. 1999; Argus 2010). This species is naturalized in many states in the northern one-half of the continental USA (Argus 2010), and has been documented in Arkansas from Carroll County. Additionally, it is naturalized in Alabama, Missouri, Tennessee, and Texas (Argus 2010; Kartesz 2015; Weakley 2020), most of which border Arkansas; it should be expected elsewhere in the state, especially the northern portions.

Salix alba, as with many other species in the genus, prefers moist habitats. In addition to highly disturbed sites, it should be expected in Arkansas along creeks, rivers, pond and lake margins, and other wet habitats.

In Arkansas, *S. alba* could be confused with the native arborescent *Salix* species: *S. caroliniana* (Carolina willow), *S. exigua* (sandbar willow), and *S. nigra* (black willow); the remaining species in the flora are shrubs. *Salix alba* may be distinguished from both *S. exigua* and *S. nigra* by its leaves with white to glaucous lower surfaces (the leaves of both *S. exigua* and *S. nigra* are green on the lower surface), and from *S. caroliniana* by its lanceolate stipules and petiolar glands (the stipules of *S. caroliniana* are rounded and the petiole lacks glands in proximity to the base of the lamina).

Salix babylonica L. (Fig. 137).

Salix babylonica (weeping willow) is a large deciduous tree to 25 m tall that is presumed to have originated in China (Fang et al. 1999; Argus 2010). It has been documented from a number of southern states (Argus 2010; Weakley 2020), including Arkansas, where it occurs outside of cultivation in several, scattered counties. This species regularly is used as a specimen tree for its unusual, aesthetically-pleasing, weeping growth form.



Taxonomic treatments of *S. babylonica* are variable (Argus 2010). Some botanists recognize a single species, including both pendulous and nonpendulous forms, whereas others recognize four species: *S. babylonica*,

with a weeping habit, *S. capitata*, *S. pseudolasiogyne*, and the commonly cultivated *S. matsudana*, with an erect or spreading habit (Fang et al. 1999; Argus 2010). Argus (2010) treated *S. babylonica* in a narrow sense, including only weeping forms. In North America, however, cultivated trees with strongly pendulous branches and branchlets have been identified as *S. babylonica* (Argus 1985, 1986, 1993), but many are hybrids with *S. alba* (*S.* × *sepulcralis*) or *S. euxina* (*S.* × *pendulina*) (Argus 2010).

In Arkansas, the elongate, pendulous branches of *S. babylonica* distinguish it from other *Salix* species. ***Habitat***: disturbed sites and waste places.

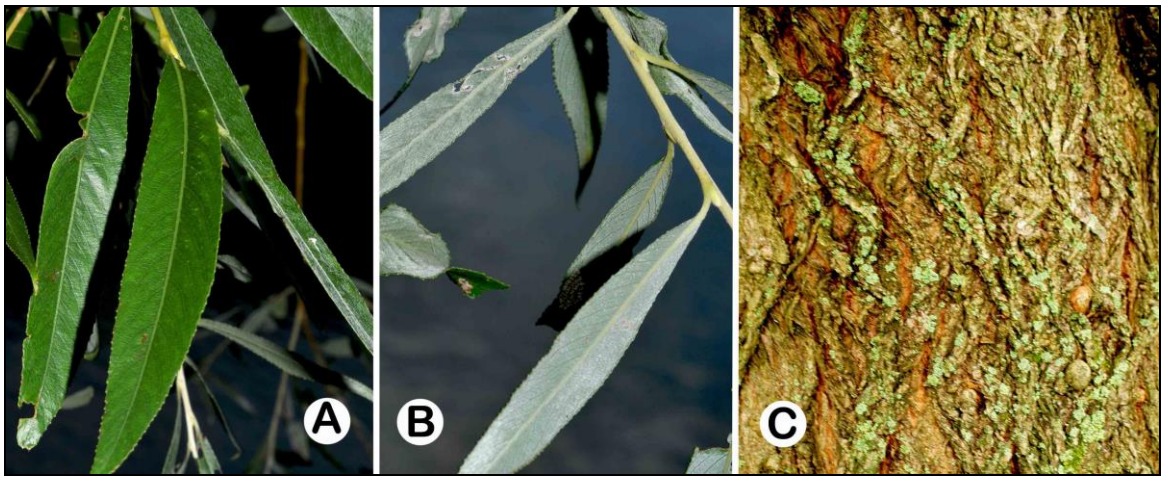


Figure 136. (A–C) *Salix alba* plant and habit. (A–B) Leaves and stem. (C) Bark. Photo credit: John Seiler, Virginia Tech University.

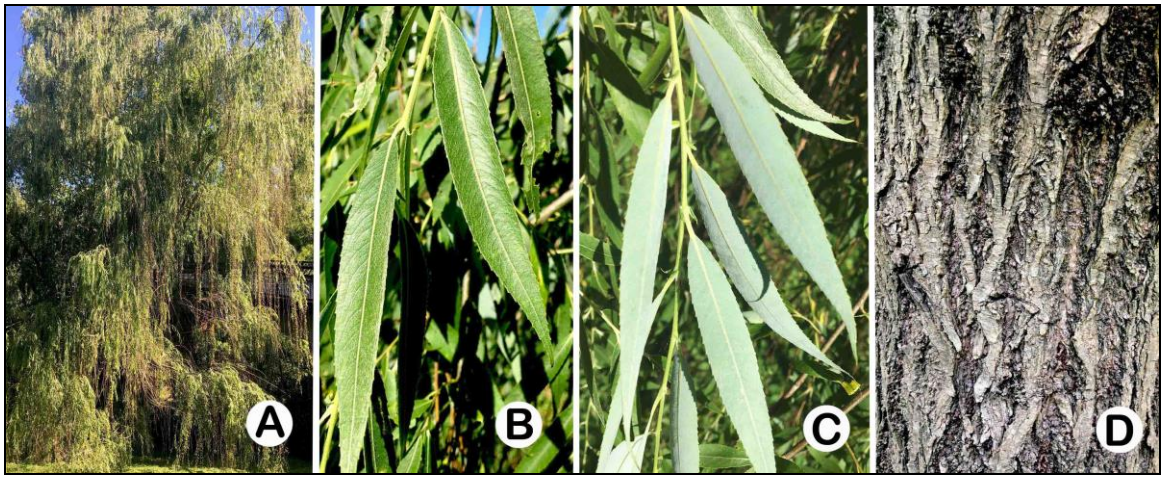


Figure 137. (A–D) *Salix babylonica* plant and habit. (A) Plant showing weeping growth form. (B–C) Leaves and stem. (D) Bark.

Senna, Cassia or Senna, Fabaceae

Senna is a large genus of about 240 species of herbs, shrubs, and small trees distributed over warm-temperate to tropical latitudes mostly in the Americas (Isely 1998).

Senna corymbosa (Lam.) Irwin and Barn.; Syn.: *Cassia corymbosa* Lam. (Fig. 138).

Senna corymbosa (Argentine senna, rainbow-shower plant) is a deciduous to semi-evergreen shrub to 3 m tall that is native to Argentina, Brazil, and Uruguay and is sparingly naturalized in the southeastern USA, from Texas eastward to South Carolina (Isely 1998; Diamond & Woods 2009;

Weakley 2020). In Arkansas, it has been documented in Clark County as spontaneous juveniles produced in the vicinity of cultivated plants of the species (Fig. 169I). *Senna corymbosa* self-seeds and spontaneous seedlings often are observed in the vicinity of cultivated plants of the species, particularly on highly disturbed sites with exposed soil.

Senna corymbosa is a prized ornamental for its showy clusters of golden-yellow flowers that are produced in late summer and early fall. The flowers are attractive to a variety of insect pollinators, particularly bees and butterflies. It is one of the few "cold-hardy" species in the genus that may be grown in warm-temperate regions (most woody species of *Senna* are frost tender and will not persist in climates where exposed to seasonal freezing temperatures). Some forms of *S. corymbosa* are cold-tolerant at least as far north as zone 8, which includes much of southern Arkansas. Plants may regrow from the roots if above ground portions are killed by freezing temperatures, and seeds also remain viable after exposure to freezing. This species sometimes is referred to as "Texas senna," even though it is not native to the USA.

In Arkansas, *S. corymbosa* may be distinguished from other shrubs by its parapinnate compound leaves that have only 4–8 leaflets and pendant, pale green, long-cylindric fruits. A conspicuous gland on the rachis between the lowermost pair of leaflets gives the leaves a malodorous odor when bruised or crushed. ***Habitat***: disturbed sites and waste places, particularly in the vicinity of reproductive age plants of the species.

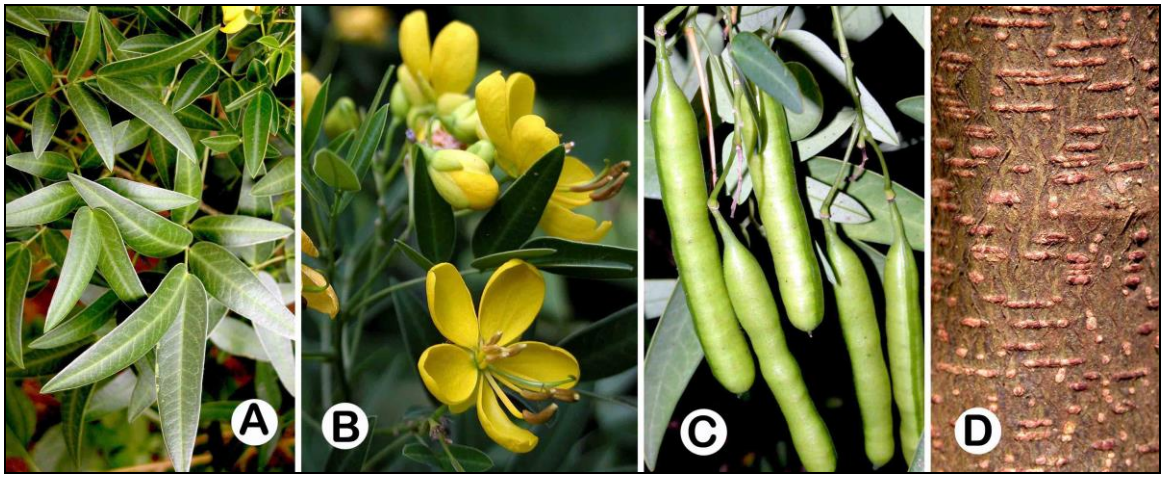


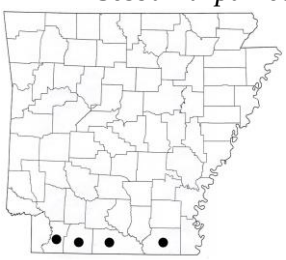
Figure 138. (A–D) *Senna corymbosa* plant and habit. (A) Leaves. (B) Flowers. (C) Mature fruits. (D) Bark.

Sesbania, Rattlebox, Fabaceae

Sesbania is a genus of about 50 species of herbs, shrubs, and small trees distributed over warm-temperate to tropical regions worldwide (Isely 1998). A number of species, including *S. grandiflora* and *S. punicea*, are important as ornamentals for their large, showy flowers, and some, such as *S. exaltata*, are ruderals that have become common agricultural weeds.

Sesbania punicea (Ca.) Benth. (Fig. 139A).

Sesbania punicea (scarlet rattlebox) is a deciduous shrub or small tree to 5 m tall that is native to Brazil and Uruguay (Isely 1998). It is known in Arkansas from Ashley, Columbia, Lafayette, and Union counties. *Sesbania punicea* commonly is cultivated in the southern USA for its showy, scarlet to reddish-purple flowers and it is naturalized and invasive in moist to wet habitats in the southeastern USA (Godfrey & Wooten 1981; Siwundla & Stucky 1989; Isely 1998; Wunderlin & Hansen 2011; Weakley 2020;



Keener et al. 2021). It is likely more widespread in the Arkansas flora than current records indicate.

When dry, the seeds become loose in the fruits and a "rattle-like" sound may be produced when the fruits or plant is shaken. The seeds are highly poisonous to humans and many species of animals because of saponins and other toxic compounds (Burrows & Tyrl 2001). ***Habitat***: disturbed areas and waste places, riparian zones, pond margins, swamps, bottomlands, and roadside ditches.

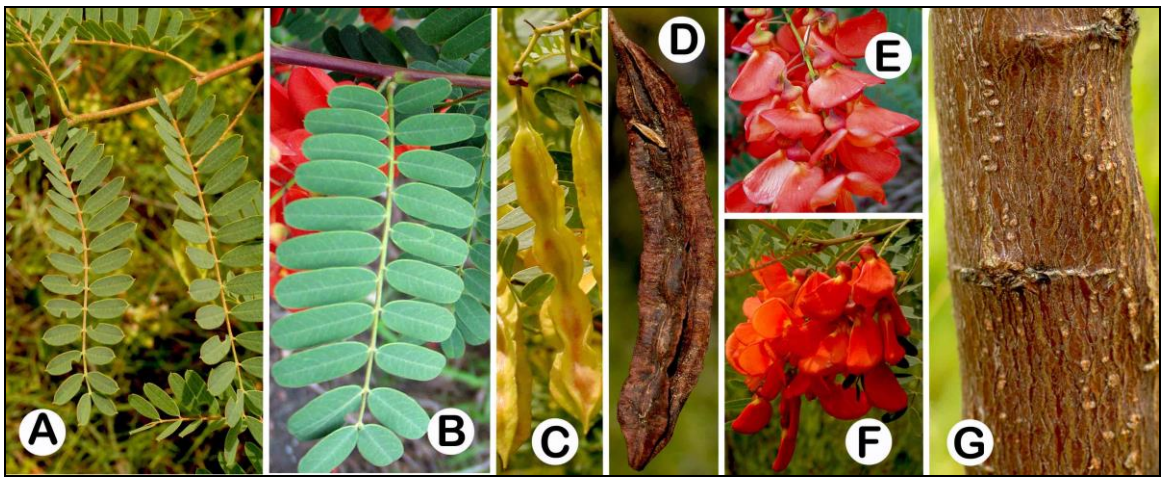


Figure 139A. (A–G) *Sesbania punicea* plant and habit. (A–B) Leaves and stem. (C–D) Mature fruits. (E–F). Flowers and inflorescence. (G) Young bark. Photo credit: John Seiler, Virginia Tech University.

With the exception of its native congener, *S. drummondii* (poison-bean, Drummond's rattlebox; Fig. 139B), which is somewhat more widespread in southern Arkansas, *S. punicea* may be distinguished from other woody plants in the Arkansas flora by its four-sided fruits with narrow wings present along the angles. *Sesbania punicea*, however, very closely resembles the native *S. drummondii*, which occurs in several counties in southern Arkansas. It can be distinguished from *S. drummondii* by its bright, orange-red to scarlet-red or reddish-purple-colored flowers (*S. drummondii* has yellow to pale yellowish-orange-colored flowers). Both species often form dense thickets, presumably through seedling recruitment. It is important to note, however, that these two species do sometimes hybridize when they occur together, and where the two species are contiguous,

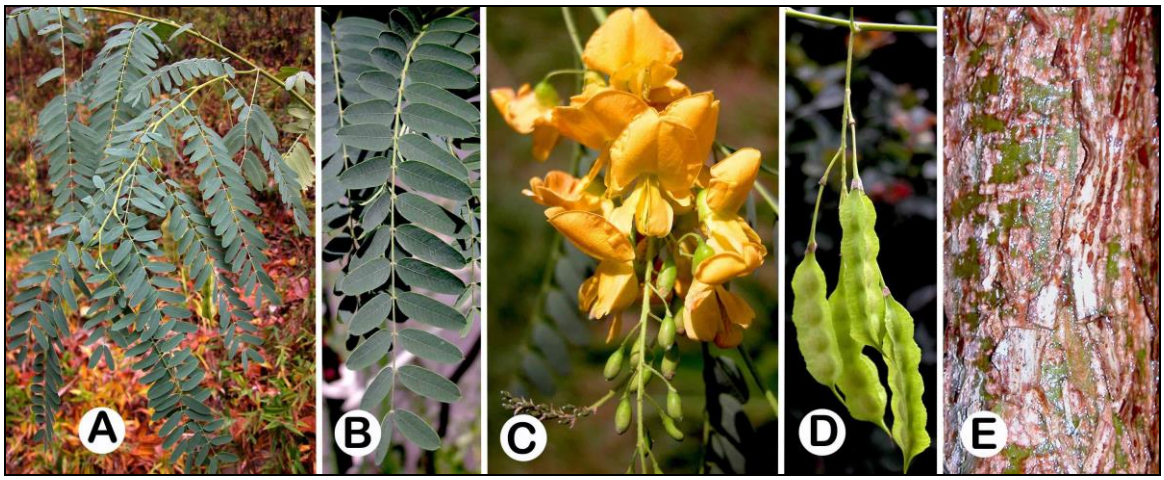


Figure 139B. (A–E) *Sesbania drummondii* plant and habit (for comparison with *S. punicea*; with the exception of flower color and subtle differences in fruit morphology, the two species almost are identical). (A–B) Leaves and stem. (C) Flowers and inflorescence. (D) Mature fruits. (E) Young bark.

introgression between them occurs and a number of intermediate phenotypes are known (Isely 1998). *Sesbania punicea* and *S. drummondii* sometimes are placed in the genus *Daubentonia*.

Spiraea, Bridal Wreath or Spirea, Rosaceae

Spiraea is a genus of 80–100 species of deciduous or occasionally semi-evergreen shrubs distributed across the northern hemisphere, but predominantly are Asiatic (Krüssmann 1978; Lu & Alexander 2003; Lis 2014). Species of *Spiraea* are prized as ornamentals for their profuse display of white or pink-colored flowers in early spring, cold hardiness, and ease of cultivation. Several nonnative species of *Spiraea* have become established to various degrees outside of cultivation in the USA. A number of horticultural hybrids have been developed among *Spiraea* species and hybridization also occurs in natural settings, complicating the identification of the species and varieties (Krüssmann 1978; Lis 2014).

The Arkansas flora has seven species of *Spiraea*; all with the exception of *S. tomentosa* are nonnative and established in the flora to various degrees. Many species of *Spiraea* form thickets or whole colonies of plants via air layering of stems and/or through the production of root suckers.

Species of *Spiraea* have alternate, simple, toothed or entire leaves and perfect (bisexual) flowers arranged in few to many-flowered, axillary or terminal inflorescences. The fruit is a small, dry follicle.

Key to *Spiraea* species:

1. Leaves narrow, linear to linear-lanceolate or lanceolate-elliptic..... **Spiraea thunbergii**
1. Leaves wider, ovate, obovate, elliptic, rhombic-ovate, or rhombic-lanceolate, sometimes lanceolate (*S. japonica*) or oblanceolate (*S. prunifolia*).

2. Inflorescence paniculate, pyramidal; flowers pink ..... **Spiraea x billiardii**
2. Inflorescence corymbose; flowers white to cream, usually pink in *S. japonica*.

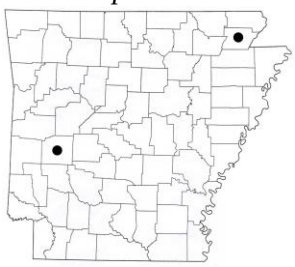
3. Plants not suckering; leaves glaucous-green, ovate, obovate, rhombic-ovate, or rhombic-lanceolate.

4. Leaves ovate, obovate, or rhombic-ovate ..... **Spiraea x vanhouttei**
4. Leaves rhombic-lanceolate ..... **Spiraea cantoniensis**

3. Plants suckering (*P. prunifolia*) or not (*P. japonica*); leaves green, ovate, elliptic, or lanceolate to oblanceolate.

5. Plants suckering and forming colonies; leaves ovate to elliptic or occasionally oblanceolate; inflorescences usually axillary, generally 3–6-flowered; flowers white ..... **Spiraea prunifolia**
5. Plants not suckering; leaves ovate to lanceolate; inflorescences mostly terminal, generally with 10 or more flowers; flowers usually pink, rarely white..... **Spiraea japonica**

Spiraea x billiardii Herinq. (Fig. 140).



Spiraea x billiardii (Billard's spirea) is a sterile, interspecific hybrid between *S. douglasii* and *S. salicifolia* that is of horticultural origin (Krüssmann 1978). It is naturalized in a number of states in the eastern USA, including Arkansas (Gentry et al. 2013; Kartesz 2015; Weakley 2020), where it has been documented from Greene and Montgomery counties. Although sexually sterile, *S. x billiardii* naturalizes via prolific suckering, through which large, clonal stands of the species can be established.

In Arkansas, *S. x billiardii* may be distinguished from other shrubs, including most other species of *Spiraea*, by its elongate, densely-flowered terminal panicles of rose-pink flowers. However, *S. x billiardii* morphologically is similar to and easily confused with its native congener, *S. tomentosa* (steeple bush). *Spiraea x billiardii* may

be distinguished from *S. tomentosa* by the mature leaves that are sparsely pubescent only on their lower surfaces (young leaves will be densely pubescent). Contrastingly, the lower leaf surfaces of *S. tomentosa* are white and densely tomentose-pubescent, with some trichomes brown or tawny-colored providing a brown hue. The two species are somewhat difficult to distinguish otherwise. ***Habitat***: waste places and disturbed areas, especially in the vicinity of where plants of the species are cultivated or where dumping of horticultural waste occurs.

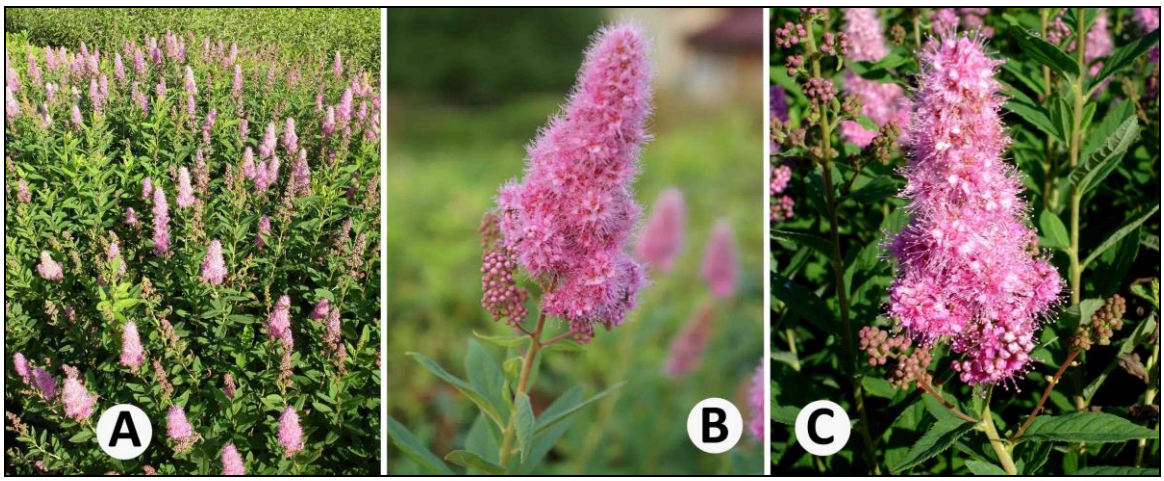
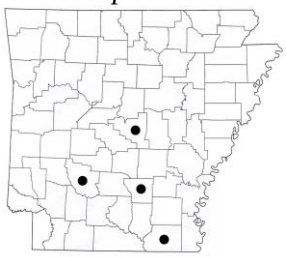


Figure 140. (A–C) *Spiraea ×billiardii* plant and habit. (A) Plants. (B–C) Flowers and inflorescence. Photo credit: Milan Havlis, Zahradnictví SAFRO.

Spiraea cantoniensis Lour. (Fig. 141).

Spiraea cantoniensis (Reeve's spirea) is a deciduous to semi-evergreen shrub to 2 m tall that is native to China and Japan (Krüssmann 1978; Lu & Alexander 2003; Lis 2014). It is naturalized in Arkansas, where it has been documented outside of cultivation from four counties scattered in the southern one-half of the state. *Spiraea cantoniensis* also is known from the floras of a number of states in the eastern USA (Lis 2014; Weakley 2020).



This species regularly is used as an ornamental for its showy, early springtime flowers, and is tolerant of high heat and drought once established. The "double-flowered" form is encountered more frequently in

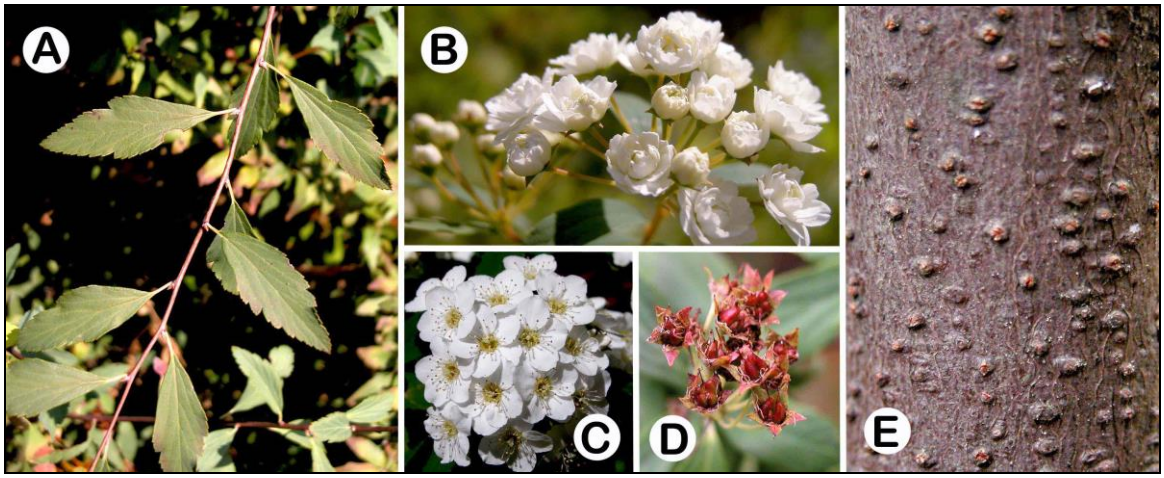


Figure 141. (A–E) *Spiraea cantoniensis* plant and habit. (A) Leaves and stem. (B–C) Flowers (Fig. B shows the "doubled" flower form). (D) Mature fruits. (E) Bark.

the flora than the wild-type form that has flowers with only five petals (Lis 2014).

Spiraea cantoniensis morphologically is similar to and easily confused with *S. ×vanhouttei* (Van Houtte's spirea). *Spiraea cantoniensis* may be distinguished from *S. ×vanhouttei* by its narrower, lanceolate to rhombic-lanceolate-shaped leaves, which are many times longer than wide (*S. ×vanhouttei* has broadly rhombic, rhombic-elliptic, ovate, or subrotund leaves that are about as long as wide). The two species are difficult to distinguish otherwise.

In Arkansas, *S. cantoniensis* may be distinguished from most shrub species by its leaves with glaucous, grayish-blue lower surfaces and numerous clusters of small white to pale cream-colored flowers (flowers often are "doubled") that regularly are produced along its stems. Most shrub species lack this combination of characteristics. ***Habitat***: disturbed sites and waste places, woodland edges, slopes, and roadsides; sometimes persisting from cultivation.

Spiraea japonica L. f. (Fig. 142).

Spiraea japonica (Japanese spirea) is a deciduous shrub to 1.5 m tall that is native to China, Japan, and Korea (Krüssmann 1978; Lu & Alexander 2003; Lis 2014). It is escaped in Arkansas, having been documented outside of cultivation in Madison County in the northwestern portion of the state (Gentry et al. 2013). This species is well-naturalized in several eastern states and is considered invasive (Vincent et al. 2011; Lis 2014; Kartesz 2015; Weakley 2020). It also is frequent in cultivation and should be expected elsewhere in Arkansas.

The species has been the source of many hybrids and cultivars that have been popular for gardens in temperate zones around the world (Lis 2014). A number of varieties and cultivars of *S. japonica* have become noxious weeds, primarily in wet sites and riparian areas (Lis 2014). In Tennessee, *S. japonica* is ranked as a significant threat to native species by the Tennessee Exotic Pest Plant Council (2009).

Spiraea japonica is highly variable in regard to leaf morphology, degree of pubescence, inflorescence size, and flower color, and as a result eight botanical varieties of *S. japonica* are recognized (Zhang et al. 2002; Lu & Alexander 2003; Zhang et al. 2006). It has been cultivated for centuries and thus a plethora of horticultural forms exist, including dwarf and low-growing or spreading varieties, variegated forms, and cultivars with yellow-green, red, or purple-colored leaves, and red, pink, or white-colored flowers.

In Arkansas, *S. japonica* potentially could be confused with its native congener, *S. tomentosa* (steeple bush, rosy meadowsweet); however, it may be distinguished from *S. tomentosa* by its flattened or dome-shaped inflorescences and leaves with green to pale glaucous-green lower surfaces.

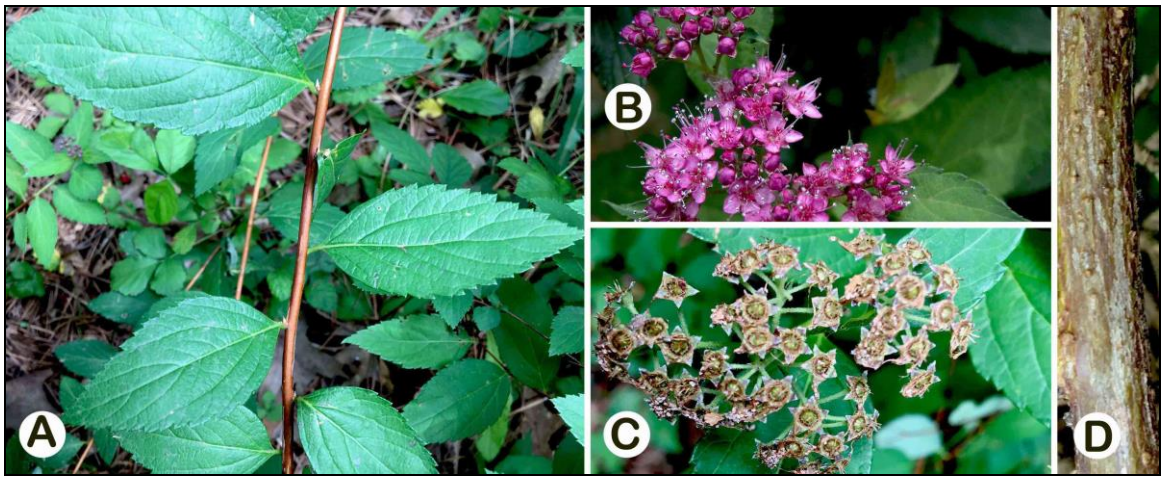
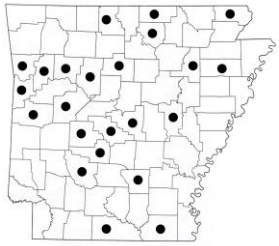


Figure 142. (A–D) *Spiraea japonica* plant and habit. (A) Leaves and stem. (B) Flowers. (C) Fruits. (D) Bark.

Contrastingly, *S. tomentosa* has narrow, elongate inflorescences and leaves that are white or whitish-brown on their lower surfaces with a dense indument of white and brown-colored tomentose trichomes. ***Habitat***: disturbed sites and waste places, open woods, woodland edges, riparian zones, old fields, and roadsides; sometimes persisting from cultivation.

Spiraea prunifolia Zab. (Fig. 143).



Spiraea prunifolia (bridal wreath spirea) is a deciduous shrub to 3 m tall that is native to China, Japan, and Korea (Krüssmann 1978; Lu & Alexander 2003; Lis 2014). It is naturalized in the eastern USA (Yatskievych 2013; Lis 2014; Kartesz 2015; Snow 2017; Weakley 2020), including Arkansas, where it occurs in several counties scattered across the state. *Spiraea prunifolia* is by far the most common species of *Spiraea* in the Arkansas flora. *Spiraea prunifolia* suckers prolifically from the roots, allowing it to establish vegetative colonies of plants.

The leaves of this species closely resemble the leaves of some species of *Prunus*; hence, the specific name of *prunifolia*. *Spiraea prunifolia* may be distinguished from smaller, shrubby species of *Prunus* by its dry, follicle fruits and its "doubled" flowers that have more than five petals (varieties or cultivars of *S. prunifolia* with five-petaled flowers are encountered less commonly in Arkansas). Species of *Prunus*, contrastingly, have fleshy, drupaceous fruits and flowers with only five petals.

The ovate to elliptic, glossy-green "plum-like" leaves with small, sharp, evenly spaced teeth, and long-pedicellate, "doubled" flowers help to distinguish *S. prunifolia* from other *Spiraea* species that are present in the Arkansas flora. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, woodland edges, cliffs and bluffs, thickets, riparian zones, old fields, and roadsides; often persisting and spreading from areas of cultivation.

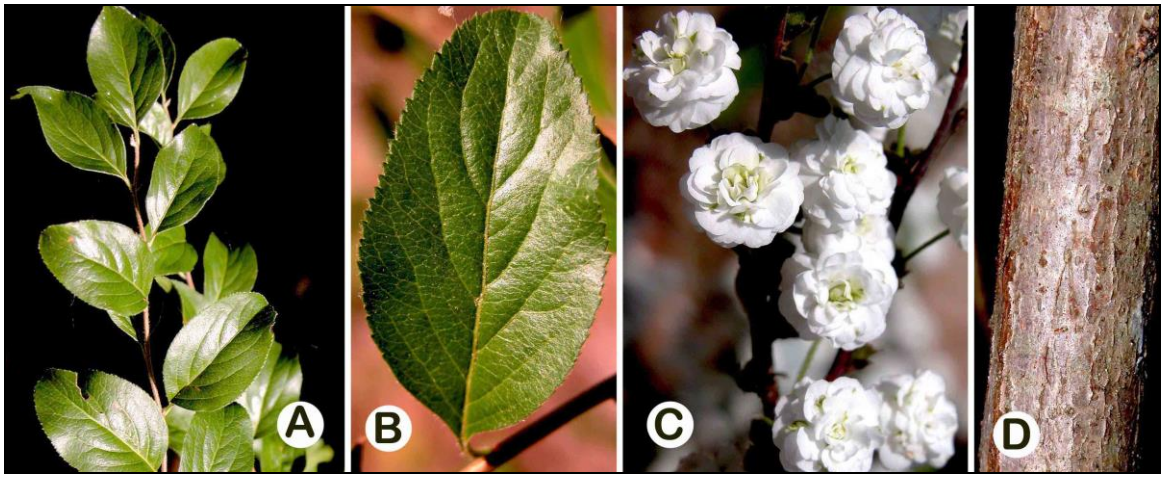
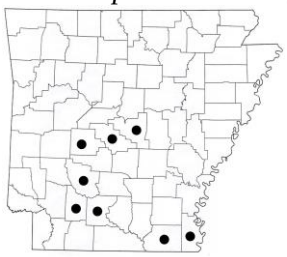


Figure 143. (A–D) *Spiraea prunifolia* plant and habit. (A–B) Leaves and stem. (C) Flowers. (D) Bark.

Spiraea thunbergii Sieb. ex Blume (including *S. ×arguta* Zab.). (Fig. 144).



Spiraea thunbergii (Thunberg's spirea, baby's breath spirea) is a deciduous shrub to 1.5 m tall that is native to China and Japan (Krüssmann 1978; Lu & Alexander 2003; Lis 2014). It is naturalized in Arkansas, where it has been documented from eight counties in the southern one-half of the state. *Spiraea thunbergii* also is known from the floras of a number of other eastern states (Lis 2014; Weakley 2020). This species, apparently, can thrive in a variety of soils and is persistent even in the presence of native vegetation, and although

established in a number of areas, it does not appear to spread aggressively or compete strongly with native species (Lis 2014).

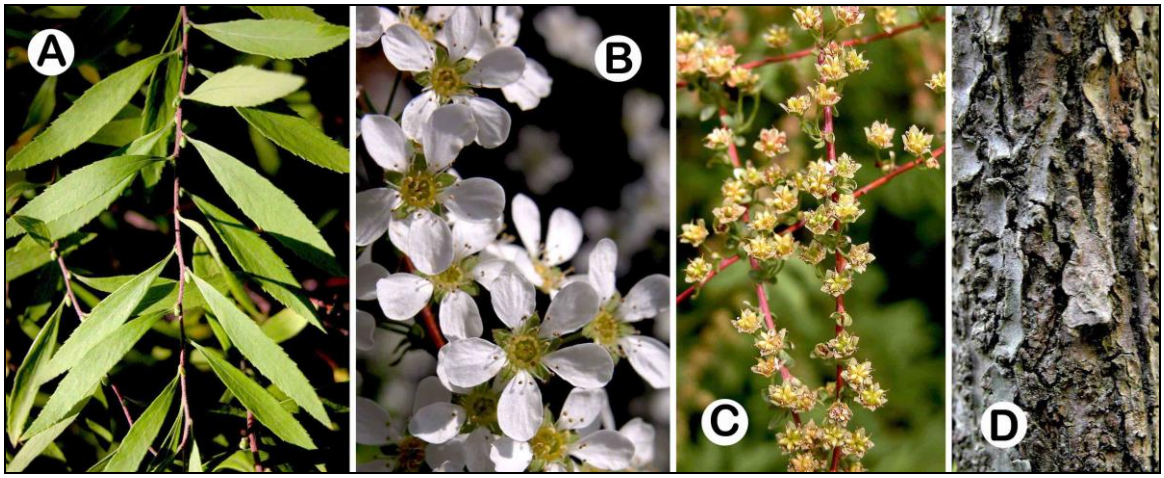


Figure 144. (A–D) *Spiraea thunbergii* plant and habit. (A) Leaves and stem. (B) Flowers. (C) Mature fruits. (D) Bark.

In Arkansas, *S. thunbergii* may be distinguished from other *Spiraea* species, along with most other shrubs, by its elongate and narrow, linear-lanceolate leaves that are only 3–7 mm wide. The profuse display of small (6–8 mm in diameter), bright white flowers on brown, leafless stems in early spring is distinctive and makes this species readily identifiable. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, woodland edges, thickets, riparian zones, old fields, and roadsides; often persisting and spreading from areas of cultivation.

Spiraea × arguta (baby's breath spirea, garland spirea) is an interspecific hybrid between *S. thunbergii* and *S. multiflora*, probably of horticultural origin. *Spiraea × arguta* and *S. thunbergii* are difficult to distinguish, and some Arkansas material designated a *S. thunbergii* may be *S. × arguta* instead — see key below to distinguish the two taxa.

1. Leaves linear-lanceolate, serrate along the entire length of the margin, 3–6 mm wide; stems noticeably branched ..... **Spiraea thunbergii**
1. Leaves oblong-obovate to oblong-oblanceolate or lanceolate, serrate or dentate only on the upper one-half to one-third of the margin, or margin completely entire, wider, 6–12 mm wide; stems generally elongate with little or no branching..... **Spiraea × arguta**

Spiraea × vanhouttei (Briot) Zab. (Fig. 145).

Spiraea × vanhouttei (Van Houtte's spirea, bridal wreath) is an interspecific hybrid between *S. cantoniensis* (Reeve's spirea) and *S. trilobata* (Asian meadowsweet) that is of horticultural origin (Krüssmann 1978; Lis 2014). It has been documented from the floras of several states, especially in the eastern USA (Lis 2014; Kartesz 2015; Weakley 2020). Although present in the USA flora and frequent in cultivation, its potential to become invasive apparently is minimal (Lis 2014). It has been documented as escaped in Arkansas from Clark County (Serviss, unpublished data), and could be expected outside of cultivation elsewhere in the state, especially in the vicinity of where plants of the species are cultivated. *Spiraea × vanhouttei* is considered one of the finest *Spiraea* for cultivation (Krüssmann 1978).

In Arkansas, *S. × vanhouttei* may be confused with the morphologically similar *S. cantoniensis* (see entry under *S. cantoniensis* for distinguishing traits between the two species).

Habitat: waste places, disturbed areas, and urban greenbelts, especially in the vicinity of where plants of the species are cultivated.

Figure 145. (A–D) *Spiraea ×vanhouttei* plant and habit. (A) Leaves and stem. (B) Flowers and inflorescence. (C) Mature fruits. (D) Bark.

Styphnolobium, Sophora or Pagoda Tree, Fabaceae

Styphnolobium (including *Sophora*) is a genus of about 40–70 species of herbs, shrubs, and trees that is distributed over temperate and tropical regions of both hemispheres (Isely 1998; Bao & Vincent 2010). Some species, such as *S. affine* and *S. japonicum*, are cultivated for their showy flowers and large, unusual fruits.

Styphnolobium japonicum (L.) Schott; Syn.: *Sophora japonica* L. (Fig. 146).

Styphnolobium japonicum (Japanese pagoda tree, Japanese sophora) is a medium-sized to large, deciduous tree to 25 m tall that is native to Korea and Japan (Bao & Vincent 2010). Although presently not known to occur outside of cultivation in Arkansas, it does have the potential to escape into the flora. *Styphnolobium japonicum* has been documented outside of cultivation in a few eastern states (Steury 2011; Zell 2012; Kartesz 2015). Considerable but localized seedling recruitment has been observed (by Serviss) in Mississippi and Oklahoma, with the production of numerous spontaneous and escaped juveniles produced from cultivated *S. japonicum* plants (Fig. 169K).

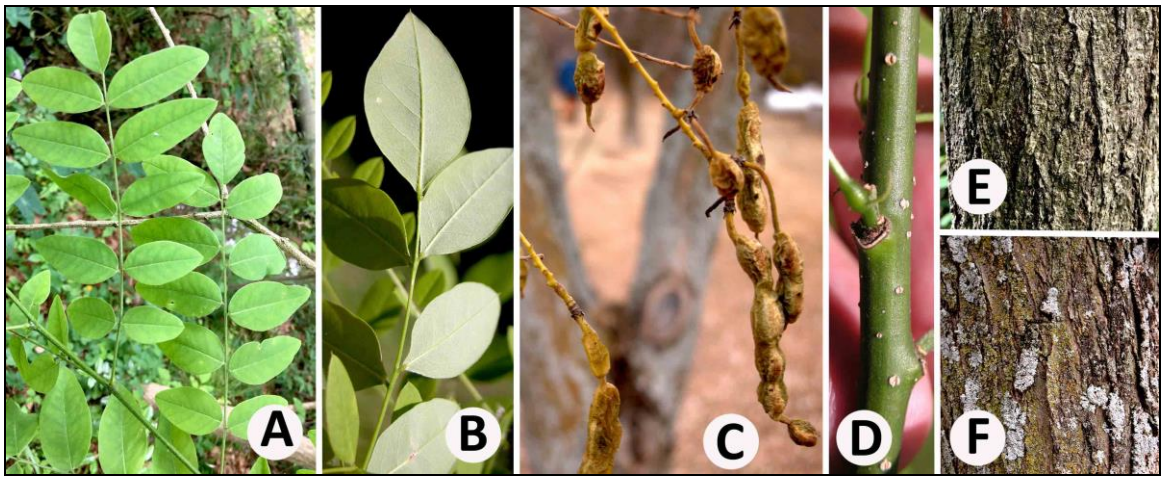


Figure 146. (A–F) *Styphnolobium japonicum* plant and habit. (A–B) Leaves and stem. (C) Mature fruits (fruits sometimes are golden-yellow late in development). (D) Twig with young bark. (E–F) Bark.

Styphnolobium japonicum sometimes is cultivated in Arkansas and the ability to successfully produce offspring offers a means of escape and establishment of the species in the state's flora.

In Arkansas, *S. japonicum* could be confused with *Styphnolobium affine* (Eve's Necklace, Texas Sophora) and *Robinia pseudoacacia* (black locust). *Styphnolobium japonicum* may be distinguished from *S. affine* by its completely white flowers (excluding the yellow spot on the banner) and semi-translucent, golden-yellow to brownish-yellow mature fruits. Contrastingly, the flowers of *S. affine* usually have some cream and/or pink coloration and the mature fruits are black. *Styphnolobium japonicum* can be distinguished from *Robinia pseudoacacia* by its unarmed habit (most plants of *R. pseudoacacia* bear stout stipular spines), generally more elongate and elliptic to oblong-shaped leaflets, absence of stipels on the leaves, rounded, dark green stems, and swollen fruits that are deeply constricted between the seeds. *Robinia pseudoacacia*, in contrast, has leaflets that generally are widely elliptic to almost round, linear stipels, angled stems, and brown, flattened fruits that are not constricted between the seeds. ***Habitat***: disturbed sites and waste places, especially in proximity to where plants of the species are cultivated.

Syringa, Lilac, Oleaceae

Syringa is a Eurasian genus of about 30 species of deciduous to rarely evergreen shrubs and small trees (Krüssmann 1978). A number of species and hybrids, such as *S. oblata*, *S. ✗ persica* and *S. vulgaris*, are highly prized ornamentals for their showy and profusely fragrant flowers.

Syringa vulgaris L. (Fig. 147).

Syringa vulgaris (common lilac) is a large, deciduous shrub or small tree to about 7 m tall that is native to southeastern Europe (Bailey & Bailey 1976; Krüssmann 1978). It has been documented escaped in Arkansas from Pulaski County, from a single record from the 1980s (Serviss et al. 2016c). This species is escaped or naturalized in several other states (Mitchell 1986; Wofford & Kral 1993; Chester et al. 1997; Haines 2011; Yatskievych 2013; Kartesz 2015; Weakley 2020; USDA, NRCS 2021), including Missouri and Tennessee, both of which border Arkansas. *Syringa vulgaris* often produces root suckers and may over time eventually form thickets; this habit may contribute to its ability to persist from cultivation and/or establish localized populations. In the USA flora, *S. vulgaris* generally occurs as an escaped species along woodland edges, thickets, fields, and roadside, and is persistent on abandoned homesteads (Haines 2011; Weakley 2020). The Arkansas material reported by Serviss et al. (2016c) was a single plant, persistent, and obviously derived in some unknown manner from cultivated sources. As no others were evident, this plant is best called a "waif" using the classification of Nesom (2000). Although it is naturalized in other (mostly more northern) states, a combination of soil and weather conditions probably constrains it in Arkansas (Serviss et al. 2016c).

Syringa vulgaris has been cultivated for centuries and over 800 varieties and horticultural forms currently exist (Krüssmann 1978). It is infamous and prized as an ornamental for its hardiness, ease of cultivation, and sweet, lilac-scented flowers, the fragrant oil of which is extracted and used to scent perfumes, soaps, body washes, and household cleaning products. The flowers also are attractive to bees and butterflies (Hilty 2002). It is tolerant of alkaline soils.

Many varieties of *S. vulgaris* are susceptible to powdery mildew (caused by fungi in the genus *Microsphaera*), where infection by the fungus produces a dense white to gray powdery covering on the leaves. Resistant varieties exist and these are best suited for cultivation.

In Arkansas, *S. vulgaris* potentially could be confused with a few of the large-leaved privet species, such as *Ligustrum japonicum* (Japanese privet) and *L. lucidum* (glossy privet); however, *S. vulgaris* can be distinguished from *Ligustrum* by its cordate (heart-shaped) leaves, capsule-type fruits, and lavender, blue, or purple-colored flowers (a few forms have white-colored flowers, but may still be distinguished by the leaves). In contrast, species of *Ligustrum* have leaves that are not cordate, but

instead with tapered bases, drupe-type fruits, and flowers that are white to whitish-cream in color. ***Habitat***: disturbed sites and waste places, thickets, and roadsides; often encountered persisting from cultivation.

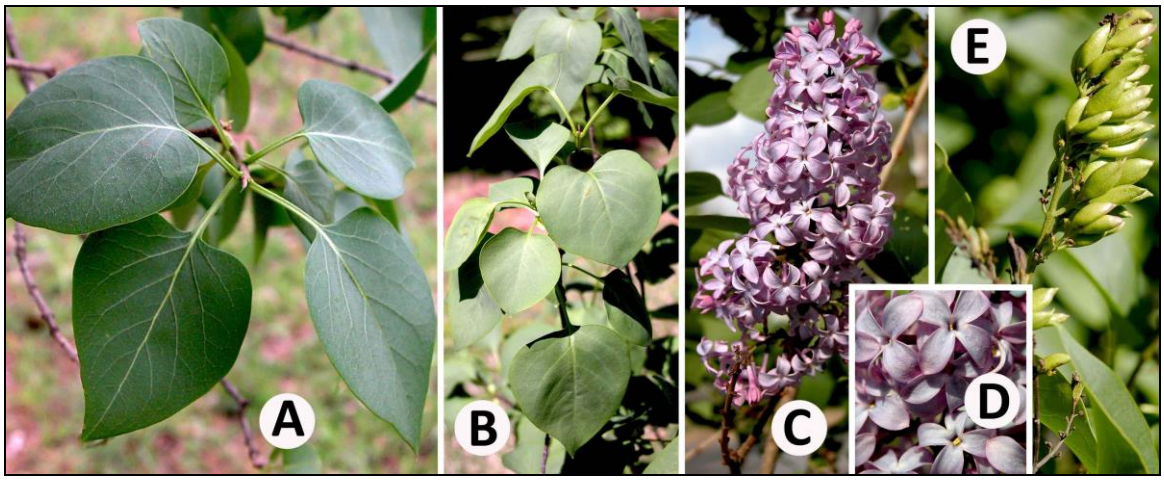


Figure 147. (A–E) *Syringa vulgaris* plant and habit. (A–B) Leaves and stem. (C–D) Flowers and inflorescence. (E) Fruits. Photo credit: E: Joseph Berger, Bugwood.

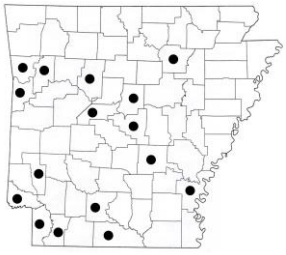
Tamarix, Salt-cedar or Tamarisk, Tamaricaceae

Tamarix is a genus of about 55 to upwards of 90 species of deciduous shrubs and trees distributed across Africa, Asia, Australia, some portions of the Americas, and Europe (Yang & Gaskin 2007; Gaskin 2015). A number of species have been introduced into the USA as ornamentals and subsequently have established in the flora; some are invasive.

At present, only *T. ramosissima* has been documented from Arkansas (Gentry et al. 2013; Gaskin 2015; Ogle et al. 2020). Gaskin (2015) notes, however, that *T. ramosissima* and *T. chinensis* are extremely similar and easily confused, and provides a few subtle character differences of the flowers by which to distinguish them. Furthermore, the two species apparently hybridize in North America where they occur together, enhancing the difficulties of species identification (Gaskin (2015).

Somewhat tentatively, the *Tamarix* species treated here is considered to be *T. ramosissima*; however, some Arkansas plants may, in fact, be *T. chinensis* or hybrids between the two species, if *T. chinensis* does occur in Arkansas. Gaskin (2015) does not list *T. chinensis* for the state; however, it is listed for Oklahoma and Texas, both of which border Arkansas. Further study of Arkansas *Tamarix* likely is needed to determine the exact species composition in the flora.

Tamarix ramosissima Ledeb. (Fig. 148).



Tamarix ramosissima (salt-cedar, tamarisk) is a large shrub or small, deciduous tree to 6 m tall that is native to Eurasia (Yang & Gaskin 2007; Gaskin 2015). It is naturalized in several states in the USA (Gaskin 2015), including Arkansas, where it occurs in several counties, mostly along major rivers. It is considered invasive in Arkansas (Gentry et al. 2013).

Three other species of *Tamarix*: *T. chinensis* (Chinese tamarisk), *T. gallica* (French tamarisk), and *T. parviflora* (small-flower tamarisk) have previously been attributed to Arkansas; however, each is now excluded based on a lack of voucher specimens (see notes on *T. chinensis* in genus description). *Tamarix* species are difficult to distinguish from one another, especially vegetatively (flower morphology often is used as an important distinguishing characteristic for species identification; Gaskin 2015). It is therefore possible, either through misidentification or lack of

discovery, that additional species of *Tamarix* are present in the state's flora; these aforementioned species also are naturalized in several other states, some of which border Arkansas.

Tamarix ramosissima possesses salt glands in its leaves that accumulate salt, which is then secreted onto the leaf surface. During precipitation events or when the leaves are shed, salt is deposited onto the soil and over time, the surface soil layers become increasing saline, which may inhibit the establishment and growth of native plant species.

Tamarix species can be invasive, especially along waterways with sandy soils and/or sand bars. In these habitats, *Tamarix* can be the dominant vegetation along the banks of waterways. In addition, species of *Tamarix*, as their common name implies, are sometimes encountered on saline sites. Collectively, *Tamarix* are referred to as salt-cedars because of their vegetative resemblance to species in the genus *Juniperus* (the common names of species in this genus often include the word "cedar," although the true cedars are members of the Eurasian genus *Cedrus*).

In Arkansas, the small, pale blue to blue-green, scale-like leaves of *T. ramosissima* clearly distinguish it from most other woody species; however, it may potentially be confused with the two species of *Juniperus*: *J. virginiana* (eastern red cedar) and *J. ashei* (Ashe's juniper). *Tamarix ramosissima* may be distinguished from *Juniperus* by the presence of flowers and fruits, leaves and young stems that are pale blue to bluish-green in color, and deciduous habit. *Juniperus* species, in contrast, are gymnosperms, so produce cones instead of flowers and fruits, have leaves and young stems that are medium to dark green in color, and are evergreen in habit. ***Habitat***: open, disturbed sites, river banks, sand bars, riparian zones, and saline sites.

Figure 148. (A–E) *Tamarix ramosissima* plant and habit. (A) Juvenile plant collected from extreme southwestern Arkansas on the bank of the Red River. (B) Naturalized plants in Arkansas. (C) Leaves. (D) Flowers and inflorescence. (E) Stem. Photo credit: D: Leslie J. Mehrhoff, University of Connecticut, Bugwood.

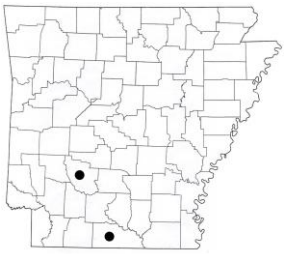
Ternstroemia, Ternstroemia or Cleyera, Theaceae

Ternstroemia is a genus of about 90 species of evergreen shrubs and trees distributed across warm-temperate, subtropical, and tropical regions of Africa, Asia, and the Americas (Min & Bartholomew 2007).

Ternstroemia gymnanthera (Wight and Arn.) Sprague (Fig. 149).

Ternstroemia gymnanthera (glossy ternstroemia) is a large, evergreen shrub or small tree to 6 m tall that is native to China, India, the Malaysian Peninsula, and Japan (Krüssmann 1978; Min & Bartholomew 2007). It regularly is cultivated in the southern USA, including Arkansas, and has been reported as a component of the naturalized floras of four southeastern states: Alabama, Arkansas, Florida, and South Carolina (Payne 2010; Serviss et al. 2018b; Weakley 2020; Keener et al. 2021;

Wunderlin et al. 2021). In Arkansas, it is known only from Clark and Union counties. While currently not well-established in the state, additional occurrences of this species in the flora are likely because of its frequent use in cultivation, tolerance for shade, and bird-dispersed seeds.



This species is used as an ornamental for its glossy, evergreen foliage, and attractive flowers and fruits. In juvenile plants, the foliage often turns purple during fall and winter (Fig. 170B). The genus *Ternstroemia* sometimes is placed within the Pentaphyllaceae family, although traditional placement within the Theaceae is maintained here.

At least some of the *Ternstroemia* material cultivated and naturalized in the southeastern USA is not unequivocally identifiable as *T. gymnanthera* — these plants may represent other species, hybrids, or horticultural selections out of the normal morphological range of wild *T. gymnanthera* (a number of horticultural varieties of *T. gymnanthera* do exist), as described by Min and Bartholomew (2007) and discussed by Weakley (2020). This certainly is the case for Arkansas, as many cultivated *Ternstroemia* plants observed produce flowers with pedicels considerably longer than the 1–1.5 cm attributed for that species in the Min and Bartholomew (2007) *Ternstroemia* treatment. Ohwi (1965) and Walker (1976), in two treatments of the Japanese flora, list a pedicel length for the flowers of up to 2 cm, which is somewhat closer to what has been observed in cultivated and escaped *Ternstroemia* plants in Arkansas. The University of Arkansas Cooperative Extension Service (2018) lists a pedicel length of ca. 1 inch (2.54 cm); this is clearly within the range of pedicel lengths observed with Arkansas *Ternstroemia* plants.

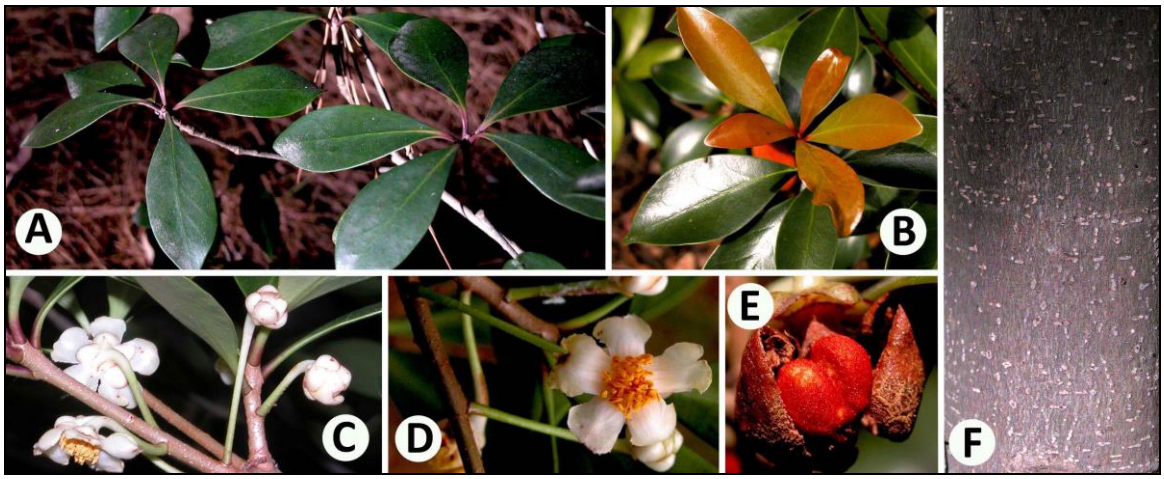


Figure 149. (A–F) *Ternstroemia gymnanthera* plant and habit. (A–B) Leaves. (C–D) Flowers. (E) Mature fruit and seeds. (F) Bark.

In Arkansas, *T. gymnanthera* has been documented outside of cultivation primarily as escaped juvenile plants in the vicinity of cultivated, reproductive age individuals. It is important to note, however, that multiple escaped plants have been documented at more than a single location. At present, little information is available regarding its naturalized status and invasive potential in the USA. ***Habitat***: disturbed areas and waste places, urban woods, woodland edges, riparian zones, and fencerows, especially in the vicinity of cultivated plants of the species.

Tetrapanax, Rice-paper Plant, Araliaceae

Tetrapanax is a monotypic genus native to Taiwan and possibly southern China (Xiang & Lowry 2007). The single species, *T. papyri*fer, sometimes is cultivated as a foliage plant for its extremely large, showy, "tropical-looking" leaves.

Tetrapanax papyrifer (Hook.) K. Koch (Fig. 150).

Tetrapanax papyrifer (rice-paper plant) is a colonial shrub or small tree to 3.5 m tall that is native to Taiwan and possibly China (Xiang & Lowry 2007). Though it currently is not known outside of cultivation in Arkansas, it occasionally is encountered in cultivation and its aggressive habit of suckering lends itself to the formation of colonies of plants (observed by Serviss in Clark County). Although not particularly cold-hardy, the crown and root system of *T. papyrifer* will overwinter in southern Arkansas, and the plant has been observed as long-persistent from cultivation, with plants spreading via root suckers and sometimes forming relatively large colonies.

Tetrapanax papyrifer does not seem to produce fruit in Arkansas; hence, any establishment in the flora presumably would be accomplished vegetatively. Escaped plants or colonies (from suckering) should be expected at sites where plants of *T. papyrifer* are cultivated.

This species is cultivated widely in China for the traditional medicine "tong cao" (Xiang & Lowry 2007) and as an ornamental elsewhere in warm-temperate to tropical regions. The stem pith cut into sections is used as a paper ("rice paper"), which was used to form a variety of artifacts, such as artificial flowers, hairpins, and various kinds of trinkets (Xiang & Lowry 2007).

The combination of the large-diameter (30–50 cm), rounded, palmately lobed leaves and thick indument of ferruginous (rusty-colored) to white-colored, stellate trichomes covering flowers, stems, and leaves clearly distinguish *T. papyrifer* from all other shrubs in the flora. The trichomes are easily dislodged from the plant by agitation and are irritating to nasal passages and the lining of the throat and respiratory track. ***Habitat****:* disturbed woods, woodland edges, greenbelts, thickets, and riparian zones, especially in the vicinity of where plants of the species are cultivated.

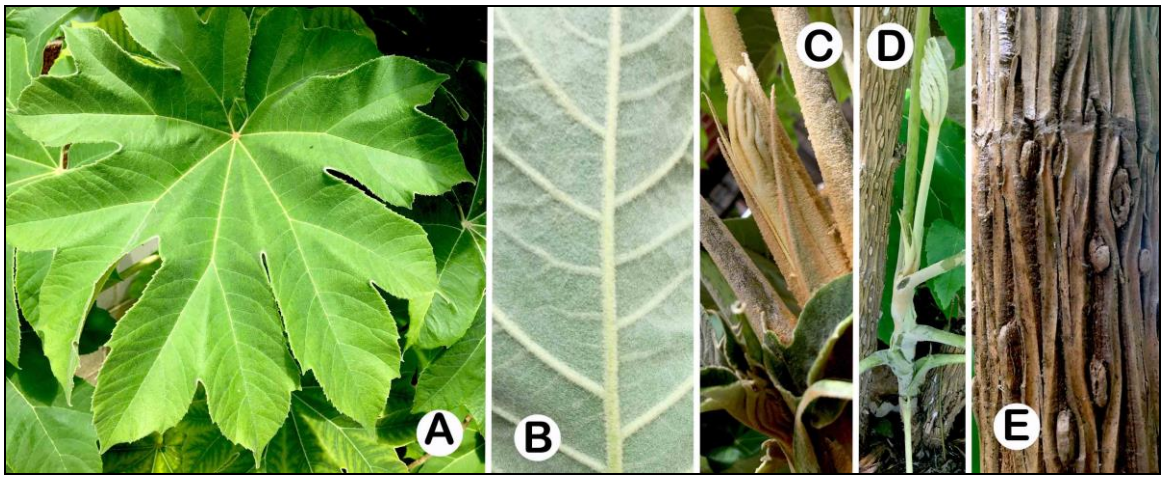


Figure 150. (A–E) *Tetrapanax papyrifer* plant and habit. (A–B) Leaves (notice the dense indument of ferruginous trichomes on the leaf lower surface in Fig. B). (C) Stem tip and leaf petiole with beige trichomes. (D) Root sucker. (E) Bark.

Trachelospermum, Jasmine Vine or Climbing Dogbane, Apocynaceae

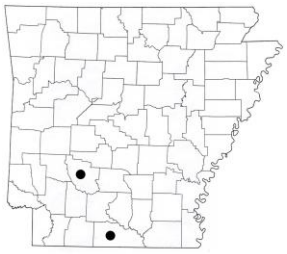
Trachelospermum is a genus of about 15 species of evergreen lianas, mostly Asiatic (Li et al. 1995b). *Trachelospermum asiaticum* and *T. jasminoides* are important ornamentals in warm-temperate and subtropical areas for their showy, fragrant flowers and glossy, evergreen foliage. These species often are gown as ground covers, particularly *T. asiaticum*, or used to cover rocks, arbors, and fences.

The two species of *Trachelospermum* currently reported from Arkansas are extremely similar morphologically, especially in regard to sterile material, and easily are confused. Plants with flowers reliably can be distinguished using the following key.

Key to *Trachelospermum* species:

1. Flowers yellow, yellowish-white, white with a yellow throat, or pure white, corolla tube dilated at or just beneath the throat, calyx lobes erect and appressed against the corolla tube ..... **Trachelospermum asiaticum**
1. Flowers white or sometimes yellowish-white, corolla tube dilated at about the middle, calyx lobes clearly spreading or reflexed..... **Trachelospermum jasminoides**

Trachelospermum asiaticum (Sieb. and Zucc.). Nakai (Fig. 151).



Trachelospermum asiaticum (Asian star jasmine, Japanese star jasmine) is a twining, evergreen liana to 10 m in length that is native to China, India, Japan, Korea, and Thailand (Bailey & Bailey 1976; Krüssmann 1978; Li et al. 1995b). It has been documented in the USA from Texas (Kartesz 2015; Weakley 2020) and Arkansas in Clark and Union counties (Serviss et al. 2015, 2020). Based on its frequent use in cultivation and seemingly invasive character, it should be expected elsewhere in the state.

Trachelospermum asiaticum is cultivated for its showy, fragrant flowers, ability to rapidly form a thick, evergreen groundcover, and tolerance of sun and shade conditions. In Arkansas, it readily forms dense carpets of trailing stems in the understory and also climbs trees via a combination of twining and adventitious roots (Serviss et al. 2015, 2020). Stems root vigorously when exposed to bare soil or climbing substrate, such as trees or fences. When climbing, the leaf morphology changes from the smaller and thinner leaves found on trailing stems to the larger, thicker leaves characteristically produced on climbing stems. This species also is tolerant of dry conditions once established. *Trachelospermum asiaticum* sometimes produces fruit in Arkansas, and the seeds are distinctive — cinnamon-brown in color with a conspicuous coma (tuft of hairs) attached to the seed body, allowing for wind dispersal. Because of these characteristics, *T. asiaticum* potentially is capable of invading into and occupying a variety of habitats. ***Habitat***: woodland edges, thickets, riparian zones, roadsides, and spreading both vegetatively and via seeds from sites of cultivation.

Some Arkansas plants of *T. asiaticum* initially were identified as *T. jasminoides* by Serviss et al. (2015, 2020), based only on sterile specimens. Upon further study and investigation, these plants were determined at a later time to be *T. asiaticum*.

In Arkansas, *T. asiaticum* potentially can be confused with two native lianas: *Gelsemium*

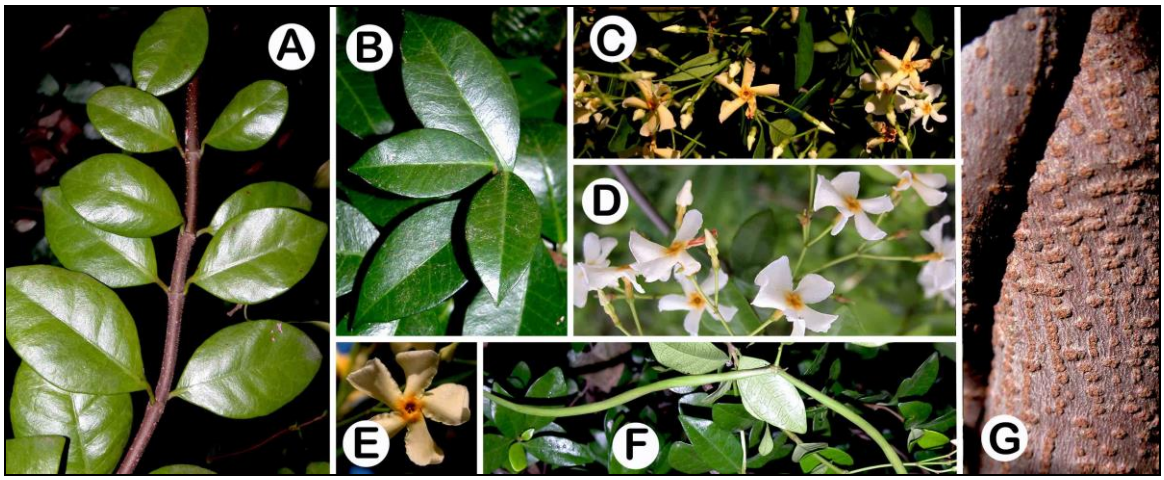


Figure 151. (A–G) *Trachelospermum asiaticum* plant and habit. (A–B) Leaves and stem. (C–E) Flowers and inflorescence (notice the erect, tightly appressed calyces and the corolla tubes dilated just below the throat in the flowers shown in Fig. D). (F) Fruits. (G) Bark.

sempervirens (yellow jasmine, evening trumpetflower) and *Thyrsanthella difformе* (climbing dogbane). *Trachelospermum asiaticum* may be distinguished from *G. sempervirens* by its white to pale yellow flowers, elongate follicles, pubescent (when young) leaves and stems, and white-milky latex that is exuded when any vegetative portion of the plant is cut or injured, and from *T. difformе* by its thickly chartaceous to coriaceous leaves. *Gelsemium sempervirens* has bright lemon-yellow flowers (also highly fragrant), short, elliptical capsules, foliage that is completely glabrous, and lacks milky latex, and *T. difformе* has membranous to chartaceous leaves without white coloration on the upper surfaces.

Trachelospermum jasminoides (Lindl.) Lem.

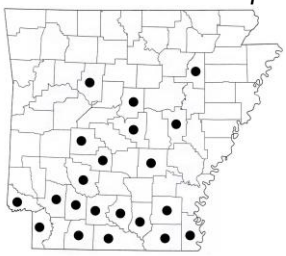
Trachelospermum jasminoides **(s**tar jasmine, Confederate jasmine) is a twining, evergreen liana to 10 m or more in length that is native to China, Japan, Korea, and Vietnam (Bailey & Bailey 1976; Krüssmann 1978; Li et al. 1995b). In addition to Arkansas, *T. jasminoides* has been recorded from the floras of a few other southeastern states, including Alabama, Louisiana, Florida, and Texas (Wunderlin & Hansen 2011; Diamond 2013; Weakley 2020). It is documented in Arkansas from Drew County (Gentry et al. 2013); however, it is important to note that the Sundell 2004 Drew County specimen, although sterile, appears to be *T. asiaticum*. If that is the case, *T. jasminoides* presently would be excluded from the state's flora (see discussion under entry for *T. asiaticum*). However, this species should be expected outside of cultivation in southern Arkansas based on its occurrence in surrounding states.

In its native China, *T. jasminoides* is used as a source of bast fiber, which is extracted from the inner bark of stems for the production of ropes, sacks, and paper, and for fragrant essential oils that are extracted from the flowers (Li et al. 1995b). All parts of the plant are poisonous (Li et al. 1995b). ***Habitat***: disturbed sites and waste places, including urban woods and greenbelts, especially in the vicinity of where plants of the species are cultivated.

Triadica, Tallow Tree or Candlenut Tree, Euphorbiaceae

Triadica is a small, exclusively Asiatic genus of three species of deciduous shrubs and trees (Li & Esser 2008; Wurdack 2016). One species, *T. sebifera*, frequently is used as an ornamental and has become an invasive weed in the southeastern USA, including Arkansas.

Triadica sebifera (L.) Small; Syn.: *Sapium sebiferum* (L.) Roxb. (Fig. 152).



Triadica sebifera (Chinese tallow tree, popcorn tree) is a small to medium-sized, deciduous tree to 15 m tall that is native to China and Japan (Li & Esser 2008; Wurdack 2016). It is naturalized and invasive in Arkansas (Gentry et al. 2013), but mostly confined to the central and southern one-half of the state. *Triadica sebifera* is extremely invasive, typically establishing in moist or wetland habitats, but also readily will colonize disturbed sites or sites with mesic soils (Godfrey & Wooten 1981; Jubinsky & Anderson 1996). This species has become a major ecological problem in the Gulf-coastal region of the USA, particularly in Florida, Louisiana, and southeastern Texas, where it occupies large expanses of coastal wetlands (Jubinsky & Anderson 1996; Oswalt 2010).

Triadica sebifera is capable of prolific seed production, and the seeds are readily consumed and dispersed by birds (Renne et al. 2000, 2001). Water also is a dispersal vector for seeds (Jubinsky 1993). Individual plants generally are reproductively mature in as little as three years (Scheld et al. 1984), and mature trees can produce thousands (or possibly more) seeds annually. Large plants sucker freely from the roots, especially if above-ground portions are damaged or cut back. These characteristics, along with its inherent ecological flexibility, facilitate its highly invasive tendencies. The range of *T. sebifera* in North America continues to expand within and from the southern USA

(California and Gulf-coastal region) northward and westward; this pattern likely will continue until the species reaches limits for drought, salinity, and cold tolerance (Pattison & Mack 2007; Gan et al. 2009; Wurdack 2016).

Triadica sebifera is cultivated for its vigorous, hardy habit, attractive autumn foliage, and interesting fruits and seeds. It has been cultivated in its native China for centuries for ornamental use, for the waxy/fatty tallow that is extracted from the seed coat and used to make candles and soap, and for a black-colored dye that is extracted from the leaves (Li & Esser 2008; Wurdack 2016).

Triadica sebifera often is referred to as popcorn tree, owing to the persistent seeds that, once dehisced from the fruits, persist and resemble popped popcorn. It also sometimes is referred to as chicken tree, candlenut tree, or candleberry tree.

The foliage and latex of *T. sebifera* contains toxic compounds, making these portions of the plant poisonous to humans and some animals (Burrows & Tyrl 2001). ***Habitat***: disturbed sites and waste places, but highly invasive into wetland habitats, including river banks and lake margins, roadside ditches, riparian zones, bottomlands, swamps, and marshlands.

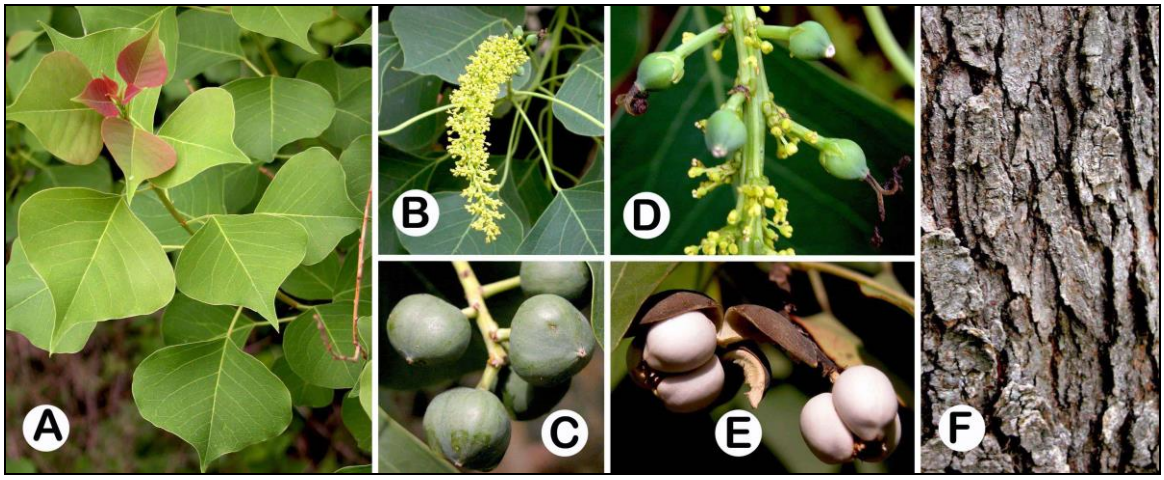


Figure 152. (A–F) *Triadica sebifera* plant and habit. (A) Leaves. (B) Staminate flowers and inflorescence. (C) Mature fruits. (D) Pistillate flowers. (E) Seeds. (F) Bark.

Ulmus, Elm, Ulmaceae

Ulmus is a genus of about 40 species of deciduous or evergreen shrubs and trees distributed mostly over temperate regions of Asia, Europe, and North America (Krüssmann 1978; Sherman-Broyles 1997; Fu et al. 2003). Species of *Ulmus* generally produce a hard, high-quality wood that is used in the manufacture of furniture, wood flooring, veneers, tool handles, bows, and baseball bats, among other materials (Hunter 1995; Yatskievych 2013). The fruits are fed on by a number of bird and mammal species (Hunter 1995; Yatskievych 2013), and in some species, such as *U. glabra*, *U. parvifolia*, and *U. pumila*, the fruits are eaten by people (Fu et al. 2003).

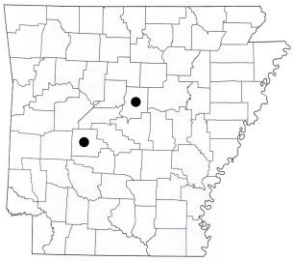
Eight species of *Ulmus* occur in the Arkansas flora, all with the exception of *U. parvifolia* and *U. pumila*, are native. Both of the nonnative *Ulmus* species have the potential to be invasive in the state.

Species of *Ulmus* have alternate, simple, toothed leaves, small, perfect, brown, reddish-brown, rusty, or green-colored flowers. The fruit is a small, flattened, prominently winged samara.

Ulmus parvifolia Jacq. (Fig. 153).

Ulmus parvifolia (Chinese elm, lacebark elm) is a large tree to 25 m tall that is native to China, Japan, and Korea (Fu et al. 2003). It has been documented from the floras of a number of southern states, including Arkansas, where currently it is known from Faulkner and Garland counties (Sherman-Broyles 1997; Thomas & Allen 1998; Wunderlin & Hansen 2011; Serviss et al. 2016c;

Serviss & Serviss 2020a; Weakley 2020). Based on its regular use as an ornamental and prolific ability to set seed, *U. parvifolia* should be expected outside of cultivation elsewhere in the state. This species is cultivated for its attractive foliage, aesthetically-pleasing growth form, and highly ornamental bark.



In Arkansas, *U. parvifolia* can be distinguished from the native species of *Ulmus* by its distinctive bark (discussed below) and leaves that generally are only once serrate, with the two sides of the blade essentially equal or subequal at the base. The native *Ulmus* species have ridged and furrowed or platy bark and leaves that are biserrate and oblique at the base. *Ulmus parvifolia* is, however, vegetatively similar to *U. pumila* (Siberian elm), which also is naturalized in Arkansas. *Ulmus parvifolia* can be distinguished from *U. pumila* by its pubescent young branches, smaller leaves, fall flowering and fruiting period, and by its tan and brown exfoliating bark with rusty-orange lenticels. Contrastingly, *U. pumila* has young branches that are pubescent early, but quickly become glabrous, larger leaves, a spring flowering and fruiting period, and dark, deeply ridged and furrowed bark that does not exfoliate. ***Habitat***: disturbed sites, waste places, and urban woods and greenbelts.

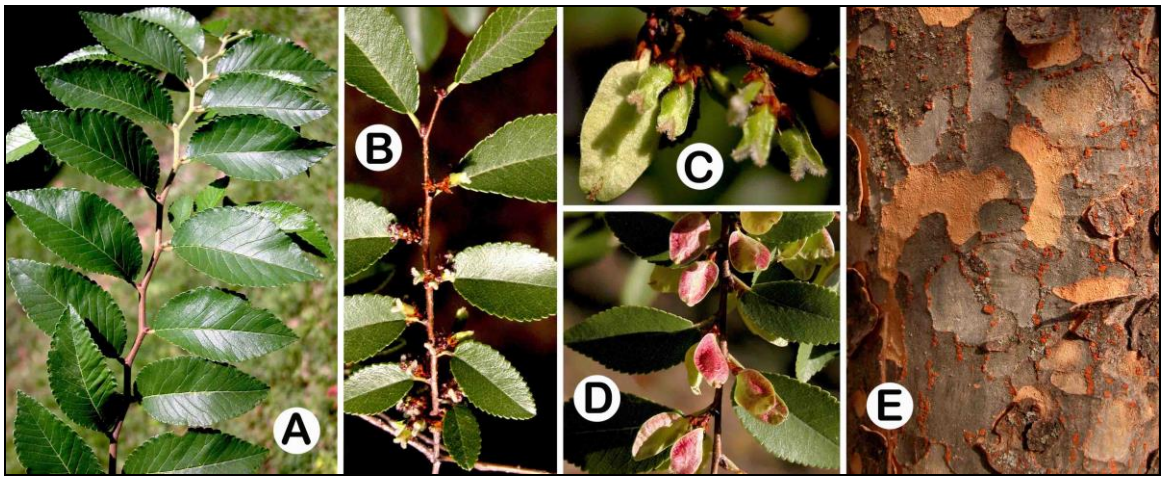
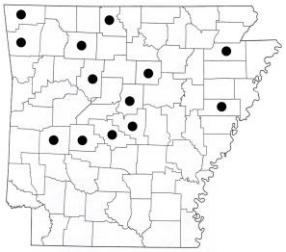


Figure 153. (A–E) *Ulmus parvifolia* plant and habit. (A–B) Leaves and stems. (C) Flowers and young fruits. (D) Nearly mature fruits. (E) Bark (notice the conspicuous exfoliating plates and rust-orange lenticels — these bark characteristics distinguish *U. parvifolia* from all other species of *Ulmus* in the state).

Ulmus pumila L. (Fig. 154).

Ulmus pumila (Siberian elm) is a large tree (occasionally, encountered as a large shrub) to 25 m tall that is native to and widespread in Asia (Fu et al. 2003). It is naturalized across much of the continental USA (Sherman-Broyles 1997; Kartesz 2015), including Arkansas, where it occurs in several counties mostly in the northern one-half of the state.



This species grows rapidly and sometimes is planted for use as a wind break. Unlike many species of *Ulmus*, the wood of *U. pumila* is weak and easily breaks (Sherman-Broyles 1997). In some environments, *U. pumila* is invasive.

Ulmus pumila can be distinguished from the native species of *Ulmus* by its leaves that generally are only once serrate and have the two sides of the blade essentially equal or subequal at the base. The native *Ulmus* species have leaves that are biserrate and oblique at the base. *Ulmus pumila* also could be confused with the native *Planera aquatica* (water elm); however, it can be distinguished from *P. aquatica* by its deeply ridged and furrowed bark, samara-type fruits, and elliptic to lanceolate leaves (*P. aquatica* has smooth bark that fractures into large, semi-exfoliating plates, a soft-spiny, nut-

like fruit, and leaves that are conspicuously often rhombic-ovate or sometimes ovate-oblong). *Ulmus pumila* is similar to *U. parvifolia* (Chinese elm, lacebark elm) — see entry for *U. parvifolia* for distinguishing characteristics between the two species). ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, riparian zones, fencerows, and roadsides.

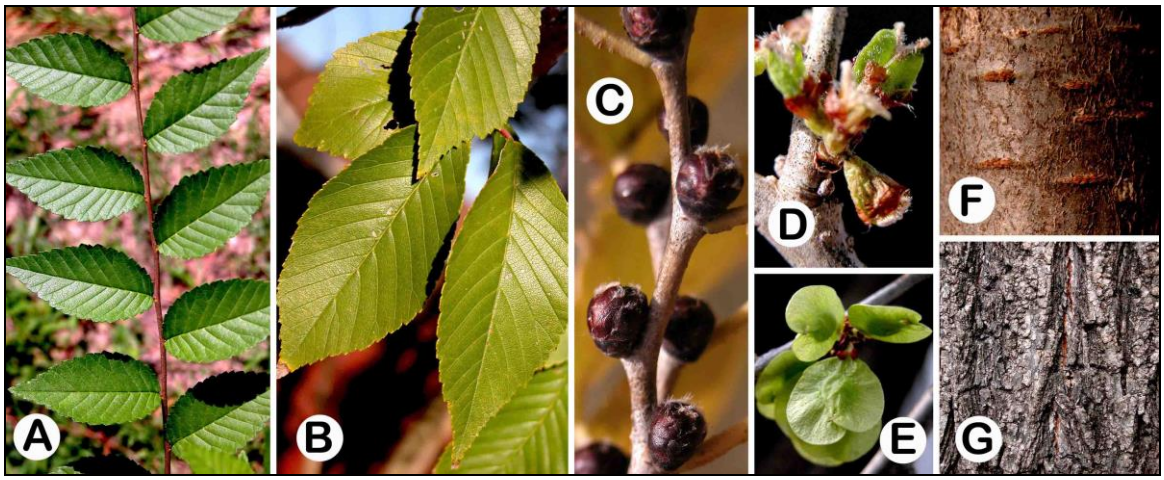


Figure 154. (A–G) *Ulmus pumila* plant and habit. (A–B) Leaves and stems. (C) Twig with flower buds (the spherical, brownish-black flower buds aid in distinguishing *U. pumila* from other *Ulmus* species in the state). (D) Flowers with young fruits. (E) Nearly mature fruits. (F) Young bark. (G) Older bark.

Ungnadia, Mexican Buckeye, Sapindaceae

Ungnadia is a monotypic genus native to New Mexico, Texas, and northern Mexico (Bailey & Bailey 1976; Krüssmann 1978; Diggs et al. 1999).

Ungnadia speciosa Endl. (Fig. 155).

Ungnadia speciosa (Mexican buckeye, Texas buckeye) is a deciduous shrub or small tree, occasionally reaching a height of 10 m tall, but usually smaller (Krüssmann 1978; Diggs et al. 1999). Although native to the south-central USA and Mexico, it occasionally is cultivated in the south, including Arkansas, for its attractive pink flowers and persistent, ornamental fruits. A single, spontaneous plant of *U. speciosa* has been observed in Clark County, Arkansas; it was produced from a cultivated individual of the species (Fig. 171A). At present, *U. speciosa* should not be considered as

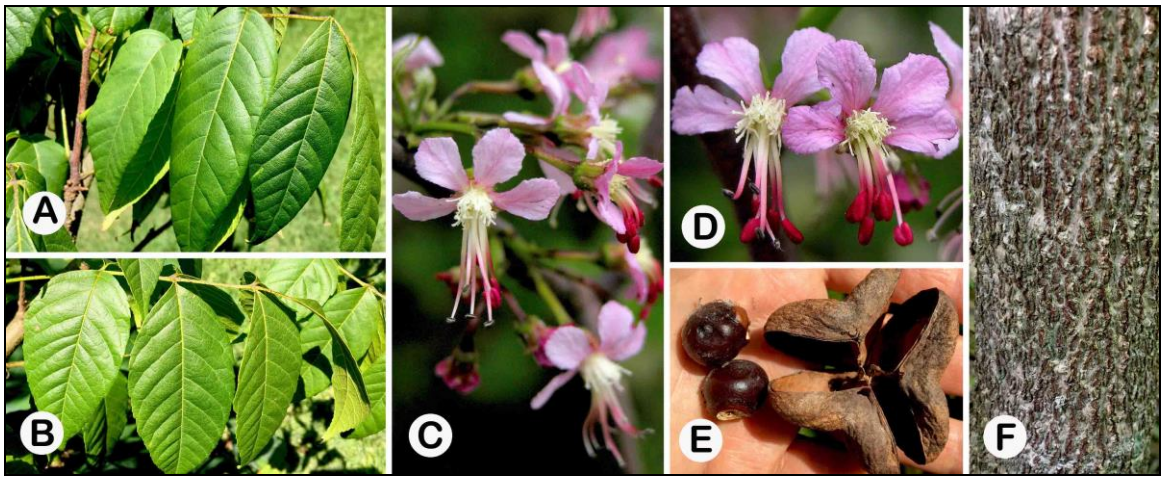


Figure 155. (A–F) *Ungnadia speciosa* plant and habit. (A–B) Leaves, leaflets, and stem. (C–D) Flowers. (E) Mature fruit and seeds or "Mexican buckeyes." (F) Bark.

a component of the state's flora; however, spontaneous or escaped plants could occur in areas where it is cultivated.

The flowers of *U. speciosa* are attractive to bees, along with other pollinators, such as hummingbirds and butterflies. The large seeds, which are mildly toxic, resemble those of buckeyes (*Aesculus*); hence, the common names of Mexican, Texas, or false buckeye.

The combination of small, pink flowers, large, woody, three-carpellate capsules, and once pinnately compound leaves, generally with seven or fewer leaflets aids in distinguishing this species from most other woody plants in Arkansas. ***Habitat***: disturbed sites and waste places.

Vernicia, Tungoil Tree or Candlenut Tree, Euphorbiaceae

Vernicia is a small genus of three species of deciduous or evergreen trees that is native to Asia (Krüssmann 1976; Li & Gilbert 2008; Gillespie 2016b). Some species are grown for the production of tungoil and/or are important as ornamentals for their large flowers, unusual, sometimes colorful fruits, and tropical-looking foliage. One species, *V. fordii*, has become naturalized to various degrees in the USA flora (Gillespie 2016b; Weakley 2020), particularly along the Gulf coast. Some species of *Vernicia* prolifically self-seed, often rapidly establishing naturalized populations of plants.

Vernicia fordii (Hemsl.) Airy-Shaw; Syn.: *Aleurites fordii* Hemsl. (Fig. 156).

Vernicia fordii (tungoil tree) is a small to medium-sized, deciduous tree to about 12 m tall that is native to China and central Asia (Krüssmann 1976; Li & Gilbert 2008). It is well-established along the Gulf coast, particularly in Mississippi and Florida, where it is listed as invasive (Wunderlin & Hansen 2011; Gillespie 2016b; Weakley 2020). In Arkansas, it is known only from Clark County (Serviss et al. 2007a). *Vernicia fordii* prolifically self-seeds and a single tree can produce numerous seedlings. Trees become reproductively mature between two and five years of age and spread and establish new populations via seed.

The seeds or "tung nuts" of *V. fordii* are extremely poisonous to humans and many types of domestic animals, and the entirety of the plant also is poisonous (Krüssmann 1976; Burrows & Tyrl 2001; Gillespie 2016b). Seeds are the source of commercial tungoil, which is used in making varnishes, lacquers, paints, linoleum, and oilcloth (Blackmon 1943; Krüssmann 1976; Gillespie 2016b). *Vernicia fordii* was introduced into the USA presumably to establish a tungoil industry

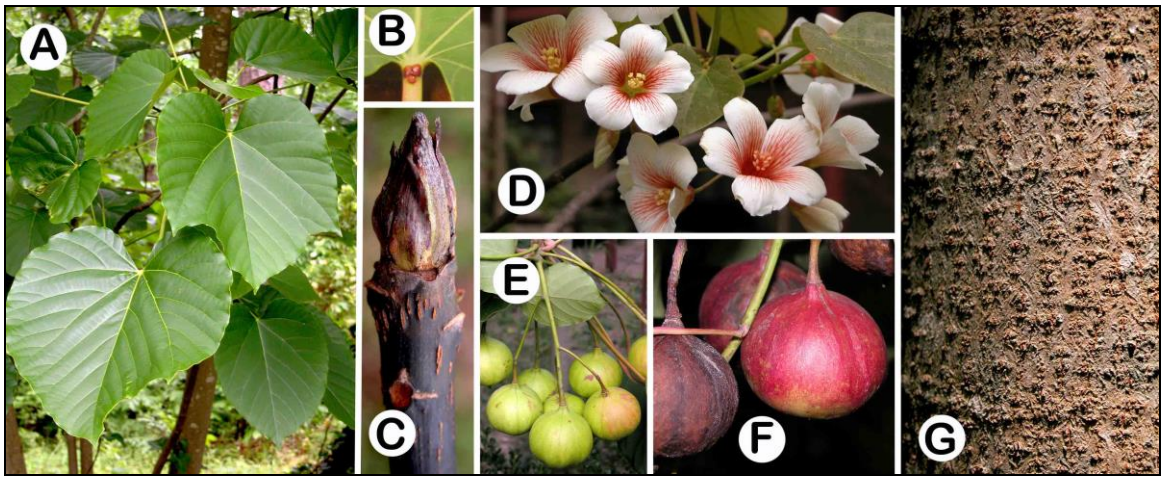


Figure 156. (A–G) *Vernicia fordii* plant and habit. (A) Leaves (notice that both lobed and unlobed leaves may occur on the same plant). (B) Petiolar glands (these can be red or brown and 2–3 in number). (C) Twig with prominent terminal bud. (D) Staminate flowers (pistillate ones are similar). (E–F) Mature fruits (the color may range from green with a yellow or orange hue to red). (G) Bark.

(Blackmon 1943), and from the 1920s–1960s, it was grown for seed oil in plantations along the Gulf coast from Florida to Texas (Gillespie 2016b). *Vernicia fordii* also is cultivated for its tropical-looking foliage and large, white and orange-red flowers.

In Arkansas, *V. fordii*, especially during juvenility, closely resembles *Firmiana simplex* (Chinese parasol tree), which also is naturalized in Arkansas (compare Fig. 171B and Fig. 165E). *Vernicia fordii* can be distinguished from *F. simplex* at all stages of development by the large, prominent, red or black glands that occur at the distal portions of the petioles at the base of the blade. The leaves of *F. simplex* lack these glands. The petiolar glands of the leaves of *V. fordii* also are useful in distinguishing it from the other large-leaved trees that occur in the state. ***Habitat***: disturbed sites and waste places, urban woods and greenbelts, woodland edges, and roadsides.

Viburnum, Arrowwood, Adoxaceae (formerly Caprifoliaceae)

Viburnum is a genus of about 200 species of deciduous or evergreen trees and shrubs distributed across temperate and subtropical regions of Asia and the Americas (Krüssmann 1978; Yang & Malécot 2011). About 10 species of *Viburnum* occur in the Arkansas flora, all but *V. dilatatum* are native. *Viburnum* species sometimes are cultivated as ornamentals for their showy flowers and/or fruits and attractive growth form.

Species of *Viburnum* are characterized by opposite, relatively large, toothed (the leaves of *V. nudum* often lack teeth) leaves, broad compound corymbose or paniculate inflorescences, and small black, blue, or sometimes red-colored, drupaceous fruits. Some species are clonal from a creeping root system.

Viburnum dilatatum Thunb. (Fig. 157).

Viburnum dilatatum (linden arrowwood) is a deciduous shrub to 5 m tall that is native to China, Japan, and Korea (Yang & Malécot 2011). It has been documented outside of cultivation in a number of eastern states, where it has shown the tendency to be invasive in certain areas (Swearingen & Bargeron 2016; Basinger 1999; Brock 2020; Floden & Saxton 2020; Weakley 2020). In Arkansas, it has been recorded from Clark County based on the presence of numerous juvenile plants generated from self-seeding of cultivated *V. dilatatum* plants (Fig. 171C). At present, this species is not well-established in Arkansas; however, it occasionally is cultivated in the state and has high potential to naturalize, based on its invasive tendencies documented in other states.

Viburnum dilatatum can be distinguished from the native species of *Viburnum* found in

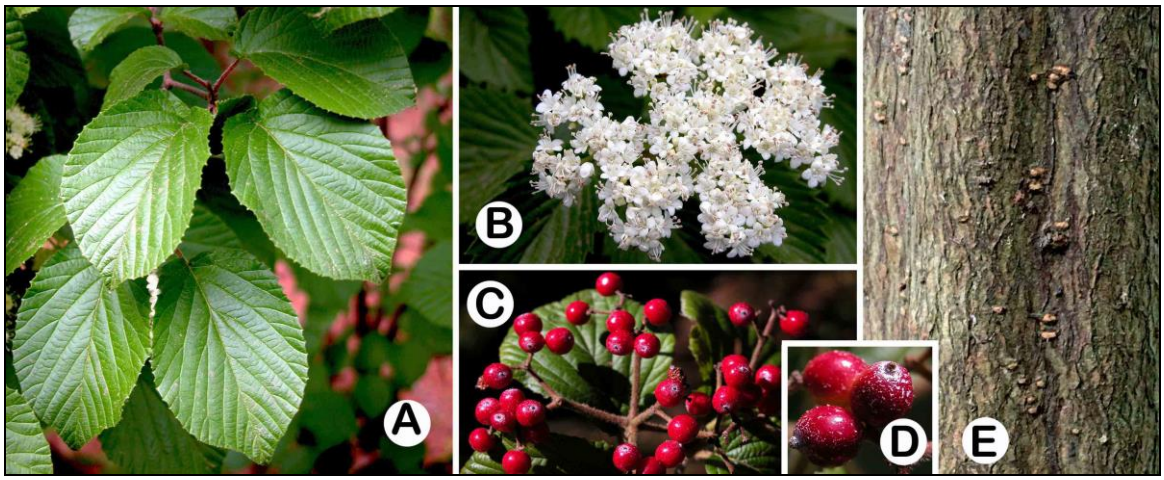


Figure 157. (A–E) *Viburnum dilatatum* plant and habit. (A) Leaves. (B) Flowers and inflorescence. (C–D) Mature fruits. (E) Bark.

Arkansas by its red-colored fruits. The native species of *Viburnum* have blue or black fruits (when mature). *Viburnum acerifolium* (maple-leaf viburnum) can have reddish-black fruits, but it has lobed leaves (the leaves of *V. dilatatum* are coarsely toothed but unlobed). ***Habitat***: disturbed or open woods, woodland edges, greenbelts, and thickets, especially in the vicinity of cultivated plants of the species.

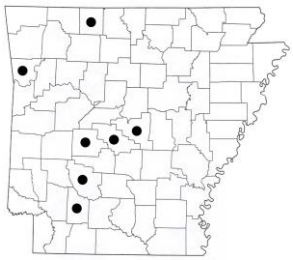
Vitex, Chaste Tree, Lamiaceae (formerly Verbenaceae)

Vitex is a large genus of about 250 species of deciduous or evergreen, aromatic shrubs and trees, distributed mostly over subtropical and tropical regions in both hemispheres (Bailey & Bailey 1976; Krüssmann 1978; Chen & Gilbert 1994c). Several species, including *V. agnus-castus*, *V. negundo*, and *V. trifolia* are important ornamentals for their colorful flowers, unusual foliage, attractive growth form, and hardy and vigorous habit, making them relatively easy to cultivate.

In the USA, *V. agnus-castus* probably is the most common species encountered in cultivation. *Vitex negundo* is highly invasive, with an ability to prolifically self-seed and rapidly establish naturalized populations (Serviss et al. 2007b). Both species are naturalized in Arkansas.

Species of *Vitex* have opposite, once palmately compound leaves with one to several leaflets that are variously toothed or entire, and small, perfect (bisexual) white, pink, blue, or yellow-colored flowers that are produced in elongate terminal or axillary inflorescences. The fruit is a small, dry drupe.

Vitex agnus-castus L. (Fig. 158).



Vitex agnus-castus (lilac chaste tree) is a large shrub or small tree to 5 m tall that is native to southern Europe and Asia Minor (Bailey & Bailey 1976; Krüssmann 1978; Griffiths 1992). At present, it is documented from Arkansas in seven scattered counties in the western one-half of the state. It also is naturalized in the southern USA, from California, eastward to Virginia, and recorded from Oregon, Kentucky, and Pennsylvania (McGregor 1986; Wunderlin & Hansen 2011; Kartesz 2015; Weakley 2020). *Vitex agnus-castus* self-seeds, although considerably less so than *V. negundo* (see entry for that species), and seedling recruitment sometimes is observed in areas where reproductively mature plants are cultivated. This species is used as an ornamental for its showy flowers, ranging in color from lilac and pink to white, and ease of cultivation. It probably has been in cultivation for centuries (Krüssmann 1978).

Vitex agnus-castus morphologically is similar to another species of *Vitex* that is naturalized in

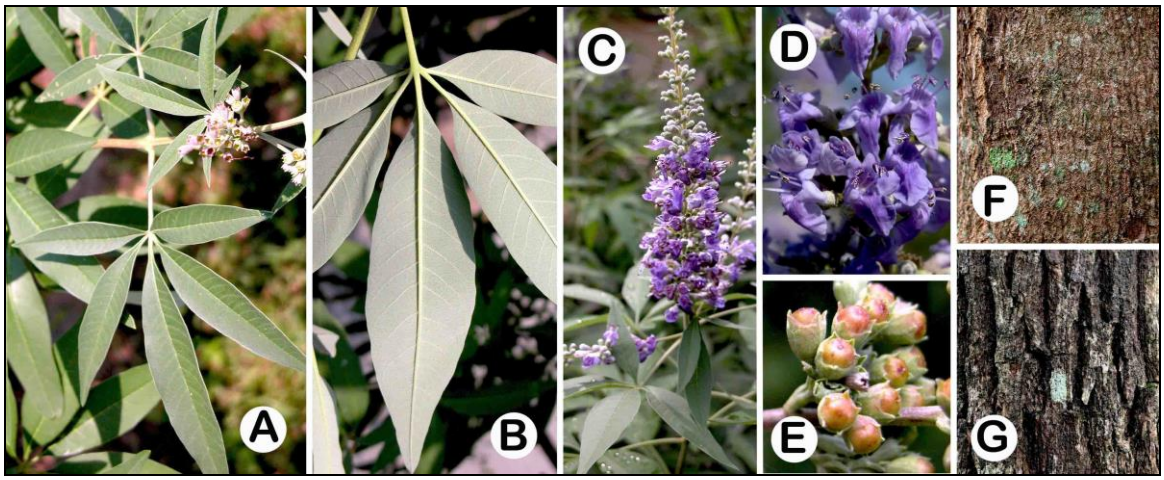
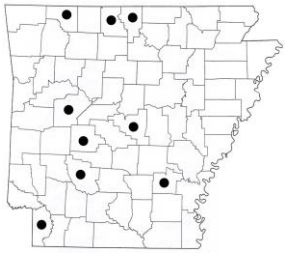


Figure 158. (A–G) *Vitex agnus-castus* plant and habit. (A–B) Leaves and stem. (C–D) Flowers and inflorescence. (E) Mature fruits. (F) Young bark. (G) Older bark.

Arkansas, *V. negundo* (negundo chaste tree). Though the two species are similar, *V. agnus-castus* can be distinguished from *V. negundo* by its leaflets with entire margins (occasionally, a few leaflets may have a conspicuous lobe or a few, large teeth), larger fruits (3-4 mm in diameter) and flowers, and erect inflorescences. Contrastingly, *V. negundo* has leaflets that are coarsely and regularly toothed or lobed (in *V. negundo* var. *negundo*, many of the leaflets may have only a few teeth or entire margins), smaller fruits (2 mm in diameter) and flowers, and inflorescences that are positioned more or less horizontally, eventually becoming pendulous. ***Habitat***: disturbed sites and waste places, especially in the vicinity of cultivated plants; also open bluffs and slopes, riparian zones, woodland edges, and waste places.

Vitex negundo L. (Fig. 159).



Vitex negundo (negundo chaste tree) is a large shrub or small tree to 5 m tall, or sometimes more, that is native to India, Mongolia, and China (Krüssmann 1978; Chen & Gilbert 1994c). It is naturalized in Arkansas in several scattered counties, and in a number of other states, including Florida, Kentucky, Louisiana, Maryland, Ohio, Oklahoma, and Texas (Serviss et al. 2007b; Wunderlin & Hansen 2011; Barger 2012; Yatskievych 2013; Kartesz 2015; Weakley 2020). This species is a prolific seed producer, resulting in naturalization that is aggressive and invasive (Serviss et al. 2007b; Barger 2012). It is not uncommon (in Arkansas) to encounter numerous seedlings and young plants in the vicinity of reproductively mature individuals (Serviss et al. 2007b). Morphologically, *V. negundo* is similar to *V. agnus-castus* (lilac chaste tree), which also is naturalized in Arkansas (see text under *V. agnus-castus* for distinguishing characteristics between the two species).

Species of *Vitex* are characterized by their opposite, once palmately compound leaves, highly aromatic foliage, small fruits, and tightly-clustered, numerous blue-colored flowers; the combination of these traits distinguishes them from most other woody plants in the Arkansas flora. Vegetatively, however, both naturalized species of *Vitex*, when sterile, somewhat resemble the two species of *Aesculus*: *A. glabra* (Ohio buckeye) and *A. pavia* (red buckeye); however, *Vitex* can readily be distinguished from *Aesculus* by their narrow twigs, small fruits (4 mm or less in diameter), and smaller, highly aromatic leaves that are densely white-tomentose pubescent on the lower surface. *Aesculus*, contrastingly, has thick twigs, large fruits (a few to several cm in diameter), and large leaves that are green on the lower surface and not aromatic. In addition, the fruits of *Vitex* persist long into the dormant season, whereas those of the *Aesculus* drop shortly after leaf abscission in early

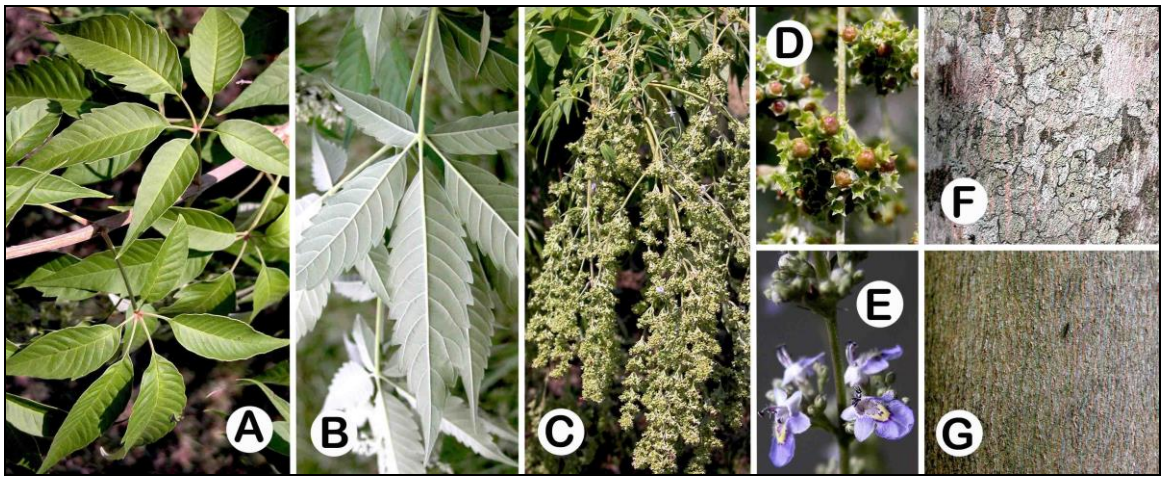


Figure 159. (A–G) *Vitex negundo* plant and habit. (A–B) Leaves and stem. (C–D) Mature fruits and infructescence. (E) Flowers. (F–G) Bark.

autumn. ***Habitat***: disturbed sites and waste places, especially in the vicinity of cultivated, reproductive age plants; also pastures, fencerows, grasslands, roadsides, open riparian zones, and woodland edges.

Numerous botanically recognized varieties of *V. negundo* occur (Chen & Gilbert 1994c) and three are present in Arkansas: (1) *V. negundo* var. *negundo*; (2) *V. negundo* var. *cannabifolia*, and (3) *V. negundo* var. *heterophylla*. Variety *negundo* probably is the most commonly encountered in the flora, and variety *heterophylla* formerly was classified as a distinct species, *V. incisa*, based on its deeply pinnately lobed leaflets. The following key can be used to distinguish these varieties; however, it is important to note that some plants may not fit exactly one of the listed varieties and intergrading forms sometimes are encountered in the state and elsewhere (Yatskievych 2013).

1. Leaflets at most with only one to a few teeth (juvenile or small plants of this variety can have coarsely toothed leaflets) ..... **Vitex negundo** var. **negundo**
1. Leaflets coarsely and regularly toothed or deeply lobed.

2. Leaflets coarsely toothed ..... **Vitex negundo** var. **cannabifolia**
2. Leaflets deeply lobed ..... **Vitex negundo** var. **heterophylla**

Wisteria, Wisteria, Fabaceae

Wisteria is a small genus of six species of deciduous lianas, distributed over Asia and North America (Krüssmann 1978; Isely 1998; Wei & Pedley 2010). Two species, *W. sinensis* and *W. floribunda* are staple ornamentals because of their profuse display of fragrant flowers in early spring that resemble clusters of grapes. Both species are well-naturalized and invasive in the eastern USA, including Arkansas. *Wisteria frutescens* (American wisteria) is the only native species of *Wisteria* in North America (Isely 1998).

Studies by Trusty et al. (2007a, 2007b, 2008) have demonstrated that much of the *W. floribunda* and *W. sinensis* material naturalized in the USA, is, in fact, a series of complex hybrids and introgressed forms between the two species. *Wisteria* × *formosa* Rehd. is the epithet that traditionally has been assign to the hybrid. Naturalized hybrid *Wisteria* genetically are diverse, and morphological characters that clearly differentiate the two introduced species (*W. floribunda* or *W. sinensis*) cannot be used to reliably identify naturalized *Wisteria* plants in the USA (Trusty et al. 2007b). These hybrid *Wisteria* have a high level of genetic diversity, but this diversity is not organized by geographic location (Trusty et al. 2007a). Urban environments have created a situation where hybridization acts as an active genetic mechanism to create novel genotypes (Arnold 1997; Trusty et al. 2007a). Trusty et al. (2007a) found a higher percentage of hybrid *Wisteria* in naturalized populations than in urban (cultivated) populations. Furthermore, they determined that hybridization between *W. floribunda* and *W. sinensis* has provided the right combination of genetic diversity and ecological amplitude for nonnative *Wisteria* to survive and reproduce in both managed and natural ecosystems in the USA. Most *W. floribunda* and *W. sinensis* plants sold in the horticultural trade likely are hybrids between the two species (Trusty et al. 2008). The long history of horticulture, rampant hybridization, and human-aided dispersal all have contributed to the ability of these plants to successfully invade natural habitats (Trusty et al. 2007a). Weakley (2020) notes that much of the material in the southeastern USA designated as *W. floribunda* and *W. sinensis* could be called *W.* × *formosa*.

Though the previously used species designations of *W. floribunda* and *W. sinensis* are maintained here, much to all of our material probably is *W.* × *formosa*, rather than the former. Further study of Arkansas *Wisteria* is needed.

Species of *Wisteria* have alternate, once pinnately compound leaves with numerous leaflets. Vines climb by twining and often grow to a considerable size, sometimes reaching a length of 25 m and several cm in diameter. Flowers are small, perfect (bisexual), white, lavender, or blue in color

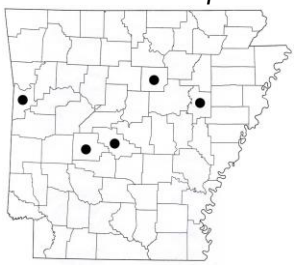
and produced in elongate, drooping, many-flowered inflorescences. The fruit is an elongate few-seeded legume. See below for key to *Wisteria* species (modified from Weakley 2020, who notes that the key may work poorly to not at all for some *W. ×formosa* material).

1. Leaflets usually 7–17(–19); inflorescence to 132 cm long, with 25–170 flowers that open successively from the base to the tip of the inflorescence, with those flowers at the base withering before those at the tip open; flowers 1.5–2 cm; stems twining to the right.

   2. Auricles of the standard's callosity 1.1–1.2 mm long; leaflets (11–) 13–17 (–19) per leaf; raceme to 132 cm long ..... **Wisteria floribunda**
   2. Auricles of the standard's callosity 0.7–0.8 mm long; leaflets 7–17 per leaf; racemes to 36 cm long ..... **Wisteria ×formosa**

1. Leaflets usually (7–)9–11(–13); inflorescence to 33 cm long, with 25–95 flowers that open nearly simultaneously or sequentially; flowers 2–2.5 cm; stems twining to the left ..... **Wisteria sinensis**

Wisteria floribunda (Willd.) DC. (Fig. 160).



Wisteria floribunda **(**Japanese wisteria) is a large, deciduous liana to 25 m in length that is native to Japan (Krüssmann 1978; Isely 1998). It has been documented from five counties in Arkansas. It probably is more widespread in the state's flora than records indicate, based on probable misidentification as the extremely similar, *W. sinensis* (Chinese wisteria) or the interspecific hybrid between *W. floribunda* and *W. sinensis*, *Wisteria ×formosa* (see discussion in genus description for more information), which is well-naturalized in Arkansas — see text and key under comments section of *W. sinensis* for distinguishing characteristics between the species.

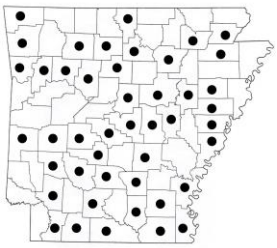
Similar to *W. sinensis* in habit, *W. floribunda* climbs aggressively over standing vegetation, including large trees. The vines, which can reach an eventual size of several centimeters in diameter, often constrict the trunks and branches of the trees they climb, damaging, toppling, or sometimes killing the tree.

The seeds, and possibly also the fruits, of both *W. floribunda* and *W. sinensis* are poisonous, owed to the glycoside, wisterin (Burrows & Tyrl 2001). Normally, ingestion of several seeds is required to induce any effects, which may include nausea, vomiting, stomach pain, and diarrhea.

Figure 160. (A–B) *Wisteria floribunda/W. ×formosa* plant and habit. (A) Leaves (with the exception of the number of leaflets, direction of twining, and minor differences in inflorescence characteristics, *W. floribunda* morphologically is very similar to *W. sinensis*). (B) Bark.

Habitat: disturbed areas and waste places, often seen spreading from areas of cultivation; also open woods, woodland edges, thickets, and riparian zones.

Wisteria sinensis (Sims) Sweet (Fig. 161).



Wisteria sinensis (Chinese wisteria) is a large, deciduous liana to 25 m in length that is native to China (Krüssmann 1978; Isely 1998; Wei & Pedley 2010). It is well-naturalized in Arkansas, occurring essentially statewide. It is an aggressive climber, easily growing to the top of large trees. Large vines constrict the trunks and branches of the trees they climb, potentially damaging or killing the tree with time. *Wisteria sinensis* is difficult to eradicate as it regrows vigorously and repetitively after being cut back.

Wisteria sinensis is extremely similar in virtually all aspects to *W. floribunda* (Japanese wisteria), which also is naturalized in Arkansas. The close similarity between the two species, along with their hybridization in the USA, often leads to difficulty in distinguishing them (see text in genus description for more information). Both species are large-bodied, aggressive, and invasive into open and wooded habitats, particularly in disturbed woods, along woodland edges, greenbelts, and riparian zones. They will grow along the ground and over existing vegetation, including climbing and covering large expanses of vegetation.

Reproduction is both via seeds and air layering of stems, which vigorously produce adventitious roots. Though the typical flower color is purple or bluish-lavender, both species have white-flowered forms. ***Habitat***: disturbed areas and waste places, often seen spreading from areas of cultivation; also open woods, woodland edges, greenbelts, thickets, and riparian zones.

Both nonnative *Wisteria* species morphologically resemble *W. frutescens* (American wisteria). *Wisteria frutescens* can be distinguished from them by its smaller, less aggressive habit, tighter, more densely-flowered inflorescences, and glabrous, cylindrical fruits with bean-shaped seeds. Both nonnative species of *Wisteria* have a larger, more aggressive habit, more open, loosely-flowered inflorescences, and densely pubescent ovaries and compressed fruits with round, flattened seeds.

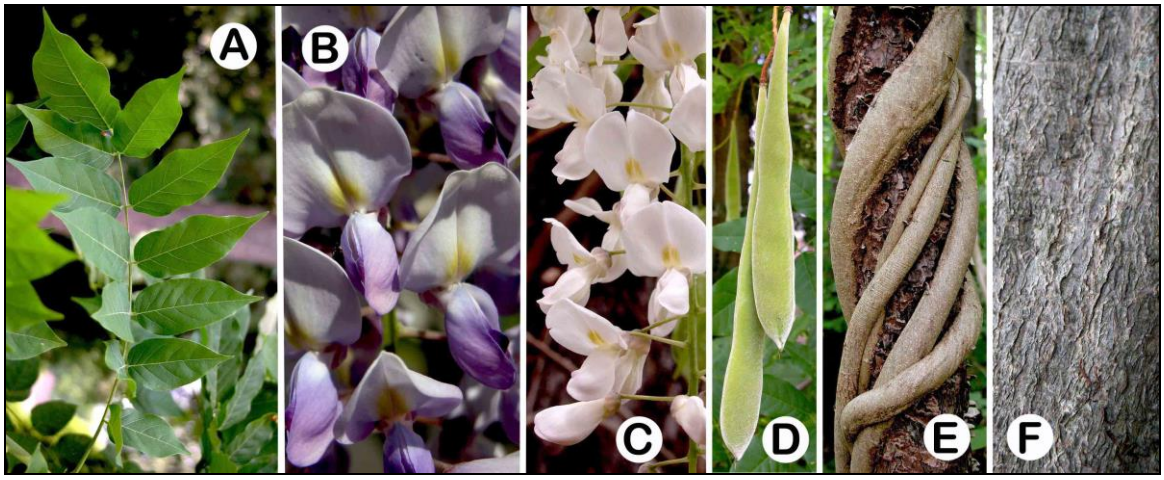


Figure 161. (A–F) *Wisteria sinensis/W. ×formosa* plant and habit. (A) Leaves. (B–C) Flowers. (D) Mature fruits. (E) Twining habit. (F) Bark.

Ziziphus, Jujube, Rhamnaceae

Ziziphus is a genus of about 100 species of deciduous or evergreen, often spiny shrubs and trees distributed mainly over subtropical and tropical regions of Asia and the Americas, with a few species in Africa (Chen & Shirarend 2007b). *Ziziphus jujube* and *Z. mauritiana*, frequently are

cultivated in Asia (and sometimes elsewhere) for their high-quality, edible fruits, which are eaten raw, dried, preserved, stewed, pickled, or used in convections (Bailey & Bailey 1976; Nesom 2016).

Ziziphus jujuba Mill. (Fig. 162).

Ziziphus jujuba (common jujube, Chinese date) is a large shrub, or more commonly a small tree to 12 m tall that is native to China (Chen & Shirarend 2007b; Nesom 2016). This species, while not currently documented outside of cultivation in Arkansas, sometimes is cultivated in the state. In Arkansas, cultivated *Z. jujuba* plants produce fruits and seeds and plants also sucker freely from the roots, sometimes forming small colonies (observed by Serviss in Arkansas from both Clark and Benton counties); it should be expected in the state persisting or spreading from areas of cultivation. Diggs et al. (1999) note that it can form extensive thickets and spread is both vegetative and via seeds in Texas. Nesom (2016) notes that it has spread widely since its introduction in the late 1800s; however, it is not always clear as to whether plants are naturalized or persisting from cultivation. This dilemma probably is worsened by the fact that the species aggressively suckers and spreads vegetatively from plants in cultivation. It is naturalized in several other southern states, from Arizona and California to Alabama and Florida (Jones & Coile 1988; Nesom 2016; Weakley 2020).

Ziziphus jujuba is fairly drought-tolerant once established, and relatively free of insect pests and diseases. It also is tolerant of alkaline soils. Fruits of cultivars of *Z. jujuba* often are considerably larger in size than those produced on wild individuals. The fruits are reminiscent of the common apple, both in texture and flavor, but include a distinct "nutty-flavored" or "date-like" overtone. Most cultivars are self-fertile and only a single plant is required for adequate fruit set, though some cultivars produce heavier fruit crops if planted with a different variety. Once dried, the mature fruits closely resemble the date fruits of commerce. The species has been cultivated in China for thousands of years (Bailey & Bailey 1976; Valder 1999).

The combination of drooping branches, small, shiny, leathery leaves, prominent stipular spines, and glossy, spherical to ellipsoid, reddish-brown fruits distinguish this species from other trees in the state. On rare occasions, plants lacking stipular spines may be encountered. ***Habitat***: hills, slopes, open and dry sites, pastures, fencerows, and grasslands, especially in the vicinity of where plants of the species are cultivated.

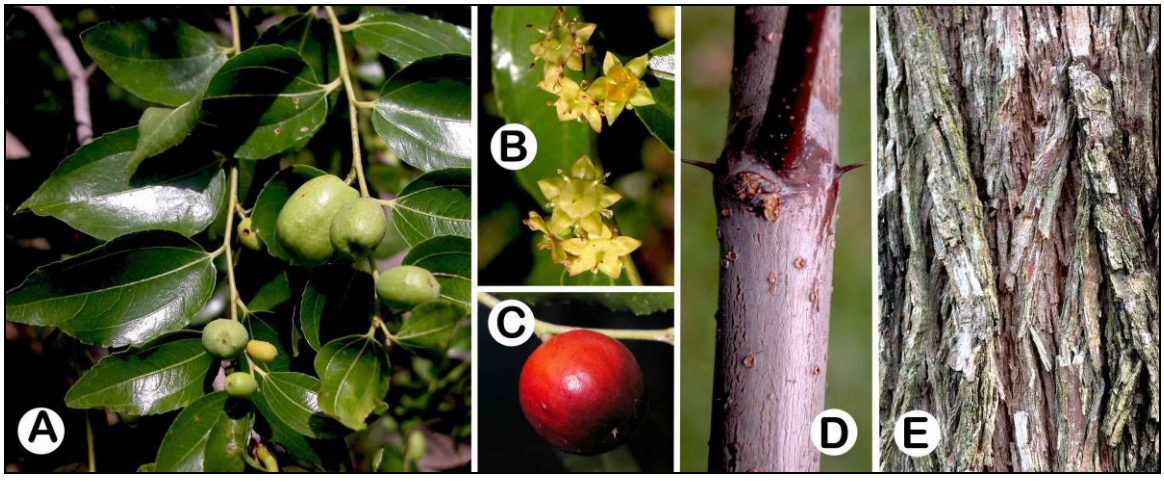


Figure 162. (A–E) *Ziziphus jujuba* plant and habit. (A) Leaves, stem, and immature fruits. (B) Flowers (color can range from green to yellow). (C) Mature fruit. (D) Stem with young bark and stipular spines. (E) Bark.

ACKNOWLEDGEMENTS

We are extremely grateful to Brent Baker (Arkansas Natural Heritage Commission) and Kristen Benjamin (Henderson State University) for their invaluable editorial suggestions regarding this paper. We thank Brent Baker for providing specimen records of *Ilex aquifolium* and *Ligustrum*

obtusifolium, updated county distributions for *Euonymus alatus*, *Hibiscus syriacus*, and *Sesbania punicea*, and specimen and habitat data for *Ilex aquifolium*. Many thanks to Theo Witsell (Arkansas Natural Heritage Commission) for distribution and specimen data for *Ilex aquifolium*, *Ligustrum obtusifolium*, *Ligustrum sinense*, and *Pyracantha coccinea*. We thank Jonathan Kennedy (Harvard University Herbarium) for providing a high resolution image of a specimen of *Euonymus europaeus*, and for information about the specimen. We thank Ron Lance (North American Land Trust) for information pertaining to the occurrence and distribution of *Pyracantha*. We also are grateful to James Peck for providing many specimens of, and associated data for, several species of woody plants from Arkansas. We would like to thank Faye Ward (Henderson State University) for compilation of occurrence data for several species and Katrina Rogers (Henderson State University) for acquisition of literature. We thank Guy Nesom for his review and editorial help with this paper. We are thankful to the Henderson State University Department of Biological Sciences and the Ellis College of Arts and Sciences for supporting this work. We give special thanks to Tricia Serviss for much assistance over the years with photography and collection of countless plant specimens.

We would like to very much thank the following people and agencies for use of their photographs and/or for assistance with the acquisition of photographs of a number of specific taxa: Adam Agosta (LSU School of Renewable Natural Resources), Joseph Berger (Bugwood), Mary S. Bowen (Louisiana Ecosystems and Plant Identification, Louisiana State University), Pat Breen (Oregon State University), Rachel L. Carroll (University of Georgia School of Forestry and Natural Resources, Center for Invasive Species and Ecosystem Health, Bugwood), Katy Chayka (Minnesota Wildflowers), Will Cook (Carolina Nature), Joseph M. DiTomaso (University of California, Davis), Douglas Doohan (Ohio State University), Dow Gardens, Peter M. Dziuk, Arthur Haines (Native Plant Trust, Go Botany), Chris Evans, (University of Illinois), Milan Havlis (Zahradnictví SAFRO®), Gerald Holmes (Strawberry Center, Cal Poly San Luis Obispo, Bugwood), Ed Jensen, Gary Johnson (Department of Forest Resources, University of Minnesota), Sven Maksymiuk (Carya Nursery), Daria Mckelvey (Missouri Botanical Garden), Leslie J. Mehrhoff (University of Connecticut), James H. Miller (USDA Forest Service), Garlan Miles (North Carolina State University Extension Gardner), Dan Mullen, Jennifer Ogle (University of Arkansas Herbarium, UARK), Ohio Perennial and Biennial Weed Guide (Ohio State University), Bruce Patterson, John Peterson (Virginia Tech University), Christopher Reid (School of Renewable Natural Resources, Louisiana State University), Rob Routledge (Sault College), Samual Royer (SEINet), John Seiler (Virginia Tech University), Salicyna, Tricia Serviss, Forest Starr and Kim Starr (Starr Environmental), Maureen Sundberg (Ecological Landscape Alliance), Howard F. Schwartz (Colorado State University), T. Davis Sydnor (The Ohio State University), Suanne Taylor, (LSU School of Renewable Natural Resources), Robert Vidéki (Doronicum Kft.), Louise Voorhagen (Louise's Plant Details), Rebekah D. Wallace (University of Georgia), Bruce Wenning (Ecological Landscape Alliance), and Paul Wray (Iowa State University).

LITERATURE CITED

Argus, G.W. 1985. Computerized Catalogue of Herbarium Specimens of *Salix* in the Southeastern United States. Ottawa.

Argus, G.W. 1986. The genus *Salix* in the southeastern United States. Syst. Bot. Monogr. 9.

Argus, G.W. 1993. *Salix*. Pp. 990–999, in J.C. Hickman (ed.). The Jepson Manual. Higher Plants of California. Berkeley, Los Angeles, and London.

Argus, G.W. 2010. *Salix* (Salicaceae). Pp. 23–162, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 7. Oxford Univ. Press, New York and London.

Arkansas Vascular Flora Committee. 2006. Checklist of the Vascular Plants of Arkansas. Arkansas Vascular Flora Committee. University of Arkansas. Fayetteville.

Arnold, M.L. 1997. Natural Hybridization and Evolution. Oxford University Press, Oxford, Amsterdam.

Atha, D., M. Gunderson, E. Whitaker, R. Alvarez, and M. Young. 2019. First report of *Callicarpa dichotoma* and *Callicarpa japonica* (Lamiaceae) spontaneous and potentially invasive in New York and New Jersey. Phytoneuron 2019–17:1–3.

Bailey, L.H. 1949. Manual of Cultivated Plants Most Commonly Grown in the Continental United States and Canada (rev. ed.). MacMillan.

Bailey, L.H. and E.Z. Bailey. 1976. Hortus Third. A Concise Dictionary of Plants Cultivated in the United States and Canada. Vols. 1–2. MacMillan.

Banasiak, S.E. and S.J. Meiners. 2009. Long-term dynamics of *Rosa multiflora* in a successional system. Biol. Invasions 11:215–224.

Bao, B. and M.A. Vincent. 2010. *Sophora*. Pp. 85–93, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Barger, T.W., H.E. Horne, D.D. Spaulding, B.D. Holt, A. Cressler, L.D. Estes, and B.M. Hughes. 2012. Noteworthy collections: Alabama; New and noteworthy records for the flora of Alabama. Castanea 77:257–269.

Basinger, M.A. 1999. Notes on some naturalized woody plant species new to Illinois. Transactions of the Ill. State Acad. of Sci. 92:33–36.

Batianoff, G.N. and D.W. Butler. 2002. Assessment of invasive naturalized plants in south-east Queensland. Plant Prot. Quart. 17(1):27–34.

Binggeli, P., J.B. Hall, and J.R. Healey. 1998. An overview of invasive woody plants in the tropics. School of Agricultural and Forest Sciences. Publication No. 13, University of Wales, Bangor.

Blackmon, G.H. 1943. The tung-oil industry. Bot. Rev. 9:1–40.

Blanchard, Jr., O.J. 2015. *Hibiscus* (Malvaceae). Pp. 252–267, in Flora of North America Editorial Committee, (eds.) Flora of North America north of Mexico, Vol. 6. Oxford Univ. Press, New York and London.

Borell, A.E. 1971. Russian-olive for wildlife and other conservation uses. Leaflet 292. Washington, DC: U.S. Department of Agriculture. Pp. 1–8.

Brock, M. 2020. New vascular plant records for Kentucky. Phytoneuron 2020–6:1–8.

Bruggers, T.V. 1986. *Elaeagnus*. Pp. 490–491, in R.L. McGregor (coordinator). Flora of the Great Plains. Great Plains Flora Association. University of Kansas Press, Lawrence.

Buchholz, J.T. and N.E. Gray. 1948. A taxonomic revision of *Podocarpus* I. The sections of the genus and their subdivisions with special reference to leaf anatomy. J. Arnold. Arbor. 29: 49–63.

Burrows, G.E. and R.J. Tyrl. 2001. Toxic Plants of North America. Iowa State University Press, Ames.

Byng, J.W. 2015. The Gymnosperms Handbook: A Practical Guide to Extant Families and Genera of the World. Plant Gateway Ltd., Hertford, United Kingdom.

Byrd, T.C. and A.R. Diamond. 2018. New vascular plant records for Alabama. Phytoneuron 2018–5:1–5.

California Invasive Plant Council. 2021. <https://www.cal-ipc.org/> Accessed May 2021.

Campbell, J. and M. Medley. 2012. The Atlas of Vascular Plants in Kentucky. <http://www.bluegrasswoodland.com/> Accessed March 2021.

Carter, R., W.W. Baker, and W.M. Morris. 2009. Contributions to the flora of Georgia, U.S.A. Vulpia 8:1–54.

Catling, P.M. and G. Mitrow. 2014a. *Chaenomeles* (Rosaceae). P. 713, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Catling, P.M. and G. Mitrow. 2014b. *Pyrus* (Rosaceae). Pp. 479–484, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Chang, M–C., L–C. Chiu, Z. Wei, and P.S. Green. 1996a. *Forsythia*. Pp. 279–280, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 15 (Myrsinaceae through Loganiaceae). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis.

Chang, M–C., L–C. Chiu, Z. Wei, and P.S. Green. 1996b. *Jasminum*. Pp. 307–319, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 15 (Myrsinaceae through Loganiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Chang, M–C., L–C. Chiu, Z. Wei, and P.S. Green. 1996c. *Ligustrum*. Pp. 299–307, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 15 (Myrsinaceae through Loganiaceae). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis.

Chen, S.–K., H. Ma, Y. Feng, G. Barriera, and P. Loizeau. 2008. *Ilex*. Pp. 359–438, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis.

Chen, S.–L. and M.G. Gilbert. 1994a. *Callicarpa*. Pp. 4–16, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis.

Chen, S.–L. and M.G. Gilbert. 1994b. *Clerodendrum*. Pp. 34–43, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Chen, S.–L. and M.G. Gilbert. 1994c. *Vitex*. Pp. 28–32, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis.

Chen, Y. and C. Schirarend. 2007a. *Rhamnus*. Pp. 139–162, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Chen, Y. and C. Schirarend. 2007b. *Ziziphus*. Pp. 119–123, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Chen, Z. and J. Wen. 2007. *Ampelopsis*. Pp. 178–184, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Chester, E.W., B.E. Wofford, and R. Kral. 1997. Atlas of Tennessee Vascular Plants. Vol. 2. Miscellaneous Publication No. 13. Austin Peay State University, Clarksville.

Clark, R.C., R.L. Jones, T.J. Weckman, R.L. Thompson, J.W. Thieret, and K. Freeman. 2005. State records and other noteworthy collections for Kentucky. Sida 21(3):1909–1916.

Diamond, A.R. 2013. New and noteworthy woody vascular plant records from Alabama. Phytoneuron 2013–47:1–13.

Diamond, A.R. 2014. New and noteworthy vascular plant records from Alabama. Phytoneuron 2014–103:1–10.

Diamond, A.R. and M. Woods. 2009. Noteworthy collections: Alabama. Castanea 74:440–443.

Dickson, E.E. 2014. *Malus* (Rosaceae). Pp. 472–479, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Diggs, G.M., Jr., B.L. Lipscomb, and R.J. O'Kennon. 1999. Shinners and Mahler's Illustrated Flora of North Central Texas. Sida, Bot. Misc. 16.

Dirr, M.A. 2002. In search of a perfect *Hydrangea*. Nursery Mgt. Production 18:16–17, 95–96.

Dirr, M.A. 2004. Hydrangeas for American Gardens. Timber Press, Portland.

Dorr, L.J. 2015. *Firmiana* (Malvaceae). Pp. 190–191, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 6. Oxford Univ. Press, New York and London.

Dreyer, G.D., L.M. Baird, and C. Fickler. 1987. *Celastrus scandens* and *Celastrus orbiculatus*: comparisons of reproductive potential between a native and introduced woody vine. Bull. Torr. Bot. Club 114:260–264.

Eckenwalder, J.E. 2009. *Diospyros* (Ebenaceae). Pp. 248–250, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 8. Oxford Univ. Press, New York and London.

Eckenwalder, J.E. 2010. *Populus* (Salicaceae). Pp. 5–22, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 7. Oxford Univ. Press, New York and London.

Egolf, D.R. and A.O. Andrick. 1995. A checklist of *Pyracantha* cultivars. USDA Agric. Res. Serv., Natl. Arbor. Contr. 8, Washington, D.C.

Fang, C.–F., S.–D. Zhao, and A.K. Skvortsov. 1999. *Salix*. Pp. 139–274, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Ferguson, A.R. 1999. New temperate fruits: *Actinidia chinensis* and *Actinidia deliciosa*. Pp. 342–347, in J. Janick (ed.). Perspectives on new crops and new uses. American Society for Horticultural Science Press. Alexandria.

Ferguson, A.R. and E.G. Bollard. 1990. Domestication of the kiwifruit. Pp. 165–246, in I.J. Warrington and G.C. Weston, (eds.). Kiwifruit science and management. Ray Richards Publisher in association with the New Zealand Soc. Hort. Sci. Auckland.

Firth, D.J. 1981. Camphor laurel (*Cinnamomum camphora*) — a new weed in north-eastern New South Wales. Aust. Weeds 1(2):26–28.

Floden, A. and M. Saxton. 2020. *Viburnum dilatatum* Thunb. — a new, potentially invasive species for Missouri. Missouriensis 38:1–3.

Freeman, C.C. and R.L. McGregor. 1998. Vascular plants new to Kansas. Sida 18: 593–604.

Frohne, G. and H.J. Pfander. 1984. A color atlas of poisonous plants. Wolfe Publ., London.

Fu, L., Y. Li, and R.R. Mill. 1999. *Podocarpus*. Pp. 81–84, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Fu, L., Y. Xin, and A. Whittemore. 2003. *Ulmus*. Pp. 1–9, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gagnon, E., A. Bruneau, C.E. Hughes, L. Paganucci de Quieroz, and G.P. Lewis. 2016. A new generic system for the pantropical *Caesalpinia* group (Leguminosae). PhytoKeys 71:1–160.

Gan, J., J.H. Miller, H. Wang, and J.W. Taylor, Jr. 2009. Invasion of tallow tree into southern US forests: influencing factors and implications for mitigation. Can. J. For. Res. 39:1346–1356.

Gaskin, J.F. 2015. *Tamarix* (Tamaricaceae). Pp. 414–417, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 6. Oxford Univ. Press, New York and London.

Geldenhuys, C.J. 1993. Reproductive biology and population structures of *Podocarpus falcatus* and *P. latifolius* in southern Cape forests. Bot. J. Linn. Soc. 112: 59–74.

Gentry, J.L., G.P. Johnson, B.T. Baker, C.T. Witsell, and J.D. Ogle. 2013. Atlas of the Vascular Plants of Arkansas. Vascular Flora Project, Univ. of Arkansas, Fayetteville.

Gillespie, L.J. 2016a. *Ricinus* (Euphorbiaceae). P. 160, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Gillespie, L.J. 2016b. *Vernicia* (Euphorbiaceae). Pp. 225–226, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Givnish, T.J. 1980. Ecological constraints on the evolution of breeding systems in seed plants: Dioecy and dispersal in gymnosperms. Evolution 34:959–972.

Godfrey, R.K. and J.W. Wooten. 1981. Aquatic and Wetland Plants of the Southeastern United States, Dicotyledons. University of Georgia Press, Athens.

Griffiths, M. 1992. Index of Garden Plants. Royal Horticultural Society. Timber Press, Portland.

Gu, C. and C. Alexander. 2003. *Exochorda*. Pp. 82–83, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gu, C. and B. Bartholomew. 2003. *Prunus*. Pp. 401–403, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gu, C. and K.R. Robertson. 2003. *Rosa*. Pp. 339–381, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gu, C. and S.A. Spongberg. 2003a. *Chaenomeles*. Pp. 171–173, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gu, C. and S.A. Spongberg. 2003b. *Eriobotrya*. Pp. 138–141, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gu, C. and S.A. Spongberg. 2003c. *Malus*. Pp. 179–189, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gu, C. and S.A. Spongberg. 2003d. *Pyracantha*. Pp. 108–111, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Gu, C. and S.A. Spongberg. 2003e. *Pyrus*. Pp. 173–179, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Haines, A. 2011. Flora Novae Angliae: A manual for the identification of native and naturalized higher vascular plants of New England. New England Wildflower Society, Yale University Press, New Haven.

Haines, A. 2014. *Exochorda* (Rosaceae). P. 384, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Hannick, V.C., J.N. Mink, J.R. Singhurst, and W.C. Holmes. 2013. Annotated checklist of the vascular flora of McLennan County, Texas. Phytoneuron 2013–29:1–37.

Hansen, C.J. and L.R. Goertzen. 2006. *Cayratia japonica* (Vitaceae) naturalized in Alabama. Castanea 71(3):248–251.

Hardin, J.W. and L.L. Phillips. 1985. Hybridization in eastern North American *Rhus* (Anacardiaceae). Assoc. Southeast Biologists. Bull. 32:99–106.

Hauenschild, F., A. Favre, G.A. Salazar, and A.N. Muellner-Riehl. 2016. Analysis of the cosmopolitan buckthorn genera *Frangula* and *Rhamnus* s.l. supports the description of a new genus, *Ventia*. Taxon 65:65–78.

Hayden, W.J. 2016. *Manihot* (Euphorbiaceae). Pp. 192–196, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Henderson, L. 2001. Alien Weeds and Invasive Plants. Plant Protection Research Institute Handbook No. 12. Agricultural Research Council, Pretoria.

Henderson, L. 2007. Invasive, naturalized and casual alien plants in southern Africa: a summary based on the Southern African Plant Invaders Atlas (SAPIA). Bothalia 37(2):215–248.

Henrickson, J. 2014. *Rhodotypos* (Rosaceae). P. 386, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Henrickson, J. and A.S. Weakley. 2014. *Kerria* (Rosaceae). Pp. 389–390, in Flora of North America Editorial Committee, eds. Flora of North America north of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Hill, S.R. and C.N. Horn. 1997. Additions to the flora of South Carolina. Castanea 62:194–208.

Hilty, J. 2002. Illinois Wildflowers. <https://www.illinoiswildflowers.info/index.htm> Accessed April 2021.

Hong, D., H. Yang, C.–l. Jin, M.A. Fischer, N.H. Holmgren, and R.R. Mill. 1998. *Paulownia*. Pp. 8–10, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 18 (Scrophulariaceae through Gesneriaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Hrusa, F., B. Ertter, A. Sanders, G. Leppig, and E. Dean. 2002. Catalog of non-native vascular plants occurring spontaneously in California beyond those addressed in The Jepson manual. Part I. Madroño 49:61–98.

Huang, P., H. Ohashi, and T. Nemoto. 2010. *Lespedeza*. Pp. 302–311, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Huang, S., H. Ohba, and S. Akiyama. 2001. *Deutzia*. Pp. 379–395, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 8 (Brassicaceae through Saxifragaceae). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis.

Huang, C., Y. Zhang, and B. Bartholomew. 1999a. *Castanea*. Pp. 315–317, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Huang, C., Y. Zhang, and B. Bartholomew. 1999b. *Quercus*. Pp. 370–380, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 4 (Cycadaceae through Fagaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Hui, R. and J. Wen. 2007. *Cayratia*. Pp. 189–194, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Hunter, C.G. 1995. Trees, Shrubs, and Vines of Arkansas. Second Edition. Ozark Society Foundation, Little Rock.

Invaders of Texas. 2020. A Citizen Science Program to Detect and Report Invasive Species. TexasInvasives.org. <https://www.texasinvasives.org/invaders/> Accessed November 2020.

Isely, D. 1998. Native and Naturalized Leguminosae (Fabaceae) of the United States (Exclusive of Alaska and Hawaii). M.L. Bean Life Science Museum. Brigham Young University.

Isely, D. and F.J. Peabody. 1984. *Robinia* (Leguminosae: Papilionoideae). Castanea 49:187–202.

Jaster, T., S.C. Meyers, and S. Sundberg (eds.). 2016. Oregon Vascular Plant Checklist [Hydrangeaceae]. Ver. 1.6. Corvallis, Oregon. <http://www.oregonflora.org/checklist.php> Accessed April 2021.

Jones, Jr., S.B. and N.C. Coile. 1988. The distribution of the vascular flora of Georgia. Herbarium, Department of Botany, University of Georgia, Athens.

Jubinsky, G. 1993. A review of the literature: *Sapium sebiferum*. Roxb. Report No. TSS 93–03. Florida Dept. Natur. Resour., Bur. Aq. Plant Manag., Tallahassee.

Jubinsky, G. and L.C. Anderson. 1996. The invasive potential of Chinese tallow-tree (*Sapium sebiferum* Roxb.) in the southeast. Castanea 61(3):226–231.

Kartesz, J.T. 2015. Taxonomic Data Center. The Biota of North America Program (BONAP). Chapel Hill, North Carolina. <http://www.bonap.org/index.html> Accessed April 2021.

Katz, G.L. and P.B. Shafroth. 2003. Biology, ecology, and management of *Elaeagnus angustifolia* L. (Russian olive) in western North America. Wetlands 23(4):763–777.

Kaul, R.B., D.M. Sutherland, and S.B. Rolfsmeier. 2006. The Flora of Nebraska. School of Natural Resources, Inst. of Agriculture and Natural Resources, Univ. of Nebraska, Lincoln.

Keener, B.R., A.R. Diamond, L.J. Davenport, P.G. Davison, S.L. Ginzbarg, C.J. Hansen, C.S. Major, D.D. Spaulding, J.K. Triplett, and M. Woods. 2021. Alabama Plant Atlas. [S.M. Landry and K.N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. Univ. of West Alabama, Livingston.

Kral, R. 1993. *Pinus* (Pinaceae). Pp. 373–398, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 2. Oxford Univ. Press, New York and London.

Krings, A. 2011. *Pistacia chinensis* (Anacardiaceae) naturalized in North Carolina, U.S.A. J. Bot. Res. Inst. Texas 5(2):867–869.

Krings, A. and R.J. Richardson. 2006. *Cayratia japonica* (Vitaceae) new to North Carolina and an updated key to the genera of Vitaceae in the Carolinas. Sida 22:813–815.

Krüssmann, G. 1976 (1984). Manual of Cultivated Broad–Leaved Trees and Shrubs. Vol. 1. Timber Press, Portland.

Krüssmann, G. 1977 (1985). Manual of Cultivated Broad–Leaved Trees and Shrubs. Vol. 2. Timber Press, Portland.

Krüssmann, G. 1978 (1986). Manual of Cultivated Broad–Leaved Trees and Shrubs. Vol. 3. Timber Press, Portland.

Krüssmann, G. 1983 (1991, 1995). Manual of Cultivated Conifers. Timber Press, Portland.

Ladd, D. and J.R. Thomas. 2015. Ecological checklist of the Missouri flora for Floristic Quality Assessment. Phytoneuron 2015–12:1–274.

Lance, R.W. and P.F. Zika. 2014. *Pyracantha* (Rosaceae). Pp. 468–472, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Landrein, S., S. Buerki, H–F. Wang, and J.J. Clarkson. 2017. Untangling the reticulate history of species complexes and horticultural breeds in *Abelia* (Caprifoliaceae). Ann. Bot. 120:257–269.

Lawrence, J.G., A. Colwell, and O.J. Sexton. 1991. The ecological impact of allelopathy in *Ailanthus altissima* (Simaroubaceae). Amer. J. Bot. 78(7):948–958.

Lewis, W.H. 2008. *Rosa carolina* (Rosaceae) subspecies and hybrids in eastern and midwestern United States, Canada, and Mexico. Novon 18(2):192–198.

Lewis, W.H. and W. Elvin-Lewis. 2017. New records and range extensions for *Rosa* (Rosaceae) in North America. J. Bot. Res. Inst. Texas 11(1):185–191.

Lewis, W.H., B. Ertter, and A. Bruneau. 2015. *Rosa* (Rosaceae). Pp. 75–119, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Li, B. and H.–J. Esser. 2008. *Triadica*. Pp. 284–285, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, B. and M.G. Gilbert. 2008. *Vernicia*. Pp. 266–267, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, B. and A.J.M. Leeuwenberg. 1996. *Buddleja*. Pp. 329–337, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 15 (Myrsinaceae through Loganiaceae). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis.

Li, B., A.J.M. Leeuwenberg, and D.J. Middleton. 1995a. *Nerium*. P. 173, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 16 (Gentianaceae through Boraginaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, B., A.J.M. Leeuwenberg, and D.J. Middleton. 1995b. *Trachelospermum*. Pp. 166–168, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 16 (Gentianaceae through Boraginaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, C., H. Ikeda, and H. Ohba. 2003a. *Kerria*. P. 192, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, C., H. Ikeda, and H. Ohba. 2003b. *Rhodotypos*. P. 192, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, J., X. Li, and D.D. Soejarto. 2007. *Actinidia*. Pp. 334–355, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, S., M.G. Gilbert, and F. White. 1996. *Diospyros*. Pp. 215–234, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 15 (Myrsinaceae through Loganiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Li, X–W., J. Li, and H. van der Werff. 2008. *Cinnamomum*. Pp. 166–187, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 7 (Menispermaceae through Capparaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Lin, Y.C., P.J. Lin, H.H. Wang, and L.F. Sun. 2011. Seed distribution of eleven tree species in a tropical forest in Taiwan. Bot. Stud. 52:327–336.

Lis, R. 2014. *Spiraea* (Rosaceae). Pp. 398–411, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Lu, L. and C. Alexander. 2003. *Spiraea*. Pp. 47–73, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Lu, L. and B. Bartholomew. 2003. *Amygdalus*. Pp. 391–395, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Lu, L. and S.A. Spongberg. 2003. *Photinia*. Pp. 121–137, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Lutz, H.J. 1943. Injuries to trees caused by *Celastrus* and *Vitis*. Bull. Torr. Bot. Club 70:436–439.

Ma, J. and M. Funston. 2008. *Euonymus*. Pp. 440–460, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Ma, J. and G.A. Levin. 2016a. *Celastrus* (Celastraceae). P. 120, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Ma, J. and G.A. Levin. 2016b. *Euonymus* (Celastraceae). Pp. 122–125, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Mack, R.N. and M. Erneberg. 2002. The United States naturalized flora: largely the product of deliberate introductions. Ann. Missouri Bot. Gard. 89:176–189.

Maddox, V.J., J.D. Byrd, Jr., and B.E. Serviss. 2010. Identification and Control of Invasive Privets (*Ligustrum* spp.) in the Middle Southern United States. Invasive Plant Science and Management 3:482–488.

Manning, S.D. 2000. The genera of Bignoniaceae in the southeastern United States. Harv. Pap. Bot. 5:1–77.

McAvoy, W.A. and K.A. Bennett. 2001. The flora of Delaware: An annotated checklist. Department of Natural Resources and Environmental Control, Dover, Delaware.

McClintock, E. 1957. A monograph of the genus *Hydrangea*. Proc. California Acad. Sci. 29:147–256.

McGregor, R.L. 2016. *Deutzia* (Hydrangeaceae). P. 472, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

McWilliams, E. 1991. The impending naturalization of *Pistacia chinensis* (Anacardiaceae) in east Texas. Sida 14(3):508–511.

Meyer, F.G. 1976. A revision of the genus *Koelreuteria* (Sapindaceae). J. Arn. Arb. 57(2):129–166.

Meyer, F.G. 1997. *Magnolia* (Magnoliaceae). Pp. 4–9, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Meyer, F.G., P.M. Mazzeo, and D.H. Voss. 1994. A Catalog of Cultivated Woody Plants of the Southeastern United States. USDA Agricultural Research Service, U.S. National Arboretum Contr. No. 7. U.S. Govt. Printing Office, Washington, DC.

Miller, A.J., D.A. Young, and J. Wen. 2001. Phylogeny and biogeography of *Rhus* (Anacardiaceae) based on its sequence data. Int. J. Plant Sci. 162(6):1401–1407.

Miller, J.H. 2003. Nonnative invasive plants of southern forests: A field guide for identification and control. Gen. Tech. Rep. SRS-62. USDA Forest Service, Southern Research Station, Asheville, NC. <https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs062/> Accessed April 2021.

Min, T. and A. Barfod. 2008. *Pistacia*. P. 345, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Min, T. and B. Bartholomew. 2007a. *Camellia*. Pp. 367–412, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Min, T. and B. Bartholomew. 2007b. *Ternstroemia*. Pp. 430–434, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Mitchell, R.S. 1986. A checklist of New York State plants. Contributions of a Flora of New York State, Checklist III. New York State Bulletin. No. 458. New York State Museum, Albany.

Moore, D.M. 1972. Trees of Arkansas. Arkansas Forestry Commission, Little Rock.

Moore, D.M. and E. Sundell. 2014. Trees of Arkansas. Eighth Revised Edition. Arkansas Forestry Commission, Little Rock.

Moore M.O. and J. Wen. 2016. *Ampelopsis* (Vitaceae). Pp. 18–19, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Moshkin, V.A. 1986a. Economic importance and regions of cultivation of castor. Pp. 1–5, in Moshkin V.A. (ed.) Castor. Russ Transly Ser 43, AA Balkema Publ. Rotterdam.

Moshkin, V.A. 1986b. History and origin of castor. Pp. 6–10, in Moshkin V.A. (ed.) Castor. Russ Transly Ser 43, AA Balkema Publ. Rotterdam.

Nesom, G.L. 2000. Which non–native plants are included in floristic accounts? Sida 19:189–193.

Nesom, G.L. 2009. Taxonomic overview of *Ligustrum* (Oleaceae) naturalized in the United States. Phytologia 91:467–482.

Nesom, G.L. 2010a. First report of *Euonymus fortunei* (Celastraceae) naturalized in Texas. Phytoneuron 2010–1:1–4.

Nesom, G.L. 2010b. *Pyracantha* (Rosaceae) naturalized in Texas and the southeastern United States. Phytoneuron 2010–2:1–6.

Nesom, G.L. 2014a. *Citrus trifoliata* (Rutaceae): Review of biology and distribution in the USA. Phytoneuron 2014–46:1–14.

Nesom, G.L. 2014b. *Photinia* (Rosaceae). Pp. 488–491, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Nesom, G.L. 2016. *Ziziphus* (Rhamnaceae). Pp. 70–73, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Nesom, G.L. and J.O. Sawyer. 2016. *Rhamnus* (Rhamnaceae). Pp. 45–52, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Nixon, K.C. 1997a. *Castanea* (Fagaceae). Pp. 439–442, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Nixon, K.C. 1997b. *Quercus* (Fagaceae). Pp. 445–506, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Ogle, J.D., T. Witsell, and J. Gentry. 2020. Trees, Shrubs, and Woody Vines of Arkansas. Ozark Society Foundation.

Ohwi, J. 1965. Flora of Japan: In English: A combined, much revised, and extended translation (F.G. Meyer and E.H. Walker (eds.). Smithsonian Institution Press, Washington, DC.

Okie, W.R. 2001. Plum crazy: Rediscovering our lost *Prunus* resources. HortScience 36:209–213.

Oregon State University Landscape Plants. 2021. *Kerria japonica*, College of Agricultural Sciences, Department of Horticulture. <https://landscapeplants.oregonstate.edu/plants/kerria-japonica> Accessed May 2021.

Oswalt, S.N. 2010. Chinese tallow (*Triadica sebifera* (L.) Small) population expansion in Louisiana, East Texas, and Mississippi. P. 5. Res. Note SRS–20, U.S. Department of Agriculture Forest Service, Southern Research Station, Asheville, NC.

Pattison, R.P. and R.N. Mack. 2007. Potential distribution of the invasive tree *Triadica sebifera* (Euphorbiaceae) in the United States: Evaluating CLIMEX predictions with field trials. Global Change Biol. 14:813–826.

Payne, D. 2010. A survey of the vascular flora of Beaufort County South Carolina. All Thesis. Paper 924, Clemson University, Clemson, South Carolina.

Peck, J.H. 2003. Arkansas flora: additions, reinstatements, exclusions, and re–exclusions. Sida 20:1737–1757.

Peck, J.H. and C.J. Peck. 1988. A bibliographic summary of Arkansas field botany. Proc. Arkansas Acad. Sci. 41:58–73.

Peck, J.H. and B.E. Serviss. 2011. *Neptunia oleracea* Lour. (Fabaceae) new to the continental United States, with new and noteworthy records of several angiosperms in Arkansas. J. Bot. Res. Inst. Texas 5(1):321–326.

Peck, J.H. and B.E. Serviss. 2016. *Ficus carica* (Moraceae) and *Kerria japonica* (Rosaceae) new to the Arkansas flora (U.S.A.), with a second record of *Canna indica* (Cannaceae) and the re–instatement of *Nerium oleander* (Apocynaceae) for the state. J. Bot. Res. Inst. Texas 10(1):169–174.

Peck, J.H., C.T. Witsell, and T.L. Foti. 2001. Arkansas field botany (flora and vegetation) bibliography (1988–2000). J. Arkansas Acad. Sci. 55:104–114.

Peng, H. and D.J. Mabberley. 2008. *Melia*. Pp. 130–131, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Peng, H. and Wm.Wayt Thomas. 2008. *Ailanthus*. Pp. 100–102, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Phipps, J.B. 2014a. *Eriobotrya* (Rosaceae). P. 432, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Phipps, J.B. 2014b. Rosaceae. Pp. 18–19, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Pittillo, J.D. and A.E. Brown. 1988. Additions to the vascular flora of the Carolinas, III. J. Elisha Mitchell Sci. Soc. 104:1–18.

Plunkett, G.M., J. Wen, P.P. Lowry II, A.D. Mitchell, M.J. Henwood, and P. Fiaschi. 2018. Araliaceae. Pp. 413–446, in Kadereit, J. and V. Bittrich. The families and genera of flowering plants. XV. Flowering plants. Eudicots. Apiales, Gentianales (except Rubiaceae). Springer, Cham.

Poindexter, D.B. 2013. Vascular flora and plant communities of Alleghany County, North Carolina. J. Bot. Res. Inst. Texas 7:529–574.

Pyšek, P. and D.M. Richardson. 2010. Invasive species, environmental change and management, and health. Annu. Rev. Environ. Resour. 2010. 35:25–55.

Qin, H. and S.A. Graham. 2007a. *Lagerstroemia*. Pp. 277–281, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Qin, H. and S.A. Graham. 2007b. *Punica*. P. 283, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Qin, H. and C. Phengklai. 2007. *Camptotheca*. Pp. 300–301, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Rehder, A. 1990. Manual of Cultivated Trees and Shrubs Hardy in North America, Exclusive of the Subtropical and Warmer Temperate Regions. Second Edition. Revised and Enlarged, T.R. Dudley (ed.). Biosystematics, Floristic, and Phylogeny Series, Vol. 1. Dioscorides Press, Portland.

Renne, I.J., S.A. Gauthreaux, Jr, and C.A. Gresham. 2000. Seed dispersal of the Chinese tallow tree (*Sapium sebiferum* (L.) Roxb.) by birds in coastal South Carolina. Am. Midland Nat. 144:202–215.

Renne, I.J., T.P. Spira, and W.C.J. Bridges. 2001. Effects of habitat, burial, and passage through birds on germination and establishment of Chinese tallow tree in Coastal South Carolina. J. Torr. Bot. Soc. 128:109–119.

Reichard, S. and F. Campbell. 1996. Invited but unwanted. Amer. Nurseryman. 184:39–45.

Reichard, S.H. and P. White. 2001. Horticulture as a pathway of invasive plant introductions in the United States. BioScience 51:103–113.

Rhoads, A.F. and T.A. Block. 2007. The Plants of Pennsylvania: An Illustrated Manual. Second Edition. University of Pennsylvania Press, Philadelphia.

Rhoads, A.F. and W.M. Klein. 1993. The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas. Amer. Phil. Soc., Morris Arboretum, University of Pennsylvania, Philadelphia.

Riley, B.P., M.A. Vincent, and M.P. Widrlechner. 2020. Ohio flora: Additions, noteworthy finds, and deletions. Phytoneuron 2020–2:1–39.

Robertson, D.J., M.C. Robertson, and T. Tague. 1994. Colonization dynamics of four exotic plants in a northern piedmont natural area. Bull. Torr. Bot. Club. 121(2):107–118.

Rohrer, J.R. 2014. *Prunus* (Rosaceae). Pp. 352–383, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 9. Oxford Univ. Press, New York and London.

Sanders, R.W. 2006. Taxonomy of *Lantana* sect. *Lantana* (Verbenaceae): 1 correct application of *Lantana camara* and associated names. Sida 22(1):381–421.

Sanders, R.W. 2012. Taxonomy of *Lantana* sect. *Lantana* (Verbenaceae): II. Taxonomic revision. J. Bot. Res. Inst. Texas 6:403–441.

Scheld, H.W., J.R. Cowles, C.R. Engler, R. Kleiman, and E.B. Schultz. 1984. Seeds of the Chinese tallow tree as a source of chemicals and fuels. P. 254, in Schultz, E.B., Jr. and R.P. Morgan (eds.). Fuels and chemicals from oil seeds: Technology and policy options. AAAS Selected Symposium 91. Westview Press, Boulder.

Serviss, B.E. 2009. *Pyracantha koidzumii* (Rosaceae) new to the Arkansas flora. J. Bot. Res. Inst. Texas 3:319–321.

Serviss, B.E. 2021. *Actinidia* (Actinidiaceae). (in press), in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 13. Oxford Univ. Press, New York and London.

Serviss, B.E. and J.H. Peck. 2008. New and noteworthy records of several non–native vascular plant species in Arkansas. J. Bot. Res. Inst. Texas 2(1):637–641.

Serviss, B.E. and J.H. Peck. 2013. Rediscovery of *Persea borbonia* var. *borbonia* (Lauraceae), *Prosopis glandulosa* var. *glandulosa* (Fabaceae), and *Pinus palustris* (Pinaceae) in Arkansas, with three new angiosperm species for Arkansas (U.S.A.). J. Bot. Res. Inst. Texas 7(2):841–845.

Serviss, B.E. and J.H. Peck. 2016a. *Camellia sasanqua* (Theaceae) in the Arkansas flora. Phytoneuron 2016–28:1–7.

Serviss, B.E. and J.H. Peck. 2016b. *Punica granatum* (Lythraceae): reaffirmed as a component of the Arkansas flora. Phytoneuron 2016–44:1–5.

Serviss, B.E. and J.H. Peck. 2019. *Abelia* (Caprifoliaceae) in the Arkansas flora. Phytoneuron 2019–7:1–7.

Serviss, B.E. and T.K. Serviss. 2020a. Noteworthy records of *Pistacia chinensis* (Anacardiaceae) and *Ulmus parvifolia* (Ulmaceae) in Arkansas. Phytoneuron 2020–85:1–4.

Serviss, B.E. and T.K. Serviss. 2020b. *Eriobotrya japonica* (Rosaceae) new for the Arkansas flora. Phytoneuron 2020–41:1–5.

Serviss, B.E., N. Freeman, and S. Melancen. 2006. Chinese flame tree (*Koelreuteria bipinnata* Franch.) new to the Arkansas flora. J. Arkansas Acad. Sci. 60:197–199.

Serviss, B.E., D.H. Mason, and T.L. Bray. 2012. A first spontaneous record of *Actinidia chinensis* var. *deliciosa* (Actinidiaceae) in the United States flora. J. Bot. Res. Inst. Texas 6(2):617–620.

Serviss, B.E., J.H. Peck, and V.L. Maddox. 2016a. *Hydrangea macrophylla* (Hydrangeaceae) adventive in the Arkansas flora. Phytoneuron 2016–66:1–6.

Serviss, B.E., J.H. Peck, and T.A. Roeser. 2014. The first naturalized occurrence of the Cannaceae family in the Arkansas (U.S.A.) flora, with additional new and noteworthy angiosperm records for the state. J. Bot. Res. Inst. Texas 8(2):637–639.

Serviss, B.E., K.B. Serviss, and J.H. Peck. 2016b. *Podocarpus macrophyllus* (Podocarpaceae): a new species, genus, and family for the Arkansas flora. Phytoneuron 2016–37:1–4.

Serviss, B.E., R. Tumlison, and J.H. Peck. 2016c. *Ilex crenata* (Aquifoliaceae), *Syringa vulgaris* (Oleaceae), and *Ulmus parvifolia* (Ulmaceae) new to the Arkansas flora, with a second record of *Pyracantha koidzumii* (Rosaceae) for the state. J. Bot. Res. Inst. Texas 10(2):563–569.

Serviss, B.E., J.W. Hardage, B.L. Olsen, and J.H. Peck. 2017a. *Euonymus japonicus* (Celastraceae) new to the Arkansas flora. Phytoneuron 2017–80:1–3.

Serviss, B.E., J.W. Hardage, K.B. Serviss, and J.H. Peck. 2018a. *Clerodendrum* (Lamiaceae) in the Arkansas flora. Phytoneuron 2018–69:1–4.

Serviss, B.E., J.W. Hardage, K.B. Serviss, and J.H. Peck. 2018c. *Pyracantha* (Rosaceae) in the Arkansas flora. Phytoneuron 2018–6:1–8.

Serviss, B.E., B.L. Olsen, J.W. Hardage, and J.H. Peck. 2018d. The first naturalized occurrence of *Jasminum* (Oleaceae) in the Arkansas flora. Phytoneuron 2018–16:1–6.

Serviss, B.E., N. Freeman, A. Leible, J. Hernandez, and C. Talley. 2007a. Tungoil tree (*Aleurites fordii* Hemsl.) (Euphorbiaceae) new to the Arkansas flora. J. Arkansas Acad. Sci. 61:128–130.

Serviss, B.E., N. Freeman, A. Leible, J. Hernandez, C. Talley, and B. Baker. 2007b. Negundo chaste tree (*Vitex negundo* L) (Verbenaceae) new to the Arkansas flora. J. Arkansas Acad. Sci. 61:131–133.

Serviss, B.E., J.W. Hardage, B.L. Olsen, K.B. Serviss, and J.H. Peck. 2017b. *Ipomoea batatas* (Convolvulaceae) spontaneous in the Arkansas flora, with additional noteworthy records of angiosperms for the state. Phytoneuron 2017–82:1–11.

Serviss, B.E., J.W. Hardage, K.B. Serviss, B.L. Olsen, and J.H. Peck. 2018b. *Ternstroemia* (Theaceae) in the Arkansas flora. Phytoneuron 2018–45:1–7.

Serviss, B.E., J.W. Hardage, F.C. Ward, B.L. Olsen, L.M. Hunter, K.B. Serviss, and J.H. Peck. 2020. *Alocasia macrorrhizos* (Araceae), *Buxus sempervirens* (Buxaceae), and *Nothoscordum gracile* (Alliaceae) new to the Arkansas flora, with additional noteworthy records of angiosperms for the state. Phytoneuron 2020–13:1–13.

Serviss, B.E., J.H. Peck, T.L. Childs, S.S. Grant, T.A. Graves, E. Holicer, S.A. McBroom, L. Thomas, and A. Leible. 2015. The first naturalized occurrence of the genus *Forsythia* (Oleaceae) in Arkansas (U.S.A.), with additional noteworthy angiosperm records for the state. J. Bot. Res. Inst. Texas 9(1):195–199.

Shelter, S.G. and S.S. Orli. 2000. Annotated Checklist of the Vascular Plants of the Washington – Baltimore Area, Part I: Ferns, Fern Allies, Gymnosperms, and Dicotyledons. National Museum of Natural History, Smithsonian Institution, Washington, DC.

Sherman-Broyles, S.L. 1997. *Ulmus* (Ulmaceae). Pp. 369–375, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Siwundla, N. and J.M. Stucky. 1989. Pericarp anatomy in *Sesbania* (Fabaceae) of the Southeastern United States and its systematic significance. Castanea 54:164–171.

Smith, E.B. 1978. An atlas and annotated and list of the vascular flora of Arkansas. E.B. Smith. Fayetteville, Arkansas.

Smith, E.B. 1988. An atlas and annotated and list of the vascular flora of Arkansas, second edition. E.B. Smith. Fayetteville, Arkansas.

Smith, E.B. 1994. Keys to the flora of Arkansas. University of Arkansas Press. Fayetteville, Arkansas.

Snow, N. 2017. New records of vascular plants for Kansas. Phytoneuron 2017–71:1–2.

Soule, J.T., J. Matthews, K.C. Blackmon, T.L. Mellichanp. 2008. Noteworthy collections: North Carolina observations on the invasive *Cayratia japonica* (Vitaceae) in North Carolina, including six new records for the state. Castanea 73(1):42–45.

Stebbins, G.L. 1950. Variation and Evolution in Plants. Columbia University Press, New York.

Steury, B.W. 2011. Additions to the Vascular Flora of the George Washington Memorial Parkway, Virginia, Maryland, and the District of Columbia. Banisteria 37:3–20.

Stokes, D.L., E.D. Church, D.M. Cronkright, and S. Lopez. 2014. Pictures of an Invasion: English Holly (*Ilex aquifolium*) in a Semi-Natural Pacific Northwest Forest. Northwest Sci. 88(2):75–93.

Sun, H. and B. Bartholomew. 2010. *Robinia*. Pp. 320–321, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Sundell, E. 1986. Noteworthy vascular plants from Arkansas USA. Castanea 51:211–215.

Swearingen, J. and C. Bargeron. 2016. Invasive Plant Atlas of the United States. University of Georgia Center for Invasive Species and Ecosystem Health. <https://www.invasiveplantatlas.org/subject.html?sub=10123> Accessed April 2021.

Takhtajan, A.L. 1986. Floristic Regions of the World. Berkley and Los Angeles.

Tang, Y., M.G. Gilbert, and L.J. Dorr. 2007a. *Firmiana*. Pp. 310–312, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Tang, Y., M.G. Gilbert, and L.J. Dorr. 2007b. *Hibiscus*. Pp. 286–294, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 12 (Hippocastanaceae through Theaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Tennessee Exotic Plant Pest Council. 2009. Invasive exotic pest plants in Tennessee—2009. Wildland Weeds 13:13–16.

Tepe, E.J. and D.G. Conover. 2019. The spontaneous occurrence of kiwifruit, *Actinidia chinensis* var. *deliciosa* (Actinidiaceae), in Ohio. Phytoneuron 2019–58:1–5.

Thomas, R.D. and C.M. Allen. 1996. Atlas of the vascular flora of Louisiana, Vol. 2: Dicotyledons (Acanthaceae through Euphorbiaceae). Louisiana Dept. of Wildlife and Fisheries. Natural Heritage Program, Baton Rouge, Louisiana.

Thomas, R.D. and C.M. Allen. 1998. Atlas of the Vascular Flora of Louisiana, Vol. 3: Dicotyledons (Fabaceae through Zygophyllaceae). Louisiana Dept. of Wildlife and Fisheries. Natural Heritage Program, Baton Rouge, Louisiana.

Trusty, J.L., L.R. Goertzen, W.C. Zipperer, and G. Lockaby. 2007a. Invasive wisteria in the southeastern United States: genetic diversity, hybridization, and the role of urban centers. Urban Ecosyst. 10:379–395.

Trusty, J.L., G. Lockaby, W.C. Zipperer, and L.R. Goertzen. 2007b. Identity of naturalized exotic *Wisteria* (Fabaceae) in the south-eastern United States. Weed Res. 47(6):479–487.

Trusty, J.L., B.G. Lockaby, W.C. Zipperer, and L.R. Goertzen. 2008. Horticulture, hybrid cultivars and exotic plant invasion: a case study of *Wisteria* (Fabaceae). Bot. J. Linn. Soc. 158(4):593–601.

Tucker, G.E. 1976. A guide to the woody flora of Arkansas. Ph.D. Diss. University of Arkansas, Fayetteville, Arkansas.

University of Arkansas Cooperative Extension Service. 2021. *Ternstroemia gymnanthera*, Little Rock. Univ. of Arkansas Division of Agriculture, Research and Extension. <https://www.uaex.edu/yard-garden/resource-library/plant-database/shrubs/japanese-ternstroemia.aspx> Accessed April 2021.

University of Florida / IFAS / Center for Aquatic and Invasive Plants. 2021. Gainesville, Florida. <https://plants.ifas.ufl.edu/plant-directory/cinnamomum-camphora/> Accessed April 2021.

USDA, NRCS. 2021. The PLANTS Database. National Plant Data Team, Greensboro, North Carolina. <http://plants.usda.gov/java/> Accessed April 2021.

Valder, P. 1999. The Garden Plants of China. Timber Press, Portland.

van der Werff, H. 1997. *Cinnamomum* (Lauraceae). P. 32, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

van Gelderen, C.J. and D.M. van Gelderen. 2004. Encyclopedia of Hydrangeas. Timber Press, Portland.

Vincent, M.A., R.L. Gardner, and B.P. Riley. 2011. Additions to and interesting records for the Ohio vascular flora (with one new record for Indiana). Phytoneuron 2011–60:1–23.

Walker, E.H. 1976. Flora of Okinawa and the Southern Ryukyu Islands. Smithsonian Institution Press, Washington, DC.

Wang, Q., S.R. Manchester, H.–J. Gregor, S. Shen, and Z.–Y. Li. 2013. Fruits of *Koelreuteria* (Sapindaceae) from the Cenozoic throughout the northern hemisphere: there ecological, evolutionary, and biogeographic implications. Am. J. Bot. 100(2):422–449.

Washington State Noxious Weed Control Board. 2021. Butterfly Bush *Buddleja davidii*. <https://www.nwcb.wa.gov/weeds/butterfly-bush#:~:text=Buddleja%20davidii%20(butterfly%20bush)%20is,Department%20of%20Agriculture%20in%202011> Accessed April 2021.

Weakley, A.S. 2020. Flora of the Southeastern United States. Edition as of 20 October 2020. Univ. of North Carolina Herbarium (NCU), Chapel Hill. <http://www.herbarium.unc.edu/ flora.htm> Accessed April 2021.

Weakley, A.S. and J. Henrickson. 2016. *Philadelphus* (Hydrangeaceae). Pp. 473–485, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Wei, Z. and B. Bartholomew. 2001. *Hydrangea*. Pp. 411–422, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 8 (Brassicaceae through Saxifragaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Wei, Z. and L. Pedley. 2010. *Wisteria*. Pp. 188–189, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

White, P.S. 1998. Biodiversity and the exotic species threat. Pp. 1–7, in Britton, K.O. (ed.) Exotic pests of eastern forests conference proceedings (1997), Nashville. U.S. Forest Service and Tennessee Exotic Pest Plant Council.

Whittemore, A.T. 1997. *Berberis* (Berberidaceae). Pp. 276–286, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Whittemore, A.T. 2004. Sawtooth Oak (*Quercus acutissima*, Fagaceae) in North America. Sida 21:447–454.

Whittemore, A.T., T.A. Atkinson, and D.D. Spaulding. 1997. *Nandina* (Berberidaceae). Pp. 273–274, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Williams, S.C., J.S. Ward, and U. Ramakrishnan. 2008. Endozoochory by white-tailed deer (*Odocoileus virginianus*) across a suburban/woodland interface. For. Ecol. Manag. 255:940–947.

Williamson, M. and A. Fitter. 1996. The varying success of invaders. Ecology 77:1661–1666.

Wilder, G.J. and M.R. McCombs. 2002. New records of vascular plants for Ohio and Cuyahoga County, Ohio. Rhodora 104:350–372.

Wu, D. and I.C. Nielsen. 2010. *Albizia*. Pp. 62–66, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Wu, D. and M. Thulin. 2010. *Pueraria*. Pp. 244–248, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Wu, Z., Z.–K. Zhou, and M.G. Gilbert. 2003a. *Broussonetia*. Pp. 26–27, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Wu, Z., Z.–K. Zhou, and M.G. Gilbert. 2003b. *Ficus*. Pp. 37–71, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Wu, Z., Z.–K. Zhou, and M.G. Gilbert. 2003c. *Morus*. Pp. 22–26, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 5 (Ulmaceae through Basellaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Wunderlin, R.P. 1997a. *Broussonetia* (Moraceae). P. 393, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Wunderlin, R.P. 1997b. *Ficus* (Moraceae). Pp. 396–399, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Wunderlin, R.P. 1997c. *Morus* (Moraceae). Pp. 390–392, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 3. Oxford Univ. Press, New York and London.

Wunderlin, R.P. and B.F. Hansen. 2011. Guide to the Vascular Plants of Florida. Third Edition. Univ. Press of Florida, Gainesville.

Wunderlin, R.P., B.F. Hansen, A.R. Franck, and F.B. Essig. 2021. Atlas of Florida Plants. [S.M. Landry and K.N. Campbell (application development), USF Water Institute.] Institute for Systematic Botany, University of South Florida, Tampa. <http://florida.plantatlas.usf.edu/> Accessed April 2021.

Wurdack, K.J. 2016. *Triadica* (Euphorbiaceae). Pp. 226–227, in Flora of North America Editorial Committee (eds.). Flora of North America North of Mexico, Vol. 12. Oxford Univ. Press, New York and London.

Xiang, Q. and P.P. Lowry. 2007. *Tetrapanax*. P. 440, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Xu, T., Y. Chen, P.C. de Jong, H.J. Oterdoom, and C.–S. Chan. 2008. *Acer*. Pp. 516–553, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Yatskievych, G. 1999. Steyermark's Flora of Missouri (rev. ed.). Vol. 1. Missouri Botanical Garden Press, St. Louis.

Yatskievych, G. 2006. Steyermark's Flora of Missouri (rev. ed.). Vol. 2. Missouri Botanical Garden Press, St. Louis.

Yatskievych, G. 2013. Steyermark's Flora of Missouri (rev. ed.). Vol. 3. Missouri Botanical Garden Press, St. Louis.

Yang, Q. and J.F. Gaskin. 2007. *Tamarix*. Pp. 59–65, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Yang, Q. and V. Malécot. 2011. *Viburnum*. Pp. 570–611, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 19 (Cucurbitaceae through Valerianaceae, with Annonaceae and Berberidaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Yang, Q., S. Landrein, J. Osborne, and R. Borosova. 2011a. *Abelia*. Pp. 644–645, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 19 (Cucurbitaceae through Valerianaceae, with Annonaceae and Berberidaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Yang, Q., S. Landrein, J. Osborne, and R. Borosova. 2011b. *Lonicera*. Pp. 620–641, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 19 (Cucurbitaceae through Valerianaceae, with Annonaceae and Berberidaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Ying, J. 2011. *Berberis*. Pp. 715–771, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 19 (Cucurbitaceae through Valerianaceae, with Annonaceae and Berberidaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Ying, J., D.E. Boufford, and A.R. Brach. 2011a. *Mahonia*. Pp. 772–782, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 19 (Cucurbitaceae through Valerianaceae, with Annonaceae and Berberidaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Ying, J., D.E. Boufford, and A.R. Brach. 2011b. *Nandina*. P. 715, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 19 (Cucurbitaceae through Valerianaceae, with Annonaceae and Berberidaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Zell, G. 2012. Non-native invasive plants of Arlington County, Virginia. Department of Parks, Recreation, and Cultural Resources. Arlington, Virginia. 4.

Zhang, D. and D.J. Mabberley. 2008. *Citrus*. Pp. 90–96, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Zhang, H., Z.F. Ma, X. Luo, and X. Li. 2018. Effects of mulberry fruit (*Morus alba* L.) consumption on health outcomes: a mini-review. Antioxidants 2018–7(5):69.

Zhang, Z. and M. Funston. 2008. *Celastrus*. Pp. 466–474, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 11 (Oxalidaceae through Aceraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Zhang, Z.–Y. and T. Santisuk. 1998. *Catalpa*. Pp. 215–216, in Z.Y. Wu and P.H. Raven (eds.). Flora of China, Vol. 18 (Scrophulariaceae through Gesneriaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Zhang, Z., L. Fan, J. Yang, X. Hao, and Z. Gu. 2006. Alkaloid polymorphisms and ITS sequence variation in the *Spiraea japonica* complex (Rosaceae) in China: Traces of the biological effects of the Himalayan-Tibet plateau uplift. Amer. J. Bot. 93:762–769.

Zhang, Z.–Y., A. Lu, and W.G. D'Arcy. 1994. *Lycium*. Pp. 301–304, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 17 (Verbenaceae through Solanaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Zhang, Z.–Y., H. Sun, and Z.J. Gu. 2002. Karyomorphological study of the *Spiraea japonica* complex (Rosaceae). Brittonia 54:168–174.

Zhang, Z.–Y., H. Zhang, and P.K. Endress. 2003. *Loropetalum*. Pp. 32–34, in Z.Y. Wu and P.H. Raven (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Photographic Plates of Juvenile Stages (Figs. 163–171).

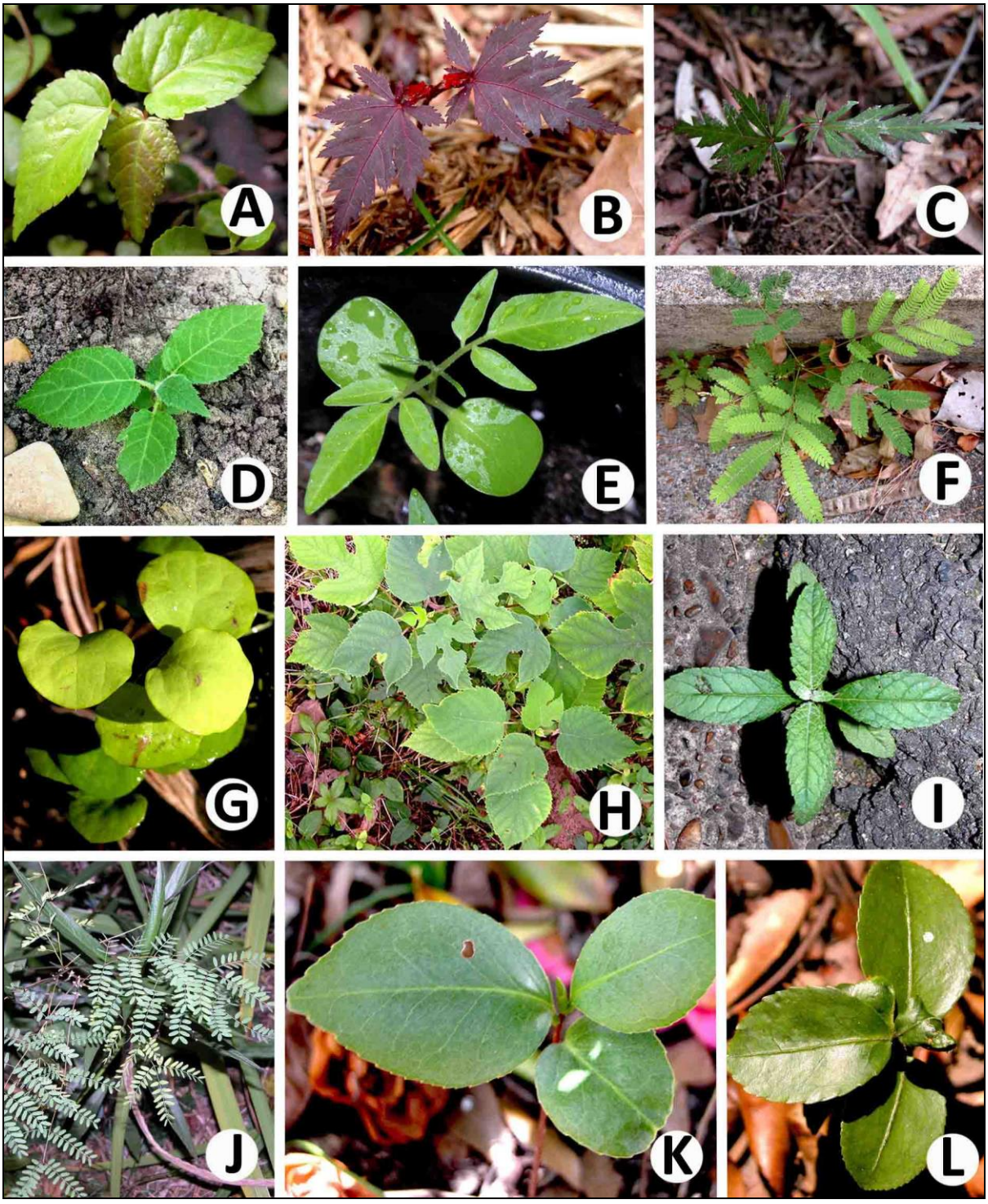


Figure 163. (A–L) Juvenile stages for *Acer* through *Camellia*. (A) *Acer ginnala*. (B) *Acer palmatum* (anthocyanic form). (C) *Acer palmatum*. (D) *Actinidia chinensis*. (E) *Ailanthus altissima*. (F) *Albizia julibrissin*. (G) *Berberis thunbergii*. (H) *Broussonetia papyrifera*. (I) *Buddleja davidii*. (J) *Caesalpinia* (*Erythrostemon*) *gilliesii*. (K) *Camellia japonica*. (L) *Camellia sasanqua*.

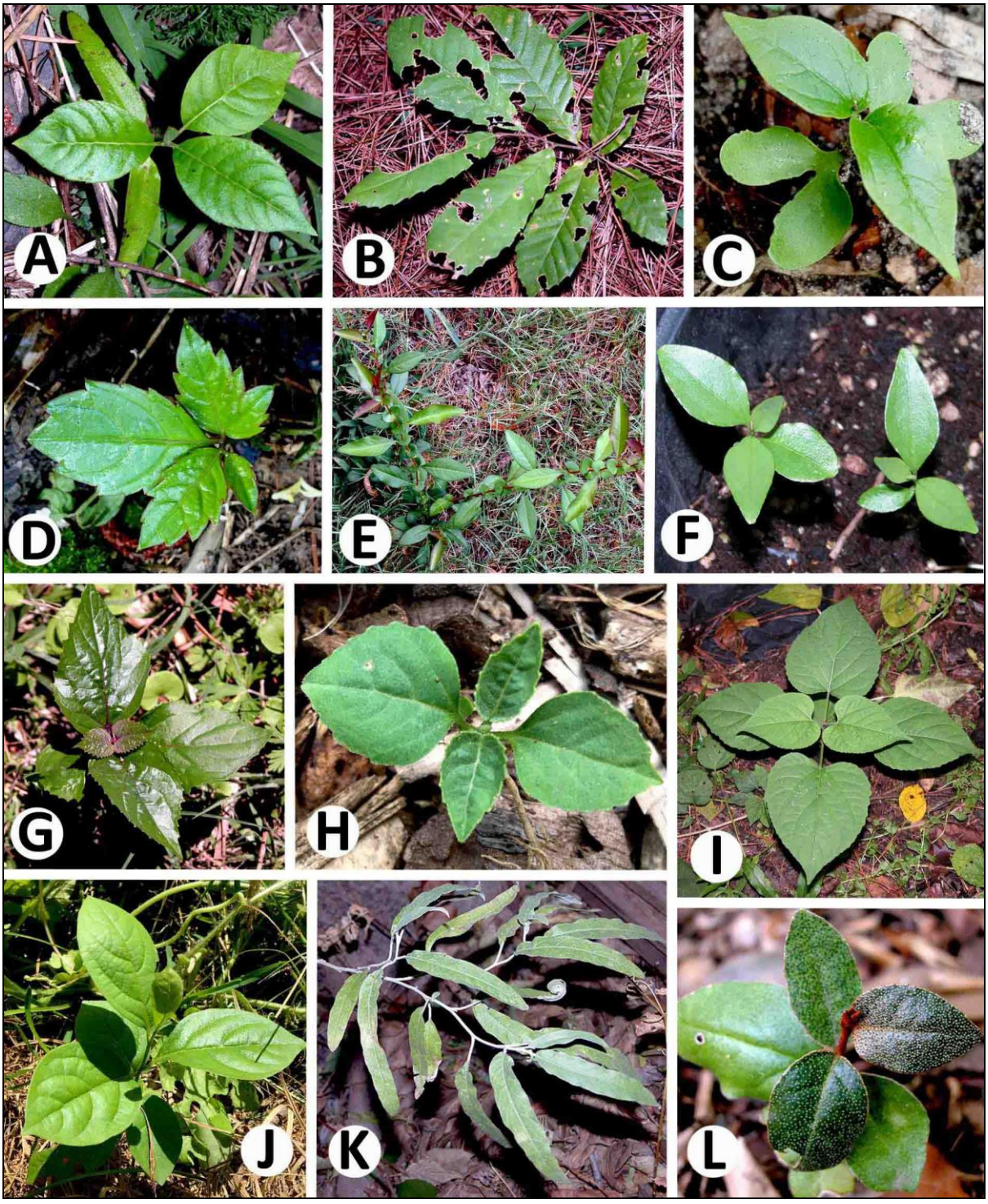


Figure 164. (A–L) Juvenile stages for *Camptotheca* through *Elaeagnus pungens*. (A) *Camptotheca acuminata*. (B) *Castanea mollissima*. (C) *Catalpa bignonioides*. (D) *Cayratia japonica* (root sucker). (E) *Chaenomeles speciosa*. (F) *Cinnamomum camphora*. (G) *Clerodendrum bungei* (root sucker). (H) *Clerodendrum trichotomum* (seedling). (I) *Clerodendrum trichotomum* (root sucker). (J) *Diospyros kaki*. (K) *Elaeagnus angustifolia*. (L) *Elaeagnus pungens*. Photo credit: C: Louise Voorhagen (Louise's Plant Details.

Figure 165. (A–L) Juvenile stages for *Elaeagnus umbellata* through *Lantana*. (A) *Elaeagnus umbellata*. (B) *Eriobotrya japonica*. (C) *Euonymus alatus*. (D) *Exochorda racemosa*. (E) *Firmiana simplex*. (F) *Hibiscus syriacus*. (G) *Ilex cornuta*. (H) *Koelreuteria bipinnata*. (I) *Koelreuteria paniculata*. (J) *Lagerstroemia indica* (seedling). (K) *Lagerstroemia indica* (older juvenile). (L) *Lantana strigocamara*.

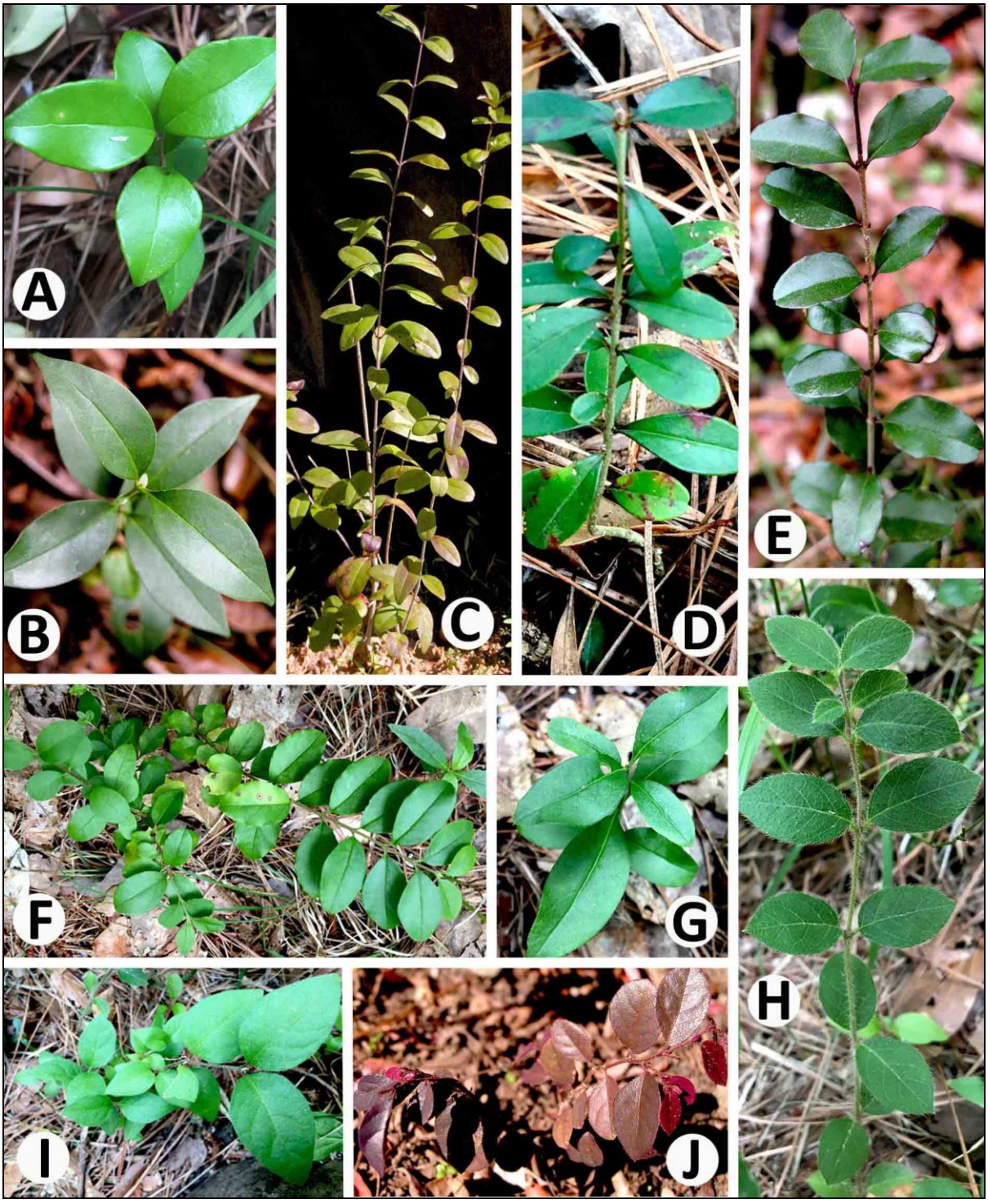


Figure 166. (A–J) Juvenile stages for *Ligustrum* through *Loropetalum*. (A) *Ligustrum japonicum*. (B) *Ligustrum lucidum*. (C) *Ligustrum obtusifolium*. (D) *Ligustrum quihoui*. (E) *Ligustrum sinense*. (F) *Ligustrum sinense* (notice that some of the leaves are more rounded in shape compared to the plant in Fig. E). (G) *Ligustrum vulgare*. (H) *Lonicera fragrantissima*. (I) *Lonicera maackii*. (J) *Loropetalum chinense* (anthocyanic form).

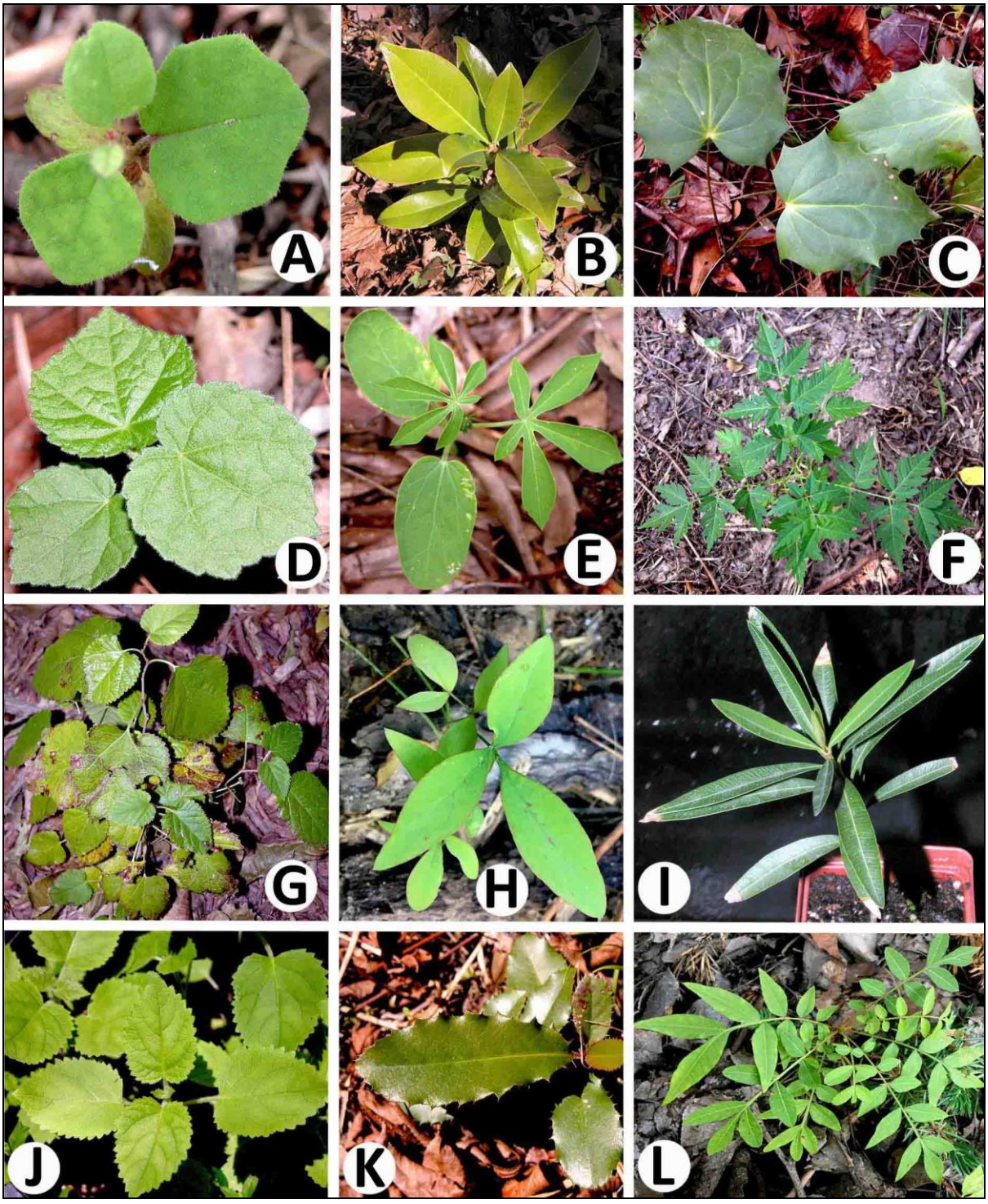


Figure 167. (A–L) Juvenile stages for *Loropetalum* through *Pistacia*. (A) *Loropetalum chinense*. (B) *Magnolia grandiflora*. (C) *Mahonia bealei*. (D) *Malvaviscus arboreus*. (E) *Manihot grahamii*. (F) *Melia azedarach*. (G) *Morus alba*. (H) *Nandina domestica*. (I) *Nerium oleander*. (J) *Paulownia tomentosa*. (K) *Photinia serratifolia*. (L) *Pistacia chinensis* (notice the narrow wings along the rachis; this trait typically is absent in mature leaves).

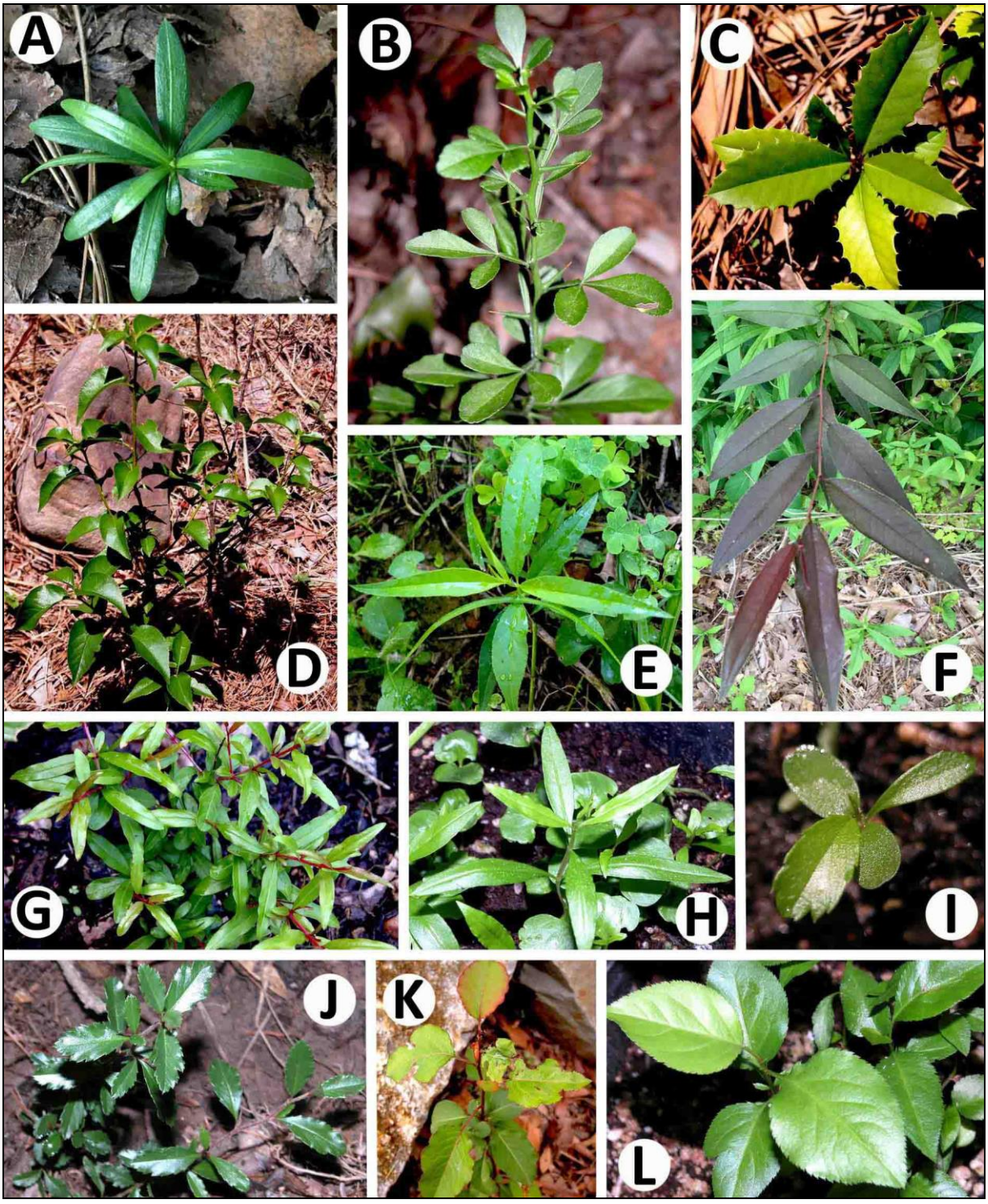


Figure 168. (A–L) Juvenile stages for *Podocarpus* through *Pyrus*. (A) *Podocarpus macrophyllus*. (B) *Poncirus* (*Citrus*) *trifoliata*. (C) *Prunus caroliniana*. (D) *Prunus mahaleb*. (E) *Prunus persica*. (F) *Prunus persica* (anthocyanic form). (G) *Punica granatum* (older juvenile). (H) *Punica granatum* (seedling). (I) *Pyracantha fortuneana* (seedling). (J) *Pyracantha fortuneana* (older juvenile). (K) *Pyrus calleryana* (older juvenile). (L) *Pyrus calleryana* (seedling).

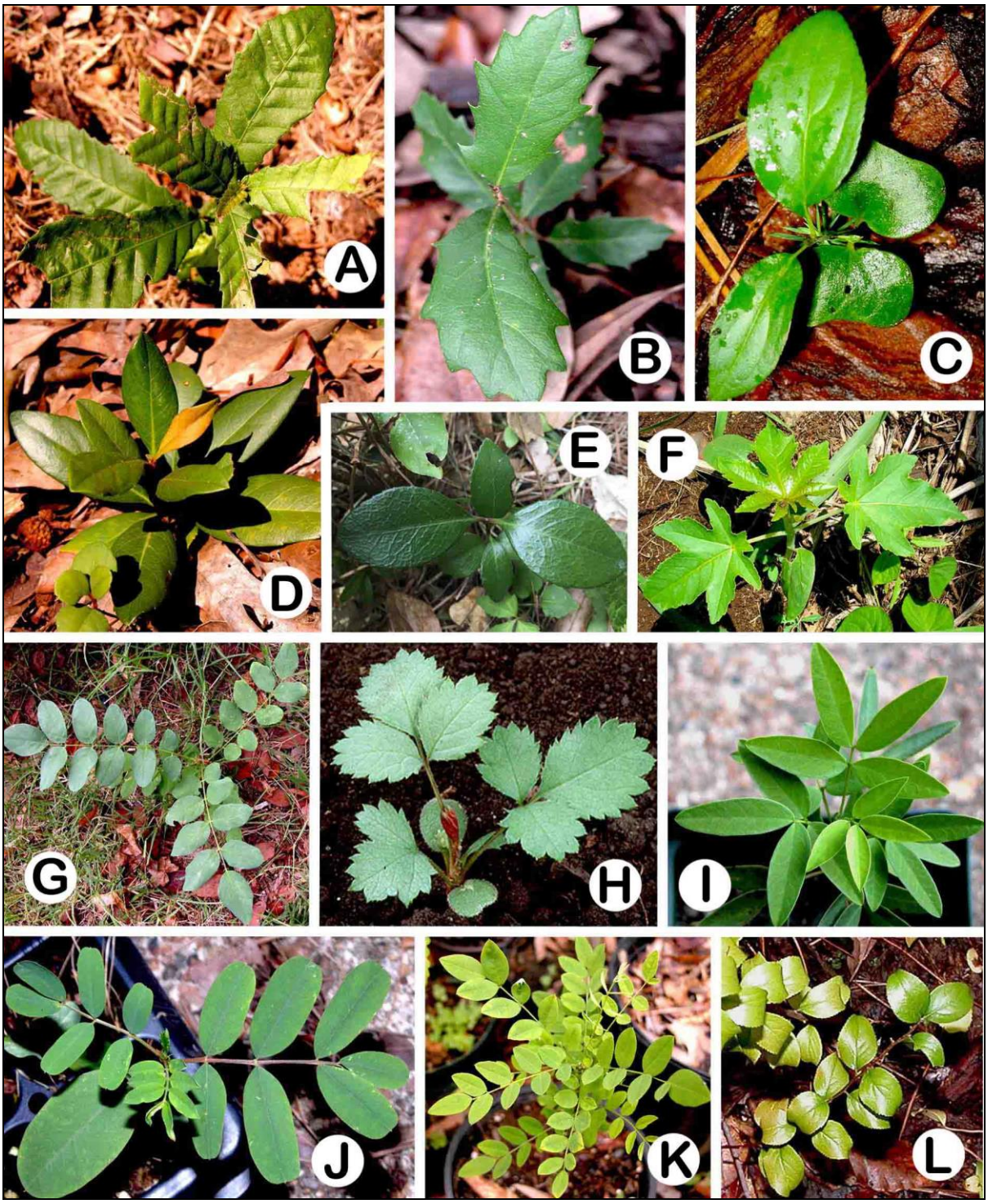


Figure 169. (A–L) Juvenile stages for *Quercus* through *Spiraea*. (A) *Quercus acutissima*. (B) *Quercus virginiana*. (C) *Rhamnus cathartica*. (D) *Rhaphiolepis indica* (older juvenile). (E) *Rhaphiolepis indica* (seedling). (F) *Ricinus communis*. (G) *Robinia hispida* (root sucker). (H) *Rosa multiflora*. (I) *Senna corymbosa*. (J) *Sesbania punicea*. (K) *Sophora* (*Styphnolobium*) *japonica*. (L) *Spiraea prunifolia*. Photo credits: C: Bruce Wenning (Ecological Landscape Alliance; F: Forest Starr and Kim Starr (Starr Environmental; H: Ohio Perennial and Biennial Weed Guide.

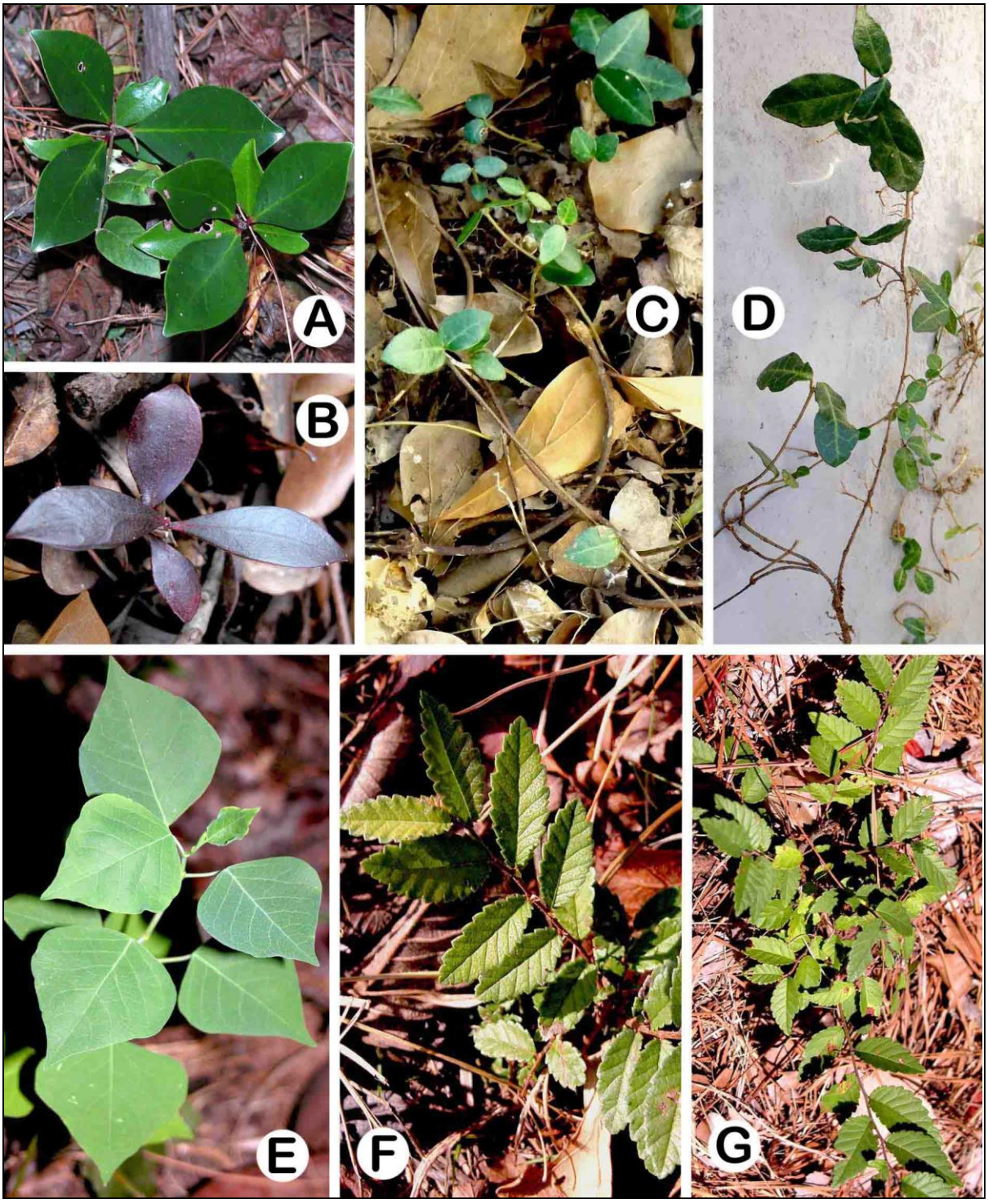


Figure 170. (A–G) Juvenile stages for *Ternstroemia* through *Ulmus*. (A) *Ternstroemia gymnanthera*. (B) *Ternstroemia gymnanthera* (seedling during winter with purple coloration). (C) *Trachelospermum asiaticum* (seedlings). (D) *Trachelospermum asiaticum* (older juvenile). (E) *Triadica sebifera*. (F) *Ulmus parvifolia*. (G) *Ulmus pumila*.

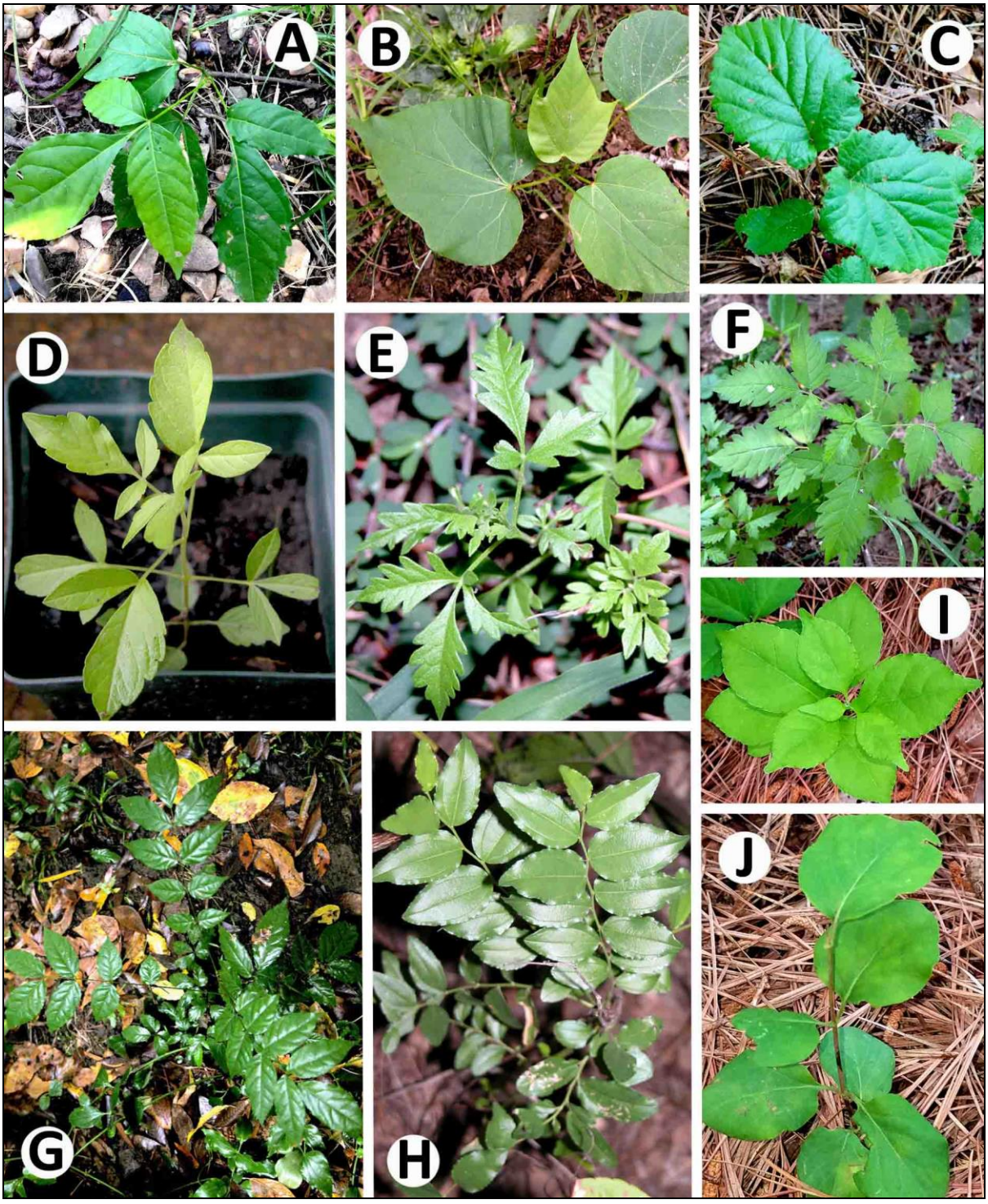


Figure 171. (A–J) Juvenile stages for *Ungnadia* through *Ziziphus*; also including *Celastrus orbiculatus* and *Lonicera japonica*. (A) *Ungnadia speciosa*. (B) *Vernicia fordii*. (C) *Viburnum dilatatum*. (D) *Vitex agnus-castus*. (E) *Vitex negundo* (variety *incisa*). (F) *Vitex negundo*. (G) *Wisteria sinensis*/*W. x formosa*. (H) *Ziziphus jujuba* (root sucker). (I) *Celastrus orbiculatus* (root sucker). (J) *Lonicera japonica*.