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Brett Serviss

Henderson State University, servisb@hsu.edu

Nicole Freeman

Henderson State University

Sara Melancen

Henderson State University

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Chinese Flame Tree (*Koelreuteria bipinnata* Franch.) (Sapindaceae) New to the Arkansas Flora

BRETT SERVISS^{1,2}, NICOLE FREEMAN¹, AND SARA MELANCEN¹

¹Henderson State University, Biology Department, P.O. Box H-7570, Arkadelphia, AR 71999-0001

²Correspondence: servisb@hsu.edu

Non-native plant species are continuously being introduced into the United States by both accidental and intentional means. Many of these species never become established in the flora, or if establishment occurs, many do not seriously threaten native plant species (Williamson 1996). However, numerous non-native plant species have become invasive subsequent to establishment and naturalization. Invasive species can alter native habitats and ecosystems and often seem to reduce native biodiversity (D'Antonia and Vitousek 1992; Daehler and Strong 1994; Wilcove et al. 1998). Some of the worst invasive plants are ornamental trees and shrubs. A few examples of woody ornamentals that have established in the Arkansas flora and subsequently become invasive include nandina (*Nandina domestica* Thunb.), Chinese privet (*Ligustrum sinense* Lour.), glossy privet (*Ligustrum lucidum* Ait.), and Chinese tallow tree [*Sapium sebiferum* (L.) Roxb.]. About 23% of the Arkansas flora consists of non-native species (Arkansas Vascular Flora Committee 2006). *Koelreuteria bipinnata* Franch. (Chinese flame tree), another non-native ornamental species, is here reported as spontaneous in the Arkansas flora. This species is

a small to medium-sized tree that is native to southwest China (Krüssmann 1977). It is occasionally cultivated in the southern US for ornamental purposes because of its showy flowers and fruits and its tolerance of a wide variety of soil types (Bailey and Bailey 1976, Krüssmann 1977, Griffiths 1994). While it is too early to determine whether or not *K. bipinnata* (Fig. 1) will become invasive or not in Arkansas, it has shown the ability to reproduce successfully, escape cultivation, and establish in the Arkansas flora.

Forty-two spontaneous plants of *K. bipinnata* were discovered growing in two places on the Ouachita Baptist University (OBU) campus in Clark County, Arkansas. Voucher specimens of *K. bipinnata* were deposited in the HSU herbarium (Serviss 7026, Serviss and Melancen 7028). Four of the 42 individuals documented were reproductive, being found with mature or nearly mature fruits. Reproductive individuals ranged in dbh from 10.1–12.0 cm. All 42 individuals were much smaller than the maximum height that can be attained for the species (about 20 m) and ranged in size from 7.2 m to seedlings only a few centimeters tall (Table 1). The 42 spontaneous

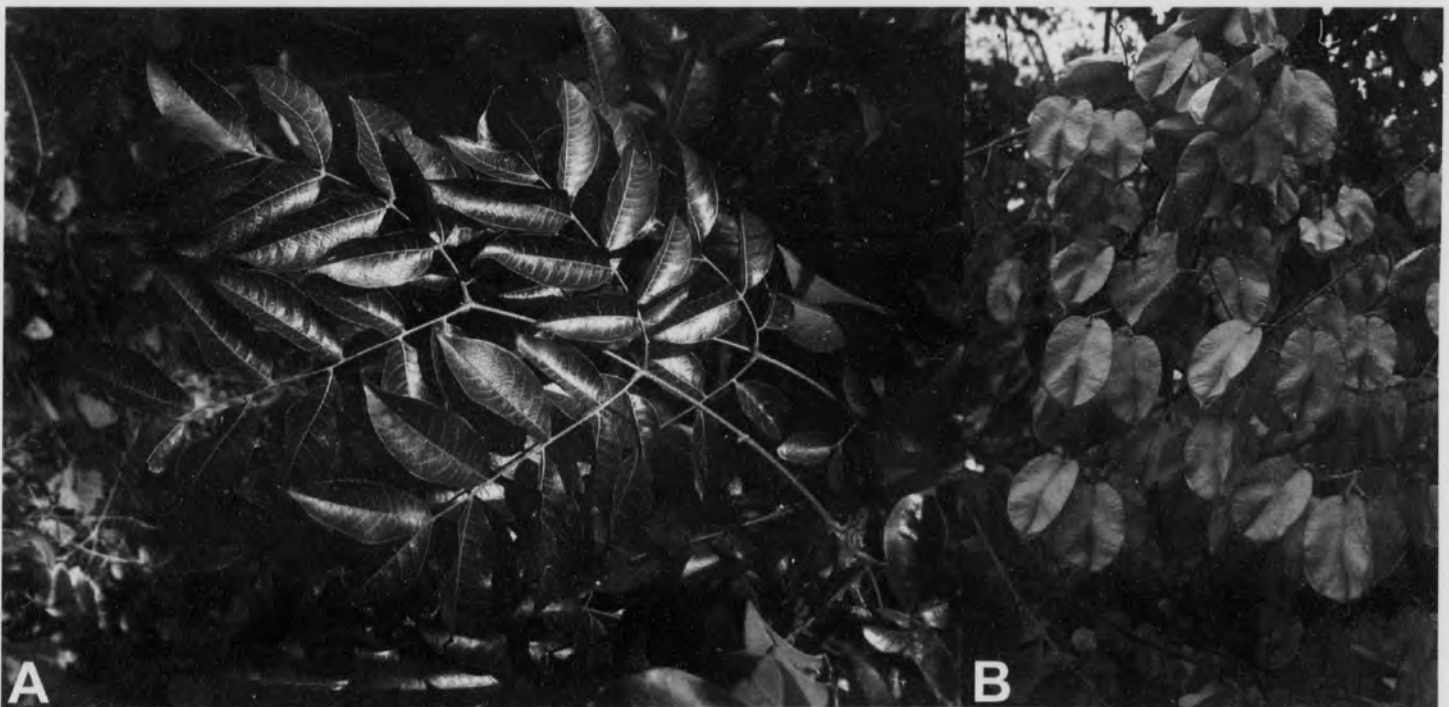


Fig. 1. Photos of *Koelreuteria bipinnata*. A. Twice pinnately compound leaf. B. Mature fruits.

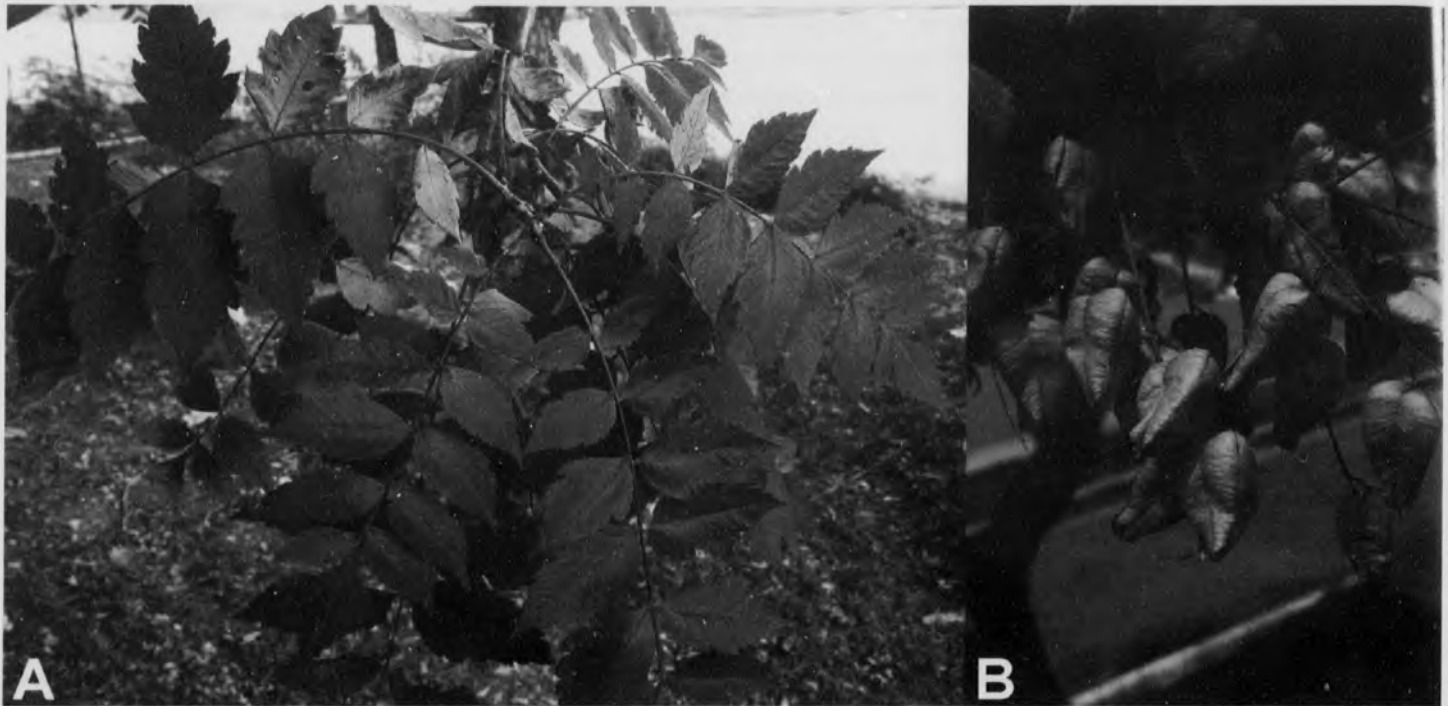


Fig. 2. Photos of *Koelreuteria paniculata* (for comparison with *K. bipinnata*). A. Once pinnately compound leaves. B. Mature fruits.

plants are distributed within two populations that occur at two widely separated areas on the OBU campus. We speculate that both populations were originally founded from seeds that were produced and then subsequently dispersed to both sites from a single, cultivated *K. bipinnata* tree on the campus. The fruits of *Koelreuteria* spp. are wind dispersed and thus the seeds can be transported great distances from the parent plant. The larger of the two populations (population one), consisting of 38 individuals, is located within a small portion of a natural area that extends through much of the campus. Much of this area consists of riparian habitat with varying degrees of disturbance. There are also several small areas in it that are without canopy cover or with only a minimal canopy present. In population one, individual plants range in development from reproductive age individuals to seedlings, and plants were found growing in areas with and without canopy cover. All plants, regardless of size, displayed only minimal branching and crown development, which is probably because of young age. The smaller population (population two), consisting of four individuals, is adjacent to the putative parent plant, which is located near the southwest corner of the campus and several hundred meters from population one. Three of the four *K. bipinnata* plants in population two were found growing in a yard, which was unkempt and overgrown with a mixture of trees, shrubs, and other vegetation. The remaining *K. bipinnata* plant occurred a short distance away from the previously mentioned yard area and was present in a highly disturbed area at the edge of a parking lot.

It is probable that at least the original spontaneous plants in population one were likely descended from the cultivated tree

on the OBU campus, but because several of these individuals are reproductive, at least some of the smaller juveniles in population one may have been produced from the original, spontaneous, now reproductive age trees. It is important, however, to note that seeds may also continue to be introduced into population one from the cultivated *K. bipinnata* tree. Although *K. bipinnata* can reach a mature size of up to 20 m (Bailey and Bailey 1976), it is capable of sexual reproduction at a much smaller size and presumably younger age. Additionally, species of *Koelreuteria* can produce hundreds of seeds per plant, grow rapidly when young, are tolerant of a wide range of soil conditions, and tolerate a variety of light regimes (observed with *K. bipinnata*). Additionally, seeds collected from *K. bipinnata* in Arkansas show high rates of germination and seedling emergence. The combination of these traits seemingly increases the likelihood that *K. bipinnata* will become firmly established and even possibly invasive in Arkansas.

Koelreuteria bipinnata is not the only species of *Koelreuteria* to be documented in the Arkansas flora. *Koelreuteria paniculata* Laxm. (golden-rain tree; Fig. 2) is also spontaneous in Arkansas. We observed two, small, spontaneous populations (composed essentially of seedlings) beneath and in proximity to two, large, presumably cultivated trees of *K. paniculata* on the Hendrix College campus in Conway, Arkansas, in 2005 and in Hot Springs, Arkansas, in 2006 (one tree at each location), indicating that the non-native *K. paniculata* is spontaneous, does reproduce successfully, and could potentially establish in Arkansas. These two species of *Koelreuteria* are somewhat similar, but can easily be distinguished by using the

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following key.

Key to the spontaneous or naturalized species of *Koelreuteria* in Arkansas:

1. Mature leaves twice pinnately compound; margins of leaflets of mature leaves with small teeth or entire (leaflet margins of juvenile plants are coarsely toothed to lobed); fruits cream colored to greenish–yellow, but usually tinged or flushed with pink to pinkish–red coloration during development, and widest in the middle (elliptic) *K. bipinnata*

1. Mature leaves mostly to wholly once pinnately compound (a few leaves may be imperfectly bipinnately compound); mature leaflets with coarse, crenate teeth, sometimes also lobed or incised; fruits green to greenish–yellow during development, and widest at the base, slightly past point of attachment of the pedicel (conical) *K. paniculata*

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Table 1. List of spontaneous *Koelreuteria bipinnata* individuals documented in Clark County, Arkansas, including reproductive status, height, and specific location in habitat.

Reproductive	Height in cm	Location in habitat
Population 1 (38 individuals)		
yes	726.4	edge; in canopy
yes	639.4	edge; in canopy
yes	607.0	edge; in canopy
no	513.0	edge; in canopy
no	509.2	edge; in canopy
no	452.1	edge; in canopy
no	416.5	edge; in canopy
yes	403.8	edge; in canopy
no	401.3	edge; in canopy
no	391.6	edge; in canopy
no	231.1	edge
no	180.3	wooded; in understory
no	179.7	wooded; in understory
no	177.8	edge; in understory
no	176.5	edge; in understory
no	166.3	edge; in understory
no	149.2	open; no canopy
no	140.3	open; no canopy
no	125.7	wooded; in understory
no	124.4	edge; in understory
no	94.6	edge
no	87.6	open; no canopy
no	69.8	open; no canopy
no	55.8	edge
no	42.5	wooded; in understory
no	40.6	open; no canopy
no	35.5	wooded; in understory
no	34.2	wooded; in understory
no	33.0	wooded; in understory
no	33.0	open; no canopy
no	30.4	open; no canopy
no	25.4	wooded; in understory
no	25.4	wooded; in understory
no	24.1	open; no canopy
no	19.6	open; no canopy
no	15.8	wooded; in understory
no	15.8	wooded edge
no	13.3	wooded edge
Population 2 (4 individuals)		
no	26.6	understory
no	21.5	open; no canopy
no	13.9	understory
no	12.7	understory