

***EUCOMMIA ULMOIDES* (HARDY RUBBER-TREE;  
EUCOMMIACEAE) AS AN ESCAPE IN NORTH AMERICA**

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*Eucommia ulmoides* Oliver (Fig. 1) is the sole living member of the genus *Eucommia* Oliver and the family Eucommiaceae. This genus is thought to have been native to mountain forests in central and western China, in open forests and in valleys, at elevations of 200–2500 m (Ying et al. 1993). It was first brought to the attention of western botanists by Augustine Henry in 1886 (Forrest 1995), shortly after which it was described by Oliver (1890), and was introduced into cultivation in Europe in 1892 and the United States in 1896 (Forrest 1995; Poor 1997; Rehder 1947). The species was thought to be extinct in the wild, surviving only through cultivation (Mabberley 1997; Poor 1997; Sargent 1913), but native stands may still exist (Swink et al. 1978; Varossieau 1942). Fossil remains of the genus have been found in North America, Europe, and Asia, evidence that the genus was widespread in the Cenozoic and that its present-day distribution is relictual (Call & Dilcher 1997). It is called hardy rubber-tree in many sources, though Barker (1984) suggested that it be called “hardy gutta tree,” “gutta-percha tree,” or “Chinese threadtree.”

*Eucommia ulmoides* is a tree to perhaps 12–20 m tall, with a spreading crown reaching about the same breadth. The single trunk has dark gray-brown bark that is ridged and furrowed. Trunks form ascending branches 1–2 m above the ground; young branchlets are shiny brown, and have septate pith, though this character may be difficult to see, since the pith is easily crushed. Buds are 5–7 mm long, sessile, ovoid, and pointed, with several overlapping chestnut brown scales; terminal buds are absent. Leaves are 8–20 cm long, alternate, simple, petiolate, exstipulate, elliptical to ovate, glabrous and glossy, with serrate margins; venation is pinnate; leaves are a deep dark green when young, becoming pale green to yellowish in autumn before leaf drop. When carefully torn and gently pulled apart, leaves show strands of latex (the gutta-percha for which the species is known). The stalked axillary flowers, which open as the leaves emerge, lack a perianth, and the plants are dioecious. Staminate flowers consist of 4–10 linear green anthers, on very short filaments, that open to release the bright yellow pollen. Pistillate flowers consist of a single bicarpellate, unilocular superior ovary with two pendulous ovules. The fruit is a flattened, elliptical samara 1.5–2 cm long that becomes dark brown at maturity, and contains 1 or 2 linear seeds. Flowering occurs in March or April, and fruits mature in September or October. There is a documented chromosome count for the species of  $2n=34$  (Tanaka & Oginuma 1983).

The relationship of *Eucommia* to other extant taxa has been difficult to discern.



FIGURE 1. *Eucommia ulmoides*. Left: branch and leaves (Vincent 10,442 [MU]); upper right: staminate flowers from a cultivated plant (Vincent 5,805 [MU]); lower right: fruits from a cultivated plant (Vincent 10,887 [MU]). The scale bar represents 1 cm for all images.

Oliver (1890) initially suggested placement of the genus in either the Ulmaceae or Euphorbiaceae, but only a few years later, he suggested placement of *Eucommia* in the Trochodendraceae (Oliver 1895). *Eucommia* was allied with the Hamamelidaceae (Hamamelidae, Hamamelidales) by Solereder (1899), but other authors (Harms 1930; Tippo 1940) placed it in Ulmaceae (Urticales, on the basis of flower morphology, fruit shape, leaf venation, and wood anatomy). It was segregated into its own family by van Tieghem (1900), a move that was supported by an extensive

analysis of the evidence by Varossieau (1942). Hutchinson (1967) placed the family in the Urticales. More recently, some authors have placed the genus in its own order, Eucommiales, on the basis of major differences, such as the absence of stipules, node anatomy, pollen wall traits, endosperm type, and the presence of a specialized latex (Cronquist 1988; Takhtajan 1981). Zhang et al. (1988) considered the family allied to Hamamelidales based on their study of the pollen. Thorne (1992) places the family in the Rosiidae, in order Cornales. Kubitzki (1993) states that its morphology and anatomy show a possible link between *Eucommia* and Cornales. Most recent DNA analyses suggest placement of the Eucommiaceae in Garryales (Bremer et al. 2001; Soltis et al. 2000).

The plant has been put to many uses, such as lumber, firewood, and a medicinal tonic (duzhong or tu-chung) made from the bark (Forrest 1995; Mabberley 1997; Sargent 1913). The tonic has been used in China for over 2000 years, purportedly to promote longevity, "nourish" the kidneys and liver, strengthen joints and the back, and prevent miscarriages (Anonymous 2001; Forrest 1995). Nakamura et al. (1997) report on antimutagenic activity of Tochu tea, made from *Eucommia ulmoides* leaves. Other scientists are testing the ability of extracts of leaves or stems of the species to inhibit bacterial growth (Jeon et al. 1998), suppress high blood pressure (Nakazawa et al. 1997), and inhibit some effects of aging (Li et al. 1998; Metori et al. 1997, 1998). The species contains a latex (gutta-percha) that is visible in a carefully-torn leaf blade (Coombes 1992). Watson (1903) thought the tree would prove useful as a source of rubber, though Rehder (1947) discounted its usefulness for commercial rubber production. The latex has been used in China for lining oil pipelines, insulating electrical lines, and filling teeth (Mabberley 1997).

Hardy rubber-tree is sometimes used as a street or lawn tree, and has been considered underutilized by some horticulturalists (Barker 1984; Dirr 1990, 1997; Gilman 1997; Poor 1997; Rehder 1947; Schnelle 1990). It is described as a vigorous and decorative plant (Coombes 1992) and an excellent shade tree of "dapper" outline when mature (Dirr 1990). It is drought-resistant (Gilman & Watson 1993), disease free, and easily propagated by seed or cuttings (Poor 1997). However, one study in Cleveland that lasted about 30 years resulted in replacement of hardy rubber-tree with other tree species, because the "overall effect was not particularly pleasing" (Todd et al. 1999). Flint (1983) states that while the species is free from insect and disease problems, it tends to produce vigorous "water sprouts" that may be a problem. *Eucommia ulmoides* is listed as hardy in USDA Zones 4–7 (Dirr, 1990, 1997; Poor 1997). It is said to be intolerant of poorly drained soil (Gilman 1997).

Plants of *Eucommia ulmoides* were recently found as escapes in Oxford, Butler County, Ohio, 15m and 20m from a pistillate tree planted on the Miami University campus. The sterile, immature saplings (up to 2 m tall) were growing in a fencerow with other weedy woody species, including *Acer platanoides* L. (Aceraceae), *Lonicera maackii* (Rupr.) Maxim. (Caprifoliaceae), and *Rhamnus cathartica* L. (Rhamnaceae). A voucher specimen (Vincent 10,442) has been deposited in herbarium MU, with duplicates at NA, MO, OS, and OSH. This record is the first report of the species (and the family) as an escape in Ohio and North America.

The discovery of *Eucommia ulmoides* as an escape is not necessarily an indication that the species will become invasive. In fact, the species is planted relatively infrequently, and since this is the first report of its escape in the more than 100 years since its introduction in the United States, it seems unlikely that it will become invasive. Hardy rubber-tree does not fit the profile of readily invasive species as described by Reichard & Hamilton (1997). Studies by Call & Dilcher (1997) of the aerodynamics of *Eucommia* fruits showed that they are dispersed in a downward spiral with an increasing lateral component. The fruits are relatively heavy and not as easily wind-blown as are samaras of other, more invasive woody plants, such as *Ulmus* species (Anonymous 2002; Sherman-Broyles et al. 1997). If more escapes of this species are to be found, it will likely be in the vicinity of pistillate trees near fence rows and woodlots.

## LITERATURE CITED

- Anonymous. 2001. *Eucommia* bark. [http://www.doctorshealthsupply.com/chineseherbs/herbal\\_ingredients/eucommia\\_bark.htm](http://www.doctorshealthsupply.com/chineseherbs/herbal_ingredients/eucommia_bark.htm) (accessed 9 October 2002).
- Anonymous. 2002. Siberian elm (*Ulmus pumila*). Wisconsin Department of Natural Resources. <http://www.dnr.state.wi.us/org/land/er/invasive/factsheets/elm.htm> (accessed 6 December 2002).
- Barker, P.A. 1984. *Eucommia ulmoides*: a tree for urban areas. *Journal of Arboriculture* 10: 233–235.
- Bremer, K., A. Blacklund, B. Sennblad, U. Swenson, K. Andreason, M. Hjerston, J. Lundberg, M. Blacklund, & B. Bremer. 2001. A phylogenetic analysis of 100+ genera and 50+ families of easterids based on morphological and molecular data with notes on possible higher morphological synapomorphies. *Plant Systematics and Evolution* 229: 137–169.
- Call, V.B. & D.L. Dilcher. 1997. The fossil record of *Eucommia* (Eucommiaceae) in North America. *American Journal of Botany* 84: 798–814.
- Coombes, A.J. 1992. *Eyewitness Handbooks of Trees*. Dorling Kindersley, New York, NY. 320 pp.
- Cronquist, A. 1988. *The Evolution and Classification of Flowering Plants* (ed. 2). New York Botanical Garden, Bronx, NY. 555 pp.
- Dirr, M.A. 1990. *Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses*. Stipes, Champaign, IL. 1007 pp.
- Dirr, M.A. 1997. *Dirr's Hardy Trees and Shrubs*. Timber Press, Portland, OR. 493 pp.
- Flint, H.L. 1983. *Landscape Plants for Eastern North America*. Wiley & Sons, New York, NY. 677 pp.
- Forrest, T. 1995. Two thousand years of eating bark: *Magnolia officinalis* var. *biloba* and *Eucommia ulmoides* in traditional Chinese medicine. *Arnoldia* 55: 13–18.
- Gilman, E.F. 1997. *Trees for Urban and Suburban Landscapes*. Delmar, Albany, NY. 662 pp.
- Gilman, E.F. & D.G. Watson. 1993. *Eucommia ulmoides*—Hardy Rubber Tree. Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Fact Sheet ST-240. 3 pp.
- Harms, H. 1930. Eucommiaceae. In: Engler, A. & K. Prantl, *Die Natürlichen Pflanzenfamilien*, Verlag W. Engelmann, Leipzig. 18a: 348–351.
- Hutchinson, J. 1967. *The Genera of Flowering Plants (Angiospermae)*. Clarendon Press, Oxford. 2 vols.
- Jeon, H.-J., J.-Y. Roh, D.-H. Kim, W.-K. Lee, & Y.-J. Ahn. 1998. Growth-inhibiting effects of various traditional drinks of plant origin on human intestinal bacteria. *Hanguk Nongwhahak Hoechi* 41(8): 605–607.
- Kubitzki, K. 1993. *The Families and Genera of Vascular Plants*. Vol. 2. Flowering Plants—Dicotyledons. Magnoliid, Hamamelid and Caryophyllid Families. Springer-Verlag, Berlin. 653 pp.
- Li, Y., T. Sato, K. Metori, K. Koike, Q.M. Che, & S. Takahashi. 1998. The promoting effects of geniposidic acid and aucubin in *Eucommia ulmoides* Oliver leaves on collagen synthesis. *Biological and Pharmaceutical Bulletin* 21(12): 1306–1310.
- Mabberley, D.J. 1997. *The Plant-Book* (ed. 2). Cambridge University Press, Cambridge, UK. 858 pp.

- Metori, K., M. Furutsu, & S. Takahashi. 1997. The preventive effect of ginseng with du-zhong leaf on protein metabolism in aging. *Biological and Pharmaceutical Bulletin* 20(3): 237–242.
- Metori, K., S.-Y. Tanimoto, & S. Takahashi. 1998. Promotive effect of *Eucommia* leaf extract on collagen synthesis in rats. *Natural Medicines* 52(6): 465–469.
- Nakamura, T., Y. Nakazawa, S. Onizuka, S. Satoh, A. Chiba, K. Sekihashi, A. Miura, N. Yasugahira, & Y.F. Sasaki. 1997. Antimutagenicity of Tochu tea (an aqueous extract of *Eucommia ulmoides* leaves): 1. The clastogen-suppressing effects of Tochu tea in CHO cells and mice. *Mutation Research* 388(1): 7–20.
- Nakazawa, Y., N. Odagiri, R. Imai, T. Yoshii, E. Tagashira, C. Nakata, T. Nakamura, M. Asaumi, S. Onizuka, M. Yahara, & T. Nohara. 1997. Effect of eucommia leaf (*Eucommia ulmoides* Oliver leaf; Du-zhong yge) extract on blood pressure: 1. Effect on blood pressure in spontaneous rats (SHR). *Natural Medicines* 51(5): 392–398.
- Oliver, D. 1890. *Eucommia ulmoides* Oliv. Hooker's *Icones Plantarum*. XX. t. 1950.
- Oliver, D. 1895. *Eucommia ulmoides* Oliv. Hooker's *Icones Plantarum*. XXIV. t. 2361.
- Poor, J.M. (ed.). 1997. *Plants that Merit Attention*. Vol. 1—Trees (revised). Timber Press, Portland, OR.
- Rehder, A. 1947. *Manual of Cultivated Trees and Shrubs Hardy in North America* (ed. 2). Macmillan, New York, NY. 996 pp.
- Reichard, S. & C.W. Hamilton. 1997. Predicting invasions of woody plants introduced into North America. *Conservation Biology* 11: 193–203.
- Sargent, C.S. 1913. *Plantae Wilsonianae*. Cambridge University Press, Cambridge, UK. 3 vols.
- Schnelle, M.A. 1990. *Eucommia ulmoides*. *American Nurseryman* 172: 142.
- Sherman-Broyles, S.L., W.T. Barker, & L.M. Schulz. 1997. Ulmaceae Mirbel—Elm Family. pp. 368–380. *In: Flora of North America Editorial Committee, eds. Flora of North America North of Mexico*. Vol. 3. Magnoliophyta: Magnoliidae and Hamamelidae. Oxford University Press, New York, NY.
- Solereder, H. 1899. Morphologie und Systematic der Gattung *Cercidiphyllum* Sieb. et Zucc. mit Berücksichtigung der Gattung *Eucommia* Oliv. *Berichte der Deutschen Botanischen Gesellschaft* 17: 387–406.
- Soltis, D.E., P.S. Soltis, M.W. Chase, M.E. Mort, D.C. Albach, M. Zanis, V. Savolainen, W.H. Hahn, S.B. Hoot, M.F. Fay, M. Axtell, S.M. Swensen, L.M. Prince, W.J. Kress, K.C. Nixon, and J.S. Farris. 2000. Angiosperm phylogeny inferred from 18s rDNA, *rbcl*, and *atpB* sequences. *Botanical Journal of the Linnean Society* 133: 381–461.
- Swink, F., M.T. Hall, & W.J. Hess. 1978. Orphans of the plant world: examples of monotypic families. *Morton Arboretum Quarterly* 14(2): 28–32.
- Takhtajan, A. 1981. *Flowering Plants Origin and Dispersal*. Singh and Koeltz, Dehra Dun, India. 310 pp.
- Tanaka, R. & K. Oginuma. 1983. Karyological study on *Eucommia ulmoides*. *Chromosome Information Service* 35: 21–22.
- Thorne, R.F. 1992. Classification and geography of the flowering plants. *Botanical Review* 58: 225–348.
- Tippo, O. 1940. The comparative anatomy of the secondary xylem and the phylogeny of the Eucommiaceae. *American Journal of Botany* 27: 832–838.
- Todd, D., D. Balsler, D. Sydnor, & J. Chatfield. 1999. Street Tree Evaluation Project. Ohio State University Agricultural Extension Bulletin 877–99. <http://ohioline.osu.edu/b877/index.html> (accessed 9 October 2002).
- van Tieghem, M.P. 1900. Sur les dicotylédones du groupe des Homoxylées. *Journal de Botanique* 14: 259–297.
- Varossieau, W.W. 1942. On the taxonomic position of *Eucommia ulmoides* Oliv. (Eucommiaceae). *Blumea* 5:81–92, table.
- Watson, W. 1903. A hardy rubber-yielding tree. *Gardener's Chronicle* 842: 104.
- Ying, T.-S., Y.-L. Zhang, & D.E. Boufford. 1993. *The Endemic Genera of Seed Plants of China*. Science Press, Beijing. 824 pp.
- Zhang, Y.-L., F.-H. Wang, & N.-F. Chien. 1988. A study on pollen morphology of *Eucommia ulmoides* Oliver. *Acta Phytotaxonomica Sinica* 26: 367–370.