

# *Aesculus octandra* Marsh.

# Yellow Buckeye

Hippocastanaceae

Horsechestnut family

Robert D. Williams

Yellow buckeye (*Aesculus octandra*), also called sweet buckeye or big buckeye, is the largest of the buckeyes and is most abundant in the Great Smoky Mountains of southeastern United States. It grows best on moist and deep, dark humus soils with good drainage in river bottoms, coves, and northern slopes. The young shoots and seeds contain a poisonous glucoside that is harmful to animals, but the shape and foliage make this an attractive shade tree. The wood is the softest of all American

hardwoods and makes poor lumber, but it is used for pulpwood and woodenware.

## Habitat

## Native Range

The range of yellow buckeye (figs. 1, 2) extends west from the mountains of southwestern Pennsylvania down the Ohio River Valley to extreme

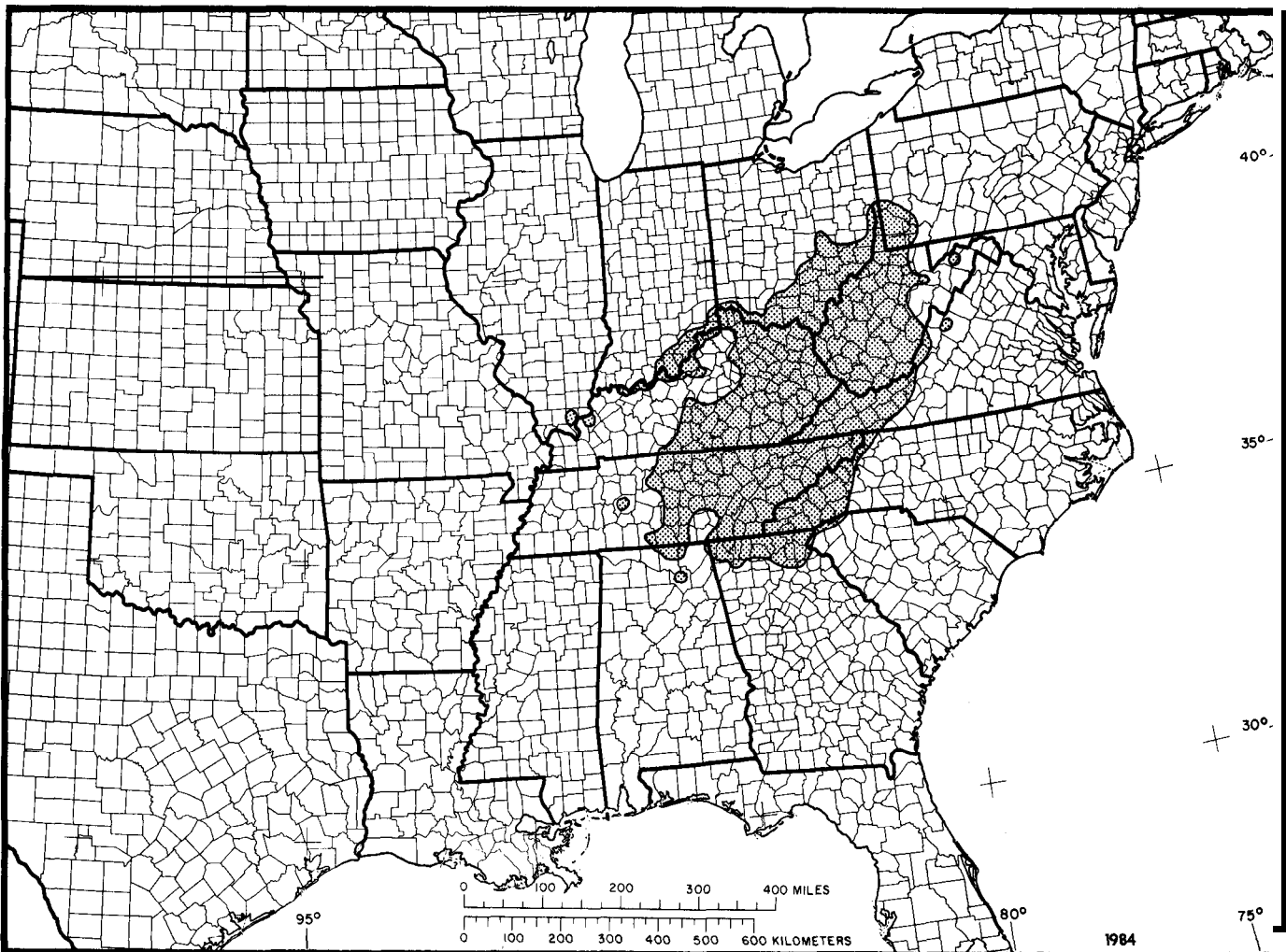


Figure 1—The native range of yellow buckeye.

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Figure 2-A yellow buckeye among cove hardwoods in North Carolina.

southeastern Illinois; south to Kentucky, central Tennessee, and northern Alabama; east to northern Georgia and extreme northwestern South Carolina; and north to western Virginia and West Virginia (7).

### Climate

Yellow buckeye grows in a wide variety of climates. Average annual precipitation ranges from 2130 mm (84 in) per year in local mountainous areas of western North Carolina to 990 mm (39 in) in southern Ohio, Indiana, and Illinois. The average annual snowfall ranges from 102 cm (40 in) in the mountains to less than 13 cm (5 in) in the southern part of the range. Average annual temperature is 10° C (50° F) in southwestern Pennsylvania and 16° C (60° F) in northern Georgia; average annual minimum temperatures are no lower than -18° C (0° F), and average annual maximum temperatures do not exceed 38° C (100° F). The frost-free period ranges from 150 days in the mountains of West Virginia to 210 days in northern Alabama and Georgia.

Distribution within the State of Ohio is influenced by climate which may be modified by topography (3).

### Soils and Topography

Yellow buckeye grows best in river bottoms, along stream banks, and in the deep soils of the North Carolina and Tennessee mountains (4), generally on soils of the orders Alfisols and Entisols. It is a bottom-land tree in the northern part of its range, but farther south it grows on high mountainous slopes. It attains its largest size and is most numerous in coves and on northern slopes in the mesophytic forests of the Appalachian and Cumberland Mountains, and it usually is found on deep dark soils with a crumb, mull humus. Yellow buckeye is a more mesophytic tree than Ohio buckeye (*Aesculus glabra*) (4).

Yellow buckeye is abundant in the mesophytic forests almost to the boundary of Wisconsin glaciation (4). It grows locally within the area of Illinoian glaciation in Ohio and Indiana but is seldom found within the area of Wisconsin glaciation.

Buckeye is considered a climax tree whose northward range was abruptly reduced during Pleistocene glaciation. If this is true, a reextension of its range northward probably has not occurred because the present environment is unfavorable (4).

The greatest concentration of yellow buckeye in the Great Smoky Mountains of North Carolina and Tennessee is in mesic coves, canyons, and ravines. The tree is commonly found at elevations from 460 to 1860 m (1,500 to 6,100 ft), with the greatest numbers occurring between 1220 and 1520 m (4,000 and 5,000 ft) (4).

In the higher Cumberland Mountains extending from about 460 or 610 m (1,500 or 2,000 ft) in elevation upward for about 300 m (1,000 ft), yellow buck-

eye may make up from 15 to 30 percent of the canopy trees in the sugar maple-basswood-buckeye forest. West of the Appalachians and in the Central States, it is found locally and is usually confined to mesophytic sites in coves, ravines, and bottoms.

### Associated Forest Cover

The mixed mesophytic forests in the southern Appalachian Mountains and in the Cumberland Plateau Region include many species of trees, and yellow buckeye is usually a constant member of these associations. It composes 15 to 23 percent of the upper canopy trees in the stands studied in that region.

Yellow buckeye is a common associate in the Sugar Maple (Society of American Foresters Type 27) forest, cover type of the central hardwood zone and the Appalachian highlands (5). It is a minor associate in five other types: Red Spruce-Yellow Birch (Type 30) and Red Spruce (Type 32) in the southern Appalachians, Red Spruce-Fraser Fir (Type 34) at the lower altitudinal range of this type, Northern Red Oak (Type 55) on moist sites in the eastern part of the type range, and Yellow-Poplar-White Oak-Northern Red Oak (Type 59) at higher elevations.

The soil and topographic conditions that are good for yellow buckeye growth generally are also excellent for the growth of yellow-poplar (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), and various oaks (*Quercus* spp.). Many of the herbaceous plants that indicate excellent oak sites in West Virginia are probably indicative of equally good sites for yellow buckeye (4).

### Life History

#### Reproduction and Early Growth

**Flowering and Fruiting**-Yellow buckeye is polygamo-monoecious; the yellow or yellowish-white flowers on a single inflorescence may be either staminate or perfect. They appear from April to June after the leaves. Only those flowers near the base of the branches of an inflorescence are perfect and fertile. The others are staminate and infertile.

The fruit of yellow buckeye is a rounded leathery three-parted capsule, 5 to 8 cm (2 to 3 in) long. More than half of the capsules are one-seeded, although two-, three-, and four-seeded forms are found in decreasing frequencies. The fruit of buckeye is potentially six-seeded, so variation in seed number may be due to aborted ovules caused by incomplete fertilization (4). The ripe seed is dark chocolate to chestnut brown, smooth and shiny, with a large light-colored

hilum so that it resembles an eye. The cotyledons are very thick and fleshy and contain no endosperm.

The seeds ripen and are dispersed in September by gravity, animal activity, and sometimes water. Number of cleaned seed per kilogram ranges from 60 to 66 (27 to 30/lb). Almost all seeds are sound. Following collection, the seeds should be kept moist to avoid loss in viability. Seeds require about 120 days stratification or prechilling to induce prompt germination (8). Germination usually is complete 3 to 4 weeks after spring sowing.

**Seed Production and Dissemination**-No information is available as to the age at which yellow buckeye trees begin bearing seeds, the number of seeds produced by individual trees, the conditions favoring seed production, or the frequency of seed years.

**Seedling Development**-Germination is hypogeal. It occurs in early spring after the seeds have wintered on the ground. Yellow buckeye develops a large taproot following germination. No reports are available concerning germination and early growth and survival of yellow buckeye under natural conditions. The natural occurrence of the tree indicates that moist, deep soils are most favorable for the germination of seeds and survival of seedlings.

**Vegetative Production**-The sprouting ability of yellow buckeye is not known. As in most hardwoods, however, sprouting is probably more vigorous when trees are cut at a young age. Trees that have apparently originated from sprouts have been observed in southeastern Ohio.

#### Sapling and Pole Stages to Maturity

**Growth and Yield**-Yellow buckeye, like Ohio buckeye, is one of the first trees to leaf out and begin shoot growth in the spring. General observation indicates that it has an intermediate growth rate. Under forest conditions it attains large size, has a long clean trunk, and is the largest of all native buckeyes. A large tree found in the Smoky Mountains National Park had a d.b.h. of 155 cm (61 in), a height of 26 m (85 ft), and a crown spread of 16.5 m (54 ft) (4). The American Forestry Association's National Register of Big Trees in 1982 recorded the largest known living specimen, located near Bowers Creek, KY, as having a d.b.h. of 124 cm (49 in), a height of 42.7 m (140 ft), and a crown spread of 16.5 m (54 ft) (1). Yellow buckeye is probably long lived. It reaches

relatively large size and maintains itself in the mixed mesophytic forest.

**Rooting Habit**-No information available.

**Reaction to Competition**-Yellow buckeye becomes established, survives, and grows in competition with its associates of the mixed mesophytic forest; thus, it must be classed as a shade-tolerant tree. The local occurrence and small number of yellow buckeye probably is due to limited seed dissemination and to the inability of the tree to establish itself on any but the most favorable sites. The critical period of competition for this species appears to be during germination and in the early life of the seedling.

Yellow buckeye is not a pioneer species and is seldom found on old fields or on other open land. The loss of viability in seed exposed to drying limits germination on dry, exposed sites.

**Damaging Agents**-No major insect enemies of yellow buckeye are known that consistently cause severe defoliation or damage to the woody parts of the tree. A buckeye lacebug (*Corythucha aesculi*) has been reported as a defoliator of buckeyes, and in southeastern Ohio the yellow buckeye frequently is infested by this insect (2,4). The insect damages the leaves during ovipositing, stomata are blocked by multitudinous flecks of fecal matter, and nymphs feed on the leaves. Foliage on the young trees and on the lower branches of older trees is attacked early in the spring, because yellow buckeye is one of the first trees in southeastern Ohio to leaf out. By the middle of July, leaves turn yellowish or brown and many young trees are nearly defoliated. This injury does not kill the trees, but it probably retards growth. The sapwood timberworm (*Hylecoetus lugubris*) tunnels under the bark and across the sapwood and causes pinhole defects. *Derocrepis aesculi* feed on buckeye leaves (2). Yellow buckeye is occasionally attacked by the walnut scale (*Quadraspidiotus juglansregiae*) (2).

Yellow buckeye is relatively free of diseases. Leaf blotch, *Guignardia aesculi*, is the most destructive disease affecting the buckeyes and horsechestnut. Rainy seasons are especially favorable for the germination of the spores of this disease. When trees are severely affected, from a distance the foliage appears to have been scorched by fire, and the disease may cause much defoliation.

A powdery mildew, *Uncinula flexuosa*, attacks the leaves of buckeye, and a leaf spot *Cercospora aesculina*, and other localized diseases of buckeye have been reported (4). A leaf scorch that first develops near the leaf center and extends outward mainly

between the veins commonly appears on urban street trees and has been attributed to heat and drought; but air pollution should also be suspect (6).

Yellow buckeye wood is relatively free from fungus defects. Only *Polyporus squamosus* (9) and *Collybia velutipes* (4) have been reported associated with rot in living trees, although other rot fungi probably attack dead wood.

## Special Uses

The abundant, large nuts of yellow buckeye contain much starch but are apparently not suitable for food because they contain a poisonous glucoside, aesculin. The American Indian ate yellow buckeye nuts but first they roasted the nuts among hot stones and then peeled and mashed them and leached them with water for several days. This treatment apparently removed the aesculin.

Young shoots and seeds of buckeye have also been reported to be poisonous to livestock (4) and some landowners in Indiana have eradicated buckeye for this reason. Because the seeds of yellow buckeye are poisonous, wild animals do not use them for food and therefore animals probably do not limit the reproduction of this species. The wood is used for pulpwood, woodenware, and sometimes for lumber.

## Genetics

The buckeye frequently have chromosome irregularity and pollen is often sterile (4). This has been considered as evidence of hybridization among the various buckeyes. One report indicated that in glaciated areas where *Aesculus octandra* is not found, its germ plasm has infiltrated the populations of *A. glabra* (4). *A. octandra* and *A. glabra* do hybridize, and intermediates showing the characters of both species occur as hybrid swarms. More often, individual plants of one species have one or more characters from introgression with the other species (3).

Yellow buckeye hybridizes with *Aesculus glabra* (*Ae. x marylandica* Booth ex Dippel); *Ae. sylvatica* (*Ae. x neglecta* Lindl., *Ae. x glaucescens* Sarg.); *Ae. pavia x sylvatica* (*Ae. x woerlitzensis* Koehne, *Ae. x dupontii*, Sarg.) (7).

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