OSAGE-ORANGE

. . . *an American wood*

There is only one species of osage-orange, including thorn and thornless varieties. The wood resembles black locust in appearance and physical properties. The sapwood is light yellow and narrow, the heartwood golden yellow to bright orange. It is very hard, heavy, strong, moderately stable, difficult to work when dry, warps badly in drying, and requires care in gluing. Exceedingly durable, it is used mainly for fence posts. During World War I a yellow dye was made from the stemwood and root bark; the stembark was also used in tanning leather. Antibiotics are extracted from the heartwood, roots, and ripe fruits. Osage-orange is planted extensively in hedges and windbreaks and has become naturalized over much of the United States.

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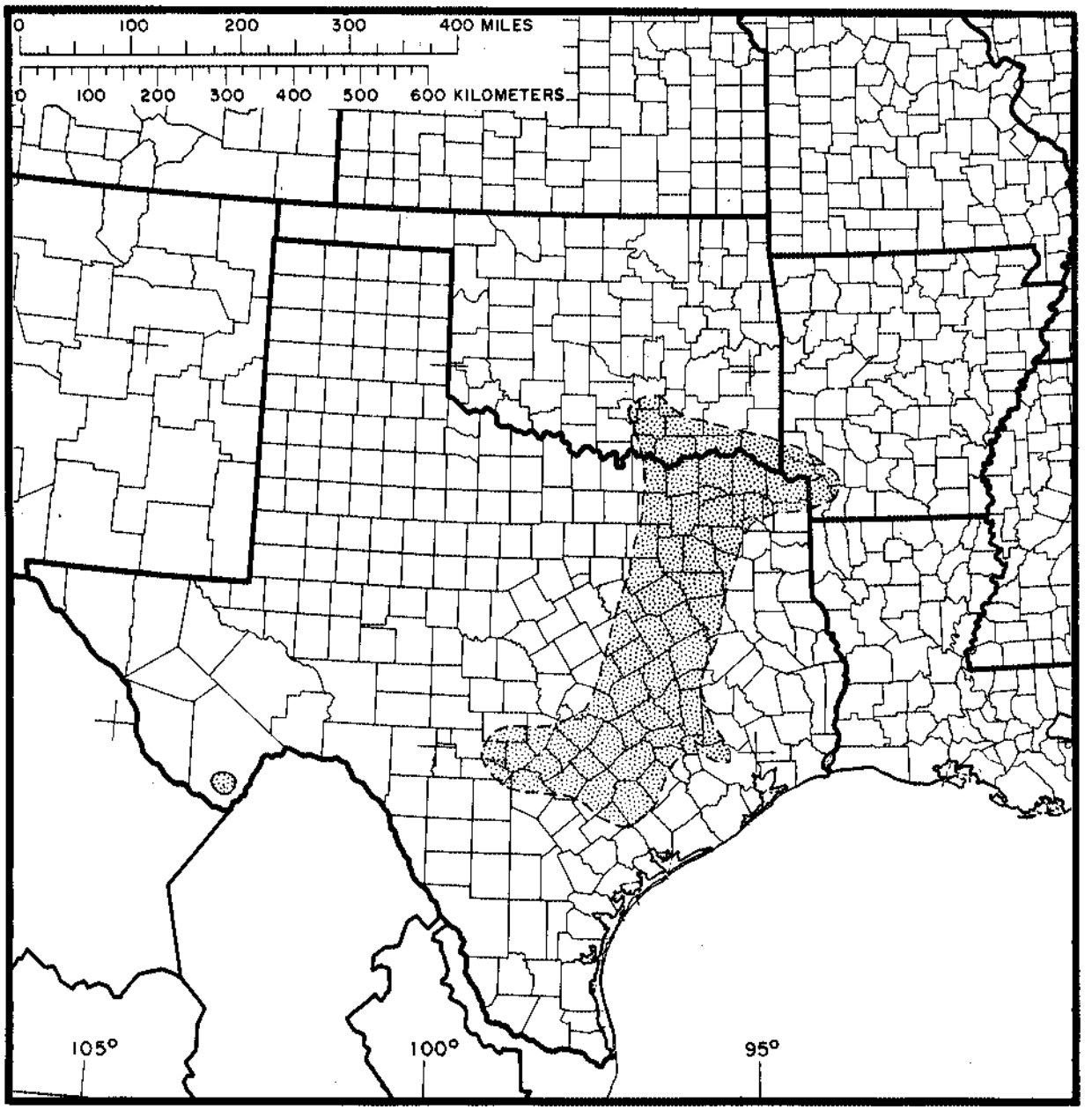

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Figure 1.–Natural range of Osage-orange, *Maclura promifera* Raf. Schneid. This map shows the approximate original natural distribution. The range has been extended greatly by planting.

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OSAGE-ORANGE

(Maclura pomifera Raf. Schneid.)

James D. Burton[1]

DISTRIBUTION

The natural range of Osage-orange lies in the Red River drainage of Oklahoma, Arkansas, and Texas. It also grows in parts of Missouri and Kansas and most of eastern and southern Texas. Therefore, the range map (fig. 1) is only approximate. Distribution is uneven, covering only about 10,000 square miles; and probably half that area produces no trees of merchantable size. Parts of this region, particularly those south of the Red River, were prairie, and Osage-orange tended to invade the prairie forming isolated small stands either pure or in mixture with other hardwoods. Some pure stands covered as much as 100 acres, but most were much smaller. Osage-orange was most abundant and grew largest in southern Oklahoma.

Distribution was greatly expanded by early settlers of the prairie states who used Osage-orange hedges to protect grain and row crops against open-range livestock before wire fencing became available in 1875. Many thousands of miles of living fence and windbarrier were planted. The species became naturalized throughout the eastern half of the United States and in many parts of the West. Osage-orange hedges were planted to mark the boundaries of plantations in the old South. The species has been planted successfully in central and eastern Europe and in southeastern Canada to control soil erosion and act as windbreaks. It is not hardy, however, in Minnesota, the Dakotas, northern Iowa, and Montana.

DESCRIPTION AND GROWTH

Osage-orange is a large shrub or small tree averaging 30 feet in height. Though it may grow taller, it rarely reaches 70 feet. It has a short trunk, deeply furrowed orange-brown bark about 1 inch thick (fig. 2), a milky sap containing latex, and a spreading crown.

Branchlets growing in full sunlight bear sharp, stout thorns, while slow-growing twigs in the Bade portions of the crown are thornless. These thorns, ½ to 1 inch long, are modified twigs; they form in leaf axils on 1-year-old twigs (fig. 3).

The leaves are alternate, simple, entire, ovate-lanceolate, 3 to 6 inches long, glossy dark green above, paler below. They turn clear yellow in autumn before falling. On 1-year-old twigs the leaves are borne on short spurs (fig. 4). These spurs are distinctive and aid identification.

The flowers are 4-part, unisexual, green, minute. They have no petals, and appear after the leaves on the same spurs (fig. 5). Each sex is borne on a separate tree. In ripening, the pistillate (female) flowers become very fleshy, much enlarged, and form an aggregate or collective fruit (fig. 6). The fruit resembles an orange, yellowish green, 3 to 6 inches in diameter, often weighing several pounds. They average 80 to the bushel. When bruised the fruit exudes a milky, acid juice which causes a dermatitis in some people. The fruit is readily eaten by squirrels, cattle, and birds; thus the seeds are spread.

Mature trees have a distinctive winter silhouette because the axes of second- and third-order branches tend to describe arcs of circles (see cover photo).

Pistillate (female) trees bear good seed crops nearly every year, beginning at age 10. Germinative capacity averages 58 percent. Seeds are nearly 1 cm. in length. The number of clean seed per pound ranges from 7,000 to 16,000, the average is 14,000.

Sympodial growth is characteristic of long shoots and water sprouts. Terminal buds of long shoots are abscissed at the level of the last fully expanded leaf. In the spring, shoot growth proceeds through expansion of the first lateral bud behind the apex. Short shoots, seedlings, and vigorous young saplings continue their original line of growth.

Prior to cultivation, Osage-orange was characteristic of rich bottomland soils. This is where it grew tallest. However, Osage-orange grows rapidly on a wide range of sites. Natural regeneration is particularly vigorous

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NOTE: This publication supersedes unnumbered publication, *Osage-Orange,* 1953.

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Figure 2.–Typical short bole, furrowed bark, and decayed heart in a vigorous, mature osage-orange.

on upland loams and clay loams formed in place over limestone. It is characteristically deep-rooted. When it grows on thin, fertile soils over limestone, its lateral rootspread is tremendous.

Osage-orange is not a component of any recognized forest type; it is a pioneer species forever invading exposed mineral soils, particularly overgrazed pastures; It is not injured by dormant-season flooding. Pure natural stands within the original range were often called "bodark swamps."

Like cottonwoods, willows, and aspens, osage-orange is very intolerant.[2] It can be regenerated artificially by coppice, by seeding, by planting seedlings, or from root cuttings or greenwood cuttings under glass. Prairie farmers customarily clearcut hedges on a 10- to 16-year cycle, obtaining 1,000 fence posts per quarter mile of single-row hedge. The slash is piled atop the stumps in order to protect the new sprouts from browsing livestock. The new sprout stand should be thinned between the third and fifth years, retaining 48 or more vigorous stems per chain. The sprouts should be protected from fire, and if injured by wildfire, they should be cut back immediately to encourage new, vigorous sprouting.

Though the Osage-orange is one of the healthiest tree species in North America, it is attacked by some parasites. Cotton root rot attacks osage-orange and most other species planted in the shelterbelts in Texas, Oklahoma, and Arizona. Losses are reported greatest on dry soils with inadequate rainfall. This is the only serious pest known. Texas mistletoe sometimes causes witches'-brooms. The larvae of the painted hickory borer feed in freshly cut wood and occasionally riddle the sapwood of standing trees, but they rarely kill a tree. The fruit tree leaf roller larvae feed on opening buds and unfolding leaves. Osage-orange is also attacked by the San Jose scale and the brown elm scale.

Osage-orange belongs to the mulberry family (Moraceae). Nearly all members of this family are woody plants, though a few are herbs. Most of them are restricted to the tropics and are trees or shrubs. A few, however, are vines, Osage-orange is one of the more specialized genera in the most primitive subfamily, Moroideae, of the Moraceae. This genus is monotypic, but some authorities recognize a thornless variety, *Maclura pomifera* var. *inermis* Andre.

The only known hybrid, *Cudrania tricuspidata* x *M. pomifera* var. *inermis* = *Macludrania hybrida* Andre, is a small tree with yellowish furrowed bark and short woody spines. *Cudrania tricuspidata* (Carr.) Bur. is a spiny shrub or small tree, native to China, Korea, and Japan, used in China for feeding the silkworm. It is recommended as a hedge for the South.

Synonyms for *Maclura pomifera* include *M. aurantiaca* Nutt. and *Toxylon* (and *Ioxylon) pomifera* Raf. ex Sarg.

COMMON NAMES

Osage-orange is the favored common name for the species. It is also called bois d'arc, bodark, hedge, hedge-apple, Osage-apple, ,horse-apple, mock-orange, bow-wood, and yellow-wood. Bodark is a corruption of bois d'arc.

Early French explorers found that the Osage Indians used this wood for bows, hence the names bois d'arc and bow-wood. The fruits resemble green oranges, hence the names Osage-orange and mock-orange.

Some of these names are ill-chosen. Mock-orange is more appropriate for *Philadelphus* L. spp. Yellowwood proper is *Cladrastis lutea* (Michx.) K. Koch.

[2] Lacks ability to grow satisfactorily in the shade of or in competition with other trees.

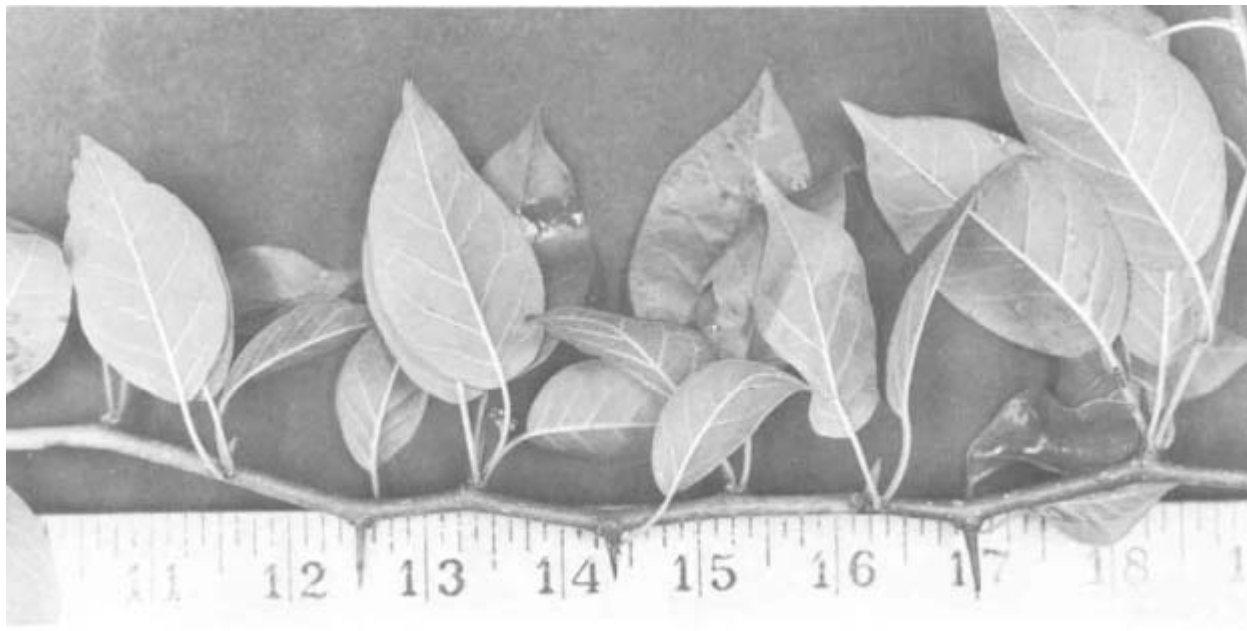

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Figure 3.–Thorns occur in leaf axils on rapidly-growing shoots formed the previous year on osage-orange (scale in inches).

SUPPLY

The original supply of Osage-orange was not great, and most natural stands of commercial size were cleared to make farms. Most of the present supply exists on nonforest land, in fence rows, along ditches and streambanks, and in old fields. More than 6,000 miles of single-row hedge, mostly 30 to 60 years old, now exist in Kansas, according to unpublished local estimate. An unknown, probably considerable, volume stands in hedge rows in Nebraska, south of the Platte River and as far west as Holdrege. Growing stock in Oklahoma was locally estimated in 1971 at 3 to 5 million cubic feet. However, regional estimates, based on 1964—65 Forest Surveys, indicate virtually no trees of commercial size and quality on commercial forest land in Oklahoma, Texas, and Louisiana. This paradox is due to two facts: (1) this species characteristically occurs on nonforest land, and (2) merchantability standards for forest trees do not apply to Osage-orange. Maxwell (1911) stated:

"The logs that go to the osage rim mills are cut from timber small in size, distorted in shape, and frequently defective in other ways. . . . Trunks are crooked and irregular, and saw logs of fair size and of even moderately symmetrical form are seldom seen. . . .

"Osage trees, under natural conditions, are oftener under than above one foot in diameter, and a comparatively straight trunk ten feet long is exceptional. Trees are found, however, as much as 30 to 40 inches in diameter a foot above the ground.

"Trees large enough for rims are nearly always defective from decay or on account of large cracks across the heart . . ."

PRODUCTION

Lumber production data for Osage-orange are available only for 1909, when 340 thousand board feet were manufactured, and 1911, when the cut was 1,210. thousand. In 1945 the average annual cut was estimated at 3 million board feet, of which 2 million consisted of fence posts.

No estimate of present or recent nationwide or regional production is available. Approximately 3 million posts are now being cut and retailed annually in Kansas, and an undetermined additional quantity are used on the farms where they are cut. Production of Osage-orange cordwood is largely a consequence of hedgerow destruction, and this tends to be intermittent. No estimates of production are available. At least one charcoal kiln in McPherson County, Kansas, operated for several years, using only Osage-orange wood from hedgerow removal.

CHARACTERISTICS AND PROPERTIES

The sapwood of Osage-orange is light yellow and narrow; the heartwood is golden-yellow to bright orange, darkening upon exposure, often with reddish streaks along the grain. The wood has no characteristic odor nor taste and growth rings are distinct. Earlywood pores are large but poorly defined because they are occluded with tyloses. Rays are barely visible to the

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Figure 4.–Upper and lower surfaces of fully expanded leaves of the osage-orange, the bearing twig with spurs, and a male flower (scale in inches).

naked eye. Wood from old-growth stands is reported to be difficult to work when dry. It should be worked green because (1) its hardness quickly dulls tools and bits, (2) rough-breaking vessels prevent smooth finishing, and (3) extraordinary care is required to prevent splitting. Seasoned wood resembles bone in its effect on tools. Resistance to splitting, however, is reported to be very high on wood from planted, naturalized, or young-growth trees; and machining qualities (smoothness of finished surface is average.

Average weight at 15 percent moisture content is 57.3 pounds per cubic foot, 4,770 pounds per thousand board feet rough, and 3,490 lb/Mbf. dressed as nominal 1- x 8-inch lumber. Average moisture content green is 31 percent and average volumetric shinkage, from green to ovendry, only 9.2 percent. Osage-orange ranks high in bending strength, hardness, stiffness, shock resistance, strength in longitudinal compression, and nail- and screw-holding ability. Ability to stay in place is average. The wood shows pronounced warping in drying and is difficult to glue. The heartwood is often confused with that of black locust *(Robinia pseudoacacia* L.) . However, the yellow pigment of osage-orange is much more

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Figure 5.–Staminate flowers (male) in the axils of leaves on year-old branchlets of the osage-orange.

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Figure 6.–Ripe fruit of the osage-orange (scale in inches).

soluble in water than that of black locust. Positive identification of black locust is further provided by a comparison of detailed anatomical features. Mechanical injury to the sapwood of osage-orange often results in "pathological heartwood," or discolored sapwood, which tends to resemble normal heartwood in morphology and durability, but not in chemical composition.

The amount of "pathological heartwood'' formed is less in osage-orange than in other angiosperms[3] similarly injured, apparently because latex exuding from certain cells in the bark seals the wound.

The heartwood is the most decay-resistant of all North American timbers, mainly because it contains an antifungal agent. This and 2' 3, 4', 5, 7, pentahydroxyflavone were extracted from the hardwood by Barnes and Gerber, 1955. Several additional flavones and xanthones have been isolated from fruits, roots, and heartwood, according to Wolfrom and Bhat, 1965.

Extraction of the heartwood and root with acetone yields a heat-stable, nontoxic antibiotic useful as a food preservative.

The water-, ethanol-, and acetone-soluble constituents of the fully ripe fruits are reported to have high antibiotic activity against bacteria and to inhibit the germination of wheat.

PRINCIPAL USES

The most important use for Osage-orange wood today is fence posts. The species has been planted extensively for hedges and wind barriers and still is, in Kansas and Oklahoma. It is used for game calls, smoking pipes, artificial limbs, and crutches. Historically, the wood was in great demand for making hubs and rims of wheels for horse-drawn vehicles. The supply became scarce even before the automobile replaced the horse. House blocks (short posts set under the corners of buildings instead of masonry foundations) were an important use. Railroad ties, bridge piling, insulator pins, telephone poles, and treenails formerly took large quantities of osage-orange wood. Lesser amounts were used for street paving blocks, machinery parts, pulley blocks, mine timber, archery (bows), planing mill products, and parquet flooring. Osage-orange is not a good fuelwood in open fireplaces, because it snaps and pops, but large quantities still are used in stoves and furnaces. The stem wood and the bark of the roots were used in making a yellow dye. During World War I this dye industry began to assume importance (the wood contains yellow, green, and brown pigments), but dyewood consumption virtually ceased with the advent of synthetic dyes.

The bark of the trunk was used, to some extent, for tanning leather. The tree was sometimes grown in Europe as food for silkworms.

Osage-orange hedges and windbreaks in prairie regions have high value as nesting sites, escape cover, and food source for quail.

[3] Seeds formed enclosed in ovary.

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