Robinia pseudoacacia L. Black Locust

Leguminosae Legume family

J. C. Huntley

Black locust *(Robinia pseudoacacia),* sometimes called yellow locust, grows naturally on a wide range of sites but does best on rich moist limestone soils. It has escaped cultivation and become naturalized throughout eastern North America and parts of the West.

Black locust is not a commercial timber species but is useful for many other purposes. Because it is a nitrogen fixer and has rapid juvenile growth, it is widely planted as an ornamental, for shelterbelts, and for land reclamation. It is suitable for fuelwood and pulp and provides cover for wildlife, browse for deer, and cavities for birds.

Habitat

Native Range

Black locust (figs. 1, 2) has a disjunct original range, the extent of which is not accurately known. The eastern section is centered in the Appalachian Mountains and ranges from central Pennsylvania and southern Ohio, south to northeastern Alabama, northern Georgia, and northwestern South Carolina. The western section includes the Ozark Plateau of southern Missouri, northern Arkansas, and northeastern Oklahoma, and the Ouachita Mountains of

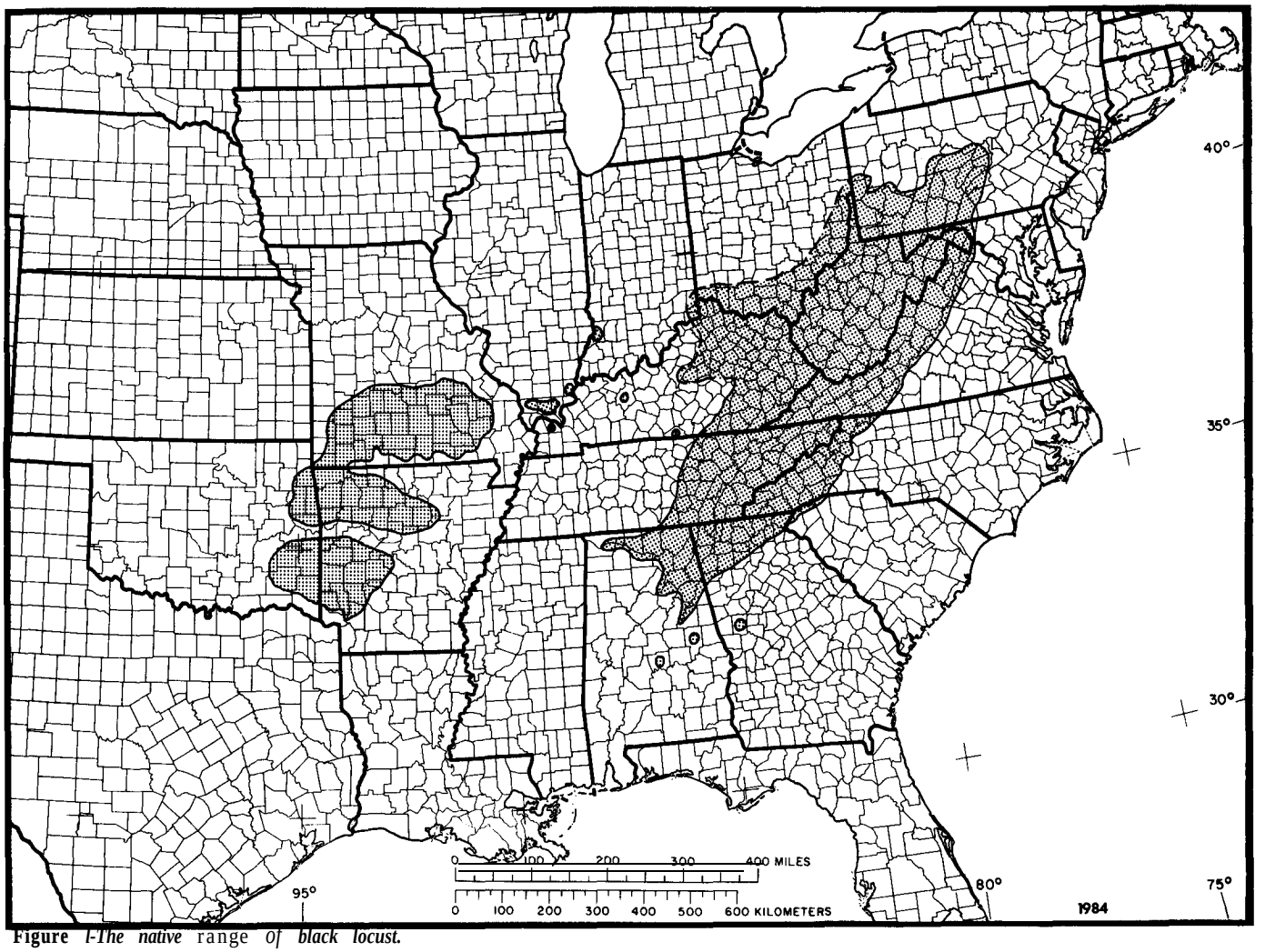

Figure *1-The native* range *of black locust.*

The author is with the Southern Region in Montgomery, AL.

Figure 2—*Black locust.*

central Arkansas and southeastern Oklahoma. Outlying populations appear in southern Indiana and Illinois, Kentucky, Alabama, and Georgia (26). Black locust has been planted widely and has become naturalized throughout the United States, southern Canada, and parts of Europe and Asia.

Climate

The native range of black locust is classified as humid, with two local areas of superhumid climate (43). The range includes the cool temperate moist forest, warm temperate montane moist forest, warm temperate montane wet forest, and warm temperate moist forest life zones (38).

Native black locust appears under the following ranges of climatic conditions (45). January normal daily temperatures: maximum, 2" to 13" C (36" to 55° F); minimum, -7" to 2" C (20° to 36" F); average -4" to 7" C (25" to 45" F); August normal daily temperatures: maximum, 27" to 32" C (81° to 90" F); minimum, 13" to 21" C (55" to 70" F); average, 18" to 27" C (64° to 81° F); mean length of frost-free period, 150 to 210 days; normal annual total precipitation, 1020 to 1830 mm (40 to 72 in); mean annual total snowfall, 5 to 152 cm (2 to 60 in). Black locust has been successfully introduced into many parts of the world where the climatic conditions are different from those of its native range.

Soils and Topography

Black locust grows naturally over a wide range of soils and topography. The most common orders of soil within its native range are Inceptisols, Ultisols, and Alfisols, and the most common soil great groups are Hapludults, Paleudults, Dystrochrepts, and Eutrochrepts (41). The species does best on moist, rich, loamy soils or those of limestone origin and thrives best on moist slopes of the eastern mountains below 1040 m (3,400 ft) *(18,21)*. In the Great Smoky Mountains National Park, the upper elevational limit is 1620 m (5,300 ft) (46). Black locust has become established on a wide variety of disturbed sites such as old fields or other cleared areas.

Black locust is very sensitive to poorly drained or compact plastic soils. Excessively dry sites are also poor for the species. Yellow, brown, or reddish-brown subsoils without pronounced mottling are better than gray, bluish-gray, or yellow subsoils mottled any color. Silt loams, sandy loams, and the lighter textured soils are superior to clay, silty clay loams, and the heavier soils. In the Central States, growth of black locust plantations was found to be closely correlated to plasticity, compactness, and structure of the subsoil, all of which influence drainage and aeration. Growth was unfavorably affected by insufficient or excessive drainage. Soil pH from 4.6 to 8.2 and the amount of mineral nutrients present showed no relationship to growth. Growth was best on limestone-derived soils and soils without pronounced subsoil development (37).

On West Virginia spoil banks, black locust was the most successful species, but survival declined as slope increased. On slopes greater than 25 percent, each 10 percent increase in slope decreased survival 3.4 percent. On slopes steeper than 40 percent, growth was inversely related to slope steepness. Survival was about 80 percent at elevations of 340 to 670 m (1,100 to 2,200 ft). Above 670 m (2,200 ft), survival decreased steadily with increasing elevation and at 1330 m (4,350 ft) survival was less than 65 percent (7).

Although black locust has done well in mine spoil banks in the Central States, it has failed consistently

when planted on badly eroded, compacted, clayey soils of the southern Appalachian Region ***(21).*** In the Arkansas Ozarks, many plantations on worn out and eroded fields were complete failures. On the southwestern Coastal Plain of Arkansas, plantations on sites previously in agricultural crops failed because of slow growth due to low soil fertility, repeated attacks by the locust borer ***(Megacyllene robiniae),*** and invasion of pine (32).

Associated Forest Cover

Black locust develops and grows best in cove or mixed mesophytic forests of the central and southern Appalachian Region. These forests are usually highly productive and characterized by a large and variable number of species. The species is often a component of mature forest on such sites but is seldom very abundant. Black locust is listed as a component of the Mixed Mesophytic Forest (6). In the Cumberland Mountains of Kentucky, it made up about 1 percent of the mixed mesophytic forest on north and south slopes but is considered as more properly belonging to other communities and as a relict from preceding stages or accidentals from nearby unlike communities. It is not listed as a component of oak-hickory forest in the Ozark and Ouachita Highlands or of oak–chestnut forest in the southern Appalachians but is listed as an associate of shortleaf pine *(Pinus echinata)* and Table Mountain pine *(P. pungens)* in the oak–pine communities of the oak-chestnut forest region.

In the forest cover type Black Locust (Society of American Foresters Type 50) the species is in pure stands or makes up the majority of stocking ***(15).*** Black locust is listed as an associate in only two other types: Yellow-Poplar (Type 57) and Yellow-Poplar-White Oak-Northern Red Oak (Type 59). Black locust is a pioneer type, usually man-influenced, and temporary. It follows disturbances and may be natural or planted. The type is found locally throughout the Eastern United States and in southern Canada. Black locust makes up a majority of the stand during early stages but is short lived and seldom matures to a sawtimber stand. A wide variety of species become associated with black locust and usually replace most of it. On good sites, single trees or small groups may persist, grow to a large size, and form a small part of the ultimate canopy layer.

Life History

Reproduction and Early Growth

Flowering and Fruiting-The fragrant, whitish flowers, borne in showy racemes, appear after leaf emergence in May or June. The perfect flowers originate in the axils of current year leaves and are pollinated by insects, primarily bees. The fruit is a flattened, oblong pod that ripens during September and October. The fruit opens on the tree and seeds are dispersed from September to April (34).

Seed Production-Black locust begins seed production at about age 6 and produces good crops at 1- to 2-year intervals. Seed production is best between 15 and 40 years of age and continues until age 60. Black locust yields 7 to 15 kg (15 to 33 lb) of seeds per 45 kg (100 lb) of fruit, and seeds average 52,900/kg (24,009/lb) *(34,37).*

Seedling Development-Because black locust has been widely planted, the proper seed treatment and nursery practices are well described. Dry seeds can be stored and retain their viability for as long as 10 years if placed in closed containers at 0" to 5" C (32" to 41" F). Because seed coats are impermeable, germination must be induced by scarification. Soaking in concentrated sulfuric acid, soaking in boiling or near-boiling water, and mechanical scarification have proved successful. Germination is epigeal (34).

During seedling development, the first leaf appears within a week after germination and is 8 to 10 cm (3 to 4 in) long after 2 months. The young stems are zig-zag, round to slightly angular, and in the latter half of the first year develop pairs of thorns from stipules at the base of leaf petioles (29). Black locust seedlings grow rapidly when planted on good sites and competition is sparse. Control of competition aids in the establishment and growth of seedlings because black locust is intolerant of shade and herbaceous competition. In plantations in the Tennessee Valley, it was a very site-exacting species and grew poorly on severely eroded sites ***(1).*** Average annual height growth of 5-year-old plantations ranged from 0.3 m (1.1 ft) on severely sheet-eroded sites to 0.8 m (2.6 ft) on sites with little or no erosion. In the Central States, annual height growth for the first 10 years averaged 0.5 m (1.5 ft) on below-average sites but was 1.2 m (4 ft) or more on good sites (37). Black locust can be established on poor and disturbed sites. It has been widely planted for erosion control along roadsides and for reclamation of surface mine spoil banks. Throughout the Eastern and Central States, reclamation plantings have been successful across a wide range of spoil bank conditions.

Vegetative Reproduction-Black locust sprouts readily from both stump and roots, especially after being cut or damaged. Although seedlings are produced, root suckers are most prevalent in natural

reproduction. Suckers usually appear in the fourth or fifth year (37). In the southern Appalachians, dense thickets of suckers develop in clearcuts *(4,28)*.

Sapling and Pole Stages to Maturity

Growth and Yield-Black locust is a medium-sized tree, generally 12 to 18 m (40 to 60 ft) in height and 30 to 76 cm (12 to 30 in) in diameter. On better sites it may reach 30 m (100 ft) in height and 122 cm (48 in) or more in diameter. The bole of open-grown trees is usually short and separates at 3 to 5 m (10 to 15 ft) into several stout branches, but in stands on good sites the bole is often clear and straight *(18,19)*.

Young trees grow very fast on good sites, but the species matures early and growth rate decreases rapidly after 30 years, especially on poor sites (table 1). Sprouts grow more rapidly than seedlings. Average yields from 27-year-old plantations in the Central States were 126 m^3/ha (1,800 ft^3/acre, 1,100 posts/acre, or 4,100 bd.ft./acre). On the best sites, black locust requires 15 to 20 years to produce post-size trees and 30 years to produce 20 cm (8 in) bolts *(37)*. Little information is available on the growth and yield of black locust in natural stands, but numerous studies have documented its early growth in reclamation plantings *(5,7,11,20,37)*. In West Virginia, slope percent, aspect, elevation, and extent of regrading accounted for 60 percent of height growth variation. Estimated annual height growth on surface-mined sites was tabulated (8).

Table 1-Average size of plantation-grown black locust in the Central States (37)

Plantation age	Site index at base age 50 years					
	9.1 m or 30 ft		18.3 m or 60 ft		27.4 m or 90 ft	
	D.b.h.	Height	D.b.h.	Height	D.b.h.	Height
yr	cm	*m*	*cm*	m	*cm*	*m*
10	4	3.7	7	8.2	11	12.8
25	10	7.6	15	14.0	21	20.7
40	—	9.1	—	17.7	27	25.6
yr	*in*	*ft*	*in*	*ft*	*in*	*ft*
10	1.6	12	2.8	27	4.4	42
25	4.1	25	6.0	46	a.4	68
40	—	30	—	58	10.8	04

Early growth information is available for black locust plantations on abandoned fields in the Arkansas Ozarks (32). On the best 11-year-old plantations, heights ranged from 7.8 to 11.5 m (25.7 to 37.8 ft) and diameters ranged from 6.9 to 10.4 cm (2.7 to 4.1 in). Many of the plantations were complete failures, and established plantations were often severely damaged by insects.

Rooting Habit-Black locust ordinarily produces a shallow and wide-spreading root system that is excellent for soil binding but is also capable of producing deep roots. In the arid Southwest, trees may develop vertical roots from 6.1 to 7.6 m (20 to 25 ft) long (37). This deep rooting ability may explain why black locust can grow in arid lands much drier than its native range. Radial root spread is about 1 to 1.5 times tree height *(10)*.

Reaction to Competition-Black locust is very sensitive to competition and is classed as very intolerant of shade (44). It is found in closed forest stands only as a dominant tree. Reproduction is not successful until perturbations create openings in which black locust, because of its rapid juvenile growth, can compete successfully. In open areas, dense herbaceous growth often prevents seedling establishment (37). On spoil banks in Illinois, survival rate of planted black locust was 83 percent on sparsely vegetated sites but was only 31 percent on densely vegetated sites (5).

Except for reclamation, most forest managers consider this tree a weed species and a strong competitor against more desirable species. Two years after clearcutting a mixed hardwood stand from a good site on the southern Cumberland Plateau, 28 percent of all woody stems taller than 1.4 m (4.5 ft) were black locust. Ten years after clearcutting a high-quality hardwood stand in the southern Appalachians, the number of free-to-grow black locust had decreased but it was still the most abundant tree species *(28)*. Dense black locust thickets occupied at least 15 percent of the area and suppressed the growth of more desirable species (4). Frill treatment with 2,4,5-T controlled the thickets. Glyphosate effectively controlled black locust in Christmas tree plantations in Maryland *(17)*.

Damaging Agents-Black locust is severely damaged by insects and disease, probably more than any other eastern hardwood species. Ubiquitous attacks by the locust borer *(Megcallene robiniae)* and by the heart rot fungi ***Phellinus rimosus*** or ***Polyporus robiniophilus*** make growing black locust for timber production impractical. Locust borer larvae construct feeding tunnels throughout the wood, and the holes serve as entry points for heart rot fungi that cause extensive wood decay.

Locust borer attacks can begin at a young age and damage can be so extensive that trees are not

suitable for fence posts. Many plantations planted in reclamation projects were seriously damaged, but more trees could be used if cut as soon as they reach post or mine-prop size. Slow-growing trees on poor sites are most susceptible to borer attack. On sites where tree vigor is low, repeated attacks often reduce black locust to sprout clumps. Damage to the sprouts is often as severe as in the original stem *(37)*.

Outbreaks of the locust leafminer *(Odontota dorsalis)* occur almost yearly. Black locust trees throughout an entire region are often defoliated, and during years of low rainfall many are killed. Attacks by the locust twig borer *(Ecdytolopha insiticiana)* occur over a wide area and in heavily infested areas seedling mortality may be high. Black locust is attacked by a wide variety of other insects that cause some degree of damage (3).

Common diseases are heart rot and witches' broom disease, caused by a virus, *Chlorogenus robiniae.* In the southern Appalachians most large trees are infected with heart rot and decay of trunk wood is extensive. In the Texas root-rot belt, black locust is extremely susceptible to *Phymatotrichum omniuorum* (21). In New Brunswick, plantings of black locust are not recommended because of high mortality and dieback of branches caused by *Nectria cinnabarina* and because of superior performance by conifer species *(40)*.

Although black locust is moderately frost hardy in the southern and central Plains, cold weather damage has occurred in the colder parts of its range (37). In the Appalachian region, it is highly susceptible to frost damage (44). Although the species has been reported to be very susceptible to fire damage, researchers concluded that parts of a study area in Illinois would be rapidly converted to black locust thickets if fire was the only management tool used *(2)*.

Special Uses

Although black locust is not an important timber tree in the United States, it is used for a wide variety of products and is planted for many specialized purposes. It is used for fence posts, mine timbers, poles, railroad ties, insulator pins, ship timber, tree nails for wooden ship construction, boxes, crates, pegs, stakes, and novelties. Pulp with satisfactory mechanical properties can be made, particularly by the sulfate process (35). It is also suitable for use in fuel plantations *(14,16)*.

Black locust is widely planted in the United States, Europe, and Asia for erosion control, reclamation of drastically disturbed sites, windbreaks, nurse crops, amelioration of sites, honey production, and ornamental use. Many early plantations on severely eroded old fields were failures, but establishment on spoil banks has been generally successful. Black locust is often broadcast or hydroseeded with a mixture of herbaceous seed. The most commonly used seeding rate is 2.2 to 3.4 kg/ha (2 to 3 lb/acre) *(12)*.

Because of its soil-improving properties, black locust is often planted in mixtures. Many species have been underplanted in black locust stands. Success of such planting has been variable and many factors have to be considered carefully (37). On mine spoil in Illinois, black locust was a valuable nurse crop for black walnut *(Juglans nigra),* silver maple *(Acer saccharinum),* and yellow-poplar *(Liriodendron tulipifera),* but not for cottonwood *(Populus deltoides)*, sweetgum *(Liquidambar styraciflua)*, or Osage-orange *(Maclura pomifera) (25).* On surface-mined land in Kansas, survival, growth, and form of black walnut were impaired when planted with black locust (39).

Black locust was superior to other hardwoods in developing wildlife habitat on mine spoils. It quickly provided cover, and by 10 to 15 years native vegetation had established a dense undergrowth (36). Its seeds are rated low as wildlife food but are used to a limited extent by Northern bobwhite, other game birds, and squirrels *(30,42)*. White-tailed deer browse the young growth, and a study in the southern Appalachians showed that 92 percent of the sprouts were browsed *(13).* Because older trees are usually infected with heart rot, woodpeckers often construct cavities in them. Nest cavities of the downy woodpecker, hairy woodpecker, and common flicker have been found *(9)*.

Genetics

Black locust is a variable species. Many cultural varieties have been recognized, especially in Europe. Forty-nine varieties have been tested in Hungary *(23)*, and varieties have been selected that increase wood production 18 to 32 percent and nectar production 74 percent *(31)*. In Korea, numerous studies have been conducted on the development, morphology, and cytological characteristics of spontaneous and colchicine-induced tetraploids of black locust (24). Shipmast locust *(Robinia pseudoacacia* var. *rectissima)*, a clone of unknown origin, is listed by Little as a natural variety (27). After protein analysis and comparison; however, Huang and others consider shipmast locust an ecological variant and believe that it should not be given varietal status (22).

Selection and propagation of trees with superior vigor, form, and resistance to borers have been attempted. The most promising selections were tested

in several States. Early results indicate significant differences in borer attack between clones and between sites; however, differences were small and may have no practical application (33).

Four hybrids are recognized (27). These are crosses with Kelsey locust, *Robinia kelseyi* Hutch. (*R. x slavinii* Rehd.); New Mexico locust, *R. neomexicana* Gray (*R. x holtii* Beissn.); clammy locust, *R. uiscosa* Vent. (*R. x ambigua* Poir.); and bristly locust, *R. hispida* L. (*R. x margaretta* Ashe).

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