

# Walnuts for the Northeast

Edward Goodell

The walnut has been held in high esteem since ancient times. The Romans considered it preeminent among nuts and gave it the name *Jovis glans* (Jupiter's nut), from which the modern taxonomic name for the walnut genus, *Juglans*, has been derived. Several species of walnuts are popular throughout the Western World today, both for their fine wood and flavorful nuts. Large commercial walnut industries exist in the Mediterranean region of Europe and on the west coast of the United States (primarily California, with 200,000 acres). Although walnuts are grown throughout much of this country, they have never been grown widely in the Northeast. Several types can be grown here, however, including the Persian walnut (*Juglans regia* L.), the black walnut (*J. nigra* L.), the butternut (*J. cinerea* L.), and the Asian walnuts (*J. ailanthifolia* Carr, *J. mandshurica* Maxim., and *J. cathayensis* Dode), all of which have nutritious, flavorful nuts. We will explore in the following the merits of these types and their cultivation in the northeastern United States and adjoining areas of Canada.

Any talk of walnuts must begin by addressing the toxic effect walnuts are said to exert on neighboring plants. Pliny the Elder, in the first century A.D., wrote, "the shadow

of walnut trees is poison to all plants within its compass. . . ." While it is true that walnut species (and some hickories) produce a toxic chemical identified as juglone (5-hydroxy-1, 4-naphthoquinone) the actual phytotoxic effect varies considerably depending on (1) the different levels of tolerance among plants, (2) whether or not the roots of adjacent plants contact the walnut root, and (3) the amount of air present in the soil. Although the black walnut probably has the most notorious reputation for allelopathy (as destructive chemical interaction between plants is known), this phenomenon has been increasingly documented throughout the plant world, and it is worth noting that tall fescue grass (*Festuca arundinacea* Schreb.) exerts a similar deleterious effect on walnuts (Rietveld 1981).

Toxic juglone is oxidized from hydrojuglone, a nontoxic substance found in all parts of the walnut plant. Oxidation of hydrojuglone occurs in the presence of air and during contact between walnut roots and the roots of other plants that contain oxidizing compounds. Hydrojuglone is highly reactive, however, and in the continued presence of air quickly breaks down into harmless substances. Root-to-root contact is therefore the only means by which damage can occur unless plants are in soil that is poorly drained, and therefore poorly aerated.

Tomatoes, apples, most ericaceous plants,

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Black walnuts (*Juglans nigra*) ripening on the tree. Al Bussewitz photo.

and many conifers are known to be adversely affected (MacDaniels 1976 and 1980). The effects of walnut toxicity are noticeable either as flagging, wilted leaves (in tomatoes) or more commonly as a long-term gradual stunting of the plant. On the other hand, many plants are not affected at all, including numerous grasses and vegetable crops, many legumes, some *Rosa* and *Vitis* species, and most native hardwoods. This immunity may result from either a root zone that does not coincide with that of the deep-rooting walnut or an actual tolerance to the toxic properties of juglone.

According to current information we can be optimistic about the prospects of successfully growing a wide range of plants in association with walnuts. A general precaution is advised: locate susceptible plants with a long life span outside the eventual root zone of walnuts. This is urged especially in wet soils, where the toxic effect is more likely. However, during the initial period of growth walnuts can be grown near even susceptible plants (as root spread is narrow and contact therefore avoided). For example, at an orchard spacing of 6 meters on-center black walnut can be interplanted with vegetable crops, small fruit, and/or Christmas trees for at least 10 years.

### Persian Walnut

The common commercial walnut is the Persian walnut, *Juglans regia*. This was the only walnut known to the Ancient Romans. *Juglans regia* came to Rome from Persia via Greece, and Roman conquerors spread it throughout southern Europe to England.

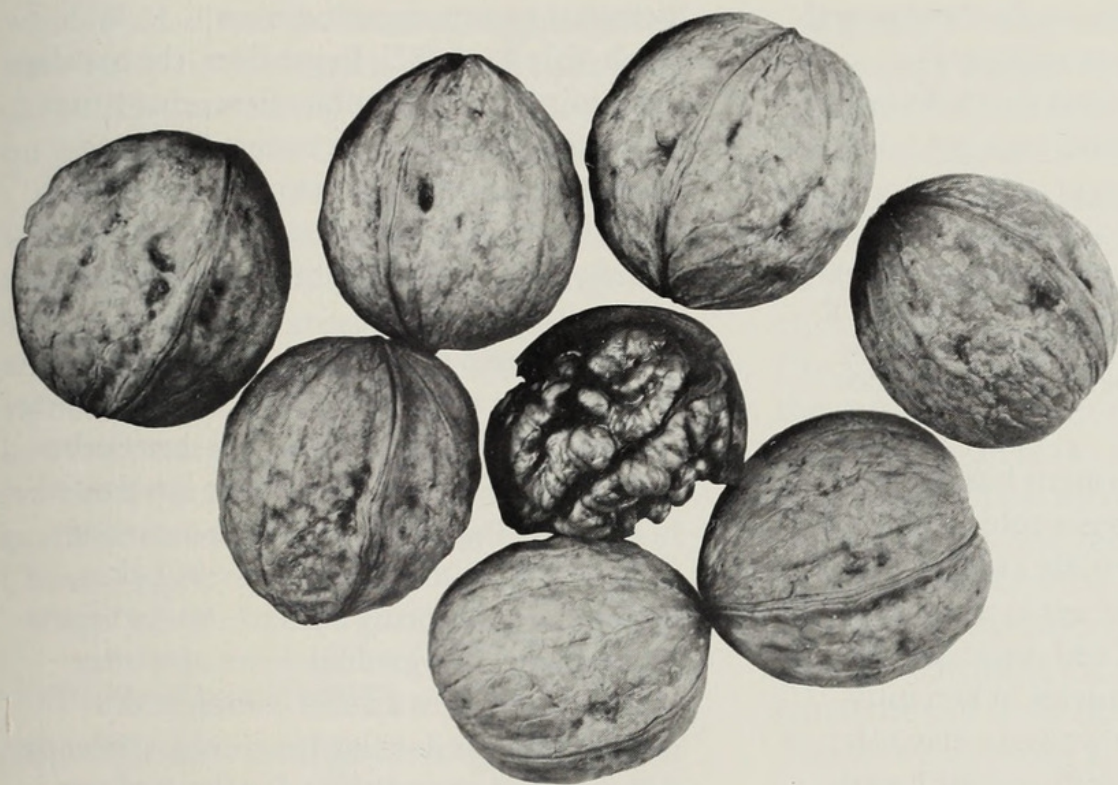
On the North American continent *Juglans*

*regia* is often called the English walnut, presumably because it was introduced here by English colonists. However, it is not grown extensively in England. Most horticulturalists call it the Persian walnut in deference to its origin.

The Persian walnut is native to the area between the Carpathian Mountains in eastern Europe and the Himalayan Mountains in northern India, a swath across the Balkan Peninsula, Turkey, Iran, Afghanistan, and the adjoining areas of the USSR. A geographically disjunct population occurs in northern China (*Iconographia Cormophytorum Sinicorum* 1972 and Meyer 1911). Wild plants are normally found in mixed broad-leaf forests, along stream banks, in valleys, and on mountain slopes (Komarov 1936). In sheltered valleys, where it thrives, *Juglans regia* may grow 20–35 m high with a straight, upright trunk and a large, spreading crown. Normally the wood is purplish brown, hard, and satin-smooth and shiny when polished. The nuts of wild trees generally have thin shells and large kernels. Various subspecies have been proposed based on nut shape, growth habit, and geographic origin (Komarov 1936 and Rehder 1940).

Persian walnuts have always been valued trees within their native and naturalized range. The timber is used in Europe for fine woodwork and veneer. Trees that are successful in the northeastern United States have come from colder regions of the species' range, Romania, Hungary, Czechoslovakia, Poland, USSR, and Germany, where they have traditionally been popular yard trees. Outstanding selections are currently being propagated and tested for commercial orchards in these countries (Shreve 1981).

Most selections of Persian walnuts cold



Carpathian walnuts, (*Juglans regia*) above, originated in the Carpathian Mountains of southern Poland.

hardy enough for North America derive from seed collected in the Carpathian Mountains of southern Poland. Reverend Paul Crath, a native of the Ukraine, worked as a Presbyterian missionary in that region between 1924 and 1936, after having been ordained a minister in Canada. Reverend Crath was keenly interested in the *Juglans regia* trees he found commonly growing in Poland, where minimum winter temperatures could reach  $-40^{\circ}\text{F}$ . He believed that some of these trees would succeed in cold areas of North America. Through arrangements with members of the Northern Nut Growers' Association and the Wisconsin Horticultural Society, he sent back several tons of seed (Devitt 1953). The resulting trees, often

called Carpathian walnut trees and known for their cold hardiness, became widely established from British Columbia to Nova Scotia and are still being selected for their hardiness, nut qualities, and yields.

Reverend Crath's introductions were not the first cold-hardy Persian walnuts brought to North America, however. Since the late 1700s German immigrants had been bringing hardy *Juglans regia* seed from their homeland to Pennsylvania and farther west. The descendants of these seedlings are on the average less tolerant of cold than the Carpathian walnuts, but several are among the most hardy and productive cultivars. Other promising introductions have been made from the Russian Ukraine, the Himalayan Mountains, and northern China. A great deal of potential still exists for collecting genetically superior seed from the

cold-temperate areas where the Persian walnut has been grown since antiquity.

In a 1936 letter Reverend Crath described the trees of the Carpathian region:

We examined 79 walnut trees in and around Cosseev. The age of the trees varied from 15–100 years. Trees 30 years old and over were from 60 to 75 feet tall, and from 1 to 3 feet in diameter. Of the 79 trees, only 3 trees were damaged by the frost of 1929 (45 degrees below zero) (Rahmlov 1962).

Experience on this continent has shown that with good site conditions a cold-hardy Persian walnut tree will rapidly grow to the size and shape of a very large apple tree. The canopy is globe shaped and dense, the bark pale gray, and the roots deep. When fully dormant, some Persian walnuts may tolerate temperatures between 30°F and 40°F without damage (O'Rourke 1969).

However, injury can occur at much higher temperatures (–13°F) if mild weather precedes a drop in temperature. Persian walnuts will grow on a variety of soils, but poor drainage invariably renders them more susceptible to winter injury. High vigor and good nut production require a fertile, nearly neutral soil and room for extensive root development.

Persian walnuts are monoecious. The staminate catkins expand from lateral buds of the previous season's growth. The clusters of 1–3 (occasionally 4–5) pistillate flowers are borne at the tips of the current season's shoots. Pistillate flowers, and the nuts that subsequently develop from them, normally appear only on growth originating from the terminal buds. On some cultivars the lateral shoots also bear flowers, which increases their yield. It is unclear as to whether all Persian walnut trees are self-fertile or not

(personal communication from L. H. Wilmoth, July 21, 1982). Regardless, the overlap in staminate and pistillate flowering times would rarely be enough to ensure a good crop. Several cultivars are notable for their self-fruitfulness, but even these seem to benefit significantly from cross-pollination with another cultivar.

In the North the most common cause of crop damage among Persian walnuts is their tendency to produce leaves and flowers before the possibility of late frosts has passed. In Ontario, Persian walnuts are most successful within 20 km of the Great Lakes, where the cool spring climate delays vegetative growth. The gradual onset of winter there also ensures a more complete dormancy and less damage from cold. Under optimal growing conditions Persian walnut seedlings bear fruit within 4–8 years and grafted cultivars within 2–5 years. A few seedlings from a Russian source have been reported to flower in their second year (McDaniel 1978). Pistillate flowers are generally produced several years before staminate flowers. In their eighth growing season, productive cultivars may bear 0.03–0.06 m<sup>3</sup> of nuts. Large trees may yield 0.2 m<sup>3</sup> (Grimo 1979). Reverend Crath reported harvests of 45–115 kg from mature, native Carpathian trees. Persian walnuts bear crops annually, though weather conditions have a considerable effect on yields. Individual trees are known to continue bearing for more than 100 years.

*Juglans regia* is unique among walnuts in that its nuts fall free from the husks at ripening time. This feature, combined with easily cracked shells, places Persian walnuts among the more desirable of nuts. The kernels can usually be extracted in large or

whole pieces from the relatively thin-shelled nuts by hand. The kernels are high in protein (20 percent) and fat (60 percent) and account for 40–60 percent of the total nut weight.

On the west coast of this country, Persian walnut trees are valued for their appearance and are grown in yards, parks, and along streets. In the cold areas of eastern Europe and northern China, they have long been valued for their nuts and timber also. Now, however, selections hardy in the northeastern United States offer nuts and timber of a quality similar to that of the European and Chinese types.

### *Growing Persian Walnuts*

Many Persian walnut growers in the North are cultivating the seedlings of superior trees in the hope of finding improved types. Plants grow readily from seeds sown in the fall, or after a relatively short (6–8 weeks) artificial cold-moist treatment. They will also germinate satisfactorily after dry storage if they are first soaked for several days in clean water that is changed daily. Spring planting is best, about 4 cm deep with a light mulch. Cans or wire mesh placed over the seeds will protect them from rodents, crows, and pheasants.

Planting sites for Persian walnuts must be chosen carefully. Adequate soil drainage is important, as moist soil delays the onset of winter dormancy, causing freeze damage (splitting) to the trunk. The soil must allow deep roots to penetrate 1.5 m, have an approximately neutral pH (pH 7) and be fertile enough to grow a good cover crop. Adding dolomitic lime or fertilizer, or planting a legume in the preceding year is recommended to improve the soil.

A single Persian walnut tree will eventually occupy a space 15 m in diameter but can be planted at half that spacing to hasten orchard production. Seedlings may be grown to bearing age for evaluation on only 3-meter spacings. Seedlings of good parentage are likely to yield one tree in ten “exceptional enough to be made permanent” (Society of Ontario Nut Growers). The hole to which the seedling is transplanted must be larger than the spread of the root system. A kilogram of bonemeal mixed into the planting soil (preferably one year in advance) is a requirement for healthy growth. Any injured roots must be trimmed off before planting, and the remaining roots carefully spread when the soil is sifted over them. It is best to place the root collar at, or slightly below, ground level. When the seedling is in place, the soil must be tamped down and watered thoroughly. A trunk guard, or a piece of woven wire coated with white latex paint, will protect against sunscald and rodents. The young tree will not be able to compete with weeds and will respond favorably to mulch as it grows.

Persian walnuts must not be fertilized in the first year, and only in the early spring thereafter. These trees use large amounts of nitrogen and phosphorus: one recommendation is 0.2 kg of 20–10–10 granular fertilizer per 3 cm of trunk diameter until the trunk diameter reaches 15 cm. After that the application rate is doubled, up to a maximum of 11–13 kg per tree with a 5–10–15 formulation. This tends to reduce vegetative growth and increase nut production.

Pruning requirements are minimal. Many Persian walnuts independently exhibit the ideal conical or dome shape, requiring only the removal of branches that are dead, rub-

bing, or malformed. A high, clear trunk can be maintained for lumber production.

Persian walnuts grown in the Northeast are potentially susceptible to several pests and diseases (Payne and Johnson 1979), including the husk fly, the codling moth, the butternut curculio (insect larva), an anthracnose fungus, a bacterial blight, and a bunch disease (which causes numerous shoots to emerge in close proximity). Choosing disease-resistant plants, removing leaves from beneath the trees after leaf fall, and timing sprays carefully will provide successful control. Trees exhibiting a bunching pattern in the branches should be removed entirely, as should trees that sucker excessively from the lower trunk. The latter is an indication of either bunch disease, walnut blight, a genetic lack of hardiness, or wet soil.

During the ripening period, squirrels poach nuts before they have fallen, but a smooth trunk collar (0.5 m high) will keep them out of the treetops as long as no access is provided by an adjoining tree or building. Even so, the nuts must be harvested frequently if squirrel populations are dense in the immediate area.

Treatment after the harvest involves drying the walnuts in an airy location for about five days. During this period the kernel loses its milky texture, becoming crisp and sweet. Like most foods, walnuts sold commercially do not compare in taste to those grown at home. Storing walnuts is best accomplished either in-shell, using rodent-proof aerated containers in an unheated room, or by freezing the kernels alone. Nuts with well-sealed shells usually retain their kernel quality until the next harvest season. Frozen kernels will store for years with very little change in quality.

Persian walnuts have much to recommend them. They are attractive landscape trees, having pale bark and a dense, round crown. Several cultivars are hardy at average minimum temperatures as low as  $-30^{\circ}\text{F}$  if soil and air drainage are adequate.

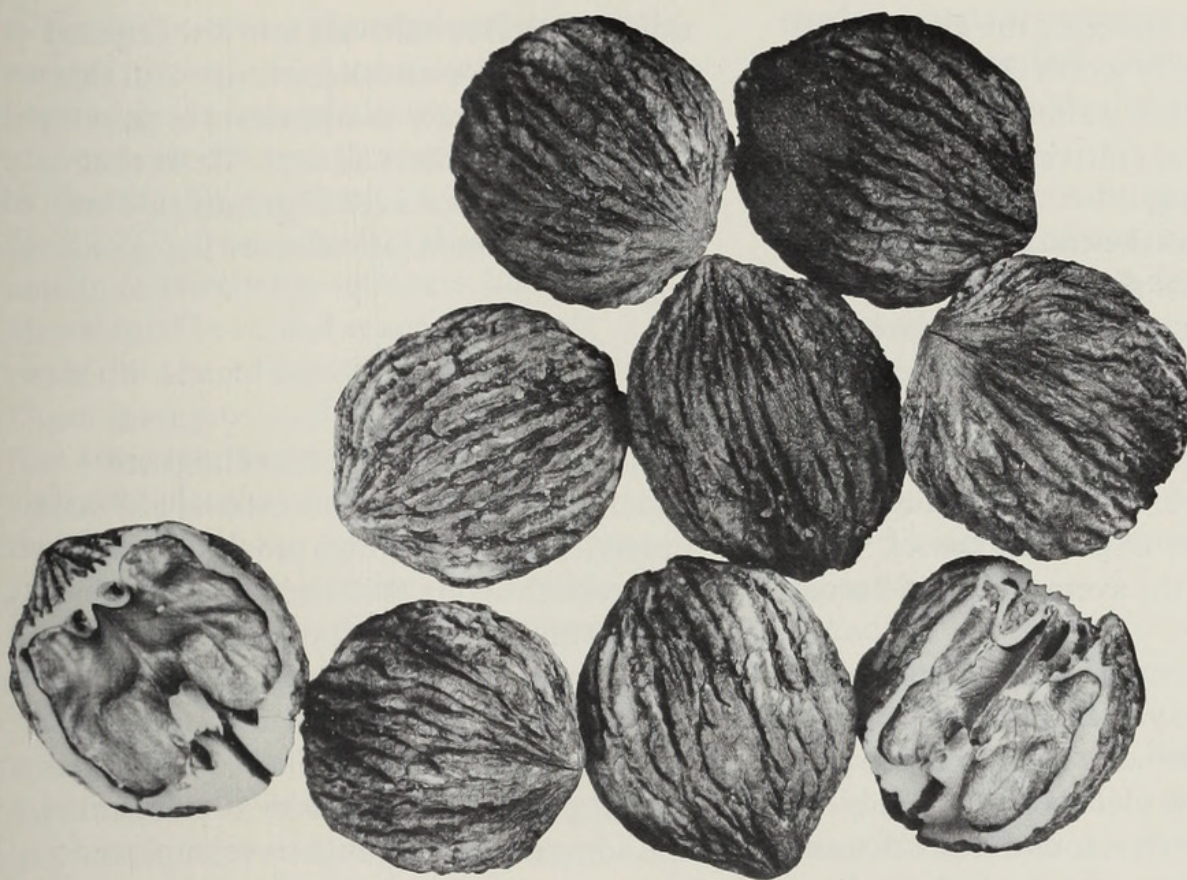
### Black Walnut

The black walnut is a native American tree that grows wild throughout eastern North America except most of New York and New England. It is among the most valued cabinet-wood and veneer trees on this continent. A commercial cracking industry in the Midwest is supported by wild collected nuts. The nuts are valued for their flavorful kernels and their shells, which are used in the manufacture of a multitude of useful products.

Soil conditions are a major influence on the growth of black walnuts. These trees do best on soils that have a neutral pH, are fertile, and have adequate water. They grow slowly on wet lands, shallow topsoils, and those that are acidic and infertile. Sapling black walnuts are intolerant of shade and are generally suited to sites where white ash (*Flaxinus americana*) grows well (Fowells 1965).

While truly wild black walnuts are uncommon east of the lower Hudson River Valley, they have often been planted as yard trees and sometimes have become naturalized.

The black walnut tree is large and straight-trunked, with an open spreading crown. The pale green pinnately compound leaves cast a dappled shade. An identifying characteristic during the dormant season is the stout, upright branchlets. These resem-



Black walnuts (*Juglans nigra*)

ble the branches of white ash, but the walnut branch arrangement is alternate instead of opposite. Black walnuts normally have deep tap roots, which when established permit them to coexist with groundcovers and allow them to tolerate some degree of drought. These trees are also tolerant of fire and smog (Duke). Their growth rate is highly dependent on site and soil conditions and genetics; 1 m per year in height is possible.

The ornamental value of the black walnut tree lies in its stately form and the dappled shade it affords. The leaves fall relatively early without spectacular coloration. The decaying husks leave an amber stain on hands, clothing, and concrete. Black walnut trees with an unbranched trunk at least 3 m high will produce both timber and nut crops.

Nuts can be harvested until the lower section reaches prime veneer log size (55 cm). Trunk diameters of orchard-grown trees can be twice that of similarly aged trees grown in timber plantations, presumably because the superior care and the wider spacing of the trees in orchards are more favorable for girth increase. Careful pruning is required in the early years to produce a straight log free of large knots.

The black walnut, the preferred commercial walnut, has a distinctive flavor, which is not diminished by cooking. The kernels contain approximately 20 percent protein, 15 percent carbohydrate, and 60 percent fat, as well as small amounts of mineral nutrients and vitamins A and B.

Unfortunately, obtaining this nutritious nut meat can be a frustrating experience. In fact, removing the nut from its messy, stain-

ing husk and then extracting the kernel from its hard shell is hardly worth the effort with most unselected black walnuts. This is not the case with several cultivars selected for their ease of cracking.

Cracking qualities depend on shell thickness and the internal shell structure. The kernel cavities of most unselected black walnuts have many partitions and deep invaginations, whereas those of named cultivars usually have fewer, and kernels can be extracted in large pieces. Also, the nuts of cultivars are usually 25 percent kernel, 5 percent more than the average for unselected seedlings.

Grafted cultivars may begin bearing nuts within two or three years, though substantial production must wait until trees are past 10 years of age. Crop yield is more closely correlated with crown size and trunk diameter than age. A vigorous tree is the best insurance of a plentiful nut crop. The biggest challenge in managing walnut trees for nut production is to maintain regular annual yields. Even the annual variation in yield is irregular. Providing adequate sunlight, nutrition, and water and controlling pests minimizes yield variations but does not necessarily eliminate them.

Black walnut cultivars have been selected primarily for ease of cracking and productivity. Very little information is available on their performance in New England, however. Although over 500 cultivar selections have been identified by the Northern Nut Growers' Association, most have not been widely propagated or tested. The performance reports that do exist vary considerably, depending on climatic, cultural, and site factors. Observations in New York, Michigan, and Ontario offer the best indica-

tion of desirable cultivars for New England. The most important characteristic for this region is a capacity to ripen nuts in growing seasons of less than 180 days. Those that have generally received high ratings when grown in northern latitudes are listed on page 16.

### *Growing Black Walnuts*

Black walnut seeds and seedlings are widely available from commercial and state nurseries. In fact, enough are sold each year to establish about 2880 hectares of plantations (Funk 1979). Seedling trees rarely equal cultivars in nut quality or productivity. A homeowner desirous of a single tree is better off purchasing a grafted cultivar. For larger plantings, seedlings are more cost-effective, and some may turn out to have improved characteristics for the Northeast. Seeds or seedlings should be obtained from parent trees with desirable traits: climatic adaptation, superior productivity and nut quality, and perhaps timber form. A large, well-filled nut produces a larger seedling. Cold stratification for 120 days results in the most prompt germination. Fall planting usually satisfies this cold requirement. Seeds sown in fall tend to germinate more quickly and in greater numbers than those sown in spring. The hulls need not be removed before planting the nuts. About 50 percent of unhulled seed will germinate. A higher germination rate can be achieved by hulling the nuts, placing them in a container of water, and discarding those that float. A well-filled nut will sink if the float test is given before appreciable drying has occurred (within 3 days of hulling).

Black walnuts are planted in the same way

as Persian walnuts. The results of a study of various methods used to protect the nuts from squirrels favored placing fresh cow manure over sown seeds as an "effective, biodegradable repellent" (Williams and Funk 1978). Due to the fact that they germinate in relatively low numbers, black walnuts should be seeded at approximately twice the desired density. Planting nuts 10 cm apart produces tall, straight seedlings that are easy to graft or transplant. It is advisable to plant several seeds wherever a tree is desired. Later (anytime within three growing seasons), all of the surviving seedlings must be removed except the one showing the best vigor and form.

In general, direct seeding is better than transplanting. Black walnuts develop a deep taproot quickly, which is often damaged in transplanting and is a setback for the entire tree. After three to four years, trees in a plantation tend to be about the same size regardless of whether they were grown from seed or transplanted (Funk 1979).

A wide hole with room for the roots to spread is best. Many labor-saving planting methods have been devised for transplanting large amounts of black walnuts, but the primary consideration is to ensure that the roots are spiraling. The survival and growth of transplanted seedlings is directly related to their size. Only year-old seedlings with a stem diameter greater than 5 mm should be planted.

It is important to provide favorable conditions for young black walnut trees. Trees that are vigorous when young are usually vigorous when older also. The most critical factors affecting growth rate are soil moisture, weed competition, wind exposure, and,

to a lesser extent, nitrogen supply. Weeds should be controlled with mulch for at least two years (preferably three or four) after planting.

Favorable soil conditions are crucial for healthy growth and nut production. The soil must be well drained. It should allow roots to penetrate at least 1.5 m. A near neutral pH should be maintained with dolomite applications. Trees bearing nuts have high nitrogen and phosphorus requirements. About 0.5 kg of 10-10-10 fertilizer per centimeter of trunk diameter is recommended for adequate nutrition.

Another way of improving the soil's fertility is to interplant black walnuts with nitrogen-fixing plants. Russian olive (*Elaeagnus umbellata*), black locust (*Robinia pseudoacacia*), European alder (*Alnus glutinosa*), and hairy vetch (*Vicia villosa*) have all proved to enhance black walnut's growth rate, especially on less than ideal sites (Funk 1979 and Ponder 1981). These fast-growing nitrogen-fixing species shelter the young walnuts from wind and reduce weed competition somewhat. Additionally, the walnut growth is forced upward, which reduces pruning requirements.

The general pruning recommendation for black walnuts is to maintain a single dominant leader and evenly spaced lateral branches. The bottom section of trunk can be developed as a valuable veneer log by pruning the branches when they reach 3 cm in diameter. Pruning can be done up to half of the tree's total height without adversely affecting the growth rate. This method keeps the knots small and confined to the central core of the veneer log. Bey (1979) provides further information on pruning for timber production. Planting black walnuts in frost

pockets increases the need for pruning, because the terminal buds are more likely to suffer freeze damage, resulting in many competing lateral shoots.

To my knowledge black walnuts growing in eastern Massachusetts have not been seriously afflicted with diseases or insects. Husk-fly maggots frequently infest the husk in early fall, turning it into a mass of black slime, but a study has shown no correlation between husk maggots and nutmeat quality (Gibson and Kearby 1976). However, some pests can affect nut production (Payne and Johnson 1979). Walnut curculios can damage tender growth and cause some nut loss. Removing infected nuts that drop prematurely is the best control. Anthracnose fungus infections of foliage and fruit cause nuts to fill poorly. Wet weather conditions mean more severe infections. Anthracnose-resistant cultivars will retain healthy foliage longer and produce better crops. Fungicide sprays during spring provide successful control. Apparently, black walnuts can be infected with walnut bunch disease without showing the normal brooming symptoms. Instead, it appears as empty or dark and shriveled nuts. There are no reliable controls for this disease. Infected trees should be destroyed.

The entire husk and enclosed nut fall during or shortly after leaf fall. The nuts that fall early are less likely to be well filled. Freshly fallen nuts are the best ones to collect. At this stage the hulls separate easily and the kernels have not had time to become stained and lose flavor. Rubber gloves (not vinyl) will protect hands from the corrosive, staining juices. The hull of a freshly harvested, well-filled black walnut will shuck off with one tap of a rubber mallet. The hulled nuts can then be washed, and dried either on newspaper or in a wire basket for

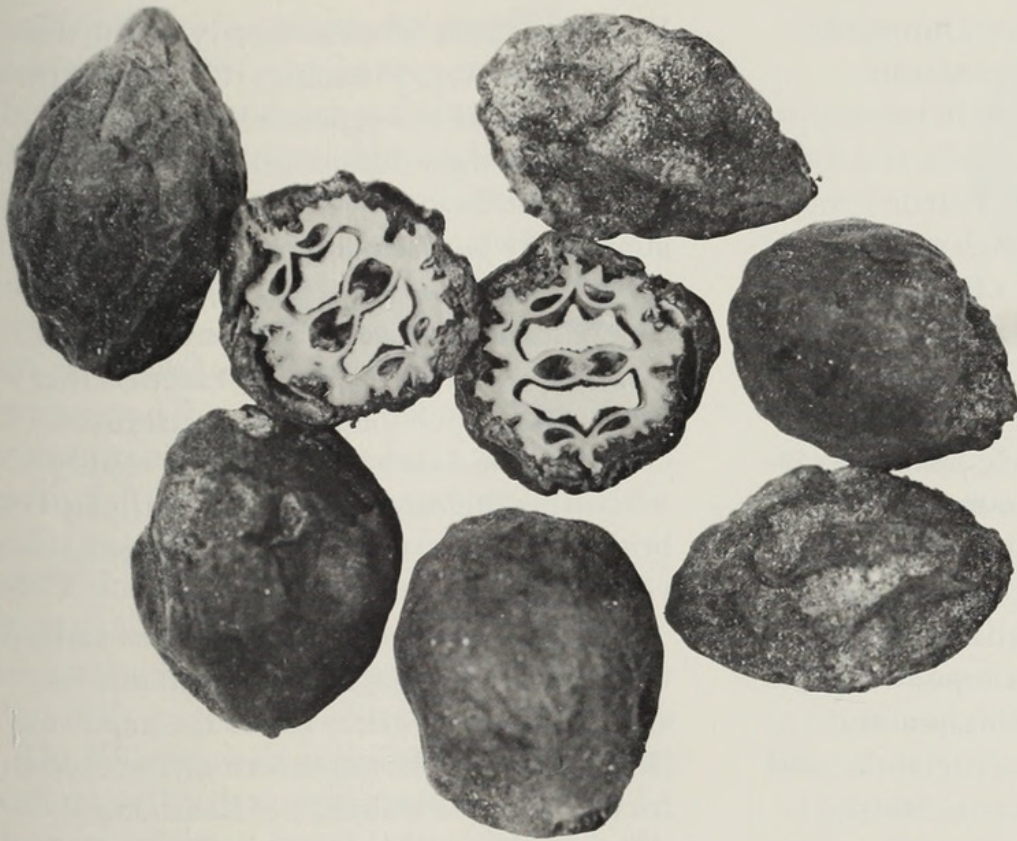
about one week. The dry nuts are best if stored in a cool, airy location, and rodent-proof containers are advisable.

Cracking by hand is usually done with a hammer or screw vise. Pouring hot water over the nuts and allowing them to steep 24 hours helps to soften the shells, which prevents them from shattering when cracked. The wire cutters used by electricians can be employed to extract the kernels. Kernels frozen in plastic bags keep well.

### **The Butternut**

The butternut, another native American tree, has a more northerly geographic distribution than its cousin the black walnut. The butternut range occupies much of New England and the St. Lawrence River Valley of Quebec, west to southern Minnesota, and south to Missouri and southern Appalachia. But rarely is it more than an occasional component of forest stands. Butternut occurs primarily on stream banks or valley slopes where the soil is moist but well drained. However, it is known to grow better than black walnut on dry, rocky soils, especially those of limestone origin (Fowells 1965).

The butternut tree is short, averaging 13 m high. Thick branches generally begin low on the trunk and rise into a broad, open crown. Butternut bark is light brown or gray and becomes deeply ridged with old age. The compound leaves resemble those of black walnut but are quite hairy and sticky in comparison. The same rust-colored, sticky pubescence also covers leaf petioles and young branchlets in their first year's growth and is especially noticeable on the nut husks. Another identifying characteristic is the leaf scar. In black walnut it is notched



Butternuts (*Juglans cinerea*)

without a downy fringe, whereas in butternut the leaf scar is not notched but does have a downy fringe.

Butternuts are among the most hardy *Juglans* species, surviving  $-40^{\circ}\text{F}$  within their natural geographic range. In spring bright green staminate catkins droop from the basal portion of the previous season's growth. The 5–8 pistillate flowers are borne on spikes at the end of new growth. The single or clustered 5–7 cm egg-shaped nuts ripen in early fall. A thin adhering husk encloses the deeply ridged, thick shell. The kernels, which are sweet and oily, are generally regarded as the best among walnuts for flavor but are normally impossible to extract in large pieces. A few cultivars exist, selected primarily for their ease of kernel ex-

traction and nut size. Cold storage is advisable, but nuts in shell reportedly keep a year or more under cool, ventilated conditions (personal communication from Stephen Breyer, July 15, 1982).

Nut production begins within six or seven years from seed (McDaniel 1979), but butternuts never seem to yield as well as black walnuts. Six bushels of nuts in hull is an exceptionally high yield from a mature tree, and large annual variations in yield are to be expected. Butternuts may produce nuts for more than 70 years.

Native Americans extracted oil from crushed butternuts by boiling them in water. In New England the flavorful kernels are still combined with maple sugar in candy. Like that of the sugar maple tree, the sap of butternut also makes a good syrup, but more boiling is required to thicken it. The husks

and inner bark yield a true dye. During the Civil War, the backwoods Confederate troops were sometimes dressed in homespun 'uniforms' of butternut-dyed cloth, and they became known as butternuts (Peattie 1966).

Butternut wood accepts a high polish and is easily worked. It was once a favorite for carriage interiors, because of its combination of beauty and lightness, and is still valued. In Wisconsin, one of the major states supplying butternut lumber, it is second only to black walnut for its economic value. The wood is also rot resistant.

Relative to other nut trees, butternuts are quite short-lived, beginning to decline in 75 years. This inherent trait is compounded by susceptibility to two fungal diseases: the butternut dieback (*Melanconis juglandis*) and the butternut canker (*Sirococcus clavigignenti juglandacearum*). These factors, along with pollution and elimination of habitat, threaten the butternut throughout much of its range.

In the colder regions of northeastern North America, growing butternuts may be the only way to harvest high-quality nuts. Cultivars are available with nuts that can be cracked easily and flavorful kernels that can be removed in large pieces. These trees are fast growing with broad canopies offering dappled shade.

### The Asian Walnuts

Three walnut species are native to east Asia: the Japanese walnut (*J. ailanthifolia* Carr), the Manchurian walnut (*J. mandshurica* Maxim.), and the Chinese walnut (*J. cathayensis* Dode). These are closely related to the American butternut and are often included in the same subsection of *Juglans*.

However, the modern authority on the walnut family, W. E. Manning (1978) places the Asian walnuts in a separate subsection on the basis of their differences in embryo development. In the field Asian walnuts can supposedly be distinguished from the butternut by their notched leaf scars, but the difference is not readily discernible. Asian walnuts bear nuts in hanging racemes that are usually much longer than butternut clusters. The Asian walnuts cross readily with other *Juglans* species, and fertile hybrids may result, especially in crosses involving the butternut.

Confusion exists about the correct scientific name for the Japanese walnut and its smooth-shelled variety called the heartnut (Rehder 1945). The name formerly accepted for the Japanese walnut, *J. sieboldiana* (Maxim.), can no longer be used because it has already been given to a fossil plant. The current consensus, with which Manning concurs, is to name the Japanese walnut *J. ailanthifolia* Carr and the heartnut *J. ailanthifolia* var. *cordiformis* (Maxim.) Rehd.

The Japanese walnut is a common forest tree of mountain regions in Japan (Sargent 1894), whereas the heartnut is a cultivated variety (Ohwi 1965). The two are identical in habit and foliage, differing only in nut characteristics. The Japanese walnut is rough and pitted like a butternut. The heartnut is smooth, heart-shaped, and valued for its ease of cracking and kernel extraction. Seedlings of both Japanese walnut and heartnut may produce either type of nut.

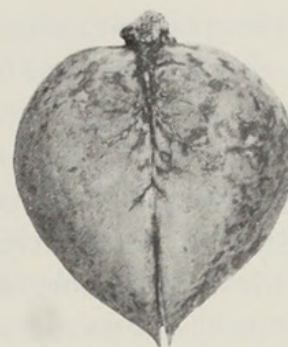
The Manchurian walnut is native to northern China, Korea, and the Amur River region of Siberia. It may grow to 20 m tall, either in mixed forests (in valleys and floodplains) or isolated on the gravelly soils

beside mountain streams. Its growth habit and racemes of 6–17 nuts are similar to those of the other Asian walnuts. The nuts vary in shell structure, are round to elongate, 2.7–5.5 cm in length, and (like butternuts) have a sharply ridged to relatively smooth shell. The Manchurian walnut is extremely hardy, on a par with the butternut. It is cultivated in cold areas of the USSR, Europe, and the Canadian plains. No nut-producing selections have been made in this country. The Lithuanian magazine *Musu Sodai* in 1976 reported a selection hardy to  $-40^{\circ}\text{F}$  that blooms first on old wood and again in 2–3 weeks on new growth (personal communication from Victor Vircau on July 19, 1982).

The Chinese walnut is a close relative and perhaps only a geographic race of the Manchurian walnut. It grows in the highlands of central China and is considered less hardy. Mature plants at the Arnold Arboretum survive temperatures as low as  $-10^{\circ}\text{F}$  without noticeable damage.

Because of its ease in cracking, the heartnut (*J. ailanthifolia* var. *cordiformis*) has received the most attention among the Asian walnuts. In its native Japan it is cultivated in orchards and marketed. Heartnut trees grow rapidly (to 6 m in eight years) and bear nuts at five years of age. They reportedly adapt to a wide range of soils, from sand to clay, and some will grow in zone 4 (avg. min. temp.  $-30^{\circ}\text{F}$ ) (Metcalf 1980). However, heartnuts seem to be adapted to a maritime climate similar to Japan's, because they suffer damage from early fall freezes and late spring frosts.

With the exception of certain cultivars, heartnuts are said to bear nuts freely but rarely heavily. Gellatly (1966) reported a



Heartnut (*Juglans ailanthifolia* var. *cordiformis*)

90 kg harvest from the cultivar called 'OK'. Five to 15 nuts occur in pendant racemes. A recently ripened soft husk may be twisted off by hand, leaving only a few fibers attached to the shell. Even if the nuts are not husked immediately, the kernels are less apt to be stained than are those of black walnuts.

Heartnuts usually have well-sealed shells and good keeping qualities. They can generally be split into two heart-shaped halves either by tapping the shells while holding the nuts on edge or by using a channel-lock tool. A certain degree of drying can enhance the cracking process. The kernels have a mild flavor similar to that of the butternut but not quite as highly regarded. The kernels are about 50 percent oil and 25–35 percent of the total nut weight.

The heartnut and butternut apparently cross-pollinate readily, resulting in a fertile and remarkably vigorous hybrid known as the buartnut (*J. cinerea*  $\times$  *J. ailanthifolia* var. *cordiformis*). Several selections combine the hardiness and flavor of butternuts with the ease of cracking and potentially greater yields of heartnuts. Two different cultivars are needed for pollination and subsequent nut production.

In the Asian walnuts and their hybrids, we have nut-producing, ornamental shade trees

for the North. Several features give them an overall exotic appearance: long hanging catkins; large, compound, seemingly tropical foliage; and pendant strings of nuts. The stout branches and broad top provide a dappled shade. Asian walnuts thrive on a variety of soils. Most are hardy throughout zone 5 and some in zone 4. The primary disease threat to these walnuts is the bunch disease.

### **Walnut Cultivars**

A considerable number of commercial nurseries supply walnut cultivars. Many of them are quite small, however, and managed on a part-time basis. As their stock may be small or sold out, it is best to place orders one-half year or more before spring planting. Nurseries usually sell scionwood for do-it-yourself propagation, and some offer custom propagation services.

Walnuts are considered difficult to propagate vegetatively. The most common means is by grafting. Among the most successful methods are: a modified side-graft, 75–80 percent (Funk 79); a root cleft-graft, 75 percent (Groenwald 1981); and greenwood budding, 90 percent (Davie and Davie 1977). I have used the sprouted-seed grafting method described for chestnuts (Jaynes 1980) with fair results. A warm post-graft environment will enhance the success of all grafting methods. Heartnuts and Persian walnuts can be layered (Gellatly 1966 and personal communication from Stephen Breyer, July 5, 1982), and both rooted cuttings (Shreve 1975) and root cuttings of black walnut have proved successful (Jaciw and Larsson 1980). Purchasing walnut cultivars is the best route for most people.

### *Persian Walnut*

The following descriptions are drawn primarily from those of Ashworth (1969), Brooks and Olmo (1972), and Grimo (1979). With the exception of 'Hansen', which is highly acclaimed, little agreement exists as to how they should be ranked.

'Broadview' originated in British Columbia from seed brought there by a Russian immigrant from the Black Sea region. Opinions differ about its kernel flavor. The nuts, which are medium to large, ripen in September at about the same time as McIntosh apples. In cracking quality they approximately equal those of 'Franquette', the standard commercial walnut cultivar in California. The nuts are 46 percent kernel and keep well in storage. 'Broadview' is considered one of the most productive cultivars. The original tree withstood temperatures as low as  $-30^{\circ}\text{F}$ , but subsequent reports indicate marginal hardiness in zone 5.

'Hansen' is probably the most favored, cold-hardy Persian walnut cultivar. It was introduced in 1952 from northwestern Ohio. The original tree may be over 100 years old and presumably is of German origin. 'Hansen' has the ability to fruit on lateral as well as terminal shoots, resulting in early (2 years after grafting) and numerous nuts. The trees remain small and are resistant to disease and husk maggots. The nuts mature early and are relatively small but at 60 percent have one of the highest percentages of kernel. The round shells are thin and smooth. The kernel flavor is mild and sweet. 'Hansen' is another self-fertile cultivar.

'Holton' is a promising cross between 'Hansen' and 'Broadview'. Preliminary observations indicate that it combines the best qualities of both parents. Like 'Hansen' it is

a hardy and a precocious bearer of nicely shaped and flavored nuts, which resist damage from husk maggots. The 'Broadview' parentage is evident in the vigor of the tree and its relatively large nuts.

'McKinster' is a Crath seedling originating from the Columbus, Ohio, area. The nuts are large (48 percent kernel) and have a good flavor. This fairly productive cultivar, which self-pollinates, is well adapted to Ohio and favored in the lower peninsula of Michigan.

'Somers' is a Crath seedling from the same source as 'Greenhaven'. 'Somers' consistently bears attractive high-quality nuts. The kernel usually constitutes more than 55 percent of the nut, and its oil content is more than 64 percent. The early ripening of 'Somers' (early to mid-September) often precedes husk-maggot damage.

### *Black Walnut*

Over 500 black walnut cultivars have been selected and named. The following are among those that have received high ratings when grown in northern locations. The descriptions are compiled from reports by Brooks and Olmo (1972), Funk (1979), MacDaniels (1974 and 1941), and Zanger (1969).

'Sparrow', from Illinois, has a very thin hull, which is easy to remove. It cracks well and has a high kernel content (29 percent) and very good flavor. Its anthracnose-resistant foliage is retained late into the fall. The nuts ripen fairly early and vary in size according to site conditions.

'Emma K', from Illinois, has a thin shell, a high kernel content, and excellent flavor. It bears nuts regularly in southern Ontario but may not fill all of them. It appears to be resistant to both anthracnose and aphids.

Other cultivars that have received high rating for northern areas are 'Burns', 'Snyder', and 'Thomas'. Less-tested black walnuts with potential value for New England include: 'Beck', 'Sparks #127', 'Sparks #147', and 'Davidson'. The latter three have been selected in Iowa for their ability to flower on lateral as well as terminal shoots. (This characteristic leads to earlier and heavier yields.)

### *Butternut*

Butternuts tend to be difficult to propagate and are not in high demand, so nurseries may not have stock on hand. A few of the better-known and available cultivars are: 'Ayers', 'Booth', 'Chamberlin', 'Craxezzy', 'Creighton', 'Joy', 'Kinnyglen', 'Kenworthy', 'Love', 'Van Sickle', and 'Weschcke'. All of these are reported to be cold hardy in the North.

### *Heartnut*

Most heartnut cultivars were selected primarily before attention was diverted to the introduction of Carpathian walnuts. The following cultivars are most likely to be available. The descriptions follow Campbell (1981), Gellatly (1966), and McDaniel (1979). 'Brock' is a relatively recent and promising cultivar from Pennsylvania. 'Etter', also from Pennsylvania, has excellent cracking qualities and is 33 percent kernel. It may be resistant to bunch disease. 'Etter' seedlings are often equal to or superior to their parent. 'Fodermaier' nuts are 37 percent kernel but rarely crack in whole pieces. Even so, it is a highly regarded heartnut. 'Fodermaier' seedlings generally produce good quality nuts.

'Marvel' and 'Rival' are both progeny of 'Fodermaier'. Other heartnuts of value include 'Canoka', 'OK', 'Rhodes', 'Schubert', and 'Wright'.

### Buartnut

I was not able to discover any nurseries that offer grafted buartnut trees. The following cultivars may be available as scions or by custom propagation: 'Corsan', 'Dunoka', 'Fioka', 'Hancock', 'Leslie', 'Mitchell', and 'Wallich'.

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