

# Butternut: An Underused Resource in North America

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**ADDITIONAL INDEX WORDS.** *Juglans cinerea*, white walnut, Juglandaceae

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**SUMMARY.** Butternut (*Juglans cinerea* L.) has many fine qualities as a nut species, however, it has never been commercially important. Although the nut is very edible, only a few cultivars have been selected that have desirable nut size and cracking qualities. In the last 20 years there has been a dramatic decline in the number of butternut in native stands caused to a large extent by the lack of natural reproduction and a damaging canker disease. Evidence suggests that superior, disease resistant trees can be propagated and if isolated from areas where the disease is prevalent, may remain disease-free. It is important that the remaining genetic diversity within the species is maintained. Various butternut conservation practices and research projects to restore butternut populations are underway in the United States and Canada.

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Butternut, also known as white walnut, lemonnut, or oilnut, is a small- to medium-size tree, frequently 40 to 60 ft (12 to 18 m) tall and 12 to 24 inches (30 to 61 cm) in diameter that seldom exceeds 75 years of age. Butternut is a shade intolerant species that may withstand competition from the sides, but will not survive shade from above. Butternut must be in the overstory to thrive (Rink, 1990).

The genus *Juglans* (Juglandaceae) consists of about 20 species referred to as walnuts and is divided into four taxonomic sections (Manning, 1978). Section *Cardiocaryon* consists of the species native to Asia; *Dioscaryon* contains one species *J. regia* L. (Persian or English walnut), the most widely commercially cultivated species (McGranahan and Leslie, 1990); *Rhysocaryon* is the section containing black walnut (*J. nigra* L.); and the section *Trachycaryon* in which butternut is the only member. Butternut hybridizes with *J. regia* and species in the section *Cardiocaryon*, but not with eastern black walnut. It has been suggested that butternut be included in section *Cardiocaryon* (Fjellstrom and Parfitt, 1994).

Butternut is seldom found growing in pure stands, but rather in association with several other tree species such as black cherry (*Prunus serotina* Ehrh.), American basswood (*Tilia americana* L.), white and northern red oak (*Quercus alba* L. and *Q. rubra* L.), black walnut (*J. nigra* L.), white ash (*Fraxinus americana* L.), red and sugar maple (*Acer rubrum* L. and *A. saccharum* Marsh.), and American elm (*Ulmus americana* L.).

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It can however be locally abundant. Its relatively short life span, lack of suitable conditions for regeneration, predation of seed by mammals, timber harvesting, and a lethal canker disease have dramatically reduced the number of butternuts throughout its range in North America. Its widely scattered growth habit within stands, relatively soft wood, medium-sized kernel, and hard shell has prevented butternut from becoming a commercially important timber or nut species.

Butternut canker, caused by the fungus *Sirococcus clavigignenti-juglandacearum* N.B. Nair, Kostichka and Kuntz (Nair et al., 1979) was first observed in 1967, and is now killing butternut throughout its native range in North America. The disease has killed up to 80 % of the trees in some states and is threatening its survival as a viable species (Ostry, 1997a, 1998a, 1998b).

### Native range

Butternut commonly grows on rich loamy soils along streambanks in mixed hardwood forests as well as on well-drained, rocky soils of limestone origin. The native range of butternut is similar to black walnut, but it extends farther north and not as far south. It ranges from eastern Canada west to Minnesota and as far south as Arkansas, Alabama, Georgia, and Mississippi. Butternut has frequently been planted outside of its native range.

### Use

Butternut is valued for its wood for furniture, paneling, specialty products, and carving, its flavorful nuts, wildlife mast, and for its contribution to forest diversity. Its light tan heartwood is very workable with hand and power tools and it can be stained to resemble black walnut.

The nut is oily, sweet, and highly edible with an exceptionally good flavor; however, the kernels are generally difficult to extract (Bixby, 1919; Woodroof, 1979). Seed production begins on trees around 20 years of age, with good seed crops occurring every 2 to 3 years, based on seedling stands not grafted trees.

Early uses of butternut included the use of bark, roots, and husks for many medicinal purposes (Krochmal and Krochmal, 1982), and the use of the toxic bark thrown in small streams for stunning fish. An orange- or yellow-brown dye made from the husks was used by Native Americans and also by the Confederate Army to dye Civil War uniforms giving rise to the name of butternuts for the troops (Peattie, 1950). Native Americans extracted oil from crushed butternuts by boiling them in water, and the sap of butternut has been used to make syrup (Goodell, 1984).

### Selected cultivars

More than 40 butternut cultivars have been described, but only a few

have survived and are available as scionwood from individual collectors and germ plasm repositories. A few genotypes with good nut qualities (large size and ease of cracking) have been propagated and some of these are available from commercial nurseries (Ashworth, 1969; Millikan and Stefan, 1989; Millikan et al., 1990). Nut quality data for some selected butternut cultivars are reported in Table 1.

There are no known cultivars of butternut in commercial trade with proven resistance to butternut canker since most, if not all were selected for various tree and nut traits in the absence of the disease and no definitive test for resistance has been developed.

### Identification, reproduction, and propagation

*Juglans cinerea* is considered to be one of the most winter-hardy of the *Juglans* species (USDA Hardiness Zone 3 to 7). Butternut can be distinguished from black walnut by stems having chambered, chocolate-brown pith and a large, conspicuous leaf scar surmounted by a raised, downy pad. The butternut fruit is ovoid-oblong, sticky-pubescent, and averages 2 to 4 inches (5 to 10 cm) in length. Fruits occur singly or in clusters of from two to five (Fig. 1). The nut is two-chambered, has a hard outer wall (pericarp), and exhibits eight prominent

Table 1. Selected cultivars of butternut and their nut quality data.<sup>z</sup>

Cultivar	Origin	Nut wt (g)	Kernel wt (g)	Percent kernel
Ayers	Michigan	9.2	2.16	23.48
Ayers	Grown in Iowa	7.0	1.38	19.71
Bear Creek	Washington (grown in Iowa)	11.5	1.86	16.32
Beckwith	Ohio (grown in Iowa)	11.0	1.13	14.09
Booth	New York (grown in Iowa)	9.2	1.62	17.61
Buckley	Iowa	16.0	1.30	16.13
Buckley	Grown in Indiana	27.0	3.90	17.10
Craxey	Michigan (grown in Ohio)	15.6	2.20	16.18
Creighton	Pennsylvania (grown in Iowa)	9.0	1.68	18.67
Doud	Indiana	16.0	2.92	18.38
George Elmer	New York (grown in Iowa)	11.2	2.54	22.68
Herrick	Iowa	20.8	3.20	15.38
Herrington	Grown in Iowa	16.4	2.25	13.66
Kenworthy	Michigan (grown in Ohio)	18.8	3.08	16.38
Painter	Pennsylvania (grown in Iowa)	21.2	3.12	14.72
Rockville	Grown in Indiana	14.4	2.22	15.42
Van Syckle	Grown in Indiana	13.2	2.00	15.15

<sup>z</sup>Bish (1990), McDaniel (1979), Millikan and Stefan (1983), Millikan et al. (1985).

ridges on the shell (four on the husk) (Fig. 2). Butternut bark is light gray, with shallow to moderately deep fissures and broad, flat ridges, developing a diamond-shape pattern in mature trees.

In spring, male flowers (catkins) preformed on the previous year's wood emerge from small, scaly, cone-like buds, and the female flowers occur in two- to eight-flowered spikes borne on the current year's shoots (Dirr, 1990). Male and female flowers mature at different times (Young and Young, 1992) ensuring out crossing in the population. Seeds of butternut, like most *Juglans* species, have a dormant embryo, but dormancy can be broken by fall sowing or by moist (e.g. in sand), prechilling of seeds at 34 to 41 °F (1 to 5 °C) for 3 to 4 months (Brinkman, 1974). Butternut seeds usually germinate in the spring following seedfall and germination is hypogeal (Rink, 1990). Young butternut trees can regenerate from stump sprouts.

Butternut is usually propagated by seed or by grafting onto black walnut rootstock because walnut rootstock is more readily available. Selected cultivars are vegetatively propagated by grafting onto seedling rootstocks. Propagation of butternut through rooting of cuttings has been reported (Pijut and Barker, 1999), but it is a time consuming process with variable success. *In vitro* techniques offer an alternative for the propagation and preservation of existing butternut germ plasm (Pijut, 1993a, 1993b, 1997).

### Nursery production

Nurseries producing butternut seedlings follow similar guidelines and cultural practices routinely used for walnut production (Jones et al., 1998; Ramos, 1998; Schaefer, 1998). Butternuts grow best on well-drained loamy soil, and in a stunted form on shallow rocky sites and limestone flats (Schaefer, 1998). Complete site preparation and weed control is preferable for establishment and rapid growth. The nursery soil is best prepared the year before planting. The soil may be fumigated to control soilborne pests, and the application of fertilizer prior to planting will assure adequate nutrient availability. Butternut fruit (nuts) mature and are harvested from September to October. Nuts can be har-

vested from the trees with a shaker or allowed to fall naturally. The husks are removed (e.g. with a flail huller) and the nuts stratified as mentioned previously, for spring planting. Like walnut, butternut should be planted *in situ* rather than transplanted (Schaefer, 1998). For intercropping and nut production, respectively, plant the trees at 40-ft (12-m) spacing or 10-ft (3-m) spacing in the rows (Schaefer, 1998). A 30 × 30-ft (9-m) orchard design is

recommended for black walnuts (Jones et al., 1998). Mulch trees with sawdust or wood chips. Select cultivars of butternut are grafted onto seedling rootstock. Nursery trees need to enter dormancy before being lifted. Seedlings can be placed in cold storage at 34 to 36 °F (1 to 2 °C) for several months. Care must be taken to keep the roots moist, but not wet, and prevent the stems from drying out during the storage period.



Fig. 1. Butternuts (*Juglans cinerea*) in their husks.



Fig. 2. Comparison of nuts with husks removed (left to right) heartnut (*Juglans ailantifolia* var. *cordiformis*), eastern black walnut (*J. nigra*), and butternut (*J. cinerea*). Butternut hybridizes with heartnut but not with eastern black walnut.

## Damaging agents

Butternut has similar insect pests to black walnut and other associated trees in its native range. The butternut curculio, *Conotrachelus juglandis* LeConte (Corneil and Wilson, 1979), is the most serious, injuring young stems and fruit.

The most serious threat to butternut is butternut canker, caused by what evidence suggests is an introduced fungus, *S. clavigignenti-juglandacearum* (Furnier et al., 1999). Young cankers on branches and stems are elliptical, sunken areas, later developing an inky black center. Multiple, perennial stem cankers often girdle and kill infected trees of all ages. The fungus has been found on branches of black walnut (Ostry et al., 1997) and heartnut, *J. ailantifolia* var. *cordiformis* (Maxim.) Rehd. (Ostry, 1997b). Examination of walnuts exhibiting branch dieback but no cankers revealed hyphal pegs and hyaline, two-celled, fusiform conidia on affected branches (Ostry et al., 1997) identical to those described for *S. clavigignenti-juglandacearum* (Nair et al., 1979). Isolations from symptomatic branches resulted in recovery of the fungus in pure culture. Branch dieback, but no cankers were also observed on heartnut (Ostry, 1997b). Hyphal pegs and conidia were present and the fungus was isolated in pure cultures from symptomatic branches.

It is known that spores of *S. clavigignenti-juglandacearum* are disseminated by rain splash and can travel in aerosols to adjacent trees where infection occurs on young branches in the upper crowns. Several insect species have been found associated with fungus spores on infected trees (Katovich and Ostry, 1998). Additional research is needed to determine if these insects could serve as vectors of the fungus, moving the pathogen over greater distances than rain splash spore dispersal. The fungus has also been found on the fruit of butternut and black walnut, causing lesions on the husks of both species (Innes, 1997).

## Current research

Research at the USDA Forest Service-North Central Research Station is directed at determining the host range of the pathogen causing butternut canker, developing a reliable disease resistance screening technique,

developing *in vitro* and various other clonal propagation techniques, and developing silvicultural strategies to regenerate and restore butternut on selected sites.

Although butternut is the only species significantly damaged by the canker disease, other *Juglans* species have been found to be susceptible in varying degrees to natural infection and to artificial inoculations. In addition, other hardwood species can be infected by *S. clavigignenti-juglandacearum* in greenhouse tests. The fungus was reisolated from wood beyond the margin of wounds from inoculated pecan (*Carya illinoensis* Wangenh. K. Koch), shagbark hickory (*Carya ovata* Mill. K. Koch), black cherry (*Prunus serotina*), northern red oak (*Q. rubra*), white oak (*Q. alba*), and black oak (*Q. velutina* Lam.) (Ostry, 1998b). It is important to determine if inconspicuous or latent infections of tree species other than *Juglans* can be a source of inoculum that could threaten new plantings. The evidence suggesting that other *Juglans* species are susceptible to this fungus means that caution is advised to avoid introducing the pathogen into these plantings, either on planting stock or on seed.

## Conservation activities

Butternut is in no immediate danger of being lost as a species, however, many butternut populations are being killed by butternut canker or lost because of unfavorable stand conditions, advanced tree age, and the lack of reproduction. Genetic diversity is being lost within the species in many parts of its range. Special surveys to determine the health of butternut have been undertaken in the United States and Canada. Results have not been encouraging and butternut has been listed as rare or a species of special concern in many areas. Restrictions on harvest of healthy butternut on some public lands have been enacted, and silvicultural guidelines for managing butternut have been suggested (Ostry et al., 1994).

Several groups in the United States and Canada are using *in situ* and *ex situ* conservation methods to conserve potentially unique butternut genotypes to maintain the species. Education and technology transfer activities have been widely used to alert land managers and owners in the public and private sec-

tors to the problem, and to elicit their assistance in research and conservation efforts to maintain butternut in the landscape.

Healthy butternut growing among diseased trees may have resistance to the canker. Selected trees located throughout much of its range have been clonally propagated by grafting and archived in replicated plantings in Minnesota, Wisconsin, Illinois, Vermont, and New York. These trees are being screened for resistance. Seed is being produced in the older plantings and these trees will be used for breeding if resistance to the disease is sufficient.

## Future outlook and recommendations

Butternut is a highly desirable nut tree that merits consideration as a specialty species. It is very cold hardy relative to black walnut and is therefore especially well suited for northern regions. There are isolated areas where butternut canker has not been found and butternut selections exist in private nurseries and collections free from the disease. Since butternut is the major natural host for the pathogen, isolated plantings of butternut have a reasonable chance of remaining disease-free if the fungus is not introduced on planting material.

It may not be possible to completely restore butternut to all parts of its natural range. The possibility of successfully reintroducing butternut into areas where the disease has eliminated the original population is unknown. However, assuming the fungus is not common on other tree species and that insect vectors are not efficient in long-range spread of the pathogen, then the possibility of restoring trees in woodlots or growing butternut for nut production in orchards should be good. Promising selections of butternut collected throughout its native range should be propagated and conserved for future restoration use and potentially for breeding and nut production.

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