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Purdue University
Forestry and Natural Resources

Identification of Butternuts
and Butternut Hybrids

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Introduction

Butternut (*Juglans cinerea*), also known as white walnut, is a native hardwood related to black walnut (*Juglans nigra*) and other members of the walnut family. Butternut is a medium-sized tree with alternate, pinnately compound leaves that bears large, sharply ridged and corrugated, elongated, cylindrical nuts born inside sticky green hulls that earned it the nickname lemon-nut (Rink, 1990). The nuts are a preferred food of squirrels and other wildlife. Butternuts were collected and eaten by Native Americans (Waugh, 1916; Hamel and Chiltoskey, 1975) and early settlers, who also valued butternut for its workable, medium brown-colored wood (Kellogg, 1919), and as a source of medicine (Johnson, 1884), dyes (Hamel and Chiltoskey, 1975), and sap sugar.

Butternut's native range extends over the entire northeastern quarter of the United States, including many states immediately west of the Mississippi River, and into Canada. Butternut is more cold-tolerant than black walnut, and it grows as far north as the Upper Peninsula of Michigan, New Brunswick, southern Quebec, and Ontario (Fig.1). Butternut is now threatened everywhere by a fungal canker disease *Sirococcus clavigignenti-juglandacearum* (*Sc-j*) (Nair et al., 1979) known as "butternut canker," and in many places it is rare. When present, it grows in widely scattered clusters on rich, loamy soils and on stream terraces; it can also compete on rocky, drier soils, and slopes (Goodrich, 1838; Johnston, 1851; Rink, 1990). Historical records indicate that butternut trees were once much more common than they are today (Johnson, 1884; Larsen, 1942) and that they may be able to occupy more habitats than those on which they are currently found.

Accurate identification of butternuts is an important part of the effort to conserve and manage this fine hardwood tree. Many landowners and resource professionals are now unfamiliar with the native butternut tree due to its increasing rarity in the landscape. Reliable identification has been complicated by the presence of hybrid trees, propagated primarily for nut production, and naturally occurring hybrids and backcrosses between butternuts and introduced Asian walnuts, primarily the Japanese walnut (*Juglans ailantifolia*).

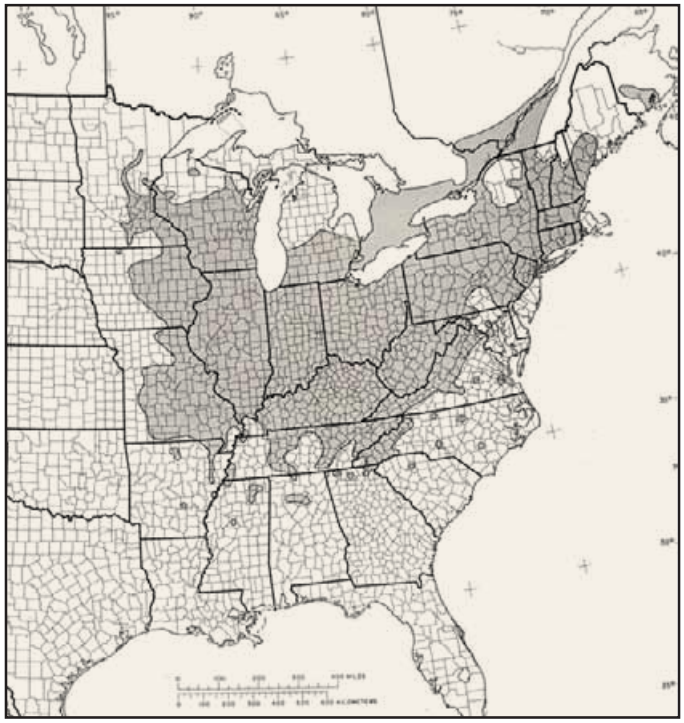

Figure 1. *Native range of butternut (*Juglans cinerea L.*).*

This publication will provide guidance for recognizing butternut trees and possible hybrids to resource professionals, nut growers, and other citizens interested in butternuts. A companion publication, *Conservation and Management of Butternuts,* FNR-421, provides information for the propagation and management of butternut trees, in hopes that landowners and resource managers who encounter butternuts can help in the effort to conserve this tree in the eastern hardwood forest.

Identifying Butternuts and Butternut Hybrids

The butternut is relatively easy to distinguish from black walnut and other native species. All walnut species have chambered pith in the center of the twigs. The pith in a butternut branch is dark chocolate-brown in color (Fig. 2A), and a butternut leaf scar is surmounted by a thick band of hairs that resemble a moustache (Fig. 2B, C). Black walnut twigs have light brown pith, and their leaf scars have no moustaches (Fig. 3). Mature butternut bark is platy and ash-gray with dark gray fissures between the platy ridges. The bark of young trees is smooth and gray or greenish-gray (Fig. 4). Mature black walnut bark is dark brown and heavily ridged or blocky. The bark of young black walnut is brown and ridged or flaky (Fig. 5). Some butternuts have very dark gray bark that closely resembles bark of black walnuts,

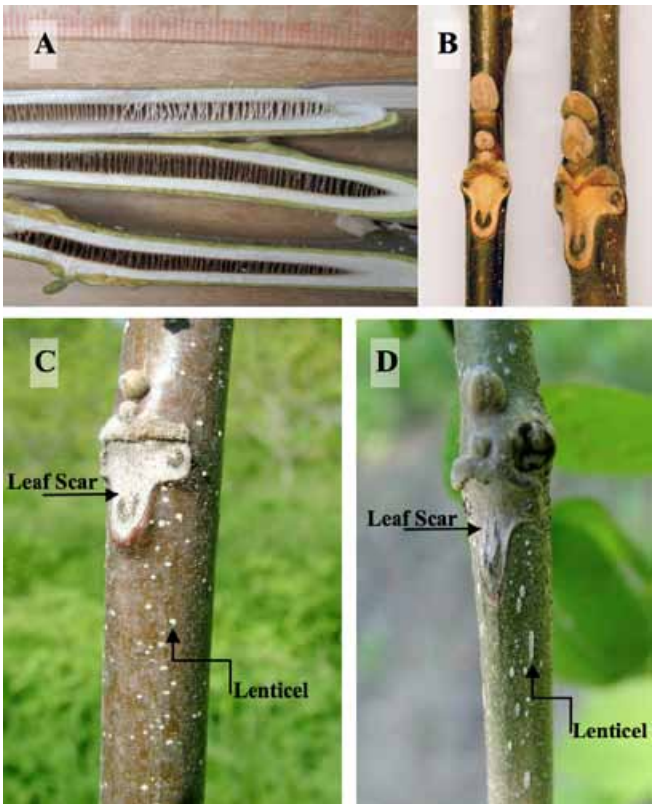

Figure 2. *Branch traits that distinguish butternuts from hybrids. Pith color of Japanese walnut (upper), hybrid tree (middle) and butternut (lower) (A); leaf scar, dormant buds and lenticels of butternut (left) and a hybrid (right) showing hairy moustache above the leaf scar, and the notch in the leaf scar of the hybrid (B), round lenticels and brown twig color on butternut (C), elongated lenticels and green or tan twig color often found in hybrids (D).*

Photos A and B, Keith Woeste, HTIRC, U.S. Forest Service. Photos C and D, Lenny Farlee, HTIRC, Purdue University.

Figure 3. *Black walnut lacks the "moustache" of dense hairs above the leaf scar found on butternuts and hybrids.*

Photo: Sally Weeks, Purdue University

(Ostry and Woeste, 2004) but it usually retains the light gray, platy surfaces on the top of bark ridges (Fig. 6). The fruit of a butternut is generally more elongated than the round-shaped fruit of a black walnut and is covered with sticky hairs (Fig. 7, 8). Pecan trees and other hickories are sometimes misidentified as butternuts. Hickories have leaflets that become progressively larger as they approach the end of the compound leaf (Fig. 9), and the nuts are enclosed in woody husks that split along four obvious sutures or seams. They also lack the moustache-like hairs found above butternut leaf scars.

Identifying a pure butternut tree can be difficult, because butternuts have hybridized with Japanese walnuts, and butternut hybrids have been unknowingly planted for decades. Japanese walnut trees were introduced into the United States in the mid to late 1800s as a potential nut crop for the northern states due to their vigor and cold hardiness (Crane and Reed, 1937). Some varieties of Japanese walnut have smooth and flattened, heart-shaped nuts, the basis for their common name of "heartnut." Other Japanese walnuts have shells similar in texture to English or Persian walnuts (*J. regia*) (Fig. 14). Butternuts can naturally hybridize with Japanese walnuts to produce vigorous F1 (first generation) hybrids, known in horticulture as *J.* ×*bixbyi*, but commonly called "buarts" (pronounced "bew-arts") by nut growers (Bixby, 1919; McKay, 1945). F1 buart hybrids have also been called butter-japs, or buartnuts (USDA, ARS National Genetic Resources Program).

Many F1 interspecific (the first cross of two species) hybrids of walnut species have been described around the world. All of them have hybrid vigor, which means the

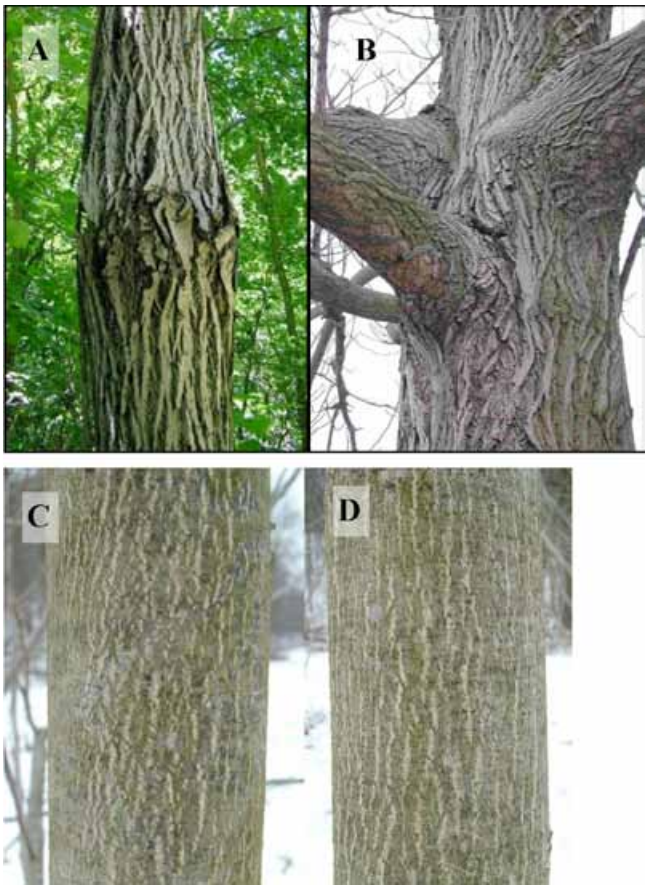

Figure 4. *Flat gray plates and darker fissures typical of mature butternut bark (A), and light bark plates and tan or even pinkish fissures typical of mature butternut hybrids (B). The bark of a young, vigorously growing butternut (C) and a hybrid butternut (D) is similar in appearance. Photos A, C, D, Lenny Farlee, HTIRC, Purdue University.*

Photo B, Keith Woeste, HTIRC, U. S. Forest Service.

Figure 5. *Bark of mature black walnut (A), and bark of young black walnut (B).*

Photo A, Sally Weeks, Purdue University, Photo B, Lenny Farlee, HTIRC, Purdue University

Figure 6. *The butternut on the left shows typical light gray bark, while the butternut on the right displays the less common dark gray bark, similar to black walnut.*

Photo: James McKenna, HTIRC, U.S. Forest Service

offspring grow faster than either of the two parent species. Nearly all of these F1 hybrids are almost completely sterile (McKay, 1945). Factors such as lack of pollen production, and premature catkin and female flower abscission lead to little or no seed set. Among walnut hybrids, buarts are unusual in that they are fertile and can produce a remarkable number of nuts. Another characteristic of the walnut family is self-compatibility, which means an individual tree can pollinate itself. Once buart trees mature, it is very likely that some buarts pollinate other buarts, some self-pollinate, and others are pollinated by pure butternut pollen. Thus, buarts (strictly defined as F1s) are not nearly as common today as are seedling derivatives of buarts that have a more complicated genetic heritage. For this reason, we refer to trees with complicated, multi-species genetic background as "hybrids," and reserve the term buart for the cases where a tree is known to be the direct product of a Japanese walnut × butternut cross (an F1), or a tree of this type that has been maintained by grafting. There are several buart cultivars propagated by nut growers in North America.

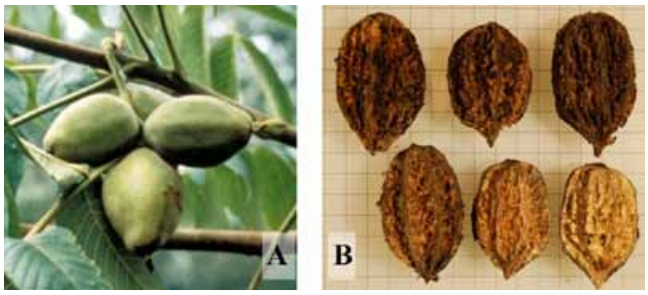

Figure 7. *Butternut fruits (A) and butternut seeds (B, upper row). Hybrid seeds are in the bottom row (B). Grid = 1 cm².*

Photo A, E. Hayes and M. Ostry, U.S. Forest Service, Photo B, Keith Woeste, HTIRC, U.S. Forest Service

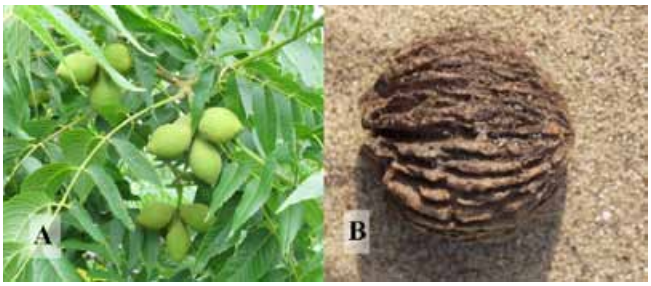

Figure 8. *Black walnut fruit (A) and seed (B).*

Photo A, Mark V. Coggeshall, Photo B, Sally Weeks, Purdue University

Figure 9. *Butternut leaves (left) normally have 9 to 17 leaflets and leaflets tend to be largest in the central part of the leaf. Hickory leaves (right) normally have 9 or fewer leaflets and leaflets become progressively larger toward the end of the leaf. A pecan leaf may have more than 9 leaflets, but these will also be largest near the end of the leaf.*

Photo: Lenny Farlee, HTIRC, Purdue University

Figure 10. *A hybrid butternut leaf (left) tends to be larger and longer, sometimes over 18 inches long, as compared to a butternut leaf (right).*

Photo: James McKenna, HTIRC, U.S. Forest Service

Besides hybrid vigor and high yielding potential, buarts and the more complex hybrids derived from them have inherited some resistance to the butternut canker fungus from Japanese walnut (Ostry, 1997). Since the introduction of Japanese walnut, several generations of butternut hybrids have naturally developed, and hybrid butternuts have become more numerous across the landscape (Hoban et al., 2009) as natural selection left behind hybrid trees that resisted butternut canker disease where pure butternuts were killed by the butternut canker. As butternut hybrids became more prevalent, more hybrid seed was collected and propagated. In some cases, due to mistaken identification, hybrids were propagated and distributed as butternuts, leading to increased distribution of hybrid trees and confusion about the identity of the butternut. In some parts of the United States today, hybrids are virtually the only "butternuts" to be found. The complex hybrids found today can be challenging to identify in the field because they present a mixture of butternut and Japanese walnut characteristics, especially

Figure 11. *Pure butternuts (left) have dropped all foliage while hybrid butternuts (right) still retain leaves in this mid-October photo from Tippecanoe County, Indiana.*

Photo: Lenny Farlee, HTIRC, Purdue University

Table 1. *Summary of characteristics of pure butternut and hybrid butternuts.*

1-Year Twigs	Butternut Characteristics	Butternut Hybrid Characteristics
Current-year stem color	Olive green changing to red-brown near terminal buds; glossy, few hairs except immediately beneath terminal buds.	Bright green to copper brown or tan, often densely covered with rust or tan hairs, especially near terminal buds. Pale green near terminal bud.
Terminal bud	Whitish to beige in color; narrower, the outer, fleshy scales more tightly compact and bud longer than hybrids.	Pale green to tan or yellowish in color, often pyramidal in shape, wider and squatter than butternut. Outer fleshy scales more divergent than butternut and often deciduous.
Lateral bud	Vegetative buds are elongated and somewhat angular, creamy white to beige in color.	Vegetative buds are rounded, and green to greenish brown in color.
Lenticels	Small, round, abundant, evenly distributed, sometimes elongating horizontally across the branch (perpendicular to the stem axis).	Large, often elongating laterally down the branch (parallel to the stem axis) on 1-year wood, patchy distribution. On 3- and 4-year wood, lenticels often form a diamond pattern as they become stretched both transversely and longitudinally.
Leaf scar	Top edge almost always straight or slightly convex; scar usually more compact.	Top edge almost always notched; often with large, exaggerated lobes.
Pith	Very dark brown.	Variable, dark brown, but more commonly medium brown or even light brown.
Mature Tree		
Bark	Varies from light grey and platy to dark grey and diamond-patterned in mature trees. In older trees, fissures between bark ridges may be shallow or deep but are consistently dark grey in color.	Silvery or light grey, rarely darker. Fissures between bark ridges moderate to shallow in depth and often tan to pinkish-tan in color.
Leaf senescence	Leaves yellow and brown by early-mid autumn, falling in early to mid autumn.	Leaves often green until late autumn, falling in late autumn or may freeze green on the tree.
Catkins	2 – 4¾ inches in length at peak pollen shed.	5 – 10 inches in length at peak pollen shed.
Nut clusters	One or two nuts per terminal in most clusters, sometimes 3 – 5, rarely more.	Usually 3 to 5 per cluster, sometimes as many as 7.

in the cases where they are more than half butternut. For example, a buart "backcrossed" to a butternut results in seedlings that are ¾ butternut and ¼ Japanese walnut. Genetic testing with DNA-fingerprinting techniques may be the only way to reliably identify and untangle the pedigree of some of these complex hybrid trees (Ross-Davis et al., 2008; Hoban et al., 2008; Woeste et. al., 2009). Butternuts do not hybridize with black walnuts but may hybridize with other walnut species in addition to Japanese walnut. These hybrids are very rare and not very fruitful and will not be covered in this publication. Hybrids are not necessarily undesirable, but we still know very little about how they will perform as possible replacements for butternuts, so careful identification is warranted if you wish to propagate and manage native butternuts.

No single trait distinguishes a butternut from a hybrid, but hybrids may be recognized using multiple characteristics (Table 1) and by using the key found in Table 2 (Ross-Davis et al., 2008). Tree growth rate, age, and other factors can cause variation in the appearance of the identifying characteristics listed, so use as many of the traits as possible. Before using the key, the first thing to consider is where the tree is growing. Trees in a natural forest, or at least 300 feet inside a woodlot where there are no signs of old home sites, orchards, or outbuildings, are much more likely to be pure butternuts. Hybrids were typically planted around farms, parks, and yards, and may naturally regenerate in nearby forest edges. Any "butternut" in a location where it may have been planted or naturalized as offspring from a planted tree may be a hybrid. Another consideration is the health and vigor of

Table 2. *Key for separating butternuts from hybrids using field characteristics. To use this key, examine each specimen for at least five of the traits listed below. For each trait, assign the specimen a score of 0, 1, or 2. Sum the scores for each of the traits you use, if the total score for your sample is 3 or less, your sample is probably a butternut. If it is greater than 3, it is probably a hybrid or a heartnut. This key is intended as a field guide and is not definitive. In some cases, only genetic testing can separate butternuts and hybrid trees.*

TRAIT 1	Leaf Retention — Figures 11, 12	SCORE
Leaves drop early in the fall, at about the same time as black walnut		0
Leaves stay green longer than black walnut but begin dropping before frost		1
Leaves stay green late into the fall and drop after a frost		2

TRAIT 2	Dormant Terminal Bud — Figures 22,23	
Terminal bud elongated and slender, conical, and tan colored		0
Terminal bud broadest at base, less elongated, slightly green colored		1
Terminal bud stout, pyramid shaped, green or yellow green in color		2

TRAIT 3	Dormant Twigs — Figures 2, 22, 23	
Dark olive green or reddish-brown, slender, sometimes with hairs below the terminal bud		0
Tan to brownish green and stout, sometimes with patches of hairs, especially below terminal bud		1
Tan to light green, stout, often with abundant rusty red or tan hairs		2

TRAIT 4	Lenticel Shape on New Twigs — Figures 2C and 2D, 22, 23	
Lenticels on most recent growth uniformly small, round, white, abundant, and evenly distributed; if some are elongated or dash-shaped, elongation is perpendicular to direction of the branch		0
Lenticels on most recent growth mostly small, round, white, abundant, with patchy distribution; if some are elongated or dash-shaped, elongation is parallel to direction of branch		1
Lenticels on most recent growth large, tan and corky, patchy distribution, many dash-shaped and elongated parallel to branch		2

TRAIT 5	Pith Color of 1-Year Twig — Figure 2A	
Very dark, chocolate brown		0
Medium brown (color of dark maple syrup)		1
Tan to honey colored		2

TRAIT 6	Leaf Scar — Figure 2	
Top edge of most leaf scars straight or slightly arched		0
Top edge of some leaf scars with small descending “V” shaped notch		1
Top edge of most or all leaf scars with clear descending “V” shaped notch		2

Figure 12. *Hybrid butternut trees may retain green foliage until a killing frost, while pure butternuts have dropped all leaves two or more weeks earlier.*

Photo: Lenny Farlee, HTIRC, Purdue University

the tree. Hybrids tend to resist butternut canker infection, or heal quickly when infected, and have a rapid growth rate due to hybrid vigor. Pure butternuts may also grow vigorously, but most native butternuts are infected with the butternut canker disease, resulting in obvious cankers on branches and trunks, decreased growth rate and tree vigor, and shortened life span. Rarely, a butternut will escape butternut canker disease because it is isolated from, or possesses some resistance to the disease, so consider additional identifying traits before making an identification decision based on tree health or location. Healthy, pure butternuts exist and are important for future breeding efforts.

Table 2. *Continued*

TRAIT 7 Leaf Length — Figure 10

Most leaves less than 18 inches long....0
Many leaves 18 inches or longer....1

TRAIT 8 Color of Bark Fissures on Mature Trees — Figures 4, 6

Dark grey or black....0
Light grey or silvery....1
Tan or slightly pinkish....2

TRAIT 9 Green Hull Characteristics

Densely hairy and very sticky....0
Somewhat hairy and only slightly sticky....2

TRAIT 10 Nut Shape — Figures 13–21

Nut cylindrical, round in cross section, with thin, sharp corrugations. The suture/seam is not easily distinguished from the longitudinal ridges....0
Nut slightly asymmetrical, with noticeable valleys between longitudinal ridges....1
Nut asymmetric, diamond shaped or flattened, with dull or sparse corrugations, the suture/seam is easily identified and forms the widest part of the body of the nut....2

TRAIT 11 Catkin Length When Fully Extended and Shedding Pollen

Shorter than 4.5 inches....0
4.5 – 5.5 inches....1
Longer than 5.5 inches....2

Evaluate your tree and sum its score for any 5 of the traits listed above. If your score is:

Zero – 3....Butternut
Greater than 3....Hybrid or Japanese walnut (heartnut)

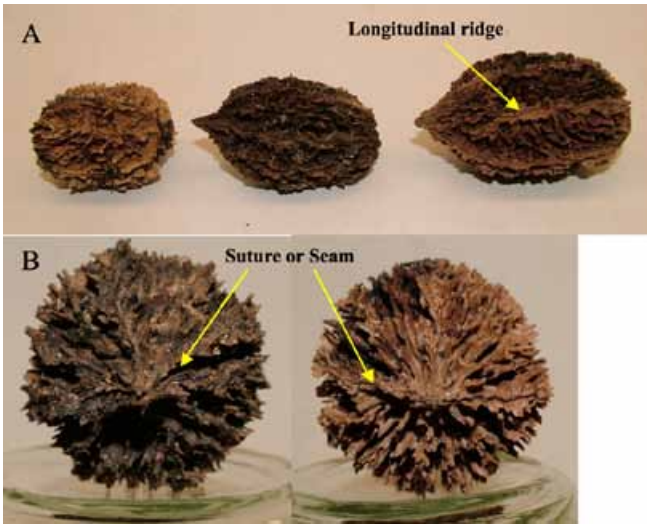

Figure 13. *Variations in butternut size and appearance (A). Looking at the end of the nut, a butternut appears round in cross-section and the sharp, thin corrugations fill the zones between ridges and suture. The nut suture is not easily distinguished until it begins to open (B).*

Photo: Lenny Farlee, HTIRC, Purdue University

While the shapes and sizes of the nut shells of butternuts vary considerably from tree to tree and across its native range (Fig. 13A), some characteristics are fairly consistent and can be valuable for differentiating native butternuts from hybrids. Native butternuts tend to be round in cross-section (Fig. 13B), while hybrid nuts tend to be asymmetrical, angular, or slightly flattened (Fig. 14-18). The shell of a butternut has extremely thin, sharp corrugations extending outward, similar to the cooling fins on a radiator. In pure butternuts, these corrugations tend to be evenly distributed between, and reach about the same height as, the longitudinal ridges and sutures on the shell (Fig. 13, 19). In contrast, hybrids tend to have thick or blunt corrugations that are unevenly or sparsely distributed between the longitudinal ridges creating the appearance of "valleys" between the ridges (Fig. 15-18, 20, 21). Some hybrid nuts, F1 buarts in particular, have irregular bumpy surfaces, with no corrugations or ridges. The suture or seam where a butternut splits open during germination is generally the same height as the ridges (Fig. 13). The seam on a hybrid nut may flare out away

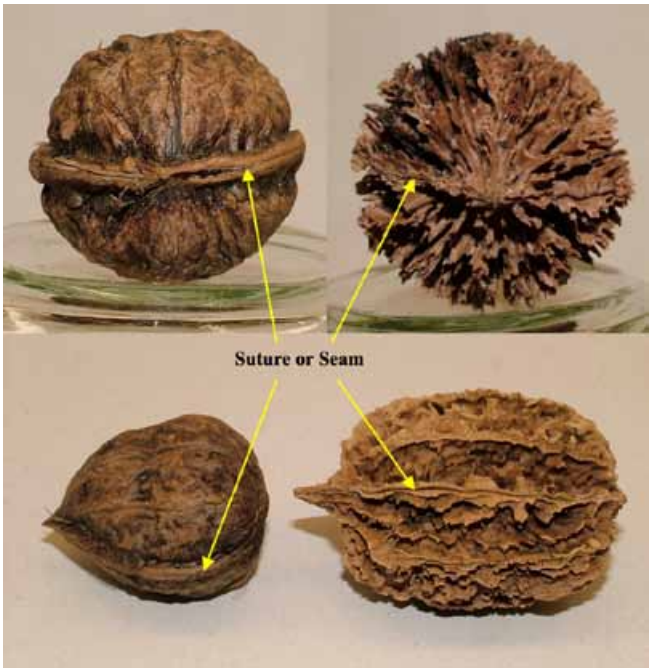

Figure 14. *Japanese walnut or heartnut (left, top and bottom) and butternut (right, top and bottom) easily hybridize to create butternut hybrids which often demonstrate physical characteristics intermediate between the parent trees. Note the prominent suture on Japanese walnut and the inconspicuous suture resembling the longitudinal ridges on the butternut.*

Photo: Lenny Farlee, HTIRC, Purdue University

Figure 15. *Hybrid butternut (left, top and bottom) and butternut (right, top and bottom) showing the prominent suture and blunt, less abundant corrugations on the hybrid nut as compared to the butternut.*

Photo: Lenny Farlee, HTIRC, Purdue University

Figure 16. *Hybrid butternut (left, top and bottom) and butternut (right, top and bottom) showing the prominent suture, more angular shape and blunt corrugations on the hybrid nut as compared to butternut.*

Photo: Lenny Farlee, HTIRC, Purdue University

Figure 17. *The differences between the hybrid butternut (left, top and bottom) and the butternut (right, top and bottom) are less pronounced, but still present including: prominent suture, blunt corrugations and ridges, and a more angular appearance of the hybrid nut as compared to the butternut.*

Photo: Lenny Farlee, HTIRC, Purdue University

Figure 18. *This suspected back-cross hybrid butternut (left, top and bottom) very closely resembles pure butternut (right, top and bottom). Some subtle differences can still be seen in the more angular appearance of the nut and the "valleys" between the ridges where corrugations are shorter and sparser than in pure butternut.*

Photo: Lenny Farlee, HTIRC, Purdue University

Figure 19. *Long, sharp corrugations located on and between the ridges of a native butternut.*

Figure 20. *Short, mostly blunt corrugations on and between ridges of a hybrid butternut.*

Figure 21. *Sparse, blunt corrugations on and between ridges of a hybrid butternut (buart).*

All photos: Lenny Farlee, HTIRC, Purdue University

Figure 22. *Elongated lenticels, stout twig, notched leaf scar, and large pyramidal terminal bud typical of hybrid butternut.*

Photo: Lenny Farlee, HTIRC, Purdue University

Figure 23. *Small, round lenticels, slender twig, arched or flat-topped leaf scar, and slender, elongated tan terminal bud typical of pure butternut.*

Photo: Lenny Farlee, HTIRC, Purdue University

from the body of the nut, creating a triangular, flattened appearance at the tip of the nut (Fig. 15-17).

Hybrids can become very difficult to separate from pure butternuts, particularly when they become more genetically mixed with native butternuts. Combining information about the location of the tree, history of the area, physical characteristics, vigor and health of the tree, and appearance of the nuts will help you determine if you have a hybrid or pure butternut.

This publication is an adaptation and expansion of an article that appeared in the *Northern Journal of Applied Forestry*: Woeste, K.E., L. Farlee, M.E. Ostry, J.R. McKenna, and S. Weeks. 2009. A Forest Manager's Guide to Butternut. *Northern Journal of Applied Forestry*. 26(1): 9-14.

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Additional Resources

Detailed information on the life-history, range, identification and a variety of other characteristics of butternut is readily available in printed and digital format.

Several research and management documents for butternut are accessible from the USDA Forest Service Northern Research Station: http://nrs.fs.fed.us/.

- The USDA Forest Service Conservation Assessment for butternut is available at www.fs.fed.us/r9/wildlife/tes/ca-overview/docs/plant_juglans_cinera-Butternut2003.pdf.
- The Fire Effects Information System (FEIS) provides an index of information for butternut at www.fs.fed.us/database/feis/plants/tree/jugcin/all.html.
- The USDA NRCS PLANTS Database also provides a butternut plant profile at http://plants.usda.gov/.
- The biological characteristics (silvics) of butternut can be found at www.na.fs.fed.us/spfo/pubs/silvics_manual/Volume_2/juglans/cinerea.htm.
- *Conservation and Management of Butternuts,* FNR-421-W, provides recommendations for retention, management and propagation of butternuts.

In addition to these information sources, many states within the range of butternuts will have information available through forestry, conservation, and botanical survey organizations.

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Indiana Forestry & Woodland Owners Assoc.
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Purdue Extension Foresters
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