



# 'Jefferson' Hazelnut (OSU 703.007)

Rebecca L. McCluskey, Shawn A. Mehlenbacher, and David C. Smith

'Jefferson' (OSU 703.007) was developed and evaluated at Oregon State University in Corvallis, Oregon, and was released in January 2009. This variety combines very high resistance to eastern filbert blight (EFB) caused by the fungus *Anisogramma anomala* (Peck) E. Müller with large nut size, good kernel quality, and high yields. 'Jefferson' was released for the in-shell market as an EFB-resistant replacement for 'Barcelona'. Kernel quality is suitable for many end-uses. Like its predecessors 'Santiam' (February 2005) and 'Yamhill' (January 2008), 'Jefferson' is suitable for planting in areas with high EFB disease pressure.

## Tree growth and habit

Compared with 'Barcelona', 'Jefferson' trees are a little smaller and have a slightly more upright growth habit (figure 1). Trees are moderately vigorous and have an upright, spreading canopy. They will be easy for growers to manage with occasional pruning. In other hazelnut cultivars, good light penetration into the canopy has been shown to increase nut set, nut size, and kernel size and reduce the occurrence of single-nut clusters that are common inside densely shaded canopies.

Tree size is estimated by measuring the trunk cross-sectional area at 30 cm from the soil line (table 1). Using this estimate, 'Jefferson' trees are 30%–40% smaller than the vigorous standard 'Barcelona' and 5%–10% smaller than 'Lewis'. When canopy width and height were measured in the ninth leaf, 'Jefferson' was 15% smaller than 'Barcelona' in both height and width. There was less than 10% difference in canopy height and spread between 'Jefferson' and 'Lewis'. Tree anchorage is strong, and no tendency to lean has been noted.

During the 8-year evaluation period, trees were irrigated regularly for the first 5 years. Establishment and performance of this cultivar under dry conditions have not been tested.

## Yield

Yield from 2004–2008 of trees planted in 2002 is the basis for comparison. Marketable nut yield is the sellable portion of the crop, after blanks and kernel defects are removed, and is calculated for each year. Marketable kernel yield is also a calculated value: marketable nut yield  $\times$  percent kernel (see table 1, footnote b).

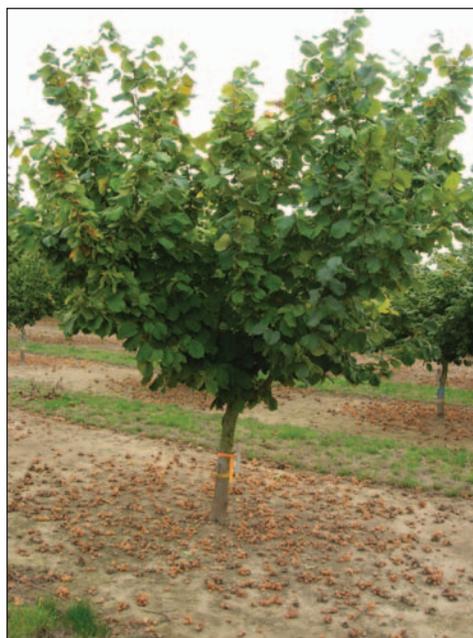


Figure 1. 'Jefferson' tree in ninth leaf (top) and in seventh leaf in mid-October (bottom).

In most years, marketable nut yield of 'Jefferson' matched or exceeded that of 'Barcelona' (figure 2, table 1). Cumulative marketable nut yield (kg/tree) was similar for 'Jefferson' and 'Lewis', and both exceeded 'Barcelona' by nearly 4 kg/tree. Kernel yield followed a similar trend (figure 3).

**Nut and kernel quality**

Nuts and kernels of 'Jefferson' are a suitable replacement for the in-shell standard 'Barcelona'. Compared with 'Barcelona', 'Jefferson' had slightly smaller nut weight, averaged over 4 years, (3.7 g vs. 3.8 g) and slightly higher kernel weight (figure 4, table 1). Nuts of 'Jefferson' had fewer defects and averaged 45% kernel, compared with 43% for 'Barcelona' (figure 5). Raw kernels are attractive and have a light brown pellicle with a moderate amount of attached fiber (figure 6). Blanching ratings are slightly better than those for 'Barcelona' and 'Lewis'.

Incidence of kernel mold in 'Jefferson' has been consistently low, even in 2005 and 2006, when it was very high in 'Lewis' and 'Santiam'. Nuts occasionally have hairline split sutures, which is reflected in the overall low frequency of kernels with black tips. Split sutures do not appear to warrant great concern. Overall, the percentage of good nuts is 76% or more in most years.

**Harvest**

Nuts of 'Jefferson' mature at the same time as those of 'Barcelona' or up to 3 days later. This is typically around mid-October in Oregon and frequently coincides with the onset of the rainy season. Nuts are borne in clusters of two to three, and about 80% fall free of the husk at maturity. The remaining nuts readily fall out of the husks as they move through mechanical harvest equipment.

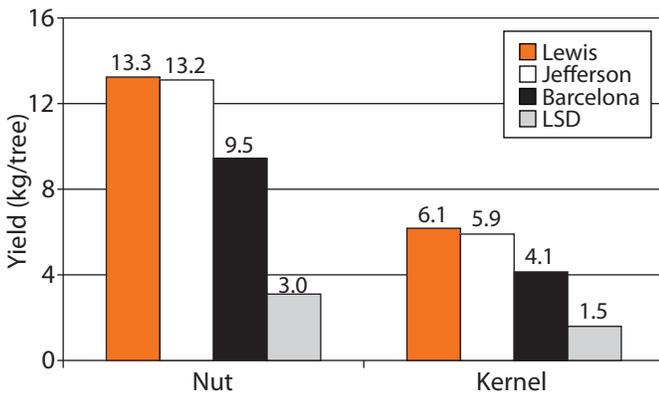


Figure 3. Cumulative marketable nut and kernel yield, third through seventh leaf.

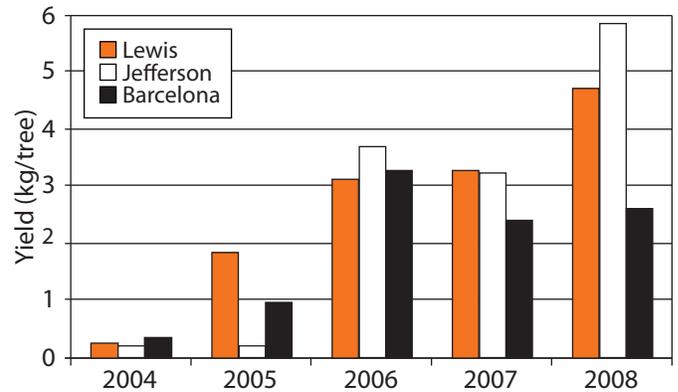


Figure 2. Marketable nut yield (trees planted in 2002).

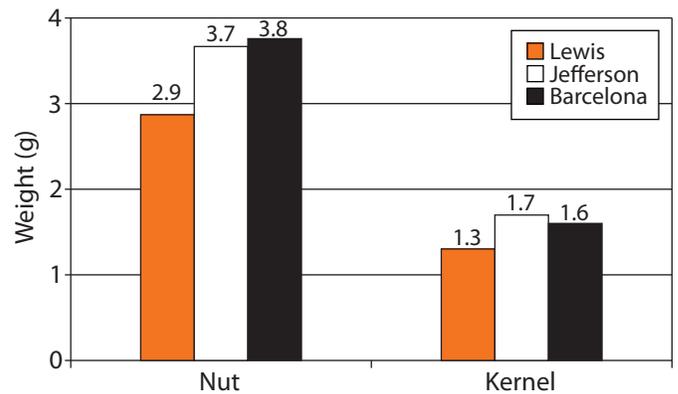


Figure 4. Average nut and kernel size, 2005–2008.

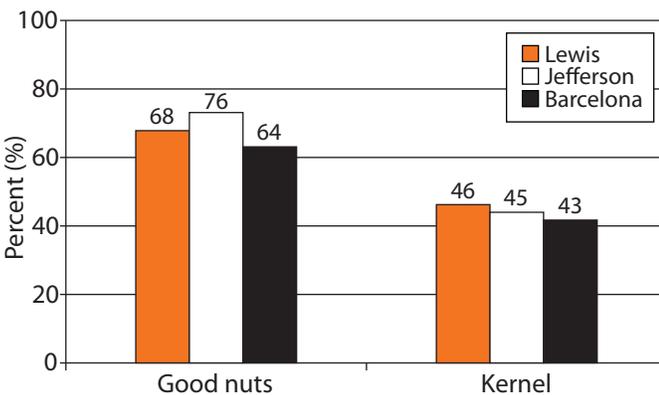


Figure 5. Average good nuts and kernel fill, 2005–2008.



Figure 6. Nuts, raw kernels, and blanched kernels of 'Barcelona' (top) and 'Jefferson' (bottom).

## Propagation and availability

Layers root well, are easy to propagate, and are vigorous. In vitro cultures have been established to allow micro-propagation on a commercial scale. Hazelnut nurseries have propagated this variety, and trees are available.

'Jefferson' was released as a public variety in the United States. It may be propagated and sold to growers in the United States with no restrictions. Oregon State University reserves the right to seek licensing agreements and legal protection in other countries for a period of 6 years following release. Trees may not be sold or given to other countries without the appropriate legal documents from Oregon State University. A licensing agreement grants Viveros Nefuen (Hijuelas, Chile) the exclusive right to propagate 'Jefferson' and sell trees in South America.

## Pest and disease tolerance

'Jefferson' is the first in-shell variety released by Oregon State University to carry the 'Gasaway' gene for resistance to EFB. Growers should **not** need to use chemical sprays to protect the trees from EFB, although they should avoid planting into or adjacent to an established orchard that is heavily infected. In 2010, small EFB cankers were observed in young 'Jefferson' trees planted in an area with high disease pressure. The trees appear to have grown out of the infection, but researchers will continue to observe them.

Susceptibility to bacterial blight caused by *Xanthomonas campestris* pv. *corylina* has not been quantified, but two of 12 trees planted in trials at Oregon State University showed signs of stress at the end of the growing season, and several sister seedlings in the original block had some shoot dieback, a typical symptom of bacterial blight. Shoot dieback has been noted in some grower orchards, particularly after cool, wet springs such as 2008 and 2010. Copper sprays are recommended to minimize damage from this pathogen, particularly in very young trees.

'Jefferson' trees appear to have a high tolerance to infestation by big bud mite (primarily *Phytoptus avellanae* Nal.); annual ratings for 3 years indicated that blasted buds were very rare. Chemical applications should **not** be necessary to control bud mite.

## Flowering characteristics

Female flowers of 'Jefferson' emerge very late in the season. Although a few flowers are present at the end of January, the period for peak flower receptivity in Oregon is typically the second through fourth week of February. Winter temperatures and tree age may accelerate or delay both pollen shed and flowering up to a week. Pollen shed is also late and typically occurs over a 3-week period in February, after 'Gamma' and 'Daviana' but before 'Epsilon', 'Eta', and 'Theta'. Pollen quantity and quality is very good.

## Pollinizer selection

Pollinizer recommendations for 'Jefferson' include only cultivars that have very high resistance to EFB. Female flowers of 'Jefferson' express incompatibility alleles  $S_1$  and  $S_3$ , but the pollen expresses only the  $S_3$  allele.

A mix of at least three pollinizers that shed pollen at different times during the bloom period is recommended (figure 7). Pollen of 'Gamma' ( $S_2 S_{10}$ ) and 'Yamhill' ( $S_8 S_{26}$ ), which shed in mid-season, would overlap the earliest females of 'Jefferson' in some years. Pollinizers 'Eta' ( $S_{11} S_{26}$ ) and 'Theta' ( $S_5 S_{15}$ ) both shed very late in the season and overlap 'Jefferson' bloom very well. To ensure good pollination, a **minimum** of 6% to 10% of the trees in the orchard should be shedding compatible pollen throughout the female bloom period. If three pollinizers are used, a good mix would be 10% 'Gamma', 30% 'Eta', and 60% 'Theta'. Additional pollinizer selections are being evaluated as alternatives to 'Gamma' and 'Yamhill' for the first half of the receptive season of 'Jefferson' females.

Any cultivar that expresses  $S_1$  or  $S_3$  in its pollen is **not** compatible with flowers of 'Jefferson'. For example, 'Delta', 'Epsilon', 'Zeta', and 'Sacajawea' all express  $S_1$  in their pollen and thus are **not** compatible with 'Jefferson'. Although 'Hall's Giant' ( $S_5 S_{15}$ ) pollen is compatible and would overlap the early period of bloom, it is not recommended because this cultivar is susceptible to EFB.

## Development

'Jefferson' (OSU 703.007) was developed by Dr. Shawn Mehlenbacher and David Smith of Oregon State University in Corvallis, Oregon. It resulted from a cross of OSU 252.146 × OSU 414.062 made in 1993. Its pedigree includes great-grandparents from Sicily ('Montebello'), Spain ('Barcelona'), Turkey ('Extra Ghiaghli' and 'Tombul Ghiaghli'), and the Pacific Northwest ('Compton' and 'Gasaway'). EFB resistance was inherited from the obsolete pollinizer 'Gasaway'. Data in this report were obtained from two trials planted in spring 2002 in Corvallis, Oregon.

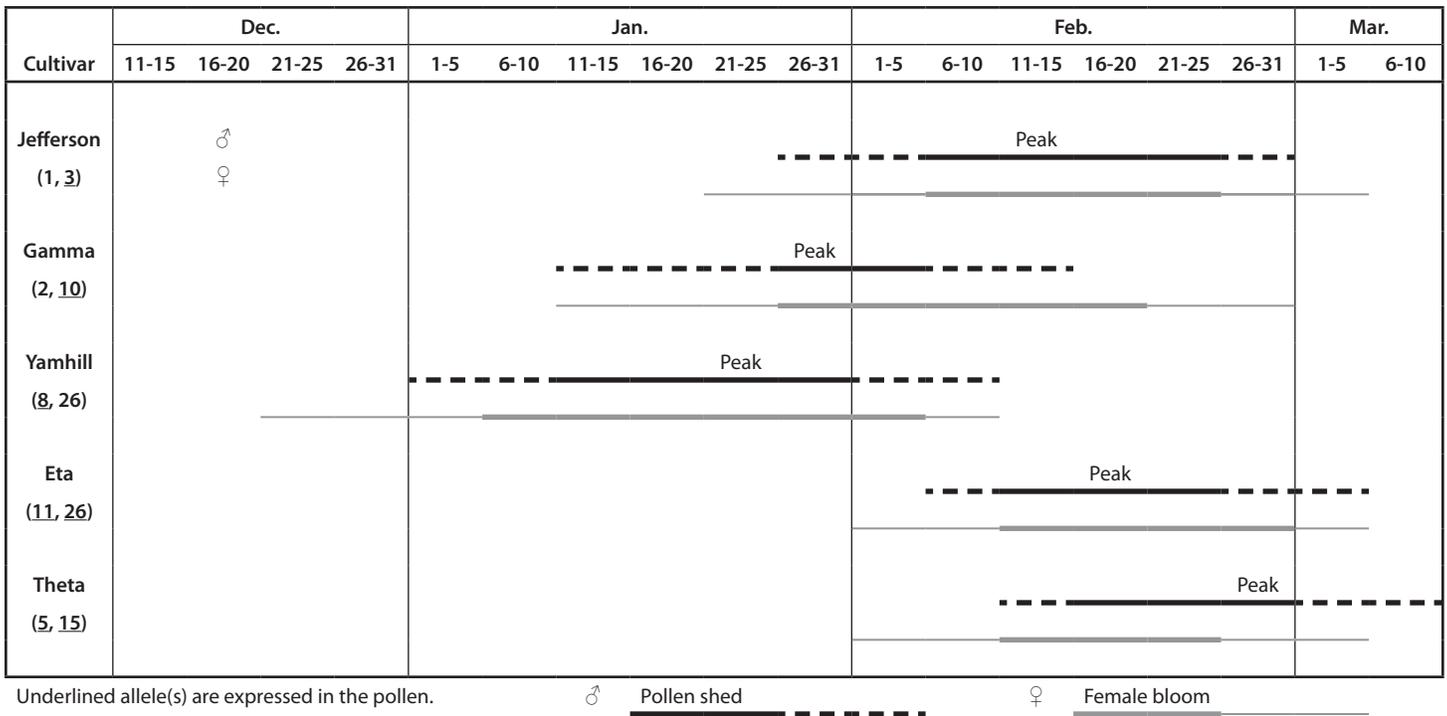


Figure 7. Average flowering time of 'Jefferson' (2006–2008) and possible pollinizers. Pollen shed of 'Yamhill' overlaps receptivity of the earliest female flowers of 'Jefferson' in most years, but 'Yamhill' flowers emerge early and will need an additional pollen source. Tree size, nut maturity, and nut size are additional factors to consider when selecting pollinizers.

**For more information**

Information on management of eastern filbert blight: <http://oregonstate.edu/dept/botany/epp/EFB/>

Information on growing hazelnuts in the Pacific Northwest: <http://www.oregonhazelnuts.org/handbook.php>

Many Oregon State University Extension Service publications are available online. Visit the OSU Extension Publications and Multimedia catalog at <http://extension.oregonstate.edu/catalog/>. Enter the word "hazelnut" in the search box to bring up a list of publications relating to hazelnut, or search for the publication numbers listed below.

- EC 1219 *Growing Hazelnuts in the Pacific Northwest*
- EC 1499 *Detecting and Controlling Eastern Filbert Blight*
- EM 8328 *2011 Hazelnut Pest Management Guide for the Willamette Valley*
- EM 8640 *Hazelnut Cultivar: 'Lewis' (OSU 243.002)*
- EM 8727 *New Hazelnut Cultivar 'Clark' (OSU 276.142)*
- EM 8786 *Hazelnuts Nutrient Management Guide*
- EM 8836 *Hazelnut Pollinizer Cultivars: Gamma (OSU 589.028), Delta (OSU 510.041), Epsilon (OSU 669.073), Zeta (OSU 670.095)*
- EM 8890 *'Santiam' Hazelnut (OSU 509.064)*
- EM 8914 *'Sacajawea' Hazelnut (OSU 540.130)*
- EM 8946 *Identification of Invasive and Reemerging Pests on Hazelnuts*
- EM 8987 *'Yamhill' Hazelnut (OSU 542.102)*

## 'Jefferson' (OSU 703.007) in a nutshell

**Table 1. Tree, nut, and kernel characteristics.**

Characteristic	'Jefferson'	'Lewis'	'Barcelona'
Nut weight (g) <sup>a</sup>	3.7	2.9	3.8
Kernel weight (g) <sup>a</sup>	1.7	1.4	1.6
Percent kernel (%)	45	46	43
Blanch rating (1–7; 7 = doesn't blanch)	3.9	4.4	4.5
Nuts free of defects (%)	76	68	64
Kernel defects (%) <sup>a</sup> :			
Blank + brown stain	4.4	2.9	7.5
Moldy kernels	3.0	7.8	2.6
Shrivel	0.9	3.6	1.6
Poor fill	14.2	19.1	21.8
Cumulative yield 2004–2008 (kg/tree)			
Field-run (nut)	18.9	19.6	14.8
Marketable (nut) <sup>b</sup>	13.2	13.3	9.5
Marketable (kernel) <sup>b</sup>	6.1	5.9	4.1
Cumulative nut yield efficiency (kg/cm <sup>2</sup> ) <sup>c</sup>	0.30	0.27	0.15
Tree size after 9 years <sup>d</sup>			
Height m (ft)	3.3 (10.8)	3.6 (11.8)	3.8 (12.5)
Canopy spread m (ft)	3.0 (9.8)	3.1 (10.1)	3.6 (11.7)
TCSA <sup>e</sup>	78.2	84.4	115.9

<sup>a</sup> Nut and kernel weight are based on 10 well-filled nuts; percentage of defects is from 100-nut samples and is an average of 4 years.

<sup>b</sup> Marketable nut yield = cumulative field run weight × percent nuts free of defects. Marketable kernel yield = marketable nut yield × percent kernel.

<sup>c</sup> Yield efficiency is a measure of cropping efficiency and adjusts for tree size (kg/TCSA).

<sup>d</sup> Tree and canopy size measurements are from the second trial, planted in 2002 with eight replications.

<sup>e</sup> TCSA = Trunk cross-sectional area (cm<sup>2</sup>) was measured 30 cm (12 inches) above the soil line when trees were in the seventh leaf.

### Flowering characteristics

Female flowers express incompatibility alleles S<sub>1</sub> S<sub>3</sub> and bloom from the beginning of February to early March, slightly later than 'Lewis'. Pollen expresses only S<sub>3</sub>.

### Time and duration of pollen shed

Pollen shed begins in early February and lasts about 3 weeks but may start a week earlier depending on the weather.

### Pollinizer recommendations

10% 'Gamma' (S<sub>2</sub> S<sub>10</sub>)—but this will not overlap early bloom every year.

30% 'Eta' (S<sub>11</sub> S<sub>26</sub>) and 60% 'Theta' (S<sub>5</sub> S<sub>15</sub>)—both are late, but 'Eta' typically sheds 1 week ahead of 'Theta'.

Additional pollinizers are planned for release in 2012. All recommended pollinizers have a very high level of resistance to eastern filbert blight.

### Time of harvest

Nuts fall within 3 days of 'Barcelona', around mid-October in Corvallis, Oregon.

### Pest and disease tolerance

**Eastern filbert blight:** High resistance from 'Gasaway'.

**Big bud mite:** High level of resistance (rated 1.1 on a scale of 1–5, 1 = no damaged buds).

**Bacterial blight:** Trees have not been tested, but symptoms of blight have been observed. As with 'Barcelona', copper sprays are recommended, especially on young trees.

**Kernel mold:** Frequency is consistently low, even in years when it is high in 'Lewis'.

### Propagation and availability

'Jefferson' was released as a public variety in the United States, with no restrictions for use by growers in the United States. Trees may not be sold or given to other countries without the appropriate legal documents from Oregon State University. A licensing agreement grants Viveros Nefuen (Hijuelas, Chile) the exclusive right to propagate 'Jefferson' and sell trees in South America.