‘Yamhill’ Hazelnut

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‘Yamhill’ is a new hazelnut (*Corylus avellana* L.) cultivar for the kernel market. It was released by the Oregon Agricultural Experiment Station in Jan. 2008. It combines complete resistance to eastern filbert blight (EFB) caused by the fungus *Anisogramma anomala* (Peck) E. Müller with high nut yield, early nut maturity, high kernel percentage, and good kernel quality. Compared with ‘Barcelona’, Oregon’s leading cultivar, ‘Yamhill’ has smaller trees, slightly higher nut yield, twice the nut yield efficiency, and similar pellicle removal ratings. The kernel quality is suitable for use in chocolate products and baked goods and is competitive with imported Turkish kernels.

Origin

‘Yamhill’, tested as OSU 542.102, resulted from a cross of OSU 296.082 × VR 8-32 made in 1990 by Shawn A. Mehlenbacher and David C. Smith (Fig. 1). OSU 296.082 is a seedling from a cross of OSU 17.068 × ‘Willamette’, and VR 8-32 is an OSU selection from a cross of the Sicilian cultivar ‘Montebello’ and the obsolete pollenizer ‘Gasaway’. Hybrid seeds from this cross were harvested in Aug. 1990, stratified, and the resulting seedlings grown in the greenhouse during the summer of 1991. In Oct. 1991, 225 seedlings from this cross were planted in the field. The designation OSU 542.102 indicates the row and tree location of the original seedling. Nuts were first observed on the original seedling in Sept. 1994. Nuts were harvested from the original seedling tree and evaluated in 1994 and in each of the next 4 years. OSU 542.102 was propagated by tie-off layerage of the suckers in the summers of 1999 and 2000. The resulting trees were lined out in a nursery row the next year and then used to plant two replicated yield trials in the spring, one in 2000 and the other in 2001. Eight trees of each genotype were planted in the first trial (Table 1) and four trees in the second trial (Tables 1–3). The trials were located at the Smith Horticulture Research Farm in Corvallis and planted as randomized complete block designs with a single tree of each genotype in

each block. Oregon’s leading cultivar, ‘Barcelona’, and the recently released ‘Lewis’ and ‘Clark’ were included as checks. Three EFB-resistant cultivars were also included: the pollenizer ‘Gamma’ in the first trial and the Spanish cultivar ‘Ratoli’ and the pollenizer ‘Epsilon’ in the second trial (Lunde et al., 2000; Mehlenbacher and Smith, 2004). Several additional numbered selections were included in both trials. The origin and meaning of the name Yamhill are uncertain, but it appears to have been used by European Americans for a Native American group of the Kalapooian family who lived along the Yamhill River (McArthur and McArthur, 2003). The Yamhill River is a tributary of the Willamette River. Yamhill County is an important hazelnut-growing area in Oregon.

Description

Trunk diameter was measured 30 cm above the soil line at the end of the growing season, in Dec. 2007, and used to calculate trunk cross-sectional area (TCA). TCA provides an estimate of tree size. In the first trial (Table 1), tree size of ‘Yamhill’ was 50% of the vigorous standard ‘Barcelona’ and smaller than ‘Lewis’ (71%) and ‘Clark’ (60%). Total nut yield per tree (third to eighth leaf) was 30.6 kg for ‘Yamhill’ versus 28.2 kg for ‘Barcelona’ or 108.5% of the control. Nut yield efficiency, which adjusts for differences in tree size, was much higher for ‘Yamhill’ (0.40 kg·cm⁻²) than for ‘Barcelona’ (0.19 g·cm⁻²), or 213% of the control. In the second trial (Table 1), TCA of ‘Yamhill’ was 71% of the vigorous standard ‘Barcelona’ and approximately the same as ‘Lewis’ (72%) and ‘Clark’ (74%). Total nut yield per tree (third to seventh leaf) was 22.1 kg for ‘Yamhill’ versus 19.8 kg for ‘Barcelona’, or 111.9% of the control. Yield efficiency was much higher for ‘Yamhill’ (0.30 kg·cm⁻²) than for ‘Barcelona’ (0.13 kg·cm⁻²), or 230% of the control. Because kernel percentage (the ratio of kernel weight to nut weight) is higher for ‘Yamhill’ (49.3%) than ‘Barcelona’ (43.4%), yields of kernels per hectare are expected to be much higher than for ‘Barcelona’ (Table 2). ‘Yamhill’ trees have a spreading growth habit and a flat top that will require pruning to allow machinery to pass underneath (Fig. 2). Occasional pruning is also desirable to allow sunlight to penetrate the canopy. In Oregon, new orchards of low-vigor cultivars are often planted at a 3 × 6-m spacing rather than the 6 × 6-m spacing used

for the vigorous ‘Barcelona’. A closer spacing of ‘Yamhill’ trees in the orchard would be appropriate to take advantage of their high yield efficiency.

‘Yamhill’ nuts are borne in clusters of four to five in husks equal in length to the nuts. The nuts fall free of the husk at maturity and can be mechanically harvested 10 to 14 d earlier than ‘Barcelona’. The earlier maturity is a significant improvement, because in most years, harvest of ‘Yamhill’ will be completed before the start of the rainy season, which coincides with the beginning of the ‘Barcelona’ harvest in the Willamette Valley. The kernels fill the nuts well even when trees have a heavy crop. The raw kernels are attractive and have little fiber on their light brown pellicles (Table 2; Fig. 3). Pellicle removal (blanching) ratings are equal to ‘Barcelona’. When lightly roasted (150 °C for 15 min) and rubbed, approximately half of the pellicle is removed. Kernel quality is suitable for many end uses, including chocolate products and baked goods, and is competitive with kernels imported from Turkey. Chocolate makers prefer kernels 11 to 13 mm in diameter. Most kernels of ‘Yamhill’ are of this size, although some are smaller. The small nuts of ‘Yamhill’ are not suited to the in-shell market. A high percentage of the kernels of ‘Yamhill’ are marketable. The frequency of blanks, poorly filled nuts, and doubles is less in ‘Yamhill’ than in ‘Barcelona’ (Table 3). ‘Yamhill’ has a low frequency of moldy kernels, which was especially striking in 2005 when mold was a problem on ‘Lewis’ and many other genotypes.

‘Yamhill’ trees set a moderate to high number of catkins that shed copious amounts of pollen early in the season with ‘Barcelona’. Pollen has been collected and used in several controlled pollinations, and both quantity and viability appear to be very good. ‘Yamhill’ has incompatibility alleles S₈ and S₂₆ as determined by fluorescence microscopy (Mehlenbacher, 1997). Both alleles are expressed in the females, but only S₈ is expressed in the pollen because of dominance. Female inflorescences of ‘Yamhill’ emerge early in the season, approximately with ‘Barcelona’, so pollenizers that shed pollen in early midseason would be suitable. We encourage the planting of three pollenizers that shed pollen at different times during the period that female inflorescences are receptive to increase the likelihood that they will be pollinated. Pollenizers with complete resistance to EFB would eliminate the need for fungicide control in the orchard. We

Fig. 1. Pedigree of ‘Yamhill’ hazelnut.

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Table 1. Nut yield, trunk cross-sectional area, and yield efficiency of 'Yamhill' and control cultivars in hazelnut trials planted in 2000 and 2001.

Cultivar	No. of trees	Yield per tree (kg)							TCA ^z (cm ²)	Yield efficiency (kg·cm ⁻²)
		2002	2003	2004	2005	2006	2007	Total		
2000 trial										
Lewis	8	1.01	2.66	4.19	6.41	14.46	11.59	40.32	109.0	0.37
Yamhill	8	0.64	3.49	4.33	6.3	7.13	8.75	30.63	76.9	0.40
Barcelona	8	0.56	1.99	3.54	4.79	8.19	9.12	28.19	152.6	0.19
Clark	8	0.77	1.46	3.34	6.19	7.23	8.70	27.70	91.9	0.30
Gamma	8	0.49	1.35	3.64	4.65	8.68	7.80	26.61	128.3	0.21
LSD (0.05)		0.17	0.44	0.57	0.82	1.60	1.32	3.25	14.2	0.03
2001 trial										
Yamhill	4	—	0.44	2.49	4.44	6.27	8.49	22.13	73.7	0.30
Barcelona	4	—	0.56	2.49	3.04	6.93	6.76	19.78	103.9	0.13
Clark	4	—	0.42	1.53	4.59	3.92	7.93	18.38	76.8	0.24
Epsilon	4	—	0.93	1.63	2.75	7.27	7.98	19.71	107.2	0.19
Lewis	4	—	1.05	2.04	4.65	3.78	10.34	21.89	75.1	0.29
Ratoli	4	—	0.21	1.10	2.27	2.82	4.50	10.90	71.2	0.15
LSD (0.05)		—	0.19	0.54	0.69	1.47	1.98	2.93	13.7	0.04

^zTrunk cross-sectional area 30 cm above soil line.

LSD = least significant difference.

Table 2. Description of nuts and kernels of 'Yamhill' in comparison with those of other hazelnut cultivars in a trial planted in 2001.^z

Genotype	10-nut wt (g)	10-kernel wt (g)	Kernel percentage ^y	Fiber ^x	Pellicle removal ^w
Yamhill	23.4	11.3	49.3	1.5	4.1
Barcelona	38.2	16.6	43.4	2.8	3.9
Clark	25.1	12.9	51.3	2.9	3.3
Epsilon	27.4	14.1	51.3	2.8	5.7
Lewis	29.4	13.7	46.7	1.2	4.1
Ratoli	17.6	9.7	55.3	2.9	3.8
LSD (0.05)	1.3	0.6	0.9	0.3	0.5

^zMeans of 4 years (2004 to 2007).

^yKernel percentage = kernel weight/nut weight.

^xFiber on the pellicle was rated from 1 (none) to 4 (much).

^wPellicle removal (blanching) was rated from 1 (complete pellicle removal) to 7 (no pellicle removal) after roasting at 130 to 150 °C for 15 min and then rubbing by hand.

LSD = least significant difference.

Table 3. Frequency of good nuts and of nut and kernel defects in 'Yamhill' and standard hazelnut cultivars in the second trial planted in 2001.

Selection	Frequency (%) ^z							
	Good	Blank	Brown stain	Poor fill	Shriveled kernels	Moldy kernels	Black tips	Twins
Yamhill	84.0	4.8	0.2	9.3	0.9	1.0	0.3	0.0
Barcelona	63.5	11.4	0.9	17.0	1.2	2.4	0.1	4.2
Clark	78.3	3.6	1.7	11.3	0.4	3.9	0.5	0.6
Epsilon	75.6	6.2	0.9	8.4	1.2	6.8	0.3	1.9
Lewis	64.5	4.1	0.1	22.3	1.9	9.4	0.4	0.7
Ratoli	70.5	11.1	0.4	8.9	0.7	5.2	0.0	1.4
LSD (0.05)	6.0	3.9	1.2	5.7	1.3	3.3	1.1	1.5

^zAverage frequency (2004 to 2007) from samples of 100 nuts per tree. Shown are percent good kernels, blanks (shells lacking kernels), brown stain disorder, moldy kernels, shriveled kernels, poorly filled nuts, twins (doubles), and kernels with black tips.

LSD = least significant difference.

recommend one-third each of 'Gamma' (S₂ S₁₀) and 'Santiam' (S₃ S₁₅), which shed pollen early in the season and which have short shedding periods. For the remaining third, we recommend a mixture of later-shedding types, including 'Delta' (S₁ S₁₅), 'Epsilon' (S₁ S₄), 'Zeta' (S₁ S₁), and 'Jefferson' (S₁ S₃), all of which have complete resistance to EFB. Pollen of 'Lewis' (S₃ S₈) and 'Clark' (S₃ S₈) expresses S₈ and is thus incompatible on female inflorescences of 'Yamhill'.

'Yamhill' has complete resistance to EFB conferred by a dominant allele from 'Gas-

away'. Trees of 'Yamhill' were inoculated in the greenhouse in 1996 with fungal spores of *Anisogramma anomala* as described by Lunde et al. (2000). Enzyme-linked immunosorbent assay (Coyne et al., 1996) 6 months after inoculation failed to detect presence of the fungus. 'Yamhill' trees in orchards in the northern Willamette Valley adjacent to infected trees of susceptible cultivars have remained free of disease. Random amplified polymorphic DNA markers UBC 152₈₀₀ and UBC 268₅₈₀ that flank the resistance allele in 'Gasaway'

Fig. 2. Tree of 'Yamhill' hazelnut.

Fig. 3. Nuts (top), raw kernels (middle), and blanched kernels (bottom) of 'Barcelona' (left column) and 'Yamhill' hazelnuts (right column).

(Mehlenbacher et al., 2004) are present in 'Yamhill'. 'Yamhill' is heterozygous for resistance and transmits this trait to half of its seedlings. Eastern filbert blight is now present throughout the Willamette Valley where 99% of the U.S. hazelnut crop is grown. Pruning to remove cankers and fungicide applications are currently used to manage the disease in orchards of 'Barcelona' and other susceptible cultivars. Like 'Santiam', released in Feb. 2005 (Mehlenbacher et al., 2007), 'Yamhill' is suitable for planting in areas with high disease pressure. The response of 'Yamhill' to inoculation with other isolates of EFB from the eastern United States has not been tested. Inoculations to date have been only with the Oregon isolate.

Susceptibility of 'Yamhill' to bacterial blight caused by *Xanthomonas campestris* pv. *corylina* has not been determined, although no trees have been lost to the disease in our trial plots.

Susceptibility to big bud mite (primarily *Phytoptus avellanae* Nal.) was rated in the second replicated trial after leaf fall once per year for 5 years (Dec. 2003 to 2007). The scale was from 1 (no blasted buds) to 5 (many blasted buds). The average ratings indicate a

high level of resistance for ‘Yamhill’ (1.1) and ‘Barcelona’ (1.1), moderate resistance for ‘Lewis’ (2.1), and an intermediate response for ‘Clark’ (3.0). Ratings for ‘Yamhill’ and ‘Barcelona’ were not significantly different [least significant difference (0.05) = 0.6]. Blasted buds are very rare on ‘Yamhill’, so chemical applications to control bud mite are unnecessary.

‘Yamhill’ layers generally root easily and abundantly. Rooted layers are easy to handle in the nursery and are less vigorous and smaller in height and caliper than those of ‘Barcelona’. Scions of ‘Yamhill’ were first distributed to nurseries in Jan. 1998 to allow propagation in advance of release. Information on its performance was provided to nurseries annually until release in Jan. 2008. In vitro cultures were first established in 1999 as part of a project funded by the Oregon Hazelnut Commission to demonstrate the feasibility of micropropagation (Bill Proebst-

ing and Luigi Meneghelli, unpublished data). The study indicated that micropropagation of hazelnut was feasible and that multiplication rates for ‘Yamhill’ were acceptable. Cultures were made available to private companies for micropropagation on a commercial scale. Several orchards have been established in the Willamette Valley using micropropagated trees.

Availability

‘Yamhill’ was released as a public cultivar and may be propagated in the United States without restriction. A list of micropropagators and nurseries, and small quantities of scion wood, may be obtained from S.A. Mehlenbacher.

Literature Cited

Coyne, C.J., S.A. Mehlenbacher, R.O. Hampton, J.N. Pinkerton, and K.B. Johnson. 1996. Use of

ELISA to rapidly screen hazelnut for resistance to eastern filbert blight. *Plant Dis.* 80:1327–1330.

Lunde, C.F., S.A. Mehlenbacher, and D.C. Smith. 2000. Survey of hazelnut cultivars for response to eastern filbert blight inoculation. *HortScience* 35:729–731.

McArthur, L.A. and L.L. McArthur. 2003. Oregon geographic names. Oregon Historical Society Press, Portland, OR.

Mehlenbacher, S.A. 1997. Testing compatibility of hazelnut crosses using fluorescence microscopy. *Acta Hort.* 445:167–171.

Mehlenbacher, S.A., A.N. Azarenko, D.C. Smith, and R.L. McCluskey. 2007. ‘Santiam’ hazelnut. *HortScience* 42:715–717.

Mehlenbacher, S.A., R.N. Brown, J.W. Davis, H. Chen, N.V. Bassil, D.C. Smith, and T.L. Kubisiak. 2004. RAPD markers linked to eastern filbert blight resistance in *Corylus avellana*. *Theor. Appl. Genet.* 108:651–656.

Mehlenbacher, S.A. and D.C. Smith. 2004. Hazelnut pollenizers ‘Gamma’, ‘Delta’, ‘Epsilon’ and ‘Zeta’. *HortScience* 39:1498–1499.