‘PollyO’ Hazelnut

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PollyO is a new hazelnut (Corylus avellana L.) cultivar for the blanched kernel market. It was released by the Oregon Agricultural Experiment Station Jan. 2018 as a complement to ‘McDonald’ and ‘Wepster’, and an alternative to ‘Yamhill’. It resembles a high level of resistance to eastern filbert blight (EFB) caused by the fungus Anisogramma anomala (Peck) E. Müller with high nut yield, small to medium nut size, high kernel percentage, early nut maturity, excellent kernel quality, and a vigorous tree. ‘PollyO’ is recommended for Oregon’s Willamette Valley and other areas with a similar climate.

Origin and Evaluation

‘PollyO’, tested as OSU 1108.001, resulted from a cross of two numbered selections in the Oregon State University (OSU) breeding program. The cross of OSU 684.104 × OSU 669.104 was made in 2001 by Shawn A. Mehlenbacher and David C. Smith (Fig. 1). The female parent, OSU 684.104, is from a cross of Birk 5-39 and ‘Mortarella’. Birk 5-39, an OSU selection grown in a small plot at Birkemeier Farms near Canby, OR, is from a cross of OSU 14.084 ('Barcelona' × ‘Daviana’) and ‘Negret’. The male parent, OSU 669.104, is a full sib of the pollenizer ‘Zeta’. OSU 669.104 carries a dominant allele for a very high level of resistance to EFB from the grower selection ‘Zimmerman’. Microsatellite marker analysis indicated that ‘Zimmerman’ is from a cross of ‘Barcelona’ and the EFB-resistant pollenizer ‘Gasaway’ (Gökirmak et al., 2009). The pedigree of ‘PollyO’ includes germplasm from Spain (‘Barcelona’, ‘Casina’, and ‘Negret’), Italy (‘Mortarella’ and ‘Montebello’), and England (‘Daviana’). ‘PollyO’ joins other EFB-resistant cultivars released by OSU (‘Dorris’, ‘Jefferson’, ‘McDonald’, ‘Yamhill’, and ‘Wepster’) (Mehlenbacher et al., 2009, 2011, 2013, 2014, 2016).

Table 1. Nut yield, trunk cross-sectional area (TCA), and yield efficiency of ‘PollyO’ in comparison with other hazelnut cultivars and selections in two trials in Corvallis, OR, and harvested in years 3 to 7 after planting.

| Selection | Yr 3 | Yr 4 | Yr 5 | Yr 6 | Yr 7 | Total | TCA (cm²) | Yield efficiency (kg cm⁻²) |
|-----------|------|------|------|------|------|-------|-----------|---------------------------|
| OSU 1014.058 | 0.56 | 2.35 | 3.21 | 5.49 | 5.60 | 17.21 | 93.9 | 0.186 |
| OSU 1086.053 | 0.38 | 1.59 | 2.59 | 6.57 | 4.39 | 15.52 | 105.4 | 0.148 |
| OSU 1086.145 | 0.17 | 2.37 | 3.77 | 8.22 | 6.39 | 20.91 | 130.6 | 0.160 |
| OSU 1154.027 | 0.13 | 2.21 | 4.62 | 6.58 | 6.95 | 20.49 | 111.3 | 0.184 |
| Jefferson | 0.40 | 2.59 | 3.01 | 5.94 | 4.98 | 16.91 | 80.3 | 0.210 |
| PollyO | 0.18 | 2.24 | 4.48 | 9.99 | 6.57 | 23.46 | 117.6 | 0.258 |
| Yamhill | 0.43 | 2.44 | 4.19 | 8.14 | 6.50 | 21.69 | 84.4 | 0.255 |
| LSD (0.05) | 0.14 | 0.43 | 0.66 | 1.10 | 0.97 | 2.10 | 11.0 | 0.021 |

LSD = least significant difference.

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“PollyO” was 0.251 kg and differences in tree size. Yield efficiency of the ratio of nut yield to TCA, adjusts yield for mean total nut yield over 4 years (2013–16) and manage in an orchard. In the first trial, should be easy to train as single-trunk trees have a globose growth habit (Fig. 2). Trees of ‘PollyO’ are vigorous and ‘Jefferson’ trees is favored by Oregon growers. ‘PollyO’ are vigorous and have a globose growth habit (Fig. 2) that should be easy to train as single-trunk trees and manage in an orchard. In the first trial, mean total nut yield over 4 years (2013–16) was 29.4 kg for ‘PollyO’ compared with 24.3 kg for ‘Jefferson’ (Table 1). Yield efficiency, the ratio of nut yield to TCA, adjusts yield for differences in tree size. Yield efficiency of ‘PollyO’ was 0.251 kg·cm⁻², which is not significantly different from ‘Jefferson’ (0.261 kg·cm⁻²). In the second trial (Table 1), mean total nut yield over 5 years (2013–2017) was 23.5 kg for ‘PollyO’ and significantly higher than ‘Jefferson’ (16.9 kg), whereas yield efficiency of ‘PollyO’ (0.201 kg·cm⁻²) was not significantly different from ‘Jefferson’ (0.210 kg·cm⁻²).

Samples of 100 nuts were cracked from each tree in each year of the trials, 2013–16 in the first trial and 2013–17 in the second, and evaluated, and no problems with defects were noted. In both trials (Table 2), ‘PollyO’ showed a high percentage of good nuts, and low percentages of blanks, brown stain, poorly filled nuts, twins, and kernels with black tips. In the first trial, the frequency of moldy kernels (2.6%) was similar to ‘Yamhill’ and lower than ‘Jefferson’. In the second trial, the frequency of moldy kernels (3.4%) was similar to ‘Jefferson’ (4.3%). Kernel percentage (the ratio of kernel weight to nut weight) for ‘PollyO’ was 47.9% in the first trial based on well-filled nuts, and 46.9% in the second trial based on field-run nuts (Table 3). In the same trials, the kernel percentage for ‘Jefferson’ was 45.7% and 44.4%, respectively. In the two trials, nut yields of ‘PollyO’ were consistently good and the nuts consistently well-filled. In contrast, ‘Yamhill’ trees occasionally set very heavy nut crops, and the nuts in those years can be so poorly filled that the kernels are not marketable. This was the case for ‘Yamhill’ in the final year of the first trial, when 27% of the nuts were poorly filled.

‘PollyO’ is being released for the blanched kernel market as a companion for ‘Wepster’ and ‘McDonald’, and an alternative to ‘Yamhill’. The nut shape is nearly round and lends itself well to sizing and cracking (Fig. 3). The shells are thin and easy to crack, and most kernels remain whole when the shell is broken. The kernel size of ‘PollyO’ is small (Table 3), similar to ‘McDonald’ but larger than ‘Wepster’ and ‘Yamhill’. The amount of fiber on the pellicle was rated on a scale of 1 (no fiber) to 4 (heavy fiber). Raw kernels of ‘PollyO’ have fibrous pellicles (mean rating of 3.3) and thus are not particularly attractive. Pellicle removal (blanching) is rated on a scale of 1 (complete pellicle removal) to 7 (no pellicle removal), with ratings <4.0 being desired. Most of the pellicle on ‘PollyO’ kernels is removed from the kernels with dry heat in the blanching process. Mean ratings were 3.7 and 3.5 in the first and second trials, respectively, which is better than ‘Yamhill’ (ratings of 5.0 and 5.1) and ‘Jefferson’ (ratings of 4.3 and 4.6). Blanching removes approximately half of the pellicle from ‘Barcelona’ kernels. Kernel texture, flavor, and aroma have been evaluated by members of the hazelnut breeding team, the Oregon Hazelnut Commission, and growers attending plot tours. Tasters

**Table 2. Frequency of good nuts, and of nut and kernel defects in ‘PollyO’ and other hazelnut cultivars and selections in two trials planted in Corvallis, OR.**

| Selection | Good | Blanks | Brown stain | Moldy | Shrivels | Poor fill | Twins | Black tips |
|-----------|------|--------|-------------|-------|----------|-----------|-------|------------|
| First trial (n = 4) planted in 2010 | | | | | | | | |
| OSU 1069.092 | 81.6 | 3.3 | 0.6 | 4.1 | 2.2 | 6.4 | 1.8 | 0.4 |
| OSU 1085.066 | 78.5 | 3.4 | 0.3 | 4.9 | 1.1 | 11.3 | 0.4 | 0.9 |
| OSU 1086.145 | 73.9 | 9.0 | 0.3 | 9.0 | 1.3 | 4.9 | 0.9 | 1.6 |
| Gamma | 75.4 | 7.6 | 1.3 | 5.4 | 0.9 | 8.3 | 0.1 | 0.3 |
| Jefferson | 73.7 | 4.0 | 0.2 | 6.1 | 0.6 | 13.3 | 0.9 | 2.1 |
| PollyO | 83.4 | 4.0 | 0.1 | 2.6 | 1.5 | 8.6 | 0.1 | 0.1 |
| Yamhill | 74.2 | 2.2 | 0.3 | 2.7 | 3.9 | 16.8 | 0.1 | 0.1 |
| LSD (0.05) | 6.8 | 2.8 | 1.2 | 2.4 | 1.8 | 5.1 | 0.9 | 0.7 |
| Second trial (n = 7) planted in 2011 | | | | | | | | |
| OSU 1014.058 | 96.0 | 1.2 | 0.0 | 1.9 | 0.4 | 0.1 | 0.2 | 0.2 |
| OSU 1086.053 | 89.1 | 6.1 | 0.0 | 4.3 | 0.2 | 0.2 | 0.2 | 0.1 |
| OSU 1086.145 | 87.8 | 6.0 | 0.0 | 3.6 | 0.8 | 0.6 | 0.6 | 0.7 |
| OSU 1154.027 | 95.0 | 2.1 | 0.1 | 1.5 | 0.5 | 0.1 | 0.5 | 0.2 |
| Jefferson | 89.0 | 3.9 | 0.1 | 4.3 | 0.4 | 0.0 | 0.6 | 1.7 |
| PollyO | 93.0 | 2.5 | 0.1 | 3.4 | 0.3 | 0.3 | 0.1 | 0.4 |
| Yamhill | 95.6 | 1.6 | 0.1 | 1.7 | 0.7 | 0.1 | 0.1 | 0.1 |
| LSD (0.05) | 2.2 | 1.4 | 0.3 | 1.1 | 0.5 | 0.3 | 0.4 | 0.5 |

*Means of years 4–7 in the first trial and years 3–7 in the second trial, 100 nuts per tree per year. LSD = least significant difference.

Fig. 2. Tree of ‘PollyO’ hazelnut in December, seventh leaf. The wooden pole is 3.05 m tall.
Table 3. Nut and kernel weight, percent kernel and ratings for fiber, blanching and bud mite susceptibility for ‘PollyO’ and other hazelnut cultivars and selections in two trials planted in Corvallis, OR.

| Selection      | Nut wt* (g) | Kernel wt* (g) | Kernel percentage^ | Fiber* | Blanching* | Bud mite* |
|----------------|-------------|----------------|--------------------|--------|------------|-----------|
| First trial (n = 4) planted in 2010 |
| OSU 1069.092   | 3.20        | 1.47           | 45.93              | 2.66   | 5.59       | 1.13      |
| OSU 1085.066   | 3.40        | 1.45           | 42.70              | 1.44   | 2.97       | 1.94      |
| OSU 1086.145   | 2.60        | 1.26           | 48.60              | 1.61   | 4.03       | 2.35      |
| Gamma          | 2.48        | 1.29           | 51.90              | 3.09   | 6.28       | 2.96      |
| Jefferson      | 3.65        | 1.67           | 45.70              | 3.00   | 4.34       | 1.34      |
| PollyO         | 2.88        | 1.38           | 47.90              | 3.28   | 3.66       | 1.15      |
| Yamhill        | 2.32        | 1.10           | 47.11              | 1.25   | 5.00       | 1.10      |
| LSD (0.05)     | 0.16        | 0.07           | 0.94               | 0.26   | 0.29       | 0.26      |
| Second trial (n = 7) planted in 2011 |
| OSU 1014.058   | 2.31        | 1.05           | 45.6               | –      | 4.7        | –         |
| OSU 1086.053   | 2.58        | 1.11           | 43.2               | –      | 3.7        | –         |
| OSU 1086.145   | 2.38        | 1.12           | 46.7               | –      | 4.4        | –         |
| OSU 1154.027   | 2.34        | 1.06           | 45.4               | –      | 4.9        | –         |
| Jefferson      | 3.45        | 1.53           | 44.4               | –      | 4.6        | –         |
| PollyO         | 2.75        | 1.29           | 46.9               | –      | 3.5        | –         |
| Yamhill        | 2.28        | 1.04           | 45.8               | –      | 5.1        | –         |
| LSD (0.05)     | 0.15        | 0.03           | 0.8                | –      | 0.3        | –         |

^Means for weights of nuts and kernels are over 4 years (years 4–7) in the first trial and 5 years (years 3–7) in the second trial. Well-filled nuts were measured in the first trial, and field-run nuts were measured in the second trial.

*Kernel percentage = (Nut wt/Kernel wt)*100.

*Amount of fiber on the pellicle was rated in the first trial from 1 (none) to 4 (much).

*Blanching was rated from 1 (complete pellicle removal) to 7 (no pellicle removal) after roasting for at least 130 °C for 15 min.

*Susceptibility to bud mite (primarily Phytophthora avellanae Nal.) was rated on four trees of each selection in the first trial on a scale of 1 (no blotched buds) to 5 (many blotched buds). Mean ratings from 5 years (2013–17). LSD = least significant difference.

Fig. 3. Nuts, blanched kernels, and raw kernels of ‘Barcelona’ (left) and ‘PollyO’ (right) hazelnuts.

considered kernel quality to be excellent, well-suited for use in baked goods and chocolate products, and worthy of a premium price in the market. Major chocolate makers prefer kernels 11 to 13 mm in diameter, and most ‘PollyO’ kernels are in this size range.

‘PollyO’ nuts are borne in clusters of three to four in husks that are ≈25% longer than the nuts (Fig. 4). The husks are slit down the side, and flare open as they dry at maturity. Approximately 92% of the nuts fall free of the husk at maturity (range 85% to 97%). Any nuts remaining in the husk would likely come out as they moved through a harvesting machine. When mature, the shells are light tan in color. Nuts in the first trial were hand-harvested, with the date and the percentage of nuts on the ground (as opposed to in the tree) recorded. To more precisely estimate nut maturity, four trees each of ‘PollyO’, ‘Jefferson’, and ‘Yamhill’ and ‘Barcelona’ were harvested by hand at weekly intervals in the final year of the first trial (2016). ‘PollyO’ nuts drop a few days earlier than ‘Yamhill’ and 10 to 14 d sooner than ‘Barcelona’. Compared with ‘Barcelona’, average harvest dates are ≈14 d earlier for ‘McDonald’, 10 d earlier for ‘Yamhill’, and 7 d earlier for ‘Wepster’, whereas ‘Jefferson’ nuts mature with ‘Barcelona’ or up to 3 d later. Many handlers offer premiums for early delivery, and ‘PollyO’ nuts would easily qualify for these premiums. Early harvest before the fall rains begin results in lower drying costs and higher nut quality.

‘PollyO’ has incompatibility alleles S2 and S10 as determined by fluorescence microscopy. Both alleles are expressed in the females, but only S10 is expressed in the pollen because of dominance. By convention, alleles expressed in the pollen are underlined. ‘PollyO’ trees set a moderate to high amount of catkins that shed copious amounts of pollen. Pollen has been collected and used in several controlled pollinations, and both quantity and viability appear to be very good. ‘PollyO’ pollen germinated well on agar plates (85% in 2014, 81% in 2015, and 48% in 2017), in contrast to ‘Barcelona’ (36%, 36%, and 40%, respectively). Time of pollen shed and female receptivity were recorded annually from mid-December to mid-March. Female inflorescences of ‘PollyO’ emerged in early midseason and were fully receptive in mid-January, overlapping the period of receptivity of ‘McDonald’, ‘Wepster’, ‘Yamhill’, and the pollinizer ‘York’. Time of pollen shed peaks in the first half of February, ≈10 days later than the other four cultivars. There would be good overlap between female receptivity and pollen shed for any combination of these five cultivars, which are also cross-compatible in all combinations and directions. Many orchard designs are possible using ‘PollyO’ (S2 S10), ‘McDonald’ (S2 S10), and ‘Wepster’ (S1 S2). Inclusion of a few trees of the pollinizer ‘York’ (S2 S12) is also recommended. ‘Yamhill’ (S9 S26) is also a suitable pollinizer for ‘PollyO’, but its tree is lower in vigor and its kernels do not blanch as well. Pollen of ‘Felix’ (S15 S12) and ‘Théa’ (S2 S12) is also compatible but they shed pollen too late to be effective pollinizers for ‘PollyO’. Pollen of ‘Jefferson’ (S1 S2) is also compatible on ‘PollyO’ females, but ‘Jefferson’ females emerge very late in the season, after most of the ‘PollyO’ pollen has been shed. Furthermore, ‘Jefferson’ has large nuts for the in-shell market, whereas all of the
Barcelona’ (S1 S2) because it expresses S2. The planting of at least three suitable pollenizers in an orchard is recommended. Pollenizers that shed pollen at different times during the period that female inflorescences are receptive increase the likelihood that the females will be pollinated. Inclusion of ‘McDonald’ and ‘Wepster’ as companion cultivars in the orchard would result in no loss in nut yield, and they could be planted in adjacent rows. The inclusion of pollenizers with a high level of EFB resistance would eliminate the need for fungicide control in the entire orchard.

Based on DNA marker data, ‘PollyO’ has a very high level of resistance to EFB conferred by a dominant allele from ‘Gasaway’ through the grower selection ‘Zimmerman’. RAPD markers 152,800 and 268,580 that flank the resistance allele in ‘Gasaway’ (Mehlenbacher et al., 2004) are present in ‘PollyO’. During the trials, a nearby heavily infected commercial orchard provided high EFB disease pressure on all plantings. No cankers were observed on the 11 trees of ‘PollyO’ in the yield trials, but were noted on adjacent trees of susceptible genotypes. To date, ‘PollyO’ has been challenged only with the Oregon isolate of the EFB fungus, and it may not be resistant when challenged with different isolates. Simple sequence repeat markers indicate genetic diversity in isolates in the eastern United States, but little diversity among isolates collected in Oregon (Muehlbauer et al., 2019).

Susceptibility to bacterial blight caused by Xanthomonas arboricola pv. coryli is not the same. The scale was from 1 (no blasted buds) to 5 (many blasted buds), with chemical control considered unnecessary for cultivars with a mean rating <3.3. The average ratings indicate high resistance for ‘PollyO’ (1.15) and ‘Jefferson’ (1.34), and an intermediate rating for ‘Gamma’ (2.96). Chemical applications should not be necessary to control bud mite on ‘PollyO’.

In general, layers are medium in caliper and moderately well-rooted, and are lower in vigor and caliper than those of ‘Jefferson’ and ‘Barcelona’. ‘PollyO’ was planted and observed in a few grover orchards under Material Transfer Agreements, and growers and nursery representatives were shown trees, nuts and kernels of ‘PollyO’ and other cultivars and selections during annual tours at the research farm. In vitro cultures were established and distributed to the private sector for commercial-scale increase by micropropagation.

Availability

OSU has filed an application for a U.S. Plant Patent for ‘PollyO’. Interested nurseries should contact the Office for Commercialization and Corporate Development, 312 Kerr Administration Building, Oregon State University, Corvallis, OR 97331–2140. Licensing agreements will be issued to nurseries in the United States on a nonexclusive basis, with sales limited to the United States. Nurseries in other countries interested in an exclusive licensing agreement for a specified geographic area should contact OSU. Nurseries in other countries may not sell trees during the 4 years after the release date. The licenses specify the per-tree royalty. Information and small quantities of scion wood for research purposes may be obtained from S.A. Mehlenbacher.

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Fig. 4. Nuts and husks of ‘PollyO’ hazelnut.