‘Sacajawea’ Hazelnut
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‘Sacajawea’ is a new hazelnut (Corylus avellana L.) cultivar for the kernel market. It combines a high level of quantitative resistance to eastern filbert blight caused by the fungus Anisogramma anomala (Peck) E. Müller with excellent kernel quality and acceptable nut yields. Compared with Oregon’s leading cultivar, ‘Barcelona’, ‘Sacajawea’ has slightly smaller trees, slightly higher nut yield efficiency, earlier nut maturity, higher percentage of kernel (the ratio of kernel to nut weight), and better pellicle removal ratings. The excellent kernel quality is comparable to the best Italian cultivars.

Origin

‘Sacajawea’ is the result of a cross of OSU 43.091 × ‘Sant Pere’ made in 1990 by Shawn A. Mehlenbacher and David C. Smith. ‘Sant Pere’, a minor cultivar from Tarragona (Spain) with very early nut maturity, was described by Tasias-Valls (1975). We believe that OSU 43.091 resulted from self-pollination of ‘Montebello’, which is partially self-compatible (Mehlenbacher and Smith, 1991). Alternatively, the pollen parent of OSU 43.091 might be an unknown cultivar or OSU selection. ‘Montebello’, a Sicilian cultivar, was described by Manzo and Tamponi (1982) and is grown under many synonyms, including ‘Nocchione’, ‘Nostrale’, ‘Comune di Sicilia’, ‘Siciliana’, and ‘Santa Maria del Gesù’.

Hybrid seeds from the cross OSU 43.091 × ‘Sant Pere’ were harvested in Aug. 1990, stratified, and the resulting seedlings grown in the greenhouse during the summer of 1991. In Oct. 1991, 135 seedlings from this cross were planted in the field. The location designation OSU 540.130 for ‘Sacajawea’ indicates the row and tree within the row of the original seedling. A few nuts were first observed on the original seedling in Sept. 1994 but were not harvested. Nuts were harvested and evaluated in each of the next 4 years. The selected tree was propagated by tioff layerage of the suckers in the summer of 1997. The resulting rooted layers were lined out in a nursery row in 1998 and used to plant a replicated yield trial in the spring of 1999 at the Smith Horticulture Research Farm in Corvallis.

Description

Trees of ‘Sacajawea’ were ≈86% of the size of the vigorous standard ‘Barcelona’ and larger than ‘Lewis’ (65%) and ‘Clark’ (59%) as measured by trunk cross-sectional area, 30 cm above the soil line, at the end of the seventh growing season (Dec. 2005) (Table 1). They have a desirable globose growth habit that should be easy to manage in a commercial orchard, but occasional pruning will be necessary to allow sunlight to penetrate the canopy. Total nut yield per tree (third to seventh leaf) was 15.1 kg for ‘Sacajawea’ versus 16.1 kg for ‘Barcelona’ or 93.9% of the control. Yield efficiency, which adjusts for differences in tree size by dividing yield by trunk cross-sectional area, was slightly higher for ‘Sacajawea’ (0.147 kg cm⁻²) than for ‘Barcelona’ (0.136 kg cm⁻²), or 108.5% of the control. Slightly closer spacing of trees in the orchard would be appropriate to take advantage of the higher yield efficiency. Because kernel percentage (the ratio of kernel weight to nut weight) (Table 2) is considerably higher for ‘Sacajawea’ (52%) than ‘Barcelona’ (43%), yields of kernels per acre would be higher than for ‘Barcelona’.

The nuts of ‘Sacajawea’ are borne in clusters of two to three in husks equal in length to the nuts. The husks are split down the side and ≈97% of the nuts fall free at maturity. The nuts are ready to be mechanically harvested 10 to 14 d before ‘Barcelona’, or approximately the third week in September in Corvallis, OR. The earlier maturity is a significant improvement, because in most years, harvest of ‘Sacajawea’ will be completed before the start of the rainy season, which coincides with the beginning of the ‘Barcelona’ harvest.

‘Sacajawea’ is being released for the kernel market, although it may also be accepted for the in-shell market. The nuts and kernels are smaller than ‘Barcelona’ but larger than ‘Clark’ and slightly larger than ‘Lewis’ (Table 2). Chocolate makers prefer kernels 11 to 13 mm in diameter; kernels of ‘Clark’ and ‘Tonda Gentile delle Lange’ are of this size. ‘Sacajawea’ kernels are larger, similar to ‘Tonda di Giffoni’ and ‘Tonda Romana’. Raw kernels are attractive and have a light brown pellicle with a small amount of attached fiber (Table 2). More than half of the pellicle is removed from the kernels with dry heat in the blanching process, yielding kernels that are bright white. Blanching ratings have averaged two to three, which is better than ‘Barcelona’ and ‘Lewis’ and similar to ‘Clark’. Kernel texture, flavor, and appearance are worthy of a premium price.

‘Sacajawea’ produces fewer nut and kernel defects than ‘Barcelona’, particularly fewer poorly filled nuts and blinks (shells lacking kernels) (Table 3). The frequency of moldsy kernels is low and similar to ‘Barcelona’. Kernel mold was a problem in 2005 in ‘Lewis’ but was minimal in ‘Sacajawea’.

Incompatibility in the diploid European hazelnut is of the sporophytic type and controlled by a single S-locus with multiple alleles (Mehlenbacher, 1997a). ‘Sacajawea’ has incompatibility alleles S1 and S2 as determined by fluorescence microscopy (Mehlenbacher, 1997b). Both alleles are expressed in the females but only S1 is expressed in the pollen because of dominance. The paternal parent ‘Sant Pere’ has alleles S2 and S20. The maternal parent OSU 43.091 (S1 S1) is listed as a cross of ‘Montebello’ (S1 S2) and the grower selection ‘Compton’ (S2 S3). OSU 43.091 (S1 S1) closely resembles ‘Montebello’, but neither S-allele of ‘Compton’ is present. The alleles of OSU 43.091 are consistent with what would be expected from self-pollination of ‘Montebello’, which is partially self-compatible (Mehlenbacher and Smith, 1991). Alternatively, the pollen parent of OSU 43.091 might be an unknown cultivar or OSU selection.

‘Sacajawea’ trees have a moderate set 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. Female inflorescences of ‘Sacajawea’ emerge early in the season, approximately with ‘Barcelona’. Pollenizers that shed pollen early in or midseason would be suitable. We encourage the planting of three pollinizers that shed pollen at different times during the period that female inflorescences are receptive to increase the likelihood that they will be pollinated. ‘Lewis’ (S1 S2) and ‘Sacajawea’ (S1 S22) are cross-compatible in both directions and could serve as pollenizers for each other. ‘Gamma’ (S1 S15) and ‘Hall’s Giant’ (S1 S13) are also suitable pollenizers. These four (‘Sacajawea’, ‘Lewis’, ‘Gamma’, and ‘Hall’s Giant’) are cross-compatible in all combinations. Pollen of ‘Barcelona’ (S1 S2) and ‘Delta’ (S1 S13) expresses S1 and is thus
incompatible on female inflorescences of 'Sacajawea'.

Two tests have shown 'Sacajawea' to have a high level of quantitative resistance to eastern filbert blight (EFB) (Table 4) caused by the pyrenomycete Antisogromma anomala. A set of potted trees was grown in a lathhouse in 2000 and placed under a structure topped with diseased wood in the spring of 2001 as described by Pinkerton et al. (1993). A second set was exposed in 2002. Cankers were counted and measured after exposure to EFB and the amount of disease expressed as total canker length per tree. A square root transformation was used to make the variances more similar. Control cultivars were included: 'Daviana' (highly susceptible), 'Barcelona' (intermediate), 'Lewis' or 'Hall's Giant' (moderately resistant), and 'Tonda di Giifoni' (highly resistant). Both tests showed that 'Sacajawea' has a level of quantitative resistance comparable to 'Tonda di Giifoni'. 'Sacajawea' does not have the complete resistance of 'Santiam' (OSU 509,064) and is not recommended for areas with high disease pressure. Pruning to remove cankers and fungicide applications are currently used to manage the disease in orchards of 'Barcelona' and other susceptible cultivars and are appropriate for 'Sacajawea' orchards.

Susceptibility 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 Pytotis avellanae Nal.) was rated in the replicated trial in Dec. 2002, 2003, and 2005. The scale was from 1 (no blasted buds) to 5 (many). Averages of ratings in winter 2002, 2003, and 2005.

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Some Oregon handlers offer premiums for early delivery and high kernel percentage. 'Sacajawea' would qualify for both premiums. Handlers may choose to offer additional incentives because of the excellent kernel quality of 'Sacajawea'. Three Italian cultivars command a premium price on the world kernel market because of their kernel quality, and a single tree of each was included in the trial. 'Tonda Gentile delle Langhe' from Piemonte in northern Italy commands a 50% premium but is highly susceptible to bud mites and EFB, and nut yields are low. 'Tonda Romana' from Lazio in central Italy commands a 25% premium. Its nuts are similar to small 'Barcelona' nuts and yield efficiency is similar, but kernels blanch poorly and trees are highly susceptible to EFB. 'Tonda di Giifoni' from Campania in southern Italy commands a 25% premium. Its trees yield well and have very good quantitative resistance to EFB, but kernel mold is a very serious problem. In 2005, 41% of the kernels of 'Tonda di Giifoni' were moldy in contrast to only 3.3% for 'Sacajawea'. 'Sacajawea' has kernel quality that merits a premium price but lacks the deficiencies of these three standard Italian cultivars.

Some year-to-year variation in the ease of rooting and abundance of roots has been noted. Rooted layers are slightly less vigorous and smaller in height and caliper than those of 'Barcelona'. Sions of 'Sacajawea' were distributed to nurseries in Jan. 2005 to
allow propagation of trees in preparation for its release. Tissue cultures were established at OSU (W. Proebsting and L. Meneghelli) in June 2005, and micropropagation is now being practiced on a commercial scale by private companies.

'Sacajawea' was released as a public cultivar and may be propagated without restriction. A list of Oregon hazelnut nurseries and micropropagators, and small quantities of scion wood, are available from the senior author (SM).

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**Table 4. Results of exposing potted hazelnut trees to eastern filbert blight in 2001 and 2002.**

| Exposure     | Selection     | No. of trees exposed | No. of trees infected | Canker length | Parentage                  |
|--------------|---------------|----------------------|-----------------------|---------------|----------------------------|
| Spring 2001  | Daviana       | 12                   | 12                    | 15.04         |                            |
|              | Hall’s Giant  | 12                   | 12                    | 11.60         |                            |
|              | Willamette    | 12                   | 12                    | 9.72          |                            |
|              | OSU 468.029   | 12                   | 11                    | 9.14          | Casina × Mortarella         |
|              | OSU 539.044   | 12                   | 12                    | 7.72          | OSU 275.031 × Sant Pere     |
|              | OSU 577.060   | 12                   | 12                    | 6.96          | T. di Giffoni × Clark       |
|              | OSU 614.060   | 12                   | 12                    | 6.82          | Camponica × Clark           |
|              | OSU 574.056   | 12                   | 12                    | 6.35          | Willamette × OSU 54.060     |
|              | Sacajawea     | 11                   | 9                     | 6.25          | OSU 43.091 × Sant Pere       |
|              | OSU 539.031   | 12                   | 11                    | 6.04          | OSU 275.031 × Sant Pere      |
|              | Tonda di Giffoni | 11                | 10                    | 5.10          |                            |
|              | LSD (0.05)    | —                    | —                     | 1.85          |                            |
| Spring 2002  | Daviana       | 12                   | 12                    | 12.46         |                            |
|              | Willamette    | 7                    | 7                     | 7.95          |                            |
|              | Lewis         | 12                   | 11                    | 6.38          |                            |
|              | Barcelona      | 6                    | 6                     | 6.14          |                            |
|              | OSU 666.064   | 12                   | 11                    | 4.95          | OSU 342.019 × Mortarella    |
|              | OSU 645.003   | 11                   | 9                     | 4.90          | OSU 245.098 × Mortarella    |
|              | Sacajawea     | 12                   | 5                     | 2.69          | OSU 43.091 × Sant Pere      |
|              | Tonda di Giffoni | 12             | 9                     | 2.57          |                            |
|              | LSD (0.05)    | —                    | —                     | 1.78          |                            |

*Sixty-six genotypes were exposed in both trials. Cankers were measured in December, ~20 months after exposure. Least squares means were calculated for square root of total canker length per tree. Number of potted trees exposed, number infected, and parentage are also shown.

*Six Barcelona trees died after the 2002 exposure from causes other than eastern filbert blight.

LSD = least significant difference.