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Mehlenbacher et al.

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(54) ***CORYLUS* PLANT NAMED 'OSU 541.147'**

(50) Latin Name: ***(Corylus americana* x *Corylus avellana)* x *Corylus avellana cultivar***
Varietal Denomination: **OSU 541.147**

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USPC **Plt./152**

(58) **Field of Classification Search**
USPC Plt./216, 152
See application file for complete search history.

(56) **References Cited**

PUBLICATIONS

Molnar et al. 2010. Survey of *Corylus* Resistance to Anisogramma anomala from different geographic locations. HortScience 45(5) 832-836. (Year: 2010).*

Molnar, Thomas J., "Genetic Resistance to Eastern Filbert Blight in Hazelnut (*Corylus*)," Dissertation, New Brunswick, NJ, Rutgers, The State University of New Jersey, 2006 (121 pages).

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(57) **ABSTRACT**

A new and distinct interspecific hybrid *Corylus* plant named 'OSU 541.147' characterized by a vigorous, upright growth habit, the production of nuts with round kernels that fall free of the husk at maturity, and resistance to eastern filbert blight caused by the fungus *Anisogramma anomala* (Peck) E. Müller.

8 Drawing Sheets

Specification includes a Sequence Listing.

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This invention was made with government support under 2016-51181-25412 awarded by USDA-National Institute of Food and Agriculture, under 58-5358-4-025 awarded by USDA-Agricultural Research Service, and under 18-13-202 awarded by USDA-Agricultural Marketing Service. The government has certain rights in the invention.

Botanical denomination: (*Corylus americana* x *Corylus avellana*) x *Corylus avellana* cultivar.

Variety designation: 'OSU 541.147'.

PARTIES TO JOINT RESEARCH AGREEMENT

Oregon State University, Rutgers, the State University of New Jersey, Board of Regents of the University of Nebraska, and Arbor Day Foundation executed a Joint Research Agreement on or before the date subject matter disclosed and claimed by the present application was made, and such subject matter was made as a result of activities undertaken within the scope of the Joint Research Agreement.

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BACKGROUND

The present invention relates to a new and distinct cultivar of hybrid *Corylus* plant, botanically known as (*Corylus americana* x *Corylus avellana*) x *Corylus avellana*, and hereinafter referred to by the name 'OSU 541.147'.

The new *Corylus* plant resulted from a controlled cross of the female parent 'NY 616' (*Corylus americana* 'Rush' x *Corylus avellana* 'Barcelona') (unpatented) x male parent *Corylus avellana* 'OSU 226.118' (unpatented) made in February 1990 (FIG. **1**). Hybrid seeds resulting from the cross were harvested in August 1990. They were provided a period of moist chilling, subsequently germinated, and the seedlings were grown in the greenhouse during the summer of 1991. From this cross, a total of 125 seedling trees were planted in a research field in Corvallis, Oreg., in October 1991. 'OSU 541.147' was discovered and selected as a single plant within that progeny of the stated cross-pollination. It was originally assigned the designation 'OSU 541.147', which indicates the row and tree location of the original seedling.

The female parent is a tree labeled 'NY 616' in row M and tree 1 (M01) in the variety plot in Corvallis, Oreg. It is an unpatented F_1 *Corylus americana* x *Corylus avellana* selec-

tion developed in New York from a cross of *Corylus americana* 'Rush' x *C. avellana* 'Barcelona' (Slate, 1930). 'Rush' is a *Corylus americana* selection from southeastern Pennsylvania. 'Barcelona' is an old *Corylus avellana* cultivar from Spain that is widely distributed in Europe and was introduced in the U.S. in about 1885 (Mehlenbacher and Miller, 1989). 'Barcelona' is more than 200 years old and is known under several different names, including 'Castanyera' in Tarragona (Spain), 'Grande' in Asturias (Spain), 'Grada de Viseu' in Portugal, and 'Fertile de Coutard' in France. The female parent contributed incompatibility allele S_{23} to 'OSU 541.147' (Table 1). 'Rush' carries a dominant allele for eastern filbert blight resistance on linkage group 7 (Bhattarai et al., 2017; Coyne et al., 1998).

TABLE 1

Incompatibility alleles of the NY hybrid hazelnuts developed in Geneva, New York, and the *Corylus avellana* parents. Also shown are the field locations at the USDA National Clonal Germplasm Repository. 'NY 616', the parent of 'OSU 541.147', carried S_{23}.

Selection	S-alleles	Location	Listed Parentage
'Buchanan' (unpatented)	12 15	N02.53	'Rush' × 'Barcelona'
'Reed' (unpatented)	12 15	N14.13	'Rush' × 'Hall's Giant'
'Potomac' (unpatented)	5 12	N01.53	'Rush' × 'DuChilly'
'NY 104' (unpatented)	14 23	N05.42	'Rush' × 'DuChilly'
'NY 110' (unpatented)	10 12	N02.42	'Rush' × 'DuChilly'
'NY 200' (unpatented)	15 23	N02.44	'Rush' × 'Hall's Giant'
'NY 398' (unpatented)	15 23	N04.22	'Rush' × 'Red Lambert'
'NY 485' (unpatented)	12 14	N03.28	'Rush' × 'DuChilly'
'NY 529' (unpatented)	3 12	N04.28	'Rush' × 'Daviana'
'NY 588' (unpatented)	15 23	N01.30	'Rush' × 'Red Lambert'
'NY 616' (unpatented)	1 23	N04.47	'Rush' × 'Barcelona'
'NY 1329' (unpatented)	3 23	N03.24	'Rush' × 'Cosford'
'NY 1408' (unpatented)	11 23	N02.24	'Rush' × 'Cosford'
'NY 1464' (unpatented)	11 23	N01.28	'Rush' × 'Cosford'
'NYF-20' (unpatented)	14 25	N02.22	'NY 157' o.p.
'NYF-45' (unpatented)	12 ?	N05.47	'Snyder' × 'NY 485'
'Barcelona' (unpatented)	1 2		possibly was 'Gustav's Zeller'
'Cosford' (unpatented)	3 11		
'DuChilly' (unpatented)	10 14		syn. 'Italian Red'
'Hall's Giant' (unpatented)	5 15		
'Red Lambert' (unpatented)	unknown		
'White Lambert' (unpatented)	5 10		
'Gustav's Zeller' (unpatented)	15 20		
'Rush' (unpatented)	12 23		by exam of progeny

The male parent 'OSU 226.118' is an unreleased selection.

'OSU 541.147' was asexually reproduced by rooted suckers in 1997 through 2006 in Corvallis, Oreg. The unique features of this new *Corylus* are stable and reproduced true-to-type in successive generations of asexual reproduction.

SUMMARY

The following traits have been observed and are determined to be the unique characteristics of 'OSU 541.147'. These characteristics in combination distinguish 'OSU 541.147' as a distinct cultivar:

1. Vigorous and upright plant habit.
2. Green to dark-green color of developing and fully expanded leaves during the spring and summer.
3. High level of resistance to eastern filbert blight (EFB) caused by the fungus *Anisogramma anomala* (Peck) E. Müller. The source of this resistance is from *C. americana* 'Rush' (unpatented; Bhattarai, et al., 2017), which differs from the single dominant allele conferred from 'Gasaway' (unpatented, Mehlenbacher et al., 1991), which protects *Corylus avellana* 'McDonald' (U.S. Plant Pat. No. 28,200, Mehlenbacher et al., 2016), 'Wepster' (U.S. Plant Pat. No. 27,141, Mehlenbacher et al., 2014), 'Dorris' (U.S. Plant Pat. No. 25,022, Mehlenbacher et al., 2014), 'Jefferson' (unpatented, Mehlenbacher et al., 2011a), 'Yamhill' (unpatented, Mehlenbacher et al., 2009), and several other *Corylus avellana* cultivars and pollenizers.
4. Expression of incompatibility alleles S_8 and S_{23} in the styles.

Comparisons in several replicated plantings in Corvallis, Oreg., Cream Ridge, N.J., and East Brunswick, N.J., show that plants of 'OSU 541.147' differed from plants of the *Corylus avellana* cultivars 'Barcelona' (unpatented), 'Tonda di Giffoni' (unpatented), 'Yamhill', 'Jefferson', 'McDonald', 'Wepster' and other cultivars and selections of *Corylus avellana* known to the Inventors, primarily in their response to EFB present in New Jersey, a region where the pathogen is native and highly genetically diverse (Muehlbauer et al., 2019). They also differed in S-alleles, nut size, kernel percentage (ratio of kernel weight to nut weight), frequency of defects (blank nuts, moldy kernels, twin kernels, etc.), time of pollen shed, and length of the husk or involucre. For example:

Eastern filbert blight response in New Jersey: In a multi-year trial in East Brunswick, N.J., 'OSU 541.147' showed no eastern filbert blight compared to the proportion of EFB-diseased wood across the canopy calculated to be 20.4% for 'Yamhill', 31.2% for 'Jefferson', 48.6% for 'Gasaway', and 67.0% for 'Barcelona'.

Pollen shed: 'OSU 541.147' generally sheds pollen in East Brunswick, N.J., a week after 'Ratoli' (unpatented, minor cultivar from Tarragona, Spain), 2-3 days after 'Yamhill' and 'Santiam' (unpatented, Mehlenbacher et al., 2007), and 2-3 days prior to 'Jefferson' and 'Gasaway'. In Corvallis, Oreg., OSU 541.147 sheds pollen between 'McDonald' (U.S. Plant Pat. No. 28,200) and 'PollyO' (U.S. Plant Pat. No. 32,459). 'OSU 541.147'=descriptor-5.

Husk Length: 'OSU 541.147' is 1.6 times nut length, slightly shorter than 'Barcelona', while 'Wepster' is 2.0 times nut length. Husks have glandular trichomes.

'OSU 541.147' produces small kernels that are suitable for the blanched kernel market for use in confections and baked goods. 'OSU 541.147' combines resistance to eastern filbert blight (evaluated against *Anisogramma anomala* present in New Jersey, Oregon, Michigan, New York, Pennsylvania, Massachusetts, Wisconsin, and Minnesota [Molnar et al., 2010a]) with round nuts and kernels and moderately good kernel blanching. The tree is vigorous with an upright habit that produces a desirable orchard tree when pruned to a single stem.

Field observations in Corvallis, Oreg., Cream Ridge, N.J., and East Brunswick, N.J., and results from greenhouse-based inoculations performed in New Brunswick, N.J., indicate that 'OSU 541.147' expresses resistance to EFB caused by the fungus *Anisogramma anomala*. The resistance is conferred by the single dominant allele from *Corylus americana* 'Rush', found on hazelnut linkage group 7 (Bhattarai et al., 2017), which is unlike the cultivars currently grown in Oregon protected by the single dominant 'Gasaway' resistance allele found on linkage group 6 (Mehlenbacher et al., 2006). EFB is now present throughout the

Willamette Valley of Oregon where 99% of the U.S. hazelnut crop is grown and is endemic to the eastern U.S. and southern Canada, where it has severely limited commercial production of European hazelnut. Fungicide applications and pruning to remove cankers are currently used to manage the disease in orchards of 'Barcelona' and other susceptible cultivars in the Pacific Northwestern U.S. 'OSU 541.147' was selected in the Willamette Valley of Oregon and subsequently evaluated in New Jersey and is adapted to the climate in both regions. 'OSU 541.147' is suitable for planting in areas with high EFB disease pressure. It has shown resistance in the eastern U.S. where the EFB fungus is native and genetically diverse (Muehlbauer et al., 2019).

The foregoing and other objects and features of the disclosure will become more apparent from the following detailed description, which proceeds with reference to the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying color photographs illustrate the overall appearance of the new cultivar, showing the colors as true as it is reasonably possible to obtain in colored reproductions of this type. Foliage colors in the photographs may differ slightly from the color values cited in the detailed botanical description which accurately describe the colors of the new *Corylus*.

FIG. **1** shows the pedigree of new cultivar 'OSU 541.147'.

FIG. **2** shows a tree of the new cultivar 'OSU 541.147' hazelnut in July of the seventh leaf pruned to a single trunk.

FIG. **3** shows immature nuts and husks of 'Yamhill', 'OSU 541.147' and 'Barcelona' in July of the seventh leaf.

FIG. **4** shows mature nuts and husks of 'OSU 541.147' growing in New Jersey.

FIG. **5** shows nuts, raw kernels, and blanched kernels of hazelnuts 'Yamhill', 'OSU 541.147' and 'Barcelona'. Top row nuts, rows 2 and 3 raw kernels, rows 4 and 5 blanched kernels.

FIG. **6** shows the time of female receptivity (bottom, red), pollen shed (top, green), and vegetative budbreak of 'OSU 541.147' and other hazelnut cultivars in Corvallis, Oreg. (December 2018-March 2019).

FIG. **7** shows the time of female receptivity (bottom, red), pollen shed (top, green), and vegetative budbreak of 'OSU 541.147' and other hazelnut cultivars in East Brunswick, N.J. (December 2017 to March 2018).

FIG. **8** shows the time of female receptivity (bottom, red), pollen shed (top, green), and vegetative budbreak of 'OSU 541.147' and other hazelnut cultivars in East Brunswick, N.J. (December 2018 to March 2019).

SEQUENCE LISTING

The nucleic acid sequences listed in the accompanying sequence listing are shown using standard letter abbreviations for nucleotide bases as defined in 37 C.F.R. 1.822. Only one strand of each nucleic acid sequence is shown, but the complementary strand is understood as included by any reference to the displayed strand. In the accompanying sequence listing:

SEQ ID NOS: 1-40 are primer sequences that can be used for genetic fingerprinting.

DETAILED DESCRIPTION

The cultivar 'OSU 541.147' has not been observed under all possible environmental conditions. The phenotype may vary somewhat with variations in environment such as temperature and light intensity, without, however, any variance in genotype. The aforementioned photographs and following observations and measurements describe plants grown in East Brunswick, N.J., under commercial practice outdoors in the field during the spring and summer. The plant used for the photographs and description were from a seven-year-old tree propagated by tie-off layerage and growing on its own roots. In the following description, color references are made to The Royal Horticultural Society Colour Chart, 1966 Edition, except where otherwise noted and where general terms of ordinary dictionary significance are used. The list of UPOV descriptors are from the Mar. 28, 1979 Hazelnut guidelines from UPOV.

Botanical classification: *Corylus* cultivar 'OSU 541.147'.

Parentage: Female, or seed, parent is 'NY 616' (*Corylus americana* x *Corylus avellana*). It was selected from a cross of *Corylus americana* 'Rush' x *Corylus avellana* 'Barcelona' (Slate, 1930). 'Rush' is a *Corylus americana* selection from southeastern Pennsylvania. 'Barcelona' is an old *Corylus avellana* cultivar from Spain that is widely distributed in Europe and was introduced in the U.S. in about 1885 (Mehlenbacher and Miller, 1989). 'Barcelona' is more than 200 years old and is known under several different names, including 'Castanyera' in Tarragona (Spain), 'Grande' in Asturias (Spain), 'Grada de Viseu' in Portugal, and 'Fertile de Coutard' in France. 'Rush' has been shown to transmit a dominant allele for resistance to EFB, which has been mapped to a different linkage group than the allele from 'Gasaway'. The 'Rush' allele that protects 'OSU 541.147' has been shown to provide resistance in the presence of multiple populations of the EFB fungus *Anisogramma anomala* (Molnar et al., 2010a, 2019; Bhattarai et al., 2017). Male, or pollen, parent is *Corylus avellana* 'OSU 226.118' (unpatented breeding selection). 'OSU 226.118' is the result of the cross of 'Tombul Ghiaghli' (unpatented, Greek origin) x OSU 42.103 (unpatented). 'OSU 42.103' is the result of a cross of 'Montebello' (unpatented) x 'Compton' (unpatented).

Incompatibility alleles: 'OSU 541.147' has incompatibility alleles S_8 and S_{23}. Hazelnuts are a wind-pollinated, monoecious species that exhibit a sporophytic self-incompatibility system controlled by a single locus designated as the S-locus with 33 alleles (Mehlenbacher, 2014). To develop 'OSU 541.147', branches of 'NY 616' were emasculated and covered to prevent foreign pollen contamination. Controlled pollinations used a mixture of pollens of three breeding selections whose S-alleles were known: 'OSU 55.129' (S_2, S_4), 'OSU 167.002' (S_3, S_{10}) and 'OSU 226.118' (S_1, S_8). Fluorescence microscopy identified the male parent of 'OSU 541.147' (S_8, S_{23}) as 'OSU 226.118' because of the common allele S_8. For comparison, *Corylus avellana* 'Sacajawea' has the alleles S_1 and S_{22}. 'Tonda di Giffoni' has the alleles S_2 and S_{23}, 'Tonda Pacifica' (U.S. Plant Pat. No. 22,715, Mehlenbacher et al., 2011b) and 'Wepster' have alleles S_1 and S_2, and 'McDonald' has alleles S_2 and S_{15}. *Corylus americana* 'Rush' has alleles S_{12} and S_{23}.

Propagation (type rooted suckers):

Time to initiate roots.—About 30 days at 20° C.

Time to produce a rooted young plant.—About six months at 22° C.

Root description.—Fine to thick; freely branching; creamy white in color.

Propagation (type whip grafting):

Time to budbreak on the scions.—About 14 days at 25° C.

Time to produce a grafted plant.—About six months at 25° C.

Plant description (descriptions are from plants grown in New Jersey unless otherwise noted):

General appearance.—Natural habit is perennial shrub, but in commercial orchards, is a single trunk tree. Upright plant habit. See FIG. **2**.

Growth and branching habit.—Freely branching; about 15 lateral branches develop per plant. Pinching, that is, removal of the terminal apices, enhances branching with lateral branches potentially forming at every node.

Vigor.—Vigorous, upright growth habit.

Size.—Plant height is about 3.6 meters; plants grown in Oregon: plant diameter or spread is about 3.2 meters (in July, seventh leaf).

Trunk at 30 cm above the soil line.—In a trial planted in Corvallis, Oreg. in 2014, trunk diameter was 7.90 cm and cross-sectional area was 49 cm^2 in December, 2019. This is slightly smaller than 'Jefferson' in the same trial.

Trunk color.—197B.

Lateral branch description:

Length.—About 20.4 cm. Ranges from 14.0 cm to 26.0 cm.

Diameter.—About 4.3 mm. Ranges from 3.0 mm to 5.0 mm.

Internode length (at base).—About 0.75 cm.

Internode length (at tip).—About 3.6 cm. Ranges from 2.5 cm to 5.0 cm.

Texture.—Smooth, pubescent.

Strength.—Strong.

Color, immature.—143C.

Color, mature.—146B.

Color of previous seasons branches.—199C.

Foliage description:

Arrangement.—Alternate, simple.

Length.—About 9.6 cm. Ranges from 7.5 cm to 11.5 cm.

Width.—About 7.1 cm. Ranges from 6.0 cm to 9.0 cm.

Shape.—Oblong to ovate.

Apex.—Obtuse to acute.

Base.—Cordate.

Margin.—Serrate.

Texture, upper and lower surfaces.—Slightly pubescent.

Venation pattern.—Pinnate.

Color.—Developing foliage — upper surface 144A, lower surfaces, 144B. Fully expanded foliage — upper surface: spring and summer, 137B; late summer and fall, 137B. Fully expanded foliage, lower surface: spring and summer, 137D; late summer and fall, 137D. Venation, upper surface: spring and summer, 145A; late summer and fall, 145A.

Venation, lower surface.—Spring and summer, 145A; late summer and fall, 145A.

Leaf bud description:

Shape.—Globular.

Time of leaf budbreak.—Medium, Descriptor-5. 'OSU 541.147' budbreak is about 8 days before 'Jefferson', four days after 'Yamhill', and concurrent with 'Santiam'.

Color of leaf buds.—145B.

Leaf bud shape (winter).—Ovoid, Descriptor-2.

Leaf bud color (winter).—Reddish green, Descriptor-2.

Petiole description:

Length.—About 9.3 mm. Ranges from 8.0 cm to 15.0 mm.

Diameter.—About 1.8 mm. Ranges from 1.0 mm to 2.0 mm.

Texture, upper and lower surfaces.—Pubescent.

Color of petiole.—143C.

Flower description:

Male inflorescences.—Catkins

Color prior to elongation.—176D.

Catkin length.—31.7 mm.

Female inflorescence style color.—047B.

Time of female flowering.—Medium (January 20 to February 10), Descriptor-5.

Time of female flowering compared to male flowering.—Protogyny, Descriptor-1.

Involucre constriction.—The involucre is not constricted, Descriptor-1.

Involucre length.—1.6 times length of nut, Descriptor-7.

Size of husk indentation.—Medium, Descriptor-7 (similar to 'Negret'), about 50% of husk length.

Strength of serration of indentation.—Medium, Descriptor-5.

Thickness of callus at base.—Thick, Descriptor-7, (similar to 'Barcelona') or about 2 mm.

Pubescence on husk.—Present, Descriptor-9.

Density of hairiness of involucre.—Strong, Descriptor-7.

Jointing of bracts.—On one side, Descriptor-2.

Nut description:

Length.—*Average* 17.4 mm.

Width.—*Average* 17.5 mm.

Depth.—*Average* 14.7 mm.

Nut shape.—Globular, Descriptor-2. See FIG. **5**.

Nut shape index.—(Width+Depth)/2*Length=0.92.

Nut compression index.—(Width/Depth)=1.19.

Nut weight.—2.62 g (in Corvallis, Oreg.).

Kernel weight.—1.16 g (in Corvallis, Oreg.).

Kernel percentage (kernel weight/nut weight).—44.1% (in Corvallis, Oreg.).

Number of fruits per cluster.—Three to four. See FIGS. **3** and **4**.

Nutshell coloration.—165A.

Number of stripes on shell.—Medium (about 20), Descriptor-5.

Shape of fruit apex.—Flat, Descriptor-1.

Prominence of fruit apex.—Slightly prominent, Descriptor-3.

Size of fruit pistil scar on shell.—Medium, Descriptor-5.

Hairiness of top of fruit.—Medium, Descriptor-5.

Curvature of nut basal scar.—Flat, Descriptor-3 (small) and similar to 'Negret'. The raised part of the shell has dimensions 3.3×1.4 mm.

Size of basal scar.—Descriptor-5. Average measurements 14.3×13.4 mm.

Double kernels.—Absent.

Kernel shape.—Globular, Descriptor-2.

Shape of kernel in cross-section.—Circular, Descriptor-2.

Lateral groove in kernel.—Present.

Corkiness of pellicle of kernel.—Slightly corky, Descriptor-3.

Color of the fiber on the kernel.—165A (Royal Horticultural Society Colour Chart Fifth Edition, 2007).

Color of the pellicle under the fiber.—165B (Royal Horticultural Society Colour Chart Fifth Edition, 2007).

Disease/pest resistance: Plants of 'OSU 541.147' are resistant to EFB caused by the fungus *Anisogramma anomala* (Peck) E. Müller. Plants have not been challenged against all populations of *Anisogramma anomala* present in North America (Muehlbauer et al., 2019); however, 'OSU 541.147' has been challenged in field trials and/or greenhouse inoculations with populations from Oregon, New Jersey, Minnesota, Michigan, Massachusetts, New York, and Pennsylvania, and no signs or symptoms of EFB have been observed (Capik and Molnar, 2012; Molnar et al., 2010a). Resistance is derived from its grandparent 'Rush'. 'OSU 541.147' has been trialed in New Jersey since 2002 under high disease pressure with no signs or symptoms of EFB observed (Capik and Molnar, 2012; Molnar et al., 2010a, 2019). In Oregon, all trees of 'OSU 541.147' have remained free of EFB. Fungicide applications are not expected to be needed to control EFB. Susceptibility to bacterial blight caused by *Xanthomonas arboricola* pv. *corylina* has not been quantified, but no trees in the trials in Oregon and New Jersey were affected. Susceptibility to bud mite (*Phytoptus avellanae* Nal.) was rated in trials in Corvallis, Oreg., in mid-December on a scale of 1 (no blasted buds) to 5 (many blasted buds). The average rating for 'OSU 541.147' was 3.5, indicating moderate susceptibility comparable to 'Clark' and 'Gamma' (Table 2). With this rating, chemical control of mites will occasionally be needed. Buds blasted by bud mites have not been observed on 'OSU 541.147' in New Jersey.

TABLE 2

Performance of 17 genotypes in a replicated trial planted in Corvallis in Spring, 2014. Four trees per selection in a randomized complete block design.

Sel		Yield (kg/tree)			
No	Selection	2017	2018	2019	Total
1	'OSU 541.147'	0.37	2.87	4.58	8.00
2	'1250.057'	1.58	2.70	3.70	7.98
3	'1252.068'	0.75	3.46	3.93	8.15
4	'1253.064'	0.77	2.40	2.24	5.41
5	'1292.065'	1.33	2.99	4.83	9.14
6	'1300.073'	1.96	3.33	4.51	9.80
7	'1304.039'	1.78	2.94	3.62	8.35
8	'1307.003'	1.23	3.30	5.06	9.58
9	'1307.055'	1.35	3.93	4.06	9.34
10	'1308.087'	1.15	3.70	4.81	9.65
11	'1310.022'	0.64	2.34	2.16	5.14
12	'1339.074'	1.17	3.89	4.55	9.60
13	'1340.018'	1.25	4.94	4.53	10.71
14	'1341.037'	1.06	2.08	4.72	7.85
15	'Jefferson'	2.39	4.77	4.60	11.75
16	'McDonald'	0.78	3.90	5.86	10.53
17	'Wepster'	2.16	4.59	5.33	12.08
	LSD (0.05)	0.57	0.95	1.14	1.81

TABLE 2-continued

Performance of 17 genotypes in a replicated trial planted in Corvallis in Spring, 2014. Four trees per selection in a randomized complete block design.

Sel No	Selection	Trunk diameter	Trunk TCA	Yield efficiency	Bud mite rating
1	'OSU 541.147'	7.89	49.03	0.164	3.50
2	'1250.057'	8.39	55.29	0.143	1.70
3	'1252.068'	8.42	55.74	0.146	1.80
4	'1253.064'	6.76	35.97	0.151	1.40
5	'1292.065'	7.79	47.80	0.192	3.10
6	'1300.073'	9.24	67.11	0.146	1.00
7	'1304.039'	6.82	36.56	0.229	1.10
8	'1307.003'	8.90	62.34	0.152	1.10
9	'1307.055'	7.71	46.73	0.200	3.10
10	'1308.087'	9.20	66.61	0.144	2.30
11	'1310.022'	7.97	49.99	0.104	1.00
12	'1339.074'	9.04	64.61	0.149	1.10
13	'1340.018'	9.48	70.74	0.151	1.10
14	'1341.037'	11.26	99.64	0.079	2.80
15	'Jefferson'	8.19	52.90	0.222	1.30
16	'McDonald'	9.74	60.07	0.177	2.10
17	'Wepster'	8.63	58.84	0.210	1.60
	LSD (0.05)	0.65	8.78	0.033	1.14

Yield per tree in each year of evaluation and total of 3 years. There were very few nuts in 2016 and they were not harvested.

Trunk diameter in cm, 30 cm above the soil line, calculated from circumference.

TCA = Trunk cross-sectional area in cm^2, calculated from circumference 30 cm above the soil line.

Yield efficiency is the ratio of total yield per tree divided by trunk cross-sectional area (units kg/cm^2).

Bud mite susceptibility rated in mid-December on a scale of 1 (no blasted buds) to 5 (many blasted buds).

Temperature tolerance: 'OSU 541.147' was selected in Corvallis, Oreg., and further evaluated in Cream Ridge, N.J. and East Brunswick, N.J., and is targeted for production in USDA Plant Hardiness Zones 6a to 7b. Plants of the new *Corylus avellana* have been observed to tolerate temperatures from −21 to 38° C.

COMPARATIVE DATA

Disease resistance: 'OSU 541.147' differs from existing *Corylus avellana* cultivars based on its source and type of resistance to eastern filbert blight (EFB) caused by *Anisogramma anomala*. Commercial cultivars previously widely grown in Oregon including 'Barcelona' (unpatented), 'Ennis' (unpatented), 'Daviana' (unpatented), 'Butler' (unpatented), etc. are highly susceptible to EFB and cannot be grown in the eastern U.S. without copious applications of chemical fungicides and heavy pruning to remove infected wood. Tree death can occur in the eastern U.S. within five years of exposure to the fungus. The more recently developed cultivars 'Santiam' , 'Yamhill', 'Jefferson', 'Dorris', 'Wepster', and 'McDonald' and their associated pollenizers are protected from EFB by a single resistance gene conferred from *Corylus avellana* 'Gasaway'. This gene provides a high level of resistance in Oregon and Washington where the diversity of the fungus is limited (Muehlbauer et al., 2019), but does not provide a similar level of protection from disease in the eastern U.S. where the pathogen is endemic and genetically diverse (Capik and Molnar, 2012; Molnar et al., 2010b; Muehlbauer et al., 2018). 'OSU 541.147' does not carry the single 'Gasaway' resistance allele. It carries the *Corylus americana* 'Rush' allele, which is a different gene on a different chromosome than 'Gasaway' (Bhattarai, et al., 2017). The allele from 'Rush' has been found to be very effective against the populations of *Anisogramma anomala* present in New Jersey and other locations (Molnar et al., 2010a, 2019).

In a multi-year trial in East Brunswick, N.J., completed in winter 2018 and spanning more than 8 years of exposure to EFB, the average proportion of diseased wood (total length of EFB-diseased stems per tree divided by total length of shoot growth) for 'OSU 541.147' was 0.0% (no EFB) compared to 20.4% for 'Yamhill' (unpatented, Mehlenbacher et al 2009), 31.2% for 'Jefferson' (unpatented, Mehlenbacher et al. 2011a), and 48.6% for 'Gasaway' (unpatented). Previous studies in New Jersey showed the proportion of diseased wood of 'Barcelona' to be 67.0%, 'Tonda di Giffoni' 39%, and 'Sacajawea' 21% (Capik and Molnar, 2012).

Differences were also observed in the number of cankers and average canker length for 'OSU 541.147' in comparison to 'Yamhill', 'Jefferson', and 'Gasaway' in the study completed in 2018. 'OSU 541.147' expressed no cankers. In contrast, 'Gasaway' exhibited an average of 93.0 cankers per tree with an average length of 130.8 cm, 'Jefferson' exhibited an average of 36.9 cankers per tree with an average length of 72.3 cm, and 'Yamhill' exhibited an average of 40.5 cankers per tree with an average length of 37.9 cm. As reported in Capik and Molnar (2012), and as a further point of comparison in regard to EFB response, 'Barcelona' exhibited an average of 20.4 cankers per tree with an average length of 61.9 cm, 'Tonda di Giffoni' exhibited an average of 39.0 cankers per tree with an average length of 24.5 cm, and 'Sacajawea' exhibited an average of 7.7 cankers per tree with an average length of 21.5 cm (Capik and Molnar, 2012).

Nut and kernel characteristics. 'OSU 541.147' hazelnut is targeted for the blanched kernel market and specifically for nut production in the eastern United States in USDA Plant Hardiness Zones 6a to 7b where most existing cultivars of *Corylus avellana* cannot be grown due to the impacts of EFB.

As shown in FIG. **5**, the nut shape is round to somewhat oblong. Kernels are round. The average single nut weight for 'OSU 541.147' over three years (2017-19) is 2.62 g, average single kernel weight is 1.16 g, with an average kernel percentage of 44.1% (FIG. **4**, Table 3). Nut weight in the same trial was 3.77 g for 'Jefferson', 2.67 g for 'McDonald' and 2.49 g for 'Wepster'. Kernel weights in the same trial were 1.70 g for 'Jefferson', 1.39 g for 'McDonald' and 1.17 g for 'Wepster'. Kernel percentage in the same trial was 45.2% for 'Jefferson', 52.3% for 'McDonald' and 47.0% for 'Wepster'. 'OSU 541.147' nuts and kernels are significantly smaller than those of 'Barcelona' and 'Jefferson', and intermediate between 'McDonald' and 'Wepster'. In a previous trial (Mehlenbacher et al., 2008), 'Barcelona' had an average nut weight of 3.85 g, average single kernel weight of 1.66 g, and an average kernel percentage of 43.1%.

In the trial planted in 2014 in Corvallis, Oreg., 'Barcelona' had an average single nut weight of 3.77 g, an average single kernel weight of 1.70, and an average kernel percentage of 45.2%. The trees produced a few nuts in 2016, but were not harvested. Nuts were harvested for three years (2017-19), dried, weighed and evaluated. Total nut weight per tree (2017-19) was 8.0 kg for OSU 541.147, which is less than for the checks 'Jefferson', 'McDonald' and 'Wepster' (Table 2). Trunk cross-sectional area (TCA) was 49.03 cm^2, or slightly smaller than 'Jefferson'. Yield efficiency, the ratio of total yield to TCA, was a respectable 0.164 kg/cm^2 and similar to 'McDonald' (0.177 kg/cm^2). Trees have an upright growth habit, and vigor similar to *C. avellana* selections in the *Corvallis* trials.

Raw kernels of 'OSU 541.147' have a medium brown pellicle with a large amount of attached fiber (average rating was 4.0 on a scale of 1 [no fiber] to 4 [much fiber]; Table 3). Pellicle removal after roasting at 150° C. for 15 min and rubbing is rated on a scale of 1 (complete pellicle removal) to 7 (no pellicle removal). Slightly less than half of the pellicle on 'OSU 541.147' kernels is generally removed after roasting with an average rating of 4.5 (Table 3), a value similar to 'Barcelona' (4.2 out of 7.0 as described in Mehlenbacher et al., 2008) and 'Yamhill' (4.1 out of 7.0 as described in Mehlenbacher et al. 2011a). In the trial planted in 2014, pellicle removal after roasting was better for 'McDonald' (3.7 out of 7) and 'Wepster' (3.0 out of 7) (Table 3).

The average percentage of good kernels (kernels free of defects) was calculated for 'OSU 541.147' in the trial planted in 2014 and found to be 85.3% (Table 3). There was on average 9.3% blank nuts, 0.3% moldy kernels, 2.4% nuts with shriveled kernels, and 2.5% poorly filled. The percentage of good kernels for 'OSU 541.147' was considerably higher than that reported for 'Barcelona' in multiple reports from Oregon (60.9% good kernels reported in Mehlenbacher et al. [2008] and 69.4% in Mehlenbacher et al. [2013]). The average percentage of good kernels for 'OSU 541.147' grown in New Jersey is slightly lower than the range reported in Oregon for 'Yamhill', 'Jefferson', 'Dorris', and 'McDonald', however the percentage of moldy nuts was generally higher for these cultivars. The incidence of twin kernels and moldy kernels with black tips is less than 0.1% in both OR and NJ.

TABLE 3

Performance of 17 genotypes in a replicated trial planted in Corvallis in Spring, 2014. Four trees per selection in a randomized complete block design.

Sel No	Selection	10-nut weight	10-kernel weight	Percent kernel	Fiber	Blanching
1	'OSU 541.147'	26.2	11.6	44.1	4.0	4.5
2	'1250.057'	36.9	16.4	44.5	3.4	4.2
3	'1252.068'	25.7	12.4	48.3	2.6	2.8
4	'1253.064'	28.4	13.0	45.9	1.9	3.0
5	'1292.065'	28.2	13.1	46.6	3.5	4.3
6	'1300.073'	25.2	12.9	51.1	2.6	4.2
7	'1304.039'	27.5	12.4	45.1	2.2	3.0
8	'1307.003'	23.7	11.9	50.2	1.0	3.0
9	'1307.055'	25.7	12.9	50.4	2.2	4.8
10	'1308.087'	30.2	13.3	44.1	2.9	4.9
11	'1310.022'	28.8	14.0	48.7	3.5	4.9
12	'1339.074'	30.5	14.6	47.9	2.0	5.8
13	'1340.018'	27.9	13.9	49.7	3.1	3.3
14	'1341.037'	30.4	13.5	44.3	2.3	2.1
15	'Jefferson'	37.7	17.0	45.2	2.8	4.1
16	'McDonald'	26.7	13.9	52.3	2.6	3.7
17	'Wepster'	24.9	11.7	47.0	2.9	3.0
	LSD (0.05)	0.6	0.3	0.5	0.2	0.2

Sel		Frequency (%)							
No	Selection	GD	BL	BS	MO	SF	PF	TW	BT
1	'OSU 541.147'	85.3	9.3	0.3	0.3	2.4	2.5	0.1	0.0
2	'1250.057'	85.4	4.8	0.3	2.0	1.1	6.0	0.5	0.1
3	'1252.068'	83.7	5.9	1.5	2.1	0.8	4.3	0.5	1.6
4	'1253.064'	84.4	6.6	1.8	3.4	1.8	3.3	0.6	1.0
5	'1292.065'	83.1	9.8	0.1	1.8	0.3	4.9	0.3	0.2
6	'1300.073'	83.6	3.5	1.8	3.5	1.6	3.9	0.2	2.3
7	'1304.039'	84.5	4.8	0.8	2.5	1.4	5.4	0.3	0.5
8	'1307.003'	86.5	7.9	0.3	2.2	1.5	2.1	0.0	0.3
9	'1307.055'	73.6	8.2	0.2	2.6	1.1	13.0	1.3	0.7

TABLE 3-continued

Performance of 17 genotypes in a replicated trial planted in Corvallis in Spring, 2014. Four trees per selection in a randomized complete block design.

10	'1308.087'	76.7	6.8	0.0	1.8	5.5	5.7	0.1	0.3
11	'1310.022'	86.9	3.4	0.1	0.5	0.5	1.7	6.0	1.9
12	'1339.074'	81.7	4.9	0.7	1.4	1.2	10.3	0.3	0.2
13	'1340.018'	73.0	4.8	0.3	2.1	3.4	16.3	0.1	0.2
14	'1341.037'	88.2	2.6	1.0	2.6	1.8	3.1	0.5	0.5
15	'Jefferson'	76.5	3.8	2.0	2.2	1.3	13.8	0.6	1.0
16	'McDonald'	86.0	3.8	0.5	2.3	4.0	3.3	0.1	0.0
17	'Wepster'	80.3	7.6	0.2	1.3	0.7	8.7	0.0	1.4
	LSD (0.05)	3.0	1.9	0.8	1.2	1.4	1.7	0.6	0.8

Weight of ten well-filled nuts, and ten kernels in grams.
Percent kernel = (kernel weight/nut weight)'100, based on well-filled nuts.
Fiber on the kernel pellicle is rated from 1 (none) to 4 (heavy fiber).
Blanching (pellicle removal) is rated from 1 (complete pellicle removal) to 7 (no pellicle removal) after roasting at 275° F. for 15-20 minutes and rubbing.
Frequency of good nuts and 7 types of defects is from two 50-nut samples per tree, averaged over four trees and three years of observation. GD = good kernels, BL = blanks, BS = brown stain, MO = moldy kernels, SH = shriveled kernels, PF = poorly filled nuts, TW = twins, and BT = kernels with black tips.

Nut maturity date. The nuts of 'OSU 541.147' are typically borne in clusters of 3-4 in husks about 60% longer than the nuts. The husks open as they dry at maturity. About 85% of the nuts fall free of the husk at maturity (range 75-90%). The other 15% of the nuts come out of the husks as they move through the harvester. When mature, the shells are medium brown in color (165A). Harvest date on average is a few days later than 'Jefferson' when grown in East Brunswick, N.J., and Corvallis, Oreg. (Table 4).

Incompatibility and pollinizers. The trees set a moderate to high number of catkins that shed pollen in early season 2-3 days after to 'Yamhill'. Pollen has been collected and germinated on agar medium and both quantity and viability appear to be good. 'OSU 541.147' has incompatibility alleles S_8 and S_{23} as determined by fluorescence microscopy. Both alleles are expressed in the female flowers but only S_8 is expressed in the pollen due to dominance. By convention, alleles expressed in the pollen are underlined.

TABLE 4

Harvest dates (2018 and 2019) in the replicated trial planted in Corvallis in 2014, and estimated percentage of nuts on the ground (vs. in the tree) on that date. Also shown for the nuts on the ground is an estimated percentage of nuts free of the husk.

2018 Harvest				2019 Harvest			
Selection	Date	% down	% free	Selection	Date	% down	% free
'05U541.147'	10/5	76	80	'541.147'	10/7	82	88
'1252.068'	10/4	98	98	'1252.068'	10/3	93	91
'1341.037'	9/28	93	98	'1341.037'	9/23	99	97
'Barcelona'	10/8	97	96	'Barcelona'	10/8	99	94
'Jefferson'	10/5	90	83	'Jefferson'	10/7	94	84
'McDonald'	9/20	92	97	'McDonald'	9/23	99	97
'Wepster'	10/5	99	96	'Wepster'	9/23	96	76

In Corvallis, Oreg., time of pollen shed and female receptivity were recorded weekly from early December 2018 to late March 2019 (FIG. **6**). Climatic conditions vary each year and impact dates of bloom but not usually the order of progression of bloom among cultivars. In 2019, pollen shed (time of male flowering) of 'OSU 541.147' began on January 25 and ended on February 25, with peak pollen shed on February 10; those dates are between those for 'Wepster' and 'PollyO'. The females reached the red dot stage on January 15 and remained receptive until February 15. Female receptivity spans a shorter time within the receptivity time of females of 'Wepster' and 'PollyO'. In East Brunswick, N.J., time of pollen shed and female receptivity were recorded weekly from early December 2017 to late March 2018 (FIG. **7**) and from early December 2018 to late March 2019 (FIG. **8**). Pollen shed of 'OSU 541.147' was about one week later than 'Jefferson' and ten days later than 'Yamhill'. Time of female receptivity overlapped the second half of 'Yamhill' and the first half of 'Jefferson'. Females emerge in early season and are generally fully receptive around mid-February in New Jersey. Pollinizer cultivars that shed compatible pollen in midseason and late midseason are recommended, with hybrid hazelnut seedlings (*Corylus americana* x *C. avellana*) planted as pollenizers in eastern and northern regions where cold temperatures and fluctuating climatic conditions can affect pollen production of *C. avellana*. In New Jersey, date of leaf budbreak of 'OSU 541.147' was four days later than 'Yamhill' and seven days earlier than 'Jefferson'. In Oregon, date of leaf budbreak of 'OSU 541.147' was with 'PollyO', one day before 'McDonald' and four days before 'Wepster'.

Propagation. Layers of 'OSU 541.147' are vigorous and root well, similar to standard cultivars of *Corylus avellana.*

Additional comparative descriptors. Tables 5 and 6 provide additional descriptors distinguishing 'OSU 541.147' from various hazelnut varieties.

TABLE 5

Additional comparative descriptors distinguishing 'OSU 541.147' from various hazelnut varieties, including measurements and RHS colors (R.H.S. Colour chart, 1966 edition. Royal Horticultural Society (Great Britain). British Colour Council, London).

Character	Unit	'OSU 541.147'	'PollyO'	'McDonald'
Lateral branch length (terminal shoot)	cm	20.4	45.6	33.5
Lateral branch diameter (terminal shoot)	mm	4.3	4.4	5.0
Internode length (above base)	cm	3.6	3.4	3.2
Branch texture		smooth, glabrous	smooth. glabrous	smooth, glabrous
Branch strength		strong	strong	strong
Branch color, immature	RHS	143C	139D	139D
Branch color, mature	RHS	146B	177D	177D
Leaf length	cm	9.6	13.3	10.4
Leaf width	cm	7.1	11.8	8.7
Leaf shape		oblong to ovate	oblong to ovate	oblong to ovate
Leaf apex		obtuse to acute	obtuse to acute	obtuse to acute
Leaf base		cordate	cordate	cordate
Leaf margin		serrate	senate	serrate
Leaf texture		slightly pubescent	slightly pubescent	slightly pubescent
Leaf venation pattern		pinnate	pinnate	pinnate
Leaf color developing leaf upper	RHS	144 A	141C	141C
Leaf color developing leaf lower	RHS	144B	139C	139C
Leaf color fully expanded leaf upper, Spr Sum	RHS	137B	146 A	139B
Leaf color fully expanded leaf upper, ea Fall	RHS	137B	146 A	139B
Leaf color fully expanded leaf lower, Spr Sum	RHS	137D	146B	139C
Leaf color fully expanded leaf lower, ea Fall	RHS	137D	146B	139C
Leaf veins, upper. Spring Summer	RHS	145 A	146 A	139C
Leaf veins, upper, ea Fall	RHS	145 A	146 A	139C

TABLE 5-continued

Additional comparative descriptors distinguishing 'OSU 541.147' from various hazelnut varieties, including measurements and RHS colors (R.H.S. Colour chart, 1966 edition. Royal Horticultural Society (Great Britain). British Colour Council, London).

Leaf veins, lower. Spring Summer	RHS	145 A	146D	139D
Leaf veins, lower, ea Fall	RHS	145 A	146D	139D
Petiole length	mm	9.3	16.3	27
Petiole diameter	mm	1.8	1.6	1.8
Petiole texture, upper & lower surfaces		pubescent	pubescent	pubescent
Petiole color, upper. Spring Summer	RHS	143C	146C	139D
Petiole color, upper, ea Fall	RHS	143C	146C	139D
Petiole color, lower, Spring Summer	RHS	143C	146D	139D
Petiole color, lower, ea Fall	RHS	143C	146D	139D
Catkin color prior to elongation	RHS	ND	138B	176D
Female flower style color	RHS	047B	047B	047B
Nut length	mm	19.9	19.5	18.4
Nut width	mm	18.8	19.8	18.9
Nut depth	mm	15.6	17.2	17.9
Nut shape		round	round	round
Nut shape index [(W + D)/2L]	ratio	0.86	0.95	1.00
Nut compression index (W/D)	ratio	1.21	1.15	1.05
Nut shell color	RHS	165A	164 A	164 A
Nut weight	g	2.62	2.88	2.51
Kernel weight	g	1.16	1.38	1.29
Kernel percentage (KW/NW)	%	44.1	47.9	51.5

Character	Unit	'Wepster'	'Felix'	'York'
Lateral branch length (terminal shoot)	cm	40	43	38
Lateral branch diameter (terminal shoot)	mm	5.4	6.0	6.0
Internode length (above base)	cm	3.1	2.8	3.2
Branch texture		smooth, glabrous	smooth, glabrous	smooth, glabrous
Branch strength		strong	strong	strong
Branch color, immature	RHS	139D	152B	152B
Branch color, mature	RHS	177C	152B	199A?
Leaf length	cm	12.1	11	11
Leaf width	cm	10.9	10	10
Leaf shape		oblong to ovate	oblong to ovate	oblong to ovate
Leaf apex		obtuse to acute	obtuse to acute	obtuse to acute
Leaf base		cordate	cordate	cordate
Leaf margin		serrate	senate	serrate
Leaf texture		slightly pubescent	slightly pubescent	slightly pubescent
Leaf venation pattern		pinnate	pinnate	pinnate
Leaf color developing leaf upper	RHS	141C	144 A	146B
Leaf color developing leaf lower	RHS	139C	145 A	146C
Leaf color fully expanded leaf upper, Spr Sum	RHS	141B	143 A	146 A
Leaf color fully expanded leaf upper, ea Fall	RHS	141A	143 A	146 A
Leaf color fully expanded leaf lower, Spr Sum	RHS	139C	139C	146C
Leaf color fully expanded leaf lower, ea Fall	RHS	139C	139C	146C
Leaf veins, upper. Spring Summer	RHS	139C	139C	146A
Leaf veins, upper, ea Fall	RHS	139C	139C	146 A
Leaf veins, lower. Spring Summer	RHS	139D	139D	148D
Leaf veins, lower, ea Fall	RHS	139D	139D	148D
Petiole length	mm	27	27	27
Petiole diameter	mm	1.8	1.8	1.8
Petiole texture, upper & lower surfaces		pubescent	pubescent	pubescent

TABLE 5-continued

Additional comparative descriptors distinguishing 'OSU 541.147' from various hazelnut varieties, including measurements and RHS colors (R.H.S. Colour chart, 1966 edition. Royal Horticultural Society (Great Britain). British Colour Council, London).

Petiole color, upper. Spring Summer	RHS	139D	139D	139D
Petiole color, upper, ea Fall	RHS	139D	139D	139D
Petiole color, lower, Spring Summer	RHS	139D	139D	139D
Petiole color, lower, ea Fall	RHS	139D	139D	139D
Catkin color prior to elongation	RHS	176C	194C shade, 176D sun	194C
Female flower style color	RHS	047B	047B	047B
Nut length	mm	18.3	18.7	18.0
Nut width	mm	19.0	18.9	19.7
Nut depth	mm	16.6	16.7	17.0
Nut shape		round	round	round
Nut shape index [(W + D)/2L]	ratio	0.97	0.95	1.02
Nut compression index (W/D)	ratio	1.15	1.13	1.16
Nut shell color	RHS	164 A	167 A	164 A
Nut weight	g	2.39	2.65	2.73
Kernel weight	g	1.11	1.32	1.23
Kernel percentage (KW/NW)	%	43.9	50.1	46.3

Character	Unit	'Dorris'	'Tonda Pacifica'	'Burgundy Lace'
Lateral branch length (terminal shoot)	cm	51	15	51
Lateral branch diameter (terminal shoot)	mm	3.8	5.0	3.8
Internode length (above base)	cm	3.3	1.3	3.3
Branch texture		smooth, glabrous	smooth, glabrous	smooth, glabrous
Branch strength		strong	strong	strong
Branch color, immature	RHS	152B	178 A	177D
Branch color, mature	RHS	152B	137 A	177C
Leaf length	cm	11	12	10.7
Leaf width	cm	10	10	7.8
Leaf shape		oblong to ovate	oblong to ovate	oblong to ovate
Leaf apex		obtuse to acute	obtuse to acute	obtuse to acute
Leaf base		cordate	cordate	cordate
Leaf margin		serrate	serrate	serrate
Leaf texture		slightly pubescent	slightly pubescent	slightly pubescent
Leaf venation pattern		pinnate	pinnate	pinnate
Leaf color developing leaf upper	RHS	144 A	187 A	187 A
Leaf color developing leaf lower	RHS	145 A	187 A	183 A
Leaf color fully expanded leaf upper, Spr Sum	RHS	143 A	183B	191A
Leaf color fully expanded leaf upper, ea Fall	RHS	143 A	137 A	191B
Leaf color fully expanded leaf lower, Spr Sum	RHS	139C	178 A	191B
Leaf color fully expanded leaf lower, ea Fall	RHS	139C	137 A	139B
Leaf veins, upper. Spring Summer	RHS	139C	183B	191A
Leaf veins, upper, ea Fall	RHS	139C	137 A	139C
Leaf veins, lower. Spring Summer	RHS	139D	178 A	182B
Leaf veins, lower, ea Fall	RHS	139D	138B	182D
Petiole length	mm	27	10	27
Petiole diameter	mm	1.8	2.5	1.8
Petiole texture, upper & lower surfaces		pubescent	pubescent	pubescent
Petiole color, upper. Spring Summer	RHS	139D	183B	191A
Petiole color, upper, ea Fall	RHS	139D	137 A	139C
Petiole color, lower, Spring Summer	RHS	139D	178 A	191A

TABLE 5-continued

Additional comparative descriptors distinguishing 'OSU 541.147' from various hazelnut varieties, including measurements and RHS colors (R.H.S. Colour chart, 1966 edition. Royal Horticultural Society (Great Britain). British Colour Council, London).

Petiole color, lower, ea Fall	RHS	139D	138B	139C
Catkin color prior to elongation	RHS	194C shade, 176D sun	176B	177 A
Female flower style color	RHS	048B	183B	183B
Nut length	mm	19.1	19.0	15.8
Nut width	mm	20.7	18.0	15.6
Nut depth	mm	18.2	16.5	12.9
Nut shape		round	round	round
Nut shape index [(W + D)/2L]	ratio	1.02	0.91	0.85
Nut compression index (W/D)	ratio	1.14	1.09	1.21
Nut shell color	RHS	164B	164 A	166C
Nut weight	g	3.35	2.24	1.72
Kernel weight	g	1.40	1.06	0.76
Kernel percentage (KW/NW)	%	43	47	44

TABLE 6

International Union for the Protection of New Varieties of Plants (UPOV) descriptors distinguishing 'OSU 541.147' from various hazelnut varieties.

No.	Character (UPOV Descriptor)	'OSU 541.147'	'PollyO'	'Burgundy Lace'	'Dorris'
1	Plant vigor	5	7	5	4
2	Plant habit	1	5	5	7
3	Plant shoot density	5	5	5	5
4	Plant suckering	5	4	5	4
5	Shoot thickness	5	7	5	7
6	Shoot hairiness	7	3	3	5
7	Shoot lenticels	7	5	3	3
8	Leaf bud shape (winter)	Ovoid; 2	2	1	3
9	Leaf bud color (winter)	Reddish green; 2	143C,1	3	2
10	Time of leaf budburst	6	6	6	6
11	Catkin length (mm) (winter)	20.1 mm; 3	20.1; 3	2	8
12	Catkin color (winter)	138B; 1	138B.1	2	2
13	Stigma color	2	047B.1	3	2
14	Time of pollen shed	6	7	6	5
15	Time of female flowering	6	6	8	6
16	Dichogamy (female vs. male)	2	2	3	2
17	Leaf blade shape	2	3	2	3
18	Leaf blade size	9.6 × 7.1; 3	13.3 × 11.8;5	11.4 × 7.4; 1	7
19	Leaf blade hairiness lower side	3	3		3
20	Petiole length	9.3 mm; 3	5	7	5
21	Petiole hairiness	7	3	3	5
22	Husk constriction	1	1	1	1
23	Husk length rcl. to nut length	6	6	3	4
24	Husk indentation	7	5	5	7
25	Husk serration of indentations	5	5	3	5
26	Husk thickness of callus at base	7	7	3	7
27	Husk hairiness (present, absent)	9	9	1	9
28	Husk hair density	8	3	3	3
29	Husk joining of bracts	1	1	1	2
30	Nuts per cluster	4	4	2	3
31	Nut size	3	4	2	5
32	Nut shape	3	1	3	1
33	Nut shape in cross-section	2	2	1	2
34	Nut shell color	3	2	3	2
35	Nut number of stripes on shell	7	3	5	3
36	Nut shape of top	1	1	4	4
37	Nut apex prominence	7	3	3	3

TABLE 6-continued

International Union for the Protection of New Varieties of Plants (UPOV) descriptors distinguishing 'OSU 541.147' from various hazelnut varieties.

38	Nut size of pistil scar	3	3	3	3
39	Nut hairiness of top	3	4	5	4
40	Nut size of basal scar	5	3	3	5
41	Nut curvature of basal scar	3	2	3	2
42	Double kernels (frequency)	1	1	1	1
43	Kernel size	3	5	2	6
44	Kernel shape	1	1	2	1
43	Kernel cross-section	2	2	1	2
46	Kernel shape of top	2	2	2	2
47	Kernel shape of base	3	3	2	3
48	Kernel lateral groove	1	1	1	1
49	Kernel fiber on skin	9	5	5	3
50	Kernel size of cavity	5	5	3	7
51	Nut ripening time	7	4	5	6
52	Nut adherence of husk after drop	1	1	1	1
53	Nut percent kernel	3	6	3	3
54	Time of leaf fall (November)	3	3	3	3

No.	Character (UPOV Descriptor)	'York'	'Felix'	'Wep-ster'	'McDonald'
1	Plant vigor	5	8	7	5
2	Plant habit	5	3	5	5
3	Plant shoot density	5	5	5	5
4	Plant suckering	4	5	3	6
5	Shoot thickness	7	7	5	5
6	Shoot hairiness	3	3	5	3
7	Shoot lenticels	5	3		
8	Leaf bud shape (winter)	3	2		
9	Leaf bud color (winter)	1	2		
10	Time of leaf budburst	6	6	6	6
11	Catkin length (mm) (winter)	7	7	5	6
12	Catkin color (winter)	2	2	1	1
13	Stigma color	1	1	1	1
14	Time of pollen shed	6	7	6	5
15	Time of female flowering	5	5	5	4
16	Dichogamy (female vs. male)	2	1	1	1
17	Leaf blade shape	3	3	3	2
18	Leaf blade size	3	2	3	3
19	Leaf blade hairiness lower side	3	3	3	3
20	Petiole length	5	5	5	5
21	Petiole hairiness	5	5	5	5
22	Husk constriction	1	3	1	1
23	Husk length rel. to nut length	4	5	7	5
24	Husk indentation	7	5	7	7
25	Husk serration of indentations	5	7	7	7
26	Husk thickness of callus at base	5	7	5	3
27	Husk hairiness (present, absent)	9	9	9	9
28	Husk hair density	3	3	3	3
29	Husk joining of bracts	2	2	2	2
30	Nuts per cluster	2	3	3	3
31	Nut size	4	4	3	4
32	Nut shape	1	1	1	1
33	Nut shape in cross-section	2	2	2	2
34	Nut shell color	2	3	2	2
35	Nut number of stripes on shell	5	7	5	5
36	Nut shape of top	3	1	1	3
37	Nut apex prominence	3	5	3	5
38	Nut size of pistil scar	3	3	3	3
39	Nut hairiness of top	3	4	3	4
40	Nut size of basal scar	3	3	3	3
41	Nut curvature of basal scar	2	2	2	2
42	Double kernels (frequency)	1	I	1	1

TABLE 6-continued

International Union for the Protection of New Varieties of Plants (UPOV) descriptors distinguishing 'OSU 541.147' from various hazelnut varieties.					
43	Kernel size	5	5	3	5
44	Kernel shape	1	1	1	1
43	Kernel cross-section	2	2	2	2
46	Kernel shape of top	2	2	3	1
47	Kernel shape of base	3	3	3	3
48	Kernel lateral groove	1	1	1	1
49	Kernel fiber on skin	5	6	5	5
50	Kernel size of cavity	5	7	5	7
51	Nut ripening time	5	6	5	4

TABLE 6-continued

International Union for the Protection of New Varieties of Plants (UPOV) descriptors distinguishing 'OSU 541.147' from various hazelnut varieties.					
52	Nut adherence of husk after drop	1	3	1	1
53	Nut percent kernel	4	5	4	6
54	Time of leaf fall (November)	4	7	4	4

Microsatellite Marker Analysis: Twenty microsatellite (simple sequence repeat) markers were used. PCR products were multiplexed post-PCR and sized using capillary electrophoresis (Table 6, and see for example Bassil et al., *Acta Horticulturae* 686:105-110, 2005; Gökirmak et al., *Genetic Resources and Crop Evolution* 56:147-172, 2009; Gürcan and Mehlenbacher. *Molecular Breeding* 26:551-559, 2010; Gürcan et al.. *Tree Genetics and Genomes* 6:513-531, 2010).

TABLE 7

Primers and annealing temperatures for the microsatellite marker loci used for fingerprinting hazelnut cultivars.

Set	Locus	Repeat Motif	Allele sizes	Primers (5'-3') (SEQ ID NO:)	(SEQ ID NO:)	Tm (° C.)	n	He	Ho	PIC	r	LG	Locus	Reference
3	A613	$(TC)_{132}$ $(CA)_1$	149-177	Ned-CACACGCCTTGTCACTCTTT (1)	R-CCCCTTTCACATGTTTGCTT(2)	60	14	0.86	0.85	0.85	0.00	11R	A613	Gurcan et al., 2010
2	A614	$(TC)_{17}$ $(CA)_{10}$ $NNN(CA)_6$	125-156	Hex-TGGCAGAGCTTTGTCAGCTT (3)	R-GCAGTGGAGGATTGCTGACT (4)	60	14	0.85	0.85	0.84	0.00	6S, 6R	A614	Gurcan et al., 2010
3	A616	$(AC)_{11}$	136-162	Fam-CACTCATACCGCAAACTCCA (5)	R-ATGGCTTTTGCTTCGTTTTG (6)	60	13	0.85	0.85	0.83	0.00	8R	A616	Gurcan et al., 2010
1	A640	$(CT)_{153}$ $(CA)_1$	354-378	F-TGCCTCTGCAGTTAGTCATCAAATGTAGG (7)	Fam-CGCCATATAATTGGGATGCTTGTTG (8)	67	11	0.80	0.73	0.77	0.04	10R	A640	Gurcan et al., 2010
3	B617	$(GA)_{15}$	280-298	Fam-TCCGTGTTGAGTATGGACGA (9)	R-TGTTTTTGGTGGAGCGATG (10)	60	9	0.80	0.78	0.78	0.01	8S, 8R	B617	Gurcan et al., 2010
2	B619	$(TC)_{21}$	146-180	Fam-AGTCGGCTCCCCTTTTCTC(11)	R-GCGATCTGACCTCATTTTTG (12)	60	14	0.88	0.88	0.87	0.00	3S, 3R	B619	Gurcan et al., 2010
4	B634	$(AG)_{15}$	218-238	Hex-CCTGCATCCAGGACTCATTA (13)	R-GTGCAGAGGTTGCACTCAAA (14)	60	9	0.76	0.76	0.73	0.00	4R	B634	Gurcan et al., 2010
4	B657	$(AG)_{15}$	210-228	Ned-GAGAGTGCGTCTTCCTCTGG (15)	R-AGCCTCACCTCCAACGAAC (16)	60	8	0.84	0.98	0.82	-0.08	11S, 11R	B657	Gurcan et al., 2010
3	B671	$(AG)_6NN$ $(GA)_{17}$	221-249	Hex-TTGCCAGTGCATACTCTGATG (17)	R-ACCAGCTCTGGGCTTAACAC (18)	60	13	0.86	0.88	0.84	-0.01	9S, 9R	B671	Gurcan et al., 2010
2	B709	$(GA)_{21}$	219-233	Ned-CCAAGCACGAATGAACTCAA (19)	R-GCGGGTTCTCGTTGTACACT (20)	60	8	0.74	0.76	0.70	-0.01	5S, 5R	B709	Gurcan et al., 2010
1	B733	$(TC)_{15}$	161-183	Ned-CACCCTCTTCACCACCTCAT (21)	R-CATCCCCTGTTGGAGTTTTC (22)	60	8	0.68	0.68	0.63	0.00	7S, 2R	B733	Gurcan et al., 2010

TABLE 7-continued

Primers and annealing temperatures for the microsatellite marker loci used for fingerprinting hazelnut cultivars.

Set	Locus	Repeat Motif	Allele sizes	Primers (5′-3′) (SEQ ID NO:)	(SEQ ID NO:)	Tm (° C.)	n	He	Ho	PIC	r	LG	Locus	Reference
2	B749	$(TC)_{12}$	200-210	Hex-GGCTGACAACACAGCAGAAA (23)	R-TCGGCTAGGTGTAGGGTTTT (24)	60	6	0.60	0.64	0.51	−0.03	1R	B749	Gurcan et al., 2010
4	B751	$(GA)_{15}$	141-153	Fam-AGCTGGTTCTTCGACATTCC (25)	R-AAACTCAAATAAAACCCCTGCTC(26)	60	7	0.80	0.78	0.77	0.01	7S, 2R	B751	Gurcan et al., 2010
1	B774	$(AG)_{15}$	195-213	Ned-GTTTTGCGAGCTCATTGTCA (27)	R-TGTGTGTGGTCTGTAGGCACT (28)	60	8	0.80	0.80	0.77	0.00	5S, 5R	B774	Gurcan et al., 2010
3	C115	$(TAA)_5$ $(GAA)_{12}$	167-225	Fam-CATTTTCCGCAGATAATACAGG (29)	R-GTTTCCAGATCTGCCTCCATATAAT (30)	60	10	0.84	0.90	0.82	0.035	4S, 4R	C115	Bassil et al., 2005b; Gokirmak et al., 2009
3	KG807	$(TAAA)_AA$ $(TAAA)_2A$ $(TAAA)_2$	226-248	F-AAGCAAGAAAGGGATGGT (31)	Fam-CTTACAGATAAATGGCTCAAA (32)	54	4	0.67	0.78	0.60	−0.07	11	KG807	Gurcan and Mehlenbacher, 2010
1	KG809	$(AGG)_6$	333-345	F-GGAAGGTGAGAGAAATCAAGT (33)	Hex-AGGCATCAGTTCATCCAA (34)	55	5	0.66	0.64	0.60	0.01	4	KG809	Gurcan and Mehlenbacher, 2010
2	KG811	$(GA)_{17}$	240-278	F-GAACAACTGAAGACAGCAAAG (35)	Ned-AAGGCGGCACTCGCTCAC (36)	58	12	0.83	0.82	0.81	0.01	2	KG811	Gurcan and Mehlenbacher, 2010
4	KG827	$(CT)_{13}AA$ $(CA)_7$	264-282	Fam-AGAACTCCGACTAATAATCCTAACCCTTGC (37)	R-GAGGGAGCAAGTCAAAGTTGAGAAGAAA(38)	67	9	0.78	0.84	0.75	−0.04	9	KG827	Gurcan and Mehlenbacher, 2010
2	KG830	$(CT)_{14}$ GTATT $(CA)_8$	279-311	Ned-TGGAGGAAGTTTTGAATGGTAGTAGAGGA (39)	R-AAAGCAACTCATAGCTGAAGTCCAATC (40)A	67	9	0.79	0.78	0.76	0.00	9	KG830	Gurcan and Mehlenbacher, 2010

Set = Multiplex set, with samples mixed after PCR but before submission for sizing by capillary electrophoresis;
Allele size = range of sizes;
Primers, forward (F, listed first) and reverse (R, second) (Hex and Fam are dyes);
Tm = Annealing temperature;
n = Number of alleles;
He = expected heterozygosity;
Ho = observed heterozygosity;
PIC = Polymorphism information content;
r = frequency of null alleles;
LG = linkage group (S is susceptible female parent 'OSU 252.146'; R is resistant parent 'OSU 414.062');
Reference is the journal article where additional details were published.

Table 8 shows allele sizes at 20 microsatellite markers for 'OSU 541.147', its female parent 'NY 616', and 13 additional cultivars and selections. 'Rush', 'Barcelona', 'Montebello' and 'Tombul Ghiaghli' are in the pedigree of 'OSU 541.147'. Cultivars 'OSU 541.147', 'NY 110', 'NY 616', 'Rush', 'Barcelona' , 'Montebello', and 'Tombul Ghiaghli' were fingerprinted in 2020. The other cultivars were fingerprinted in 2018 for 'PollyO' (U.S. Plant Patent Publication No. US-2020-0008334-P1). 'OSU 541.147' is easily distinguished from all others shown in Table 8. 'OSU 541.147' shares an allele with its mother 'NY 616' at all SSR loci.

TABLE 8

Allele sizes at 20 microsatellite markers

Marker	'OSU 541.147'	'NY 616'	'Rush'	'Barcelona'	'Montebello'	'Tombul Ghiaghli'
A613	161/161	161/163	153/163	153/161	151/153	153/169
A614	124/150	124/132	124/133	124/132	124/132	132/150
A616	144/150	144/150	140/150	144/152	152/160	152/160
A640	356/374	356/356	356/356	354/374	362/374	354/374
B617	289/289	281/289	281/285	285/289	285/293	293/295
B619	158/170	158/172	158/168	158/172	160/166	166/170

TABLE 8-continued

Allele sizes at 20 microsatellite markers

B634	228/228	228/240	230/240	228/228	232/236	228/232
B657	222/222	214/222	214/214	218/222	218/226	210/214
B671	225/249	225/231	231/231	225/229	225/243	229/249
B709	229/235	229/235	229/229	227/235	229/235	223/229
B733	173/175	173/175	175/175	173/175	175/185	173/175
B749	216/216	208/216	206/208	216/216	216/216	216/216
B751	148/150	144/150	150/150	144/154	154/154	148/154
B774	205/217	205/213	205/205	209/213	209/213	201/217
C115	182/215	174/215	215/215	174/194	174/197	174/182
KG807	252/252	242/252	238/242	238/252	238/242	230/253
KG809	339/342	339/339	339/339	339/339	339/348	339/342
KG811	263/267	263/267	255/263	261/267	251/267	245/267
KG827	278/282	270/282	270/272	282/284	282/282	278/284
KG830	291/295	291/307	307/307	291/295	291/295	289/295

Marker	'NY 110'	'Daviana'	'Mortarella'	'Negret'	'Casina'
A613	153/163	167/179	151/153	153/159	151/153
A614	124/132	148/150	132/135	132/132	124/139
A616	140/150	150/152	150/158	152/160	144/152
A640	356/374	354/354	354/374	354/368	354/372
B617	285/293	289/295	293/295	285/291	285/295
B619	168/168	168/178	158/172	166/170	150/158
B634	232/240	228/236	228/236	228/234	228/232
B657	214/218	218/226	218/224	218/222	216/218
B671	229/231	239/249	225/243	229/237	229/249
B709	229/229	229/229	221/229	223/227	227/233
B733	163/175	173/181	175/175	167/175	175/175
B749	208/216	216/216	214/216	216/216	214/216
B751	144/150	144/152	144/154	152/154	152/154
B774	205/209	213/215	209/220	209/215	209/215
C115	174/215	174/194	182/215	182/215	174/197
KG807	242/242	238/252	230/234	238/252	238/252
KG809	339/339	339/342	342/342	339/342	339/339
KG811	255/263	255/261	261/267	259/267	251/267
KG827	272/284	272/272	282/282	272/284	272/284
KG830	295/295	289/295	291/307	295/303	295/303

Marker	'Polly0'	'McDonald'	'Wepster'	'Yamhill'	'Tonda Pacifica'
A613	153/167	153/169	159/167	153/163	159/169
A614	124/158	135/158	135/158	132/158	135/150
A616	144/152	150/160	152/160	150/150	150/160
A640	354/354	362/368	368/374	354/368	368/374
B617	285/295	293/295	293/295	289/295	293/295
B619	158/166	158/172	166/172	158/172	166/172
B634	228/236	222/228	228/228	236/236	228/228
B657	218/218	210/218	226/226	218/228	210/226
B671	229/249	229/237	239/249	225/243	229/239
B709	223/227	229/229	229/235	229/229	229/235
B733	175/181	173/175	173/175	181/185	173/175
B749	216/216	214/216	214/216	216/216	214/216
B751	144/154	144/144	144/144	152/152	144/154
B774	209/209	209/220	209/213	209/217	209/213
C115	194/215	174/197	182/194	197/215	174/182
KG807	238/252	252/252	252/252	230/252	228/252
KG809	342/342	339/339	342/342	348/348	339/342
KG811	261/267	245/267	257/257	251/261	245/257
KG827	272/284	272/284	270/282	282/282	270/284
KG830	291/295	291/295	295/305	291/295	291/295

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tggaggaagt tttgaatggt agtagagga 29

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aaagcaactc atagctgaag tccaatc 27

We claim:

1. A new and distinct variety of *Corylus* plant named 'OSU 541.147' as illustrated and described.

* * * * *

FIG. 1

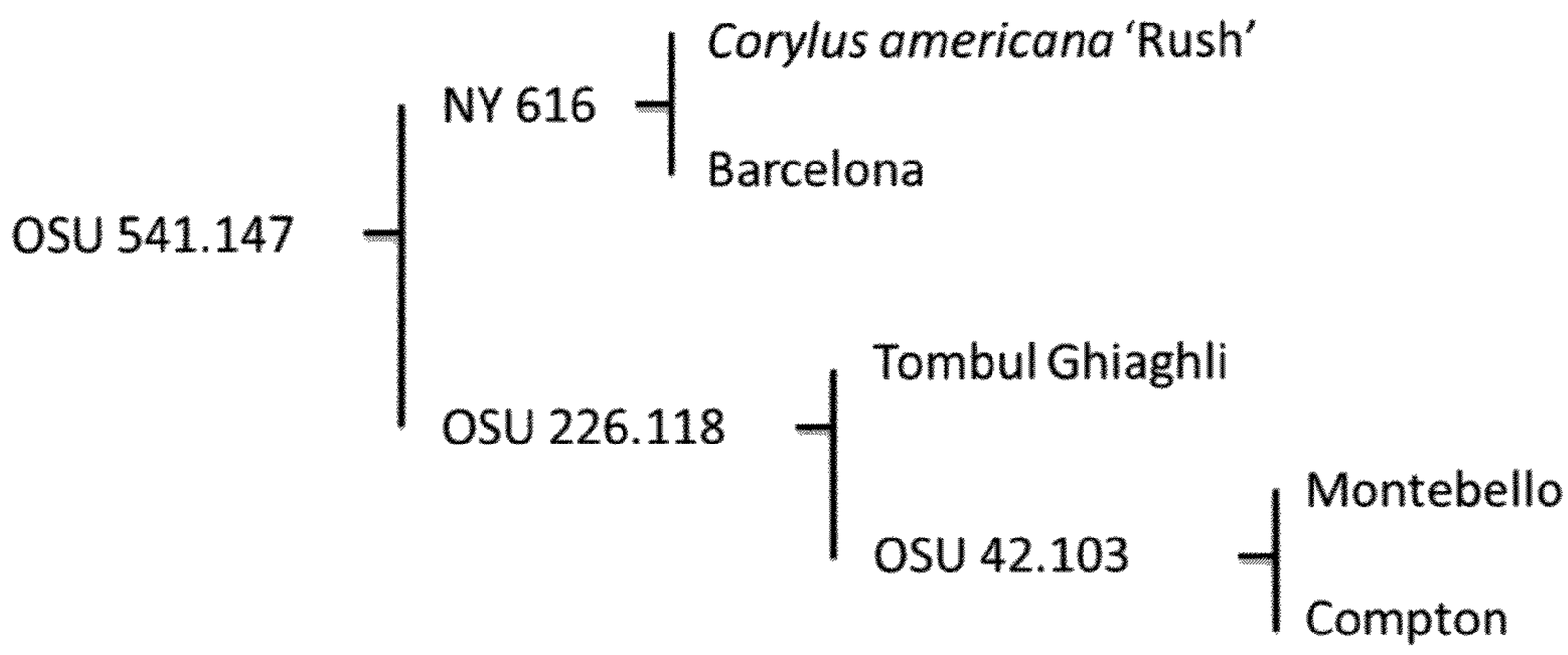

Corylus americana 'Rush'
NY 616
Barcelona
OSU 541.147
Tombul Ghiaghli
OSU 226.118
Montebello
OSU 42.103
Compton

FIG. 2

FIG. 3

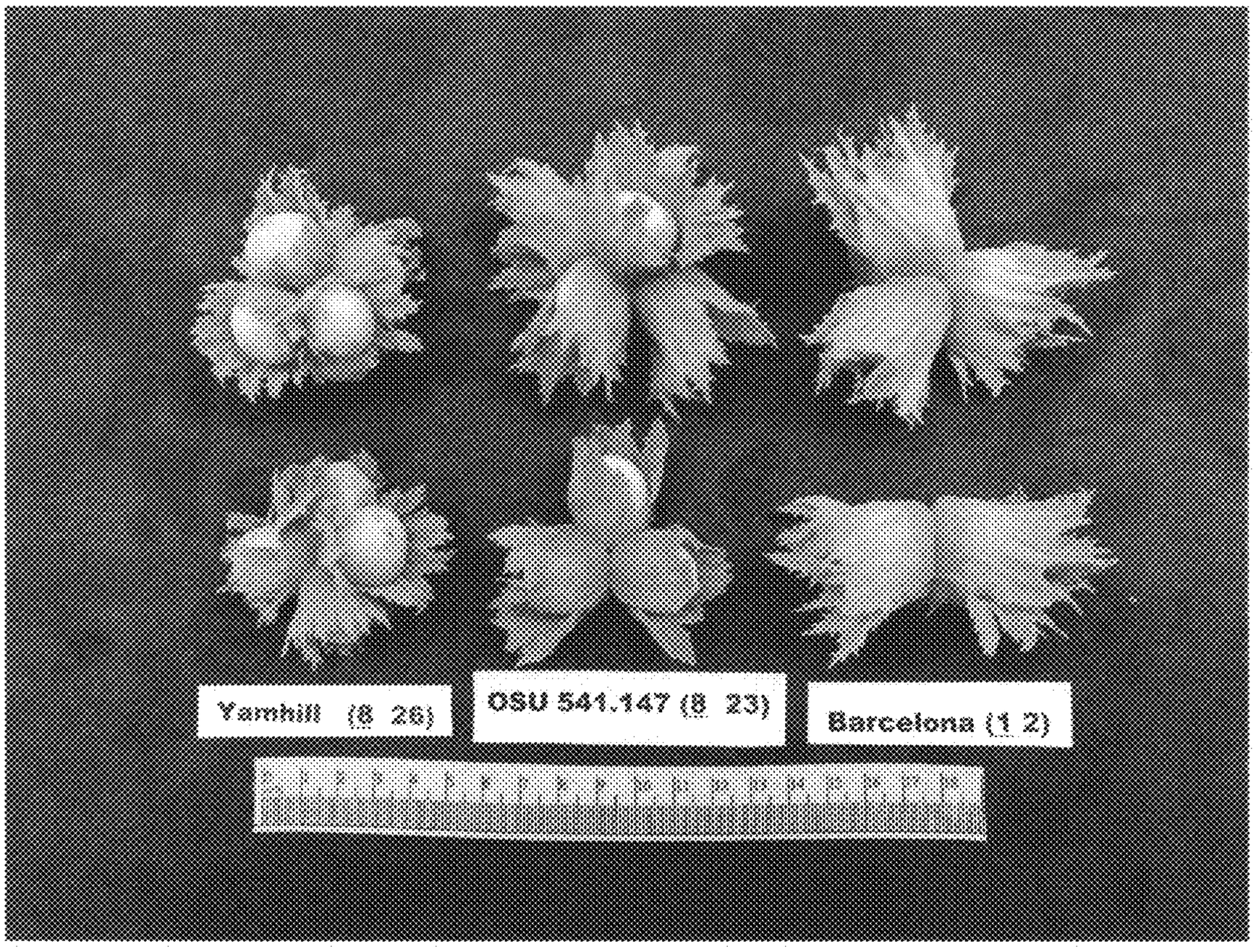


FIG. 4

FIG. 5

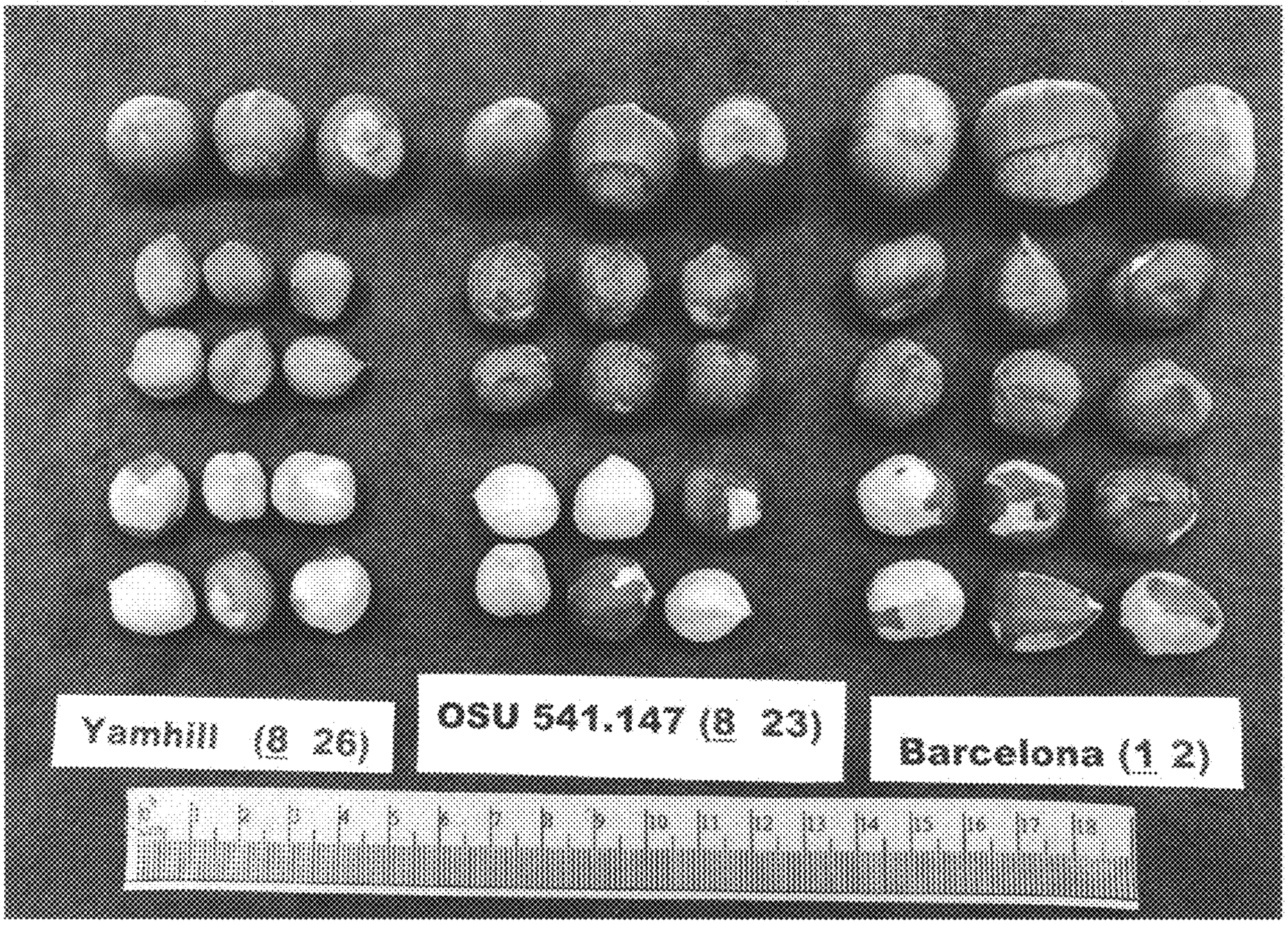


FIG. 6

Phenology Chart 1. Notes on female receptivity, pollen shed and leaf budbreak in Corvallis, OR (Dec. 2018- Mar. 2019).

	Dec					Jan						Feb					March			
Genotype	6-Dec	11-Dec	18-Dec	22-Dec	30-Dec	4-Jan	6-Jan	18-Jan	20-Jan	28-Jan	30-Jan	5-Feb	10-Feb	18-Feb	19-Feb	25-Feb	3-Mar	7-Mar	11-Mar	16-Mar
541.147										15	30	30	60	85	100-30	90	done			BB 3/20
(8 23)								Rd	i+2/S	i+2/S+2	i/S+3			iS+3	S+3		gr tip			
									red	red	red				blk					
McDonald							?		75	100	100-40	85	done			gr tip				BB 3/21
(2 15)				Rd+			Rd+3		Rd+2/i+ 2		Rd+3	i+2/S		i+3/S			late flowers emerging		i/S+3 red/dk/bl k	S+3
				gr tip					red			red	dark	dk-blk						
Wepster									10	50	90	100-50	80	done		gr tip				
(1 2)		Rd+2		Rd+3			Rd+2				Rd+3/i+2	i+3	i+3/S	i+2/S+2					S+2 red/dk	BB 3/24
							gr tip		red			red		dark						
PollyO											?	40	50	65	85	100	-50	-70	-95	BB 3/20
(2 10)			Rd		Rd+		Rd+2			Rd+3/i	i+2	i+3/S							i/S+3	
							red				red			dark					black	

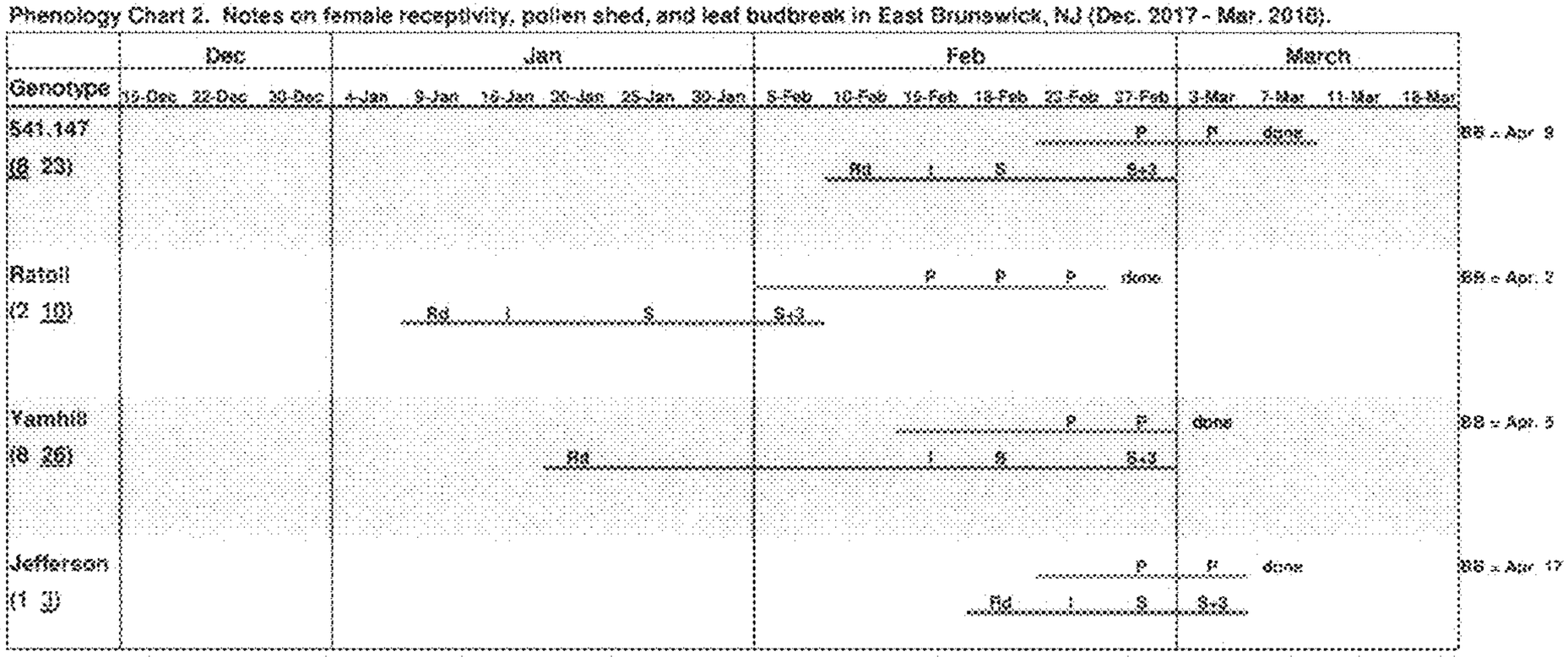
Green = Pollen shed (a minus sign in front of the number indicates the percent of catkins that have already shed out).

Female flower stages: RD = Red dot; I = styles protruding ~1-3mm, straight; S = first appearance of 'spiders' or flowers with reflexed styles, and S+3 = majority of flowers are in 'spider' or fully reflexed stage.

Red = female flower color; red, blk (black), dk (dark, not quite red, not yet black).

FIG. 7

Phenology Chart 2. Notes on female receptivity, pollen shed, and leaf budbreak in East Brunswick, NJ (Dec. 2017 - Mar. 2018).



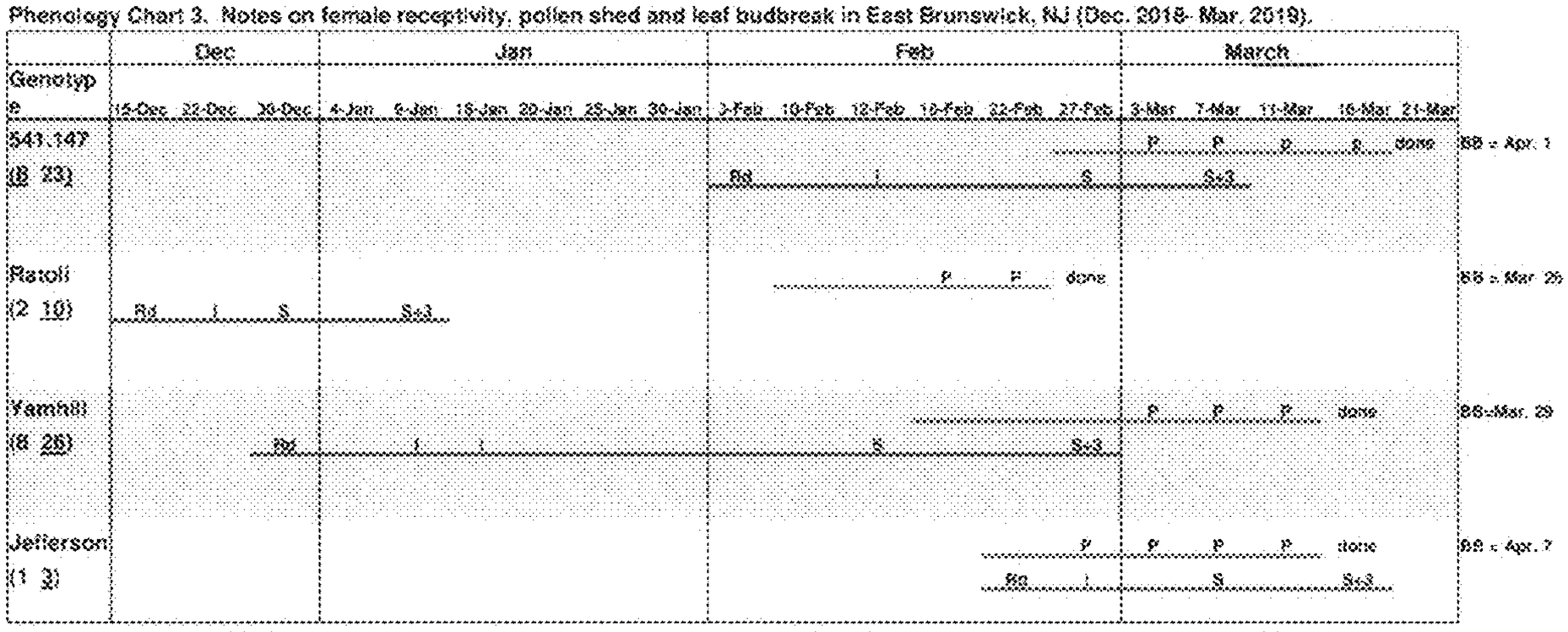
Red Bar - Flower stages: Rd= Red dot; I = styles protruding ~1-3 mm, straight, S = first appearance of 'spiders' or flowers with reflexed styles; S+3 = majority of flowers in 'spider' or fully reflexed stage.

Green Bar - Pollen stages: P signals actively shedding pollen. Green bar prior to P signals elongation stage.

BB = date of leaf budbreak

FIG. 8

Phenology Chart 3. Notes on female receptivity, pollen shed and leaf budbreak in East Brunswick, NJ (Dec. 2018- Mar. 2019).



Red Bar - Flower stages: Rid= Red dot; I = styles protruding ~1-3 mm and straight; S = first appearance of 'spiders' or flowers with reflexed styles; S+3 = majority of flowers in 'spider' or fully reflexed stage.

Green Bar - Pollen stages: P signals actively shedding pollen. Green bar prior to P signals elongation stage.

BB = date of leaf budbreak