US00PP22715P2

(12) **United States Plant Patent**
Mehlenbacher

(10) **Patent No.: US PP22,715 P2**
(45) **Date of Patent: May 8, 2012**

(54) ***CORYLUS* PLANT NAMED 'TONDA PACIFICA'**

(50) Latin Name: ***Corylus avellana***
Varietal Denomination: **Tonda Pacifica**

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(73) Assignee: **The State of Oregon, Acting by & Through the State Board of Higher Education, Orgeon State University**, Corvallis, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/928,688**

(22) Filed: **Dec. 16, 2010**

(51) **Int. Cl.**
A01H 5/00 (2006.01)

(52) **U.S. Cl.** **Plt./152**

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

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(57) **ABSTRACT**

A new and distinct cultivar of *Corylus* plant named 'Tonda Pacifica' is provided.

2 Drawing Sheets

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Latin name of the genus and species of the plant claimed: *Corylus avellana.*

Variety denomination: 'Tonda Pacifica'.

BACKGROUND OF THE INVENTION

The present invention relates to a new and distinct cultivar of *Corylus* plant (hazelnut, filbert), botanically known as *Corylus avellana*, and hereinafter referred to by the name 'Tonda Pacifica.'

The new *Corylus* resulted from a controlled cross of female parent 'Tonda Gentile delle Langhe' and male parent OSU 23.024 made in 1981 by Maxine M. Thompson. Neither parent was protected by a plant patent. Hybrid seeds from the cross were harvested in August 1981, stratified, and seedlings grown in the greenhouse during the summer of 1982. From this cross, total of 95 seedling trees were planted in the field in Corvallis in October, 1982. 'Tonda Pacifica' was discovered and selected as a single plant within the progeny of the stated cross-pollination in a controlled environment in Corvallis, Oreg., USA. It was originally assigned the designation OSU 228.084, which indicates the row and tree location of the original seedling. 'Tonda Gentile delle Langhe' is an important cultivar in Piemonte, northern Italy. The male parent, OSU 23.024, is from a controlled cross of 'Barcelona' and 'Extra Ghiaghli'. 'Extra Ghiaghli', obtained as scions from Greece, is a clone of the important Turkish cultivar 'Tombul'.

The new cultivar was asexually reproduced by rooted suckers annually for seven years in Corvallis, Oreg. The new cultivar was also asexually propagated by whip grafting in Corvallis, Oreg. The unique features of this new *Corylus* are stable and reproduce true-to-type in successive generations of asexual reproduction.

SUMMARY OF THE INVENTION

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

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1. Globose plant habit.
2. Yellowish-green developing and fully expanded leaves during the spring and summer.
3. Susceptibility to eastern filbert blight caused by the fungus *Anisogramma anomala* (Peck) E. Müller.
4. Absence of random amplified polymorphic DNA markers 152-800 and 268-580 in DNA of 'Tonda Pacifica' amplified by the polymerase chain reaction (PCR). These two markers are linked to a dominant allele for resistance to eastern filbert blight from the cultivar Gasaway, not patented.
5. Expression of incompatibility alleles S_1 and S_2 in the styles.
6. DNA fingerprints at 28 microsatellite marker loci differ from its parent 'Tonda Gentile delle Langhe' and grandparents 'Barcelona' and 'Extra Ghiaghli'. The microsatellite primers are shown in Table 1, and allele sizes are shown in Table 2.

Comparisons in three replicated trials conducted in Corvallis, Oreg., plants of the new *Corylus* differed from plants of the *Corylus avellena* cultivar 'Tonda Gentile delle Langhe', not patented, and other cultivars and selections of *Corylus avellena* known to the Inventors primarily in nut size, nut shape, kernel percentage (ratio of kernel weight to nut weight), frequency of blank nuts (nuts lacking kernels), time of pollen shed, time of nut maturity, length of the husk or involucre, and plant size. 'Tonda Pacifica' combines the high kernel quality of its parent 'Tonda Gentile delle Langhe' with higher yields, thinner shells, and lower susceptibility to bud mites (primarily *Phytoptus avellanae* Nal.).

BRIEF DESCRIPTION OF THE PHOTOGRAPHS

The accompanying colored 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.

The photograph on the first sheet comprises a side perspective view of a typical plant of 'Tonda Pacifica' in Corvallis, Oreg.

The photograph on the second sheet shows typical nuts, raw kernels, and blanched kernels of 'Tonda Pacifica'.

DETAILED DESCRIPTION OF THE INVENTION

The cultivar 'Tonda Pacifica' 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 Corvallis, Oreg. under commercial practice outdoors in the field during the fall, winter, and spring. Plants used for the photographs and description were about twelve years old. In the following description, color references are made to The Royal Horticultural Society Colour Chart, 1966 Edition, except where general terms of ordinary dictionary significance are used. The following description is based on self-rooted trees growing in Corvallis, Oreg. For grafting, the rootstocks were cv. 'Montebello', not patented, propagated by tie-off layerage (stooling).

Botanical classification: *Corylus avellana* cultivar 'Tonda Pacifica.'

Parentage:

Female, or seed, parent.—*Corylus avellana* 'Tonda Gentile delle Langhe', not patented.

Male, or pollen, parent.—*Corylus avellana* selection OSU 23.024, not patented.

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.

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:

General appearance.—Perennial shrub. Globose plant habit, with slightly pendulous shoots.

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

Plant height.—About 5 meters.

Plant diameter or spread.—About 5 meters.

Lateral branch description.—Length: About 20 cm. Diameter: About 6 mm. Internode length: About 3.6 cm. Texture: Smooth, glabrous. Strength: Strong. Color, immature: 146C. Color, mature: 195A.

Foliage description:

Arrangement.—Alternate, simple.

Length.—About 11 cm.

Width.—About 10 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 and lower surfaces: 144A. Fully expanded foliage, upper surface: Spring and summer, 136A; late summer and fall, 136A. Fully expanded foliage, lower surface: Spring and summer, 137C; late summer and fall, 137C. Venation, upper surface: Spring and summer, 139A; late summer and fall, 139A. Venation, lower surface: Spring and summer, 139C; late summer and fall, 139C.

Petiole.—Length: About 11 mm. Diameter: About 1.9 mm. Texture, upper and lower surfaces: Pubescent. Color, upper surface: Spring and summer, 146D; late summer and fall, 146D. Color, lower surface: Spring and summer, 146D; late summer and fall, 146D.

Flower description: Male inflorescences are catkins, color prior to elongation 194C. Female inflorescence style color 048C.

Nuts description:

Length.—About 19 mm. Width: About 18 mm. Depth: About 16.5 mm. Shape: Round. Nut shape index [(Width+Depth)/2*Length]=0.91. Nut compression index (Width/Depth)=1.09. Nut shell color: 164A. Nut weight: About 2.24 grams. Kernel weight: About 1.06 grams. Kernel percentage (kernel weight/nut weight): About 47%.

Disease/pathogen/pest resistance: Plants of the new *Corylus* are susceptible to eastern filbert blight caused by the fungus *Anisogramma anomala* (Peck) E. Muller. Plants of the new *Corylus* are moderately resistant to bud mites (*Phytoptus avellanae* Nal.), while plants of 'Tonda Gentile delle Langhe' are highly susceptible, and plants of 'Barcelona' are highly resistant.

Temperature tolerance: Plants of the new *Corylus* have been observed to tolerate temperatures from about −10° C. to about 38° C. in the field in Corvallis, Oreg.

Nut yields of 'Tonda Pacifica' are similar or slightly higher than nut yields for 'Barcelona'. Since 'Tonda Pacifica' trees are smaller than 'Barcelona' trees, the nut yield efficiency for 'Tonda Pacifica' is significantly higher than that for 'Barcelona'. The nuts of 'Tonda Pacifica' are borne in clusters of 3-4 in husks 75 to 100% longer than the nuts. The husks are slit down the side and the nuts fall free at maturity. The harvest date for the nuts of 'Tonda Pacifica' is estimated to be 7-10 days before 'Barcelona'. 'Tonda Pacifica' produces fewer blank nuts and fewer defects than 'Barcelona'. Raw kernels have a moderate amount of fiber attached to the pellicle, which can be mostly removed by light roasting and rubbing. Blanching scores for 'Tonda Pacifica' are better than for 'Barcelona' and 'Tonda Gentile delle Langhe'.

Fingerprinting with microsatellite markers, also known as simple sequence repeat (SSR) markers, was performed. Twenty nine marker loci (Table 1) were selected from those published for hazelnut (Bassil et al. (2005) J. Amer. Soc. Hort. Sci., 130:543-549; Bassil et al. (2005) Acta Hort., 686:105-110; Boccacci et al. (2005) Molec. Ecol. Notes, 5:934-937; Gürcan et al. (2010) Tree Genetics and Genomes (available on-line as DOI 10.1007/s11295-010-0269-y); Gürcan et al. (2010) Molecular Breeding, 26:551-559). SSR markers have been used for fingerprinting hazelnut accessions (Boccacci et al. (2006) Genome 49:598-611; Gökirmak et al. (2009) Genetic Resources and Crop Evolution, 56:147-172; Gürcan et al. (2010) Plant Breeding, 129:422-434). Using primers designed for each SSR loci, hazelnut DNA was amplified by PCR. One of the two primers was fluorescently labeled with FAM, HEX, or NED, and the size of the amplified fragment was determined by capillary electrophoresis on an ABI 3100 instrument (Applied Biosystems; Foster City, Calif.). 'Tonda

Pacifica' was found to exhibit different allele sizes at certain loci that allowed for it to be distinguish from other hazelnut genotypes such as its parent 'Tonda Gentile delle Langhe' and its grandparents 'Barcelona' and 'Extra Ghiaghli' (Table 2).

TABLE 1

Primers and annealing temperatures for the 29 microsatellite marker loci used to fingerprint 'Tonda Pacifica' and five other hazelnut cultivars.

Locus	Tm	Allele Sizes	Repeat Motif
A613	60	149-177	$(TC)_{13}(CA)_{12}$
A614	60	125-156	$(TC)_{17}(CA)_{10}NNN(CA)_6$
A616	60	136-162	$(AC)_{11}$
A640	67	354-378	$(CT)_{15}(CA)_{13}$
B029b	58	114-136	$(GA)_{13}$
B619	60	146-180	$(TC)_{21}$
B628	60	290-312	$(TC)_7NN(CT)_6$
B634	60	218-238	$(AG)_{15}$
B657	60	210-228	$(AG)_{15}$
B664	60	186-216	$(TC)_{21}$
B665	60	177-203	$(CT)_{17}$
B670	60	153-182	$(GA)_{19}$
B671	60	221-249	$(AG)_6NN(GA)_{17}$
B706	60	168-206	$(CT)_{28}$
B720	60	159-179	$(AG)_{14}$
B732	60	140-156	$(GA)_{13}$
B733	60	161-183	$(TC)_{15}$
B741	60	176-194	$(GT)_5(GA)_{12}$
B749	60	200-210	$(TC)_{12}$
B751	60	141-153	$(GA)_{15}$
B758	60	154-176	$(CT)_{15}$
B767	60	198-238	$(TC)_{15}(AT)_7$
B776	60	134-148	$(GA)_{17}$
B795	60	296-332	$(TC)_8Ns(CT)_7Ns(CT)_{10}Ns(TC)_5$
C115	60	167-225	$(TAA)_5(GAA)_{12}$
KG807	54	226-248	$(TAAA)AA(TAAA)_2A(TAAA)_2$
KG810	56	366-392	$(AG)_{15}$
KG827	67	264-282	$(CT)_{13}AA(CA)_7$
KG830	67	279-311	$(CT)_{14}GTATT(CA)_8$

Locus	Forward Primer (5'-3') (SEQ ID NO)	Reverse Primer (5'-3') (SEQ ID NO)
A613	Ned-CACACGCCTTGTCACTCTTT (1)	R-CCCCTTTCACATGTTTGCTT (30)
A614	Hex-TGGCAGAGCTTTGTCAGCTT (2)	R-GCAGTGGAGGATTGCTGACT (31)
A616	Fam-CACTCATACCGCAAACTCCA (3)	R-ATGGCTTTTGCTTCGTTTTG (32)
A640	F-TGCCTCTGCAGTTAGTCATCAAATGTAGG (4)	Fam-CGCCATATAATTGGGATGCTTGTTG (33)
B029b	Ned-CAATTTACACCTCAGGGAAGAG (5)	R-AAGTTCACCCAAGAAATCCAC (34)
B619	Fam-AGTCGGCTCCCCTTTTCTC (6)	R-GCGATCTGACCTCATTTTTG (35)
B628	Fam-AATCCCCTCTAGCCCCATTA (7)	R-CACAGAATATTTGTAATTACCACCACA (36)
B634	Hex-CCTGCATCCAGGACTCATTA (8)	R-GTGCAGAGGTTGCACTCAAA (37)
B657	Ned-GAGAGTGCGTCTTCCTCTGG (9)	R-AGCCTCACCTCCAACGAAC (38)
B664	Ned-CAAAGCCGTCGACAACAG (10)	R-TTTGCATTTGATGCCGATAA (39)
B665	Hex-GCAACCACCAAATTGCACTA (11)	R-GCTTTTAAAGTCCACGCATGA (40)

TABLE 1-continued

Primers and annealing temperatures for the 29 microsatellite marker loci used to fingerprint 'Tonda Pacifica' and five other hazelnut cultivars.

B670	Fam-CAACACTCACGTTTGGTTGC (12)	R-TCTGTGTTGTTGGGAGTGGA (41)
B671	Hex-TTGCCAGTGCATACTCTGATG (13)	R-ACCAGCTCTGGGCTTAACAC (42)
B706	Fam-TGCATGAAATGGAATCACAGA (14)	R-AGCAAAGAGGTAAGCAAATTCA (43)
B720	Fam-CTCTGTGTCGGCTTTCTGGT (15)	R-ATAAACCTCACGCCACACCT (44)
B732	Fam-GCCCTTCTTCTTTTCTGCAA (16)	R-AGTGCCACCTCAACAAATCC (45)
B733	Ned-CACCCTCTTCACCACCTCAT (17)	R-CATCCCCTGTTGGAGTTTTC (46)
B741	Fam-GTTCACAGGCTGTTGGGTTT (18)	R-CGTGTTGCTCATGTGTTGTG (47)
B749	Hex-GGCTGACAACACAGCAGAAA (19)	R-TCGGCTAGGGTTAGGGTTTT (48)
B751	Fam-AGCTGGTTCTTCGACATTCC (20)	R-AAACTCAAATAAAACCCCTGCTC (49)
B758	Fam-TAATTTAAGCTGCCGTGCAA (21)	R-TGCAAAATTGCATTGCTCAT (50)
B767	Fam-CCACCAACTGTTTCACACCA (22)	R-GCGAAATGGAGCTCTTGAAC (51)
B776	Fam-TGTATGTACACACGGAGAGAGAGA (23)	R-TGAGGGGAAGAGGTTTGATG (52)
B795	Fam-GACCCACAAACAATAACCTATCTC (24)	R-TGGGCATCATCCAGGTCTA (53)
C115	Fam-CATTTTCCGCAGATAATACAGG (25)	R-TCCAGATCTGCCTCCATATAAT (54)
KG807	AAGCAAGAAAGGGATGGT(26)	Fam-CTTACAGATAAATGGCTCAAA (55)
KG810	TCCTCACCAATCACACTATTT (27)	Ned-TTATTCCACCAAAGTCTACCTC (56)
KG827	Fam-AGAACTCCGACTAATAATCCTAACCCTTGC (28)	R-GAGGGAGCAAGTCAAAGTTGAGAAGAAA (57)
KG830	Ned-TGGAGGAAGTTTTGAATGGTAGTAGAGGA (29)	R-AAAGCAACTCATAGCTGAAGTCCAATCA (58)

Tm = annealing temperature.

One of the two primers at each locus had a fluorescent label (Fam, Hex or Ned) to allow sizing with capillary electrophoresis.

TABLE 2

Allele sizes in 'Tonda Pacifica' and five other hazelnut cultivars at 29 microsatellite loci. The female parent of 'Tonda Pacifica' is 'Tonda Gentile delle Langhe'. The male parent is OSU 23.024, which is from a cross of 'Barcelona' x 'Extra Ghiaghli'. Note that one of the alleles of 'Tonda Pacifica' is from 'Tonda Gentile delle Langhe', and the other is from either 'Barcelona' or 'Extra Ghiaghli'.

	Cultivar					
Micro-satellite Locus	Tonda Pacifica	Tonda Gentile delle Langhe	Barcelona	Extra Ghiaghli	Clark	Lewis
A613	157/167	151/157	151/159	167/169	151/177	151/177
A614	134/148	125/134	125/131	125/148	131/131	131/148
A616	148/158	148/150	142/150	150/158	148/150	148/150
A640	368/374	354/368	354/374	374/374	354/354	354/354
B029b	118/120	120/124	124/130	118/132	124/130	124/124
B619	164/170	148/164	156/170	164/174	156/168	156/168
B628	297/297	297/299	293/297	293/297	297/297	293/297
B628	298/298	298/300	294/298	294/298	298/298	294/298
B634	226/226	226/226	226/226	226/226	230/234	226/234
B657	210/226	218/226	218/222	210/222	210/218	214/222
B664	186/206	186/206	206/214	206/208	192/204	188/208
B665	178/185	185/189	189/195	178/189	195/195	193/195
B670	169/182	159/182	153/159	169/177	173/177	159/173
B671	227/237	237/241	223/227	227/247	223/247	223/223
B706	174/206	190/206	168/190	172/174	190/200	190/200
B720	161/167	167/167	161/167	165/179	159/159	159/179

TABLE 2-continued

Allele sizes in 'Tonda Pacifica' and five other hazelnut cultivars at 29 microsatellite loci. The female parent of 'Tonda Pacifica' is 'Tonda Gentile delle Langhe'. The male parent is OSU 23.024, which is from a cross of 'Barcelona' x 'Extra Ghiaghli'. Note that one of the alleles of 'Tonda Pacifica' is from 'Tonda Gentile delle Langhe', and the other is from either 'Barcelona' or 'Extra Ghiaghli'.

	Cultivar					
Micro-satellite Locus	Tonda Pacifica	Tonda Gentile delle Langhe	Barcelona	Extra Ghiaghli	Clark	Lewis
B732	140/154	140/154	150/154	140/154	150/154	150/150
B733	171/173	171/173	171/173	171/171	171/179	173/179
B741	176/186	176/184	176/186	176/184	176/186	176/186
B749	206/208	206/208	208/208	208/208	208/208	206/208
B751	143/153	149/153	143/153	143/147	147/151	151/153
B758	160/160	160/168	168/168	160/160	168/168	168/168
B767	198/216	211/216	211/237	198/204	204/235	211/235
B776	136/136	136/136	134/136	134/136	136/136	136/136
B795	312/330	312/330	330/330	296/310	330/330	330/330
C115	173/182	173/173	193/193	182/193	193/193	193/193
KG807	246/248	234/248	234/248	248/250	226/248	234/248
KG810	378/382	374/378	374/378	378/382	378/380	378/382
KG827	268/282	268/268	280/282	276/282	270/276	270/280
KG830	291/295	291/295	291/295	289/295	295/303	291/303

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tcctcaccaa tcacactatt t 21

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agaactccga ctaataatcc taacccttgc 30

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gcagtggagg attgctgact 20

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ataaacctca cgccacacct 20

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catcccctgt tggagttttc 20

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cgtgttgctc atgtgttgtg 20

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tgcaaaattg cattgctcat 20

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tgaggggaag aggtttgatg 20

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tgggcatcat ccaggtcta 19

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tccagatctg cctccatata at 22

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cttacagata aatggctcaa a 21

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ttattccacc aaagtctacc tc 22

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gagggagcaa gtcaaagttg agaagaaa 28

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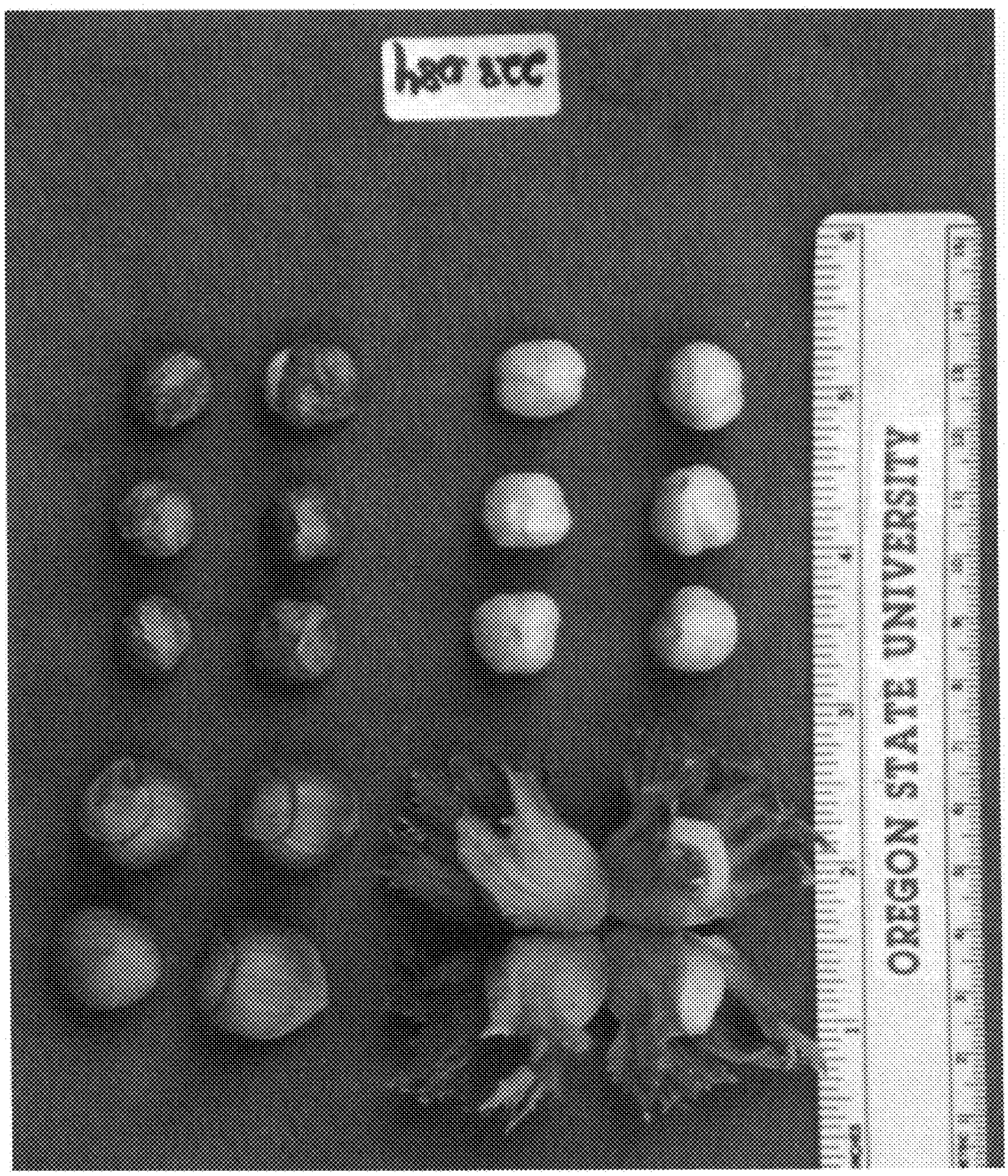
aaagcaactc atagctgaag tccaatca 28

What is claimed is:

1. A new and distinct *Corylus* plant named 'Tonda Pacifica' as illustrated and described.

* * * * *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