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STRAWBERRY PLANT NAMED 'UCD FINN'

- Latin Name: Fragaria x ananassa Duchesne Varietal Denomination: **UCD Finn**
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See application file for complete search history.

References Cited (56)

U.S. PATENT DOCUMENTS

PP30,492 P3 * 5/2019 Hancock A01H 6/7409 Plt./209

OTHER PUBLICATIONS

Bringhurst et al. Six new strawberry varieties released. California Agriculture 1980, 34: 12-15. (Year: 1980).*

Pincot et al. Social Network Analysis of the Genealogy of Strawberry: Retracing the Wild Roots of Heirloom and Modern Cultivars, Genealogy of Cultivated Strawberry, posted online 2020, retrieved from the Internet at https://www.biorxiv.org/content/10.1101/2020. 09.30.320689v1.full.pdf, 31 pp. (Year: 2020).*

Test Agreement for Strawberries, 10 pp. 2016, Dec. 6, 2021.

* cited by examiner

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(57)ABSTRACT

'UCD Finn' is an extreme day neutral cultivar of a strawberry plant adapted for summer-planting that provides high yields.

2 Drawing Sheets

Genus and species The strawberry plant of this invention is botanically known as Fragaria x ananassa Duchesne.

Variety denomination: The variety denomination is 'UCD Finn'.

BACKGROUND

The terms 'extreme day-neutral' (EDN) and 'summerplant' are synonyms for photoperiod insensitive cultivars adapted for summer-plant production. EDN cultivars flower 10 under short and long daylengths and are adapted for contraseason production. While many day neutral (DN) cultivars flower over the summer months, many do not perform well or produce high yields when planted at the height of summer. The specific factors that differentiate DN from EDN 15 cultivars are unknown but appear to be genetically complex. Empirical testing (phenotyping in summer-plant production systems) was conducted on cultivars to identify summerplant-adapted hybrids and to determine the genotype of hybrids for the PERPETUAL FLOWERING (PF) mutation, 20 which enables flowering under long daylengths and is necessary for production in contra-season production systems, e.g., summer planting for fall production.

BRIEF SUMMARY

This invention relates to a new and distinct extreme day-neutral (or summer-plant) strawberry cultivar designated as 'UCD Finn'. 'UCD Finn' is adapted for contraseason and protected culture production in California and other parts of the world. 'UCD Finn' originated from a cross that is believed to have occurred in the winter of 2012 between 'Cabrillo' (U.S. Plant Pat. No. 27,830) and '08C150P009' (unpatented). It is unknown which plant is the female parent. The parent varieties were identified and the pedigree reconstructed using DNA forensic approaches involving exclusion analysis of DNA fingerprints of the strawberry germplasm collection of about 1,200 individual cultivars maintained by the applicant/assignee in Davis, Calif. Seeds of the cross were harvested from greenhousegrown plants in the spring of 2012 and germinated in June 2012. Seedlings were transplanted to a greenhouse in July 2012 and transplanted to the field in October 2012. Daughter plants (clones) of 'UCD Finn' were initially produced and harvested from the mother plant in 2013. 'UCD Finn' has since been preserved by asexual propagation.

The plant of this selection was initially tested as '12C112P004' and later called 'EDN15' for evaluation in field trials.

'UCD Finn' was initially selected based on the intensity of flowering under long day lengths and high summer temperatures in Winters, Calif. It was discovered using phenotypic analysis and genotyping with single nucleotide 25 polymorphism (SNP) markers that 'UCD Finn' is heterozygous for the PF mutation, which is a single dominant mutation that is necessary and sufficient for day-neutral flowering in descendants of a male wild ecotype Fragaria virginiana subsp. glauca plant that was collected in the

Wasatch mountains in Utah (see, e.g., Bringhurst et al., *Calif. Agric.* 34: 12-15, 1980; Bringhurst et al., *Acta Hortic.* 265: 35-42, 1989). 'UCD Finn' was determined to be well-adapted for summer-plant production.

Comparison variety 'UCD Mojo' (U.S. Plant patent application Ser. No. 17/160,298, filed Jan. 27, 2021) is homozygous for the PF mutation. Comparison variety 'Portola' (U.S. Plant Pat. No. 20,552) is heterozygous for the dominant PF mutation. Fruit of 'UCD Finn' has higher sugar-to-acid ratios and is therefore sweeter than fruit from 'Portola'. 10 'UCD Finn' also has firmer fruit compared to 'Portola' and a fruit total soluble solids content that is significantly greater than that of 'Portola'. The internal fruit color of 'UCD Finn' is more red than that of 'Portola' and 'UCD Mojo'.

'UCD Finn' was genotyped with a 50,000-SNP array 15 (Hardigan et. al., Frontiers in Plant Science 10:1789, 2020). After quality- and LD-pruning, 31,212 SNP markers with well-separated codominant genotypic clusters were selected for further analysis. The analyses confirmed that 'UCD Finn' is genetically distinct from parent varieties 'Cabrillo' 20 and '08C150P009', 'UCD Mojo', 'Portola', and over 500 additional varieties that were tested. 'UCD Finn' is also shorter and a more spreading plant type than parent variety 'Cabrillo', which has leaves that are more upright than those of 'UCD Finn'. In addition, the fruit of 'UCD Finn' is long 25 and conic compared to shorter, round conic fruit of 'Cabrillo'; and the internal color of 'UCD Finn' is a darker red compared to 'Cabrillo'. Stolon (runner) production for 'UCD Finn' is significantly less that than of parent '08C150P009'. UCD is also more susceptible to Verticillium 30 Wilt and Anthracnose relative to parent '08C150P009'.

'UCD Finn' is maintained by annual asexual propagation by stolons in Winters, Calif.

BRIEF DESCRIPTION OF THE DRAWINGS

The colors in the photograph are depicted as nearly true as is reasonably possible to obtain in color reproductions of this type.

FIG. 1 depicts general plant and fruiting characteristics of 40 'UCD Finn'.

FIG. 2 shows a representative fruit of 'UCD Finn'.

DETAILED DESCRIPTION

Based on field testing of day-neutral hybrids in 2016, 'UCD Finn' was selected for advanced testing in replicated yield trials in 2017, 2018, and 2019. The 2017 and 2018 yield trials were performed in 24-plant (small) plots, whereas the 2019 yield trials were performed in 50-plant 50 (large) plots. The most important observations and conclusions from these yield trials are enumerated below.

The cumulative marketable fruit yields of 'UCD Finn' and 'UCD Mojo' were comparable to those of 'Portola' in both conventional and organic production systems (Tables 1 and 2). We did not observe statistically significant differences in cumulative marketable fruit yields among cultivars within or among environments.

Yields for all cultivars were substantially lower in organic than conventional production systems (Tables 1 and 2). 60 Yields for 'UCD Finn' and 'UCD Mojo' were greater than 'Portola' in large-plot conventional trials. The difference for 'UCD Mojo' was significant (p=0.005), whereas the difference for 'UCD Finn' was not (p=0.1)). The marketable fruit percentages of 'UCD Finn', 'UCD Mojo', and 'Portola' 65 were not significantly different (Table 2).

TABLE 1

		Cultivar Yield and Fruit Weight Least Square Means.						
		Small Plot			Large Plot		Large Plot	
				Mar-	(Conventional)		(Organic)	
)	Culti- var	Yield (kg/ ha)	Fruit Weight (g/ fruit)	ket- able Fruit (%)	Yield (kg/ ha)	Fruit Weight (g/ fruit)	Yield (kg/ ha)	Fruit Weight (g/ fruit)
	UCD	49,540	22.4	84.1	43,354	24.8	15,906	19.0
	Finn UCD Mojo	45,342	24.1	77.2	45,137	26.8	12,281	19.6
5	Portola	53,202	23.5	81.1	42,084	25.4	19,599	21.2

Cultivars were grown in randomized complete blocks experiment designs with two replications/entry and multiple harvests/environment. Cultivars were grown in 24-plant (small) plots in Ventura, CA in 2017 and Oso Flaco, CA in 2017 and 2018, and 50-plant (large) plots in Guadalupe, Ventura, Oso Flaco, and Lompoc, CA in 2019. Least square means (LSMs) are shown for cultivars across small-plot or large-plot yield trial environments and for conventional and organic production systems in large-plot yield trials

TABLE 2

	Contras	sts Among		Least-Squa uit Weight.	ire Mean	s for Yield	
5		UCD I Port		UCD N Port	2	UCD I	
	Experiment & Trait	Esti- mate	p- value	Esti- mate	p- value	Esti- mate	p- value
О	Small Plot	_					
5	Yield (kg/ha) Fruit Weight (g/fruit) Marketable Fruit (%) Large Plot (Conventional)	-3,662 -1.2 3.1	0.9360 0.0750 0.6989	-7,860 0.5 -3.8	0.5011 0.0578 0.5089	4,198 -1.7 6.9	0.9001 0.0075 0.0781
.0	Yield (kg/ha) Fruit Weight (g/fruit) Large Plot	1,270 -0.6	0.7631 0.6346	3,053 1.4	0.1554 0.1406	-1,782 -2.0	0.5422 0.0224
	(Organic) Yield (kg/ha) Fruit Weight (g/fruit)	-3,693 -2.2	0.1002 0.1327	-7,318 -1.6	0.0051 0.3294	3,626 -0.6	0.1067 0.8669

Cultivars were grown in randomized complete blocks experiment designs with two replications/entry and multiple harvests/environment. Cultivars were grown in small (24 plant) plots in Ventura, CA in 2017 and Oso Flaco, CA in 2017 and 2018, and large (50 plant) plots in Guadalupe, Ventura, and Oso Flaco, CA in 2019. Contrasts are shown for comparisons of UCD Finn and UCD Mojo to Portola and each other.

'UCD Finn' and 'UCD Mojo' were significantly sweeter than 'Portola' (Tables 3 and 4). When compared to 'Portola', mean Brix (° Bx) increase was 1.21 for 'UCD Finn' (p=0.0009) and 0.95 for 'UCD Mojo' (p=0.0106). The improved sweetness was a significant factor in the selection of 'UCD Finn' and 'UCD Mojo' for commercial advancement.

'UCD Finn' and 'UCD Mojo' were also significantly firmer than 'Portola' (Tables 3 and 4). When compared to 'Portola', the mean increase in fruit firmness was 52.3 g for 'UCD Finn' (p=0.0005) and 81.8 g for 'UCD Mojo' (p≤0.0001).

The titratable acid (TA) percentages of 'UCD Finn' and 'UCD Mojo' were not significantly different from 'Portola'; however, 'UCD Mojo' was significantly more acidic than 'UCD Finn' (Table 4).

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The sugar-to-acid ratio (TSS/TA) was significantly greater for 'UCD Finn' than 'UCD Mojo' and 'Portola' (Table 4). The higher the ratio the greater the perceived sweetness; hence, 'UCD Finn' had greater perceived sweetness than 'UCD Mojo'. The sugar-to-acid ratios for 'UCD Mojo' and 'Portola' were not significantly different.

TABLE 3

Cultivar Least Square Means for Fruit Quality Traits.								
	Firm-	v	Degrees Brix (° Bx)		Sugar:Acid Ratio			
Cultivar	ness (g)	Fresh	Frozen	(%)	(° Bx/TA)			
UCD Finn UCD Mojo Portola	370 399 318	8.88 8.62 7.67	9.44 8.92 7.83	0.72 0.83 0.75	13.3 10.8 10.5			

Cultivars were grown in randomized complete block experiment designs on five farms over two years (five year x location combinations) with two replications/entry, two harvests/ environment, and one to three subsamples/harvest. Least square means were estimated for cultivars across locations and years. Fruit firmness (g of force) was measured on fresh fruit samples in the field using a handheld penetrometer with a 3mm probe. Degrees Brix (° Bx) was measured on fresh fruit samples in the field using a handheld refractometer (Fresh) and previously frozen fruit samples in the laboratory using a benchtop refractometer (Frozen). Titratable acid (TA) percentages were measured on previously frozen fruit samples in the laboratory using a benchtop titrator.

TABLE 4

Contrasts Between Cultivar Least-Square Means for Fruit Quality Traits								
	UCD Finn - UCD Mojo - Portola Portola		2	UCD Finn - UCD Mojo				
Trait	Esti- mate	p- value	Esti- mate	p- value	Esti- mate	p- value		
° Bx Fresh	1.21	0.0009	0.95	0.0106	0.26	0.8089		
° Bx Frozen	1.61	0.0008	1.09	0.0179	0.51	0.4060		
TA (%)	-0.04	0.6199	0.08	0.1158	-0.11	0.0114		
° Bx/TA	2.77	0.0081	0.22	0.9894	2.55	0.0149		
Firmness (g)	52.29	0.0005	81.78	<0.0001	-29.69	0.1102		

Cultivars were grown in randomized complete blocks experiment designs on five farms over two years (five year x location combinations) with two replications/entry, two harvests/environment, and one to three subsamples/harvest.

The improved sweetness and firmness of 'UCD Finn' and 'UCD Mojo' persisted in postharvest storage (Tables 5-7). 45 'UCD Finn' and 'UCD Mojo' were significantly sweeter and firmer than 'Portola' over 14 days in cold storage. As expected, fruit weight decreased for each cultivar over time in cold storage. The weight loss from desiccation was significantly greater for 'Portola' than 'UCD Finn' (Table 6). The fruit weight loss for 'UCD Mojo' was not significantly different from 'Portola' or 'UCD Finn'. We did not observe significant differences among cultivars for leakage or mold percentages.

TABLE 5

	Cultivar Least Square Means for Postharvest Traits.							
Cultivar	Mar- ket- ability	Firm- ness (g)	Degrees Brix (° Bx)	Fruit Weight (g)	Leak- age (A)	Mold (A)		
UCD Finn	2.0	397	8.5	514	1.1	0.7		

TABLE 5-continued

Cultivar Least Square Means for Postharvest Traits.						
Cultivar	Mar- ket- ability	Firm- ness (g)	Degrees Brix (° Bx)	Fruit Weight (g)	Leak- age (A)	Mold (A)
UCD Maio	2.2	414	8.3	527	0.0	0.9
Mojo Portola	2.1	325	7.5	535	0.4	0.7

Fruit were stored in standard 'one-pound' clamshells at 4° C. for 14 days. Traits were measured at 0, 7, and 14 days postharvest (DPH). The marketability of fruit was visually rated on a 1 to 5 scale, where 1 = excellent, 2 = good, 3 = fair, 4 = poor, and 5 = unacceptable. Fruit firmness (g) was measured on fresh fruit samples using a handheld penetrometer with a 3 mm probe. Degrees Brix was measured using a handheld refractometer. Fruit weight (g) was the weight of fruit stored in a standard 'one-pound' clamshell.

TABLE 6

	Contrasts Be	tween L	east-Square	Means	for Posthar	vest Tra	its.
0			O Finn - ortola		O Mojo - ortola		Finn - Mojo
	Trait	Esti- mate	p- value	Esti- mate	p- value	Esti- mate	p- value
5	Marketability Firmness (g) Brix (° Bx) Fruit Weight (g) Leakage (%) Mold (%)	-0.1 72.1 1.1 -20.8 0.7 0.0	0.8129 <0.0001 <0.0001 0.0033 0.7373 1.0000	0.1 89.1 0.8 -8.1 -0.4 0.3	0.9103 <0.0001 0.0006 0.4960 0.9460 0.9795	-0.2 -17.0 0.3 -12.7 1.1 -0.3	0.4171 0.5521 0.6718 0.1274 0.4029 0.9795

Fruit were stored in standard 'one-pound' clamshells at 4° C. for 14 days. Traits were measured at 0, 7, and 14 days postharvest (DPH). The marketability of fruit was visually rated on a 1 to 5 scale, where 1 = excellent, 2 = good, 3 = fair, 4 = poor, and 5 = unacceptable. Fruit firmness (g) was measured on fresh fruit samples using a handheld penetromete rwith a 3 mm probe. Degrees Brix was measured using a handheld refractometer. Fruit weight (g) was the weight of fruit stored in a standard 'one-pound' clamshell. Contrasts were estimated as differences between cultivar least-square means (UCD Finn - Portola, UCD Mojo - Portola, and UCD Finn - UCD Mojo).

TABLE 7

Cultivar 1	Least Square Means	for Postharvest Tra	aits.
Trait	UCD Finn	UCD Mojo	Portola
0 DPH			
Marketability	1.0	1.2	1.0
Firmness (g)	359	396	305
Brix (° Bx)	9.0	8.4	7.4
Fruit Weight (g)	523	536	544
Leakage (%)	0.0	0.0	0.0
Mold (%)	0.0	0.0	0.0
7 DPH			
Marketability	2.0	2.2	2.3
Firmness (g)	427	437	338
Brix (° Bx)	8.7	8.3	7.7
Fruit Weight (g)	515	527	535
Leakage (%)	0.0	0.0	0.0
Mold (%)	0.0	0.2	0.2
14 DPH			
Marketability	3.1	3.3	3.2
Firmness (g)	406	409	331
Brix (° Bx)	8.0	8.3	7.3
Fruit Weight (g)	505	518	526
Leakage (%)	3.3	0.0	1.2
Mold (%)	2.0	2.7	1.8

Fruit were stored in standard 'one-pound' clamshells at 4° C. for 14 days. Traits were measured at 0, 7, and 14 days postharvest.

These cultivars were screened for resistance to *Fusarium* wilt, *Verticillium* wilt, and *Macrophomina* (Table 8). 'UCD Finn' and 'UCD Mojo' were susceptible to *Fusarium* wilt,

whereas 'Portola' is resistant. 'UCD Mojo' was resistant to *Macrophomina*, whereas 'UCD Finn' and 'Portola' are susceptible. The three cultivars were moderately susceptible to *Verticillium* wilt and not significantly different.

TABLE 8

	Resistance Macrophomina	e to Soilborne Diseases. a Fusarium wilt Verticillium wilt				
Cultivar	2016	2016	2017	2017	2018	
UCD Finn UCD Mojo Portola	5.0a 1.4b 4.8a	5.0a 5.0a 1.3b	5.0a 4.6a 2.1b	3.1a 3.3a 3.9a	3.9a 2.3a 3.1a	

Macrophomina, Fusarium wilt, and Verticillium wilt resistance phenotypes for UCD Finn, UCD Mojo, and Portola. Plants were scored on a 1-5 ordinal scale, where 1 = resistant, 2 = moderately resistant, 3 = moderately susceptible, 4 = susceptible, and 5 = highly susceptible. Resistance phenotypes were recorded from field tests of artificially inoculated plants grown in fumigated soils at Armstrong Farm, Davis, CA. Least-square means (LSMs) were estimated from four replications per environment with plants grown in randomized complete blocks experiment designs. LSMs followed by the same letter are not significantly different.

BOTANICAL DESCRIPTION

The following botanical descriptors are characteristic of 'UCD Finn'. The descriptors were collected from two different sites in October, 2020 in Santa Maria, Calif. Colors are designated with reference to The Royal Horticultural Society (R.H.S.) Colour Chart, Sixth Edition, 2015. The characteristics of 'UCD Finn' may vary in detail, depending upon environmental factors and culture conditions.

Growth habitat:

Semi-upright.—Plant height average of 236 mm. Plant spread average of 451 mm.

Density of foliage: Medium.

Vigor: Medium.

Position of inflorescence in relation to foliage: Above.

Number of stolons: Medium.

Stolon, anthocyanin coloration: Strong. Stolon, pubescence: Present, but sparse.

Stolon, color: 144C. Leaf size: Medium.

Leaf color: Adaxial 147A, Abaxial 147B.

Leaf blistering: Medium. Leaf glossiness: Medium glossy.

Leaf variegation: Absent.

Mid-tier (from middle of the plant), terminal leaflet length: ⁴⁵ Average of 108 mm.

Mid-tier (from middle of the plant), terminal leaflet width: Average of 128 mm.

Terminal leaflet, shape of base: Obtuse. Terminal leaflet, margin: Serrate to crenate.

Terminal leaflet, shape in cross section: Straight.

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Petiole, length: Average of 172 mm.

Petiole, attitude of hairs: Slightly outwards.

Petiole, color: 144C.

Stipule, core color: 145C.

Stipule, margin color: 144A.

Pedicel, attitude of hairs: Upwards.

Pedical, color: 144B.

Flower, arrangement of petals: Overlapping.

10 Flower, petal number: Average of 6.

Flower, petal length: Average of 10.4 mm.

Flower, petal width: Average of 10.8 mm.

Flower, petal, color of upper side: N155C.

Flower, petal, color of lower side: N155C.

Flower, calyx diameter: Average of 27 mm.

Flower, color of calyx: 147A.

Flower, corolla diameter: Average of 26 mm.

Flower, number of sepals per flower: Average of 12.

Flower, stamen number: Average of 25.

20 Fruit, achene color: 11A.

Fruit, position of achenes: Below surface.

Fruit, length: Average of 49 mm.

Fruit, width: Average of 40 mm.

Fruit, extent/size of hollow core: 11 mm.

25 Fruit size: Average of 28 grams/per fruit.

Fruit shape: Conical.

Fruit, difference in shape of terminal and other fruits: None or very slight.

Fruit, exterior color: N45B.

30 Fruit, flesh color: 44A.

Fruit, core color: 35A.

Fruit, evenness of color: Even or very slightly uneven.

Fruit glossiness: Medium.

Fruit, evenness of surface: Even or very slightly uneven.

35 Fruit, width of band without achenes: Absent or very narrow.

Fruit, position of calyx attachment: Level with fruit.

Fruit, attitude of sepals: Outwards.

Fruit, diameter of calyx in relation to fruit diameter: Same size.

40 Fruit, adherence of calyx: Medium.

Fruit firmness: Firm.

Time of beginning of flowering: Early.

Time of beginning of fruit ripening: Early.

Type of bearing: Extreme day neutral.

What is claimed is:

1. A new and distinct cultivar of strawberry plant named 'UCD Finn', substantially as described and illustrated herein.

* * * *

FIG. 1



FIG. 2

