



NOT FOR DISSEMINATION

Breeding and Genetics of Strawberries in Florida - Vance M. Whitaker, UF

All projects are under NCCC 212 **Objective 1**: Develop improved small fruit germplasm through cooperative breeding and evaluation programs.

Cultivar Development – collaborators include Dr. Christie Almeyda, NC State; Dr. Kim Lewers, USDA-ARS, Beltsville, MD; Dr. Gina Fernandez, NC State.

Impact Statement: UF strawberry varieties ‘Florida Brilliance’ (released 2017; 55% of acreage) and Sensation® ‘Florida127’ (released 2013; 35% of acreage) together make up about 90% of the 10,000 acres of strawberries grown in central Florida. Driscoll’s proprietary varieties continue to be about 10% of acreage. Several multistate breeding and trialing collaborations are in place as detailed below.

In terms of cultivar development and release efforts, we continue to work collaboratively with the NCPN by sending tissue cultures of released varieties to the NC State micropropagation unit. A collaborative germplasm exchange with Dr. Kim Lewers, USDA, Beltsville, MD, was officially established in 2020 in which crosses are being made between UF and USDA accessions to combine flavor from the USDA parents and *Colletotrichum gloeosporioides* resistance from UF parents. Gina Fernandez of NC State continues to trial our new varieties as they become available in order to provide recommendations to growers in the mid-Atlantic. Thus far the newer UF varieties flower too early in the winter in this region.

Latest Releases Commercialized

Impact Statement: Two new UF strawberry cultivars have been released and patents applied for in July, 2020. These are detailed below. Trade names are in process.

‘FL 16.78-109’ (PPAF) is a new strawberry variety that produces extremely unique white-colored fruit with a pink blush. This variety will provide strawberry growers and marketers with new opportunities in retail and food service markets. ‘FL 16.78-109’ fruit are consistently sweet throughout the season and have a unique aroma reminiscent of apricot and pineapple. The first

plants have been planted in October 2020 and limited quantities of fruit will be available in select retail markets throughout this winter.



'FL 16.30-128' (PPAF) is a new strawberry variety that is intended to complement the production of 'Florida Brilliance' and Sweet Sensation (R) 'Florida127' and give growers another variety alternative with excellent early-season yields. Fruit of 'FL 16.30-128' are medium-large sized, firm, uniformly shaped, and have exceptional color and flavor.



Table 1. Marketable yield and average fruit weight of ‘Florida Brilliance’, Sensation® ‘Florida127’ and FL 16.30-128 at the University of Florida Gulf Coast Research and Education Center (GCREC) at Wimauma, FL during two seasons.

Cultivar	Marketable yield (g/plant)													
	November		December		January		February		March		Total	Wt/fruit(g) ^z		
<i>2018-19</i>														
FL Brilliance	21.4	a ^y	118.9	a	140.9	a	558.3	a	173.5	a	1013.0	a	28.1	b
Florida127	30.5	a	28.6	c	75.8	b	557.3	a	152.1	a	806.2	b	30.4	a
FL 16.30-128	19.3	a	74.4	b	103.3	ab	390.8	b	114.1	b	740.0	b	26.6	b
<i>2019-20</i>														
FL Brilliance	4.3	b	104.0	a	180.7	b	436.3	a	180.7	a	905.8	a	22.4	c
Florida127	8.3	a	80.2	b	259.8	a	446.7	a	141.3	b	936.2	a	27.3	a
FL 16.30-128	4.2	b	93.6	ab	176.0	b	343.1	b	155.6	ab	772.4	b	24.0	b

^zMean fruit weight was determined by dividing total marketable fruit yield per plot by total marketable fruit number per plot.

^yMean separation within columns is by Tukey’s HSD test, $P \leq 0.05$.

Table 2. Trained sensory panel ratings (0 to 10 linear scale, with increasing intensity) for ‘Florida Brilliance’, ‘Florida127’ and FL 16.30-128 on seven harvests over two seasons.

Cultivar	Firmness	Sweetness	Sourness	Strawberry flavor	Green/unripe flavor
<i>January 2019 (n^z = 8)</i>					
FL Brilliance	5.9 a ^y	4.7 b	5.1 a	3.7 b	2.0 a
Florida127	5.4 ab	4.3 b	4.3 a	4.2 a	1.8 a
FL 16.30-128	4.6 b	5.7 a	4.9 a	5.1 a	1.4 a
<i>February 2019 (n = 9)</i>					
FL Brilliance	5.5 a	3.4 b	5.4 a	3.7 b	2.1 a
Florida127	4.9 a	4.9 a	3.9 b	4.5 b	1.7 a
FL 16.30-128	5.8 a	5.3 a	4.9 ab	5.1 a	1.4 a
<i>March 2019 (n = 8)</i>					
FL Brilliance	6.8 a	3.5 a	5.4 a	3.0 b	2.2 a
Florida127	5.6 b	4.3 a	5.6 a	4.0 a	1.8 ab
FL 16.30-128	5.7 b	4.5 a	5.0 a	4.1 a	1.2 b
<i>December 2019 (n = 9)</i>					
FL Brilliance	6.7 a	3.9 b	5.3 a	3.8 b	2.5 a
Florida127	5.4 b	4.9 a	4.8 a	5.5 a	1.6 b
FL 16.30-128	3.9 c	5.7 a	5.7 a	5.8 a	1.6 b
<i>January 2020 (n = 9)</i>					
FL Brilliance	4.5 a	5.5 a	3.3 a	4.7 a	1.0 a
Florida127	4.1 a	5.8 a	3.8 a	4.8 a	1.4 a
FL 16.30-128	4.2 a	5.9 a	3.9 a	5.1 a	0.8 a
<i>February 2020 (n = 10)</i>					
FL Brilliance	4.5 a	4.1 a	5.0 a	3.8 a	1.3 a
Florida127	4.3 a	4.7 a	4.7 a	4.2 a	1.1 a
FL 16.30-128	4.6 a	5.0 a	5.4 a	4.2 a	1.0 a
<i>March 2020 (n = 9)</i>					
FL Brilliance	6.3 a	4.7 a	4.6 a	4.0 a	1.1 a
Florida127	4.6 b	4.8 a	3.9 a	4.3 a	1.2 a
FL 16.30-128	5.4 ab	5.8 a	5.2 a	5.1 a	0.7 a

^zNumber of trained panelists

^yMean separations within harvest dates and columns are by Tukey’s HSD test, $P \leq 0.05$.

DNA Test Development – collaborators include Dr. Nahla Bassil, USDA-ARS, Corvallis, OR and Dr. Steven J. Knapp, UC-Davis, Davis, CA.

Impact Statement: An increasing number of DNA tests are being developed, published, and made available to the strawberry breeding and genetics community.

A strawberry DNA testing handbook has been developed and made available on GDR. Please use the following link (<https://www.rosaceae.org/organism/Fragaria/x-ananassa?pane=resource-4>) and click on the handbook at the bottom. It will be continually updated as new DNA tests are developed. Many of these tests have been developed and shared via multi-institutional collaborations, including Dr. Nahla Bassil, USDA-ARS, Corvallis, OR and Dr. Steven J. Knapp, UC-Davis, Davis, CA.

Genomic Selection Methodology Development – collaborators include Dr. Rex Bernardo, University of Minnesota, St. Paul, MN and Dr. Patricio Munoz, UF Horticultural Science, Gainesville, FL.

Impact Statement: The impacts of the RosBREED consortium continue to be felt across many Rosaceae breeding programs, including the strawberry breeding program at UF. We continue to conduct research into effective applications of genomic prediction in strawberry parent and seedling selection, continuing the work that began during RosBREED.

Please see Gezan et al., 2017 and Zingaretti et al., 2020 below under publications. We also have an accepted publication in *Frontiers in Plant Science* on the use of genomic prediction over multiple breeding cycles, Osorio et al. that will hopefully be available soon.

Recent Selected Publications

- Barbey, C.R., M. Hogshead, A.E. Schwartz, N. Mourad, S. Verma, S. Lee, V.M. Whitaker and K.M. Folta. 2020. The genetics of differential gene expression related to fruit traits in strawberry. *Frontiers in Genetics* 10:1317.
- Zingaretti, L.M., S.A. Gezan, L.F.V. Ferrao, L.F. Osorio, A. Monfort, P.R. Munoz, V.M. Whitaker and M. Perez-Enciso. 2020. Exploring deep learning for complex trait genomic prediction in polyploid outcrossing species. *Frontiers in Genetics* 11:25.
- Whitaker, V.M., S.J. Knapp, M.A. Hardigan, P.P. Edger, J.P. Slovin, N.V. Bassil, T. Hytonen, K.K. Mackenzie, S. Lee, S. Jung, D. Main, C.R. Barbey and S. Verma. 2020. A roadmap for research in octoploid strawberry. *Horticulture Research* 7:1-17.
- Salinas, N., Z. Fan, N. Peres, S. Lee and V.M. Whitaker. 2020. *FaRCa1* confers moderate resistance to the root necrosis form of strawberry anthracnose caused by *Colletotrichum acutatum*. *HortScience* 55:693-698.

- Whitaker, V.M. and Z. Fan. 2020. What will Florida strawberry varieties look like in the future? A breeder's perspective. *International Journal of Fruit Science*, 1-5
<https://doi.org/10.1080/15538362.2020.1755770>
- Salinas, N, S. Verma, N.A. Peres and V.M. Whitaker. 2019. *FaRCa1*: A major subgenome-specific locus conferring resistance to *Colletotrichum acutatum* in strawberry. *Theoretical and Applied Genetics* 132:1109-1120.
- Whitaker, V.M., N.A. Peres, L.F. Osorio, Z. Fan, M.C.N. Nunes, A. Plotto and C.A. Sims. 2019. 'Florida Brilliance' Strawberry. *HortScience* 54:2073-2077.
- Oh, Y., J.D. Zurn, N.V. Bassil, P.P. Edger, S.J. Knapp, V.M. Whitaker and S. Lee. 2019. The Strawberry DNA Testing Handbook. *HortScience* 54:2267-2270.
- Barbey, C.R., S. Lee, S. Verma, K.A. Bird, A.E. Yocca, P.P. Edger, S.J. Knapp, V.M. Whitaker and K.M. Folta. 2019. Disease Resistance Genetics and Genomics in Octoploid Strawberry. *G3: Genes, Genomes, Genetics* 9:3315-3332.
- Deschamps, S., V.M. Whitaker and S. Agehara. 2019. White-striped plastic mulch reduces root-zone temperatures during establishment and increases early season yields of annual winter strawberry. *Scientia Horticulturae* 243:602-608.
- Anciro, A., J. Mangandi, S. Verma, N. Peres, V.M. Whitaker and S. Lee. 2018. *FaRCg1*: a quantitative trait locus conferring resistance to *Colletotrichum gloeosporioides* in octoploid strawberry. *Theoretical and Applied Genetics* 131:2167-2177.
- Mangandi, J., S. Verma, L.F. Osorio, N.A. Peres, E. van de Weg and V.M. Whitaker. 2017. Pedigree-based analysis in a multiparental population of octoploid strawberry reveals QTL alleles conferring resistance to *Phytophthora cactorum*. *G3: Genes, Genomes, Genetics* 7:1707-1719.
- Gezan, S., L.F. Osorio, S. Verma and V.M. Whitaker. 2017. An experimental validation of genomic selection in octoploid strawberry. *Horticulture Research* 4:16070.
- Verma, S, J.D. Zurn, N. Salinas, M.M. Mathey, B. Denoyes, J.F. Hancock, C.E. Finn, N.V. Bassil and V.M. Whitaker. 2017. Clarifying sub-genomic positions of QTLs for flowering habit and fruit quality in U.S. strawberry (*Fragaria x ananassa*) breeding populations using pedigree-based QTL analysis. *Horticulture Research* 4:17062.
- Whitaker, V.M., L.F. Osorio, N.A. Peres, Z. Fan, M. Herrington, M. Cecilia do Nascimento Nunes, A. Plotto and C. Sims. 2017. 'Florida Beauty' Strawberry. *HortScience* 52:1443-1447.
- Roach, J., S. Verma, N.A. Peres, A.R. Jamieson, W.E. van de Weg, M.C.A.M. Bink, N.V. Bassil, S. Lee and V.M. Whitaker. 2016. *FaRXf1*: a locus conferring resistance to angular leaf spot caused by *Xanthomonas fragariae* in octoploid strawberry. *Theoretical and Applied Genetics* 129:1191-1201.