

# ‘Solar Dancer’ Hybrid Tomato: Fla. 8814 and Fla. 8925 Breeding Lines

Samuel F. Hutton and John W. Scott

*Institute of Food and Agricultural Sciences (IFAS), University of Florida, Gulf Coast Research and Education Center, 14625 CR 672, Wimauma, FL 33598*

Joshua H. Freeman

*Institute of Food and Agricultural Sciences (IFAS), University of Florida, North Florida Research and Education Center, 155 Research Road, Quincy, FL 32351*

*Additional index words. Solanum lycopersicum, heat tolerance, disease resistance, fusarium wilt race 3, Tomato spotted wilt virus, Groundnut ringspot virus, Tomato chlorotic spot virus*

‘Solar Dancer’ is a heat-tolerant (HT) fresh market hybrid tomato (*Solanum lycopersicum*) that has resistance to three tospoviruses, *Tomato spotted wilt virus* (TSWV), *Groundnut ringspot virus* (GRSV), and *Tomato chlorotic spot virus* (TCSV); this resistance is conferred by the *Sw-5* gene. It also carries resistance to all three races of fusarium wilt incited by *Fusarium oxysporum* f. sp. *lycopersici*. Compared with most existing cultivars, Solar Dancer has superior fruit-setting ability under high temperatures (>32 °C day/>21 °C night). The interior fruit color is deep red due to its homozygosity for the crimson (*og<sup>c</sup>*) gene, and fruit have demonstrated very good resistance to cracking and other defects. There are few acceptable HT tomato cultivars adapted to Florida conditions that have combined tospovirus and fusarium wilt race 3 resistance. ‘Solar Dancer’ has performed consistently well on the peninsula of Florida, where its high yield potential and good fruit marketability make it an attractive cultivar choice. The seed parent of the hybrid is Fla. 8814, which is the tospovirus and fusarium wilt race 3-resistant parent. The pollen parent is Fla. 8925, which provides the heat tolerance to the hybrid.

## Origin

‘Solar Dancer’ is an F<sub>1</sub> hybrid that was tested as Fla. 8982. Its pedigree is shown in Fig. 1. Fla. 8814 is its source of resistance to TSWV, GRSV, TCSV, and fusarium wilt race 3. Fla. 8814 resulted from the selfing of Fla. 8684, a hybrid between Fla. 7804 and

NC 1 CS. The *I-3* gene for *Fol3* resistance is from Fla. 7804, a UF/IFAS breeding line release that was used as an F<sub>7</sub> in the final cross that resulted in the development of Fla. 7946 (Scott, 2004). The *Sw-5* gene for tospovirus resistance comes from NC 1 CS, an inbred line released from North Carolina State University (Panthee and Gardner, 2011). Fla. 8814 is homozygous for the *og<sup>c</sup>* gene for higher lycopene, as are both of its parents. Fla. 8925 is the HT parent of ‘Solar

Dancer’. The HT of this parent comes from Fla. 8044, an excellent HT inbred line with this trait in the background of both its parents. The HT in Fla. 7722 traces to Fla. 7171, which is the HT parent in the hybrid ‘Solar Set’ (Scott et al., 1988). The HT in Fla. 7906 traces to Fla. 7236 in both Fla. 7756 (Scott et al., 2009) and in Fla. 7744. Fla. 8925 is homozygous for the *og<sup>c</sup>* gene, as are both Fla. 8044 and Fla. 8027.

## Description

‘Solar Dancer’ has a strong, medium to large size, determinate (*sp*) vine with good fruit cover. Fruit of the hybrid are large (Tables 1 and 2) with uniform green shoulders (*u* or *ug* gene), a deep flat-round shape, and smooth blossom scars. Fruit maintain a regular symmetrical shape and have demonstrated good resistance against radial and concentric cracking as well as cuticle cracking, as reflected by the low cull rates across multiseason hybrid trials (Tables 1 and 2). ‘Solar Dancer’ has yielded well relative to commercial controls in these trials (Tables 1 and 2), and maturity is early under high-temperature conditions (Table 1). As such, this hybrid may provide an attractive option for growers during the early fall Florida production season, as well as for growers in other areas where its disease resistances

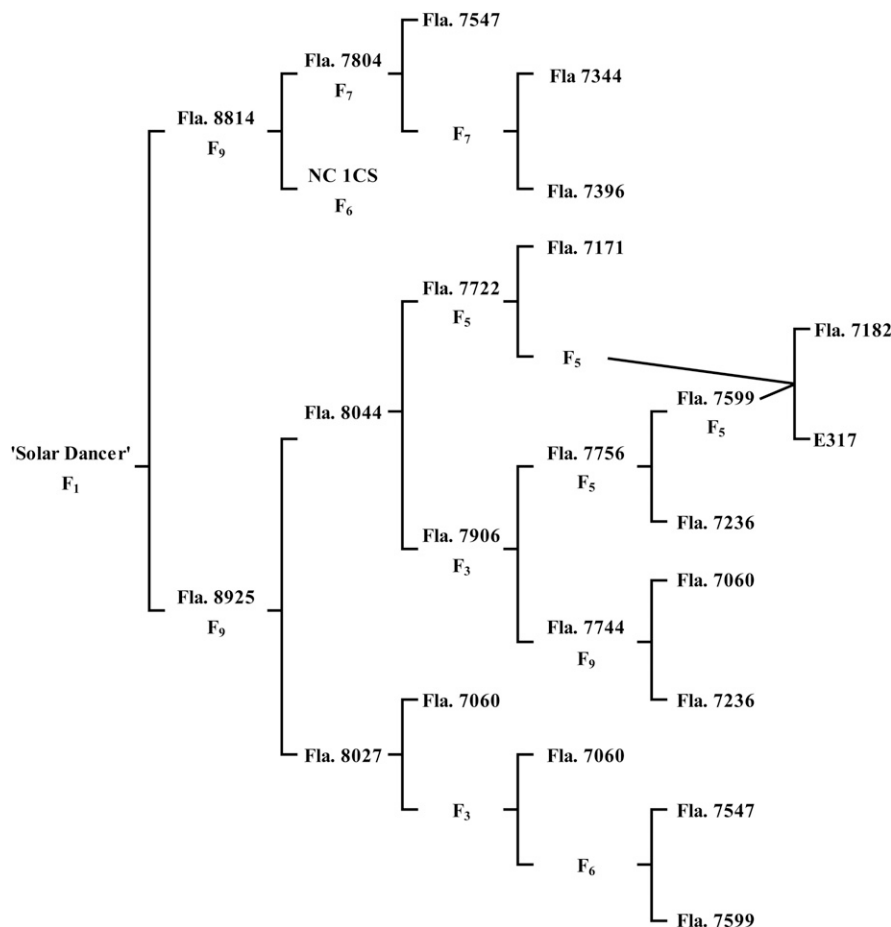


Fig. 1. Pedigree of ‘Solar Dancer’ hybrid tomato.

Received for publication 24 Jan. 2020. Accepted for publication 23 Feb. 2020.

Published online 7 April 2020.

We thank Dolly Cummings, Reza Shekaste-band, Tim Davis, and Jose Diaz for their technical assistance.

S.F.H. is the corresponding author. E-mail: sfhutton@ufl.edu.

This is an open access article distributed under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).

Table 1. Early and total marketable yields, percent culls, and average fruit size for selected tomato genotypes harvested at the vine-ripe stage during early fall seasons in Florida.

Season	Genotype	Marketable yield (11.34 kg cartons/ha)				Culls (% by wt)	Avg fruit size (g)
		Early harvest		All harvests			
		Total	Extra-large	Total	Extra-large		
Balm, Fall 2016	Solar Dancer	932 a <sup>z</sup>	781 a	4,532 a	3,175 a	19 d	181 a
	HM 1823	541 b	447 b	3,679 ab	2,538 ab	22 cd	179 a
	Tasti-Lee	452 bc	225 bc	1,806 c	502 d	42 b	142 b
	Florida 47	245 bc	215 bc	2,493 bc	1,354 c	37 b	156 b
	Florida 91	109 c	109 c	2,644 bc	1,789 bc	33 bc	184 a
Balm, Fall 2015	Dixie Red	74 c	74 c	1,159 d	892 de	67 a	193 a
	Tasti-Lee	1,510 a	588 b	5,019 b	1,248 d	19 bc	142 d
	Solar Dancer	1,203 b	986 a	6,795 a	3,956 b	15 cd	170 b
	HM 1823	1,100 b	1,001 a	6,094 a	4,473 a	17 bc	190 a
	Florida 47	754 c	541 b	3,383 c	1,920 c	45 a	156 c
Balm, Fall 2014	Dixie Red	625 c	598 b	2,805 c	2,261 c	31 ab	198 a
	Solar Fire	1,977 a	1,048 ns	3,578 ns	1,779 ns	23 ns	155 bc
	Fla. 8925	1,964 a	1,599	3,998	3,212	23	180 a
	Tasti-Lee	1,381 ab	684	2,958	1,394	18	144 c
	Florida 47	652 b	519	2,422	1,952	21	170 ab

<sup>z</sup>Mean separation in columns within seasons by Duncan's multiple range test at  $P < 0.05$ . The experiments were completely randomized block designs with three blocks and eight-plant plots in 2016, two blocks and 10-plant plots in 2015, and two blocks and six-plant plots in 2014.

Table 2. Total marketable yields, percent culls, and average fruit size for selected tomato hybrids harvested during the vine-ripe stage in multiple seasons in Florida.

Season	Hybrid	Marketable yield (11.34 kg cartons/ha)		Culls (% by wt)	Avg fruit size (g)
		Total	Extra-large		
Balm, Spring 2017	HM 1823	8,031 a	6,998 a	10 ab	221 a
	Solar Dancer	7,579 ab	4,292 b	13 a	164 d
	Solar Fire	6,432 a-c	4,497 b	11 ab	181 c
	Florida 47	6,010 a-c	4,754 b	14 a	196 b
	Florida 91	4,984 bc	4,275 b	6 b	218 a
Quincy, Spring 2017	Tasti-Lee	4,507 c	2,263 c	9 ab	156 d
	Florida 47	6,097 a	4,769 a	11 ns	211 a
	Quincy	5,816 a	4,031 ab	11	198 ab
	Dixie Red	5,654 a	4,640 a	10	213 a
	Solar Dancer	5,549 a	3,489 b	12	190 b
Homestead, Winter 2016–17	Tasti-Lee	3,988 b	689 c	12	157 c
	Sanibel	3,198 a	2,296 a	11 a	ND <sup>y</sup>
	Solar Dancer	2,758 ab	1,762 ab	6 b	
	Southern Ripe	2,251 bc	1,836 ab	6 b	
	Dixie Red	2,086 c	1,552 bc	7 ab	
Balm, Spring 2016	Tasti-Lee	2,002 c	1,117 c	7 b	
	Florida 47	1,967 c	1,354 bc	7 b	
	Solar Dancer	5,459 a	3,620 a	15 b	181 bc
	HM 1823	5,043 a	3,860 a	19 ab	196 b
	Tasti-Lee	4,354 b	1,987 b	21 ab	153 c
	Florida 47	4,087 b	2,367 b	29 ab	164 bc
	Florida 91	2,718 c	2,081 b	31 ab	198 b
	Dixie Red	843 d	697 c	35 a	241 a

<sup>z</sup>Mean separation in columns within seasons by Duncan's multiple range test at  $P < 0.05$ . ns means not significant at  $P = 0.05$ . The experiments were completely randomized block designs with three blocks and eight-plant plots in Balm in 2017, four blocks and 10-plant plots in Quincy in 2017, and four blocks and eight-plant plots in Homestead in Winter 2016–17, and with three blocks and eight-plant plots in Balm in 2016.

<sup>y</sup>ND indicates no data.

Table 3. External color, internal color, and firmness for selected tomato hybrids grown at the Gulf Coast Research and Education Center in Balm, FL, during Fall 2018 and Fall 2017.

Season	Hybrid	Fruit color <sup>z</sup>				Firmness <sup>y</sup> (mm deformation)
		External		Internal		
		L*	Hue angle	L*	Hue angle	
Fall 2018	Solar Dancer	41.4 ab <sup>x</sup>	44.3 ns	33.2 b	33.9 c	ND <sup>w</sup>
	Dixie Red	40.5 b	44.5	35.1 a	38.6 b	
	Tasti-Lee	41.5 a	44.7	33.6 b	32.9 c	
	Southern Ripe	40.6 ab	45.2	36.0 a	41.2 a	
Fall 2017	Solar Dancer	41.2 bc <sup>x</sup>	45.0 b	34.2 c	34.2 d	142.0 ns
	Cypress	41.7 ab	45.3 ab	36.1 b	40.6 b	141.3
	Southern Ripe	41.6 ab	46.7 a	36.9 b	41.8 b	134.1
	Tasti-Lee	40.8 c	44.6 b	34.1 c	36.5 c	129.0
	HMX1823	42.2 a	44.8 b	38.4 a	44.0 a	125.3

<sup>z</sup>Data obtained with a Minolta CR-300 Chroma Meter; higher "L" numbers indicate lighter color (value) and lower hue angles indicate more red color (hue).

<sup>y</sup>Determined with an Institute of Food and Agricultural Sciences pressure tester using a 1-kg weight for 5 s with a fruit contact plate 1.5 cm in diameter. Pressure applied over a locale in equatorial plane. Lower values indicate greater firmness.

<sup>x</sup>Mean separation in columns within seasons by Duncan's multiple range test at  $P < 0.05$ . The experiments were completely randomized block designs with three blocks and nine-plant plots in 2018, and three blocks and eight-plant plots in 2017. Ten fruit per plot were harvested at the breaker stage and ripened in a laboratory at 24 °C until table ripe for color and firmness measurements. ns indicates not significantly different.

<sup>w</sup>ND indicates no data.

Table 4. Response of tomato genotypes to thrips inoculation with *Tomato spotted wilt virus* at the transplant stage in Fall 2017.

Genotype <sup>z</sup>	Total plants (no.)	Healthy plants (%)
Solar Dancer	32	100
Fla. 8980	32	100
Fla. 8124C	32	100
Fla. 7777	25	40

<sup>z</sup>Fla. 8980 and Fla. 8124C are *Sw-5* homozygous controls (the former with *Sw-5* derived from Fla. 8814), and Fla. 7777 is the susceptible control.

Table 5. Response of tomato genotypes to inoculation with race 3 of *Fusarium oxysporum* f. sp. *lycopersici* ( $10^7$  spores/mL) at the cotyledon stage.

Genotype <sup>z</sup>	Total plants (no.)	Healthy plants (%)
Fla. 8814	56	100
Fla. 7547	48	100
Horizon	16	0
Manapal	64	0
Bonny Best	64	0

<sup>z</sup>Fla. 7547 (*I*, *I-2*, *I-3*) was the resistant control; Horizon (*I*, *I-2*), Manapal (*I*), and Bonny Best (susc.).

and heat tolerance are desirable. In addition, ‘Solar Dancer’ may be well-suited as a main-season variety in various production areas of the Southeast. The fruit flavor of the hybrid was rated over several seasons by Hutton as a 3 (acceptable) on a scale from 1 (poor) to 5 (excellent). Fruit firmness and exterior color were comparable to those of other commercial hybrids (Table 3). The internal flesh and locule color are deep red, typical of tomatoes with the crimson (*og<sup>c</sup>*) gene. The interior L\* and hue angle scores for ‘Solar Dancer’ were similar to those of Tasti-Lee<sup>®</sup>, also a crimson hybrid, and these were lower than the L\* and hue angle scores for other noncrimson hybrids, indicating a darker and deeper red

color. Fruit size of ‘Solar Dancer’ averaged  $\approx 180$  g.

Fla. 8814 has a medium to large determinate vine with good fruit cover. Fruit are medium to large ( $\approx 145$  g), flat-round (oblate), and highly symmetrical in shape. Fruit are highly tolerant to common fruit disorders and have excellent blossom scar smoothness, likely due to the *n-2* nipple tip gene (Barten et al., 1994). Fla. 8925 has a medium determinate vine that produces fruit that are large ( $\approx 180$  g) and generally tolerant to common fruit disorders. Heat tolerance in Fla. 8925 is demonstrated by its high yield and early maturity under high temperatures (Table 1). Both Fla. 8814 and Fla. 8925 have shown good performance in hybrid combinations with other parents.

### Disease Resistance

‘Solar Dancer’ is homozygous for resistance to fusarium wilt (*Fusarium oxysporum* f. sp. *lycopersici*) races 1 and 2 (*I* and *I-2* genes) and heterozygous for resistance to race 3 (*I-3* gene). It is homozygous for the *Sm* gene for resistance to gray leafspot (*Stemphyllium* sp.), and it is heterozygous for resistance to TSWV, GRSV, TCSV, and other tospoviruses against which *Sw-5* is effective (Table 4) and for the *Ve* gene for resistance to verticillium wilt race 1 (*Verticillium dahliae*). Fla. 8814 is the donor of the *I-3* (Table 5), *Sw-5*, and the *Ve* genes, and both Fla. 8814 and Fla. 8925 carry the *I*, *I-2*, and *Sm* genes. Fla. 8925 is susceptible to the fruit disorder graywall, but Fla. 8814 is highly resistant. Slight graywall symptoms have been observed in ‘Fla. 8982’ under conditions of very high graywall pressure. ‘Fla. 8982’ is tolerant of most common fruit

disorders, but it has expressed slight zippering under some conditions, and late-maturing fruit have, on occasion, shown slight pointiness of the blossom scar.

### Availability

Seeds of ‘Solar Dancer’, Fla. 8814, and Fla. 8925 are being released through the Florida Foundation Seed Producers (FFSP), P.O. Box 309, Greenwood, FL 32443 (<http://ffsp.net>). A seed company will be solicited for exclusive rights to produce commercial seed of ‘Solar Dancer’. Small quantities of seed for research purposes are available from S.F. Hutton under an MTA. If Fla. 8814 or Fla. 8925 are used for developing other commercial hybrids, then users should contact FFSP to discuss a royalty contract.

### Literature Cited

- Barten, J.H.N., J.W. Scott, and R.G. Gardner. 1994. Characterization of blossom-end morphology genes in tomato and their usefulness in breeding for smooth blossom-end scars. *J. Amer. Soc. Hort. Sci.* 119:798–803.
- Panthee, D.R. and R.G. Gardner. 2011. ‘Mountain Majesty’: A tomato spotted wilt virus-resistant fresh-market hybrid tomato and its parents NC 714 and NC 1CS. *HortScience* 46:1321–1323.
- Scott, J.W., S.M. Olson, H.H. Bryan, T.K. Howe, P.J. Stofella, and J.A. Bartz. 1988. Solar Set: A heat tolerant, fresh market tomato hybrid. *Fla. Agr. Exp. Sta. Circ.* S-259.
- Scott, J.W. 2004. Fla. 7946 tomato breeding line resistant to *Fusarium oxysporum* f. sp. *lycopersici* races 1, 2, and 3. *HortScience* 39:440–441.
- Scott, J.W., S.M. Olson, and J.A. Bartz. 2009. ‘Tribeca’ Hybrid Tomato; Fla. 8124C and Fla. 8249 Breeding Lines. *HortScience* 44:471–473.