

‘CaroTex-312’, a High-yielding, Orange-fruited, Habanero-type, F₁ Hybrid Pepper

Kevin M. Crosby¹

Texas A&M University, Department of Horticultural Sciences, Vegetable and Fruit Improvement Center, 1500 Research Parkway, Suite 120, College Station, TX 77845

Richard L. Fery

U.S. Department of Agriculture, Agricultural Research Service, U.S. Vegetable Laboratory, 2700 Savannah Highway, Charleston, SC 29414

Daniel I. Leskovar

Texas A&M AgriLife Research and Extension Center, 1619 Garner Field Road, Uvalde, TX 78801

Justin Butcher

Texas A&M University, Department of Horticultural Sciences, Vegetable and Fruit Improvement Center, 1500 Research Parkway, Suite 120, College Station, Texas 77845

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The Agricultural Research Service of the U.S. Department of Agriculture and the College of Agriculture and Life Sciences of Texas A&M University announce the release of the high-yielding, orange-fruited, Habanero-type, F₁ hybrid pepper (*Capsicum chinense* Jacq.) cultivar CaroTex-312. Open-pollinated cultivars of Habanero peppers are used extensively by U.S. growers and these cultivars have historically suffered from several deficiencies, including low yields, late maturity, disease and pest susceptibility, and lack of uniformity. Transition to F₁ hybrid cultivars for *C. annuum* pepper types such as jalapeño, bell, and ancho has led to greatly increased yields, earlier maturity, and superior fruit quality. Heterosis has been exploited in these *C. annuum* types and should also be a beneficial trait in *C. chinense* cultivars to maximize performance and quality (Butcher et al., 2012). The release of ‘CaroTex-312’ will provide pepper growers currently growing open-pollinated Habanero-type cultivars access to a high-yielding, F₁ hybrid cultivar.

Origin

‘CaroTex-312’ is the result of an F₁ cross made at Charleston, SC, between ‘TigerPaw-NR’ and UV88-2004. ‘TigerPaw-NR’ is a high-yielding, orange-fruited, extremely pungent,

open-pollinated cultivar released by the U.S. Department of Agriculture (USDA) on 9 Jan. 2006 (Fery and Thies, 2007). ‘TigerPaw-NR’ is homozygous for a single dominant gene that conditions a high level of resistance to the southern root-knot nematode [*Meloidogyne incognita* (Chitwood) Kofoid and White]. UV88-2004 is an advanced, Habanero-type breeding line developed by Texas A&M University. It is a pungent, orange-fruited, open-pollinated line that exhibits resistance to Tomato spotted wilt virus (TSWV) and Pepper mottle virus (PepMoV). It is homozygous for the *Tsw* gene that conditions resistance to some strains of TSWV (Black et al., 1996). ‘CaroTex-312’ was evaluated under the experimental designation PX-312 in replicated and/or observational plantings at Charleston, SC, and College Station, TX.

Description

‘CaroTex-312’ has a compact plant habit and produces campanulate-shaped (lantern-shaped), orange-colored fruit (Fig. 1). The period from transplanting to first harvest of mature fruit is 76 to 85 d at Charleston, SC, and College Station, TX. There are typically two pedicels per axil and the pedicel position at anthesis is pendant. Flower petal color is white; the stamens have white filaments and purple anthers. At full anthesis, the length of the style is slightly greater than the length of the stamen. The leaves are large, lanceolate-shaped, and have an intermediate green color. Pubescence is absent from both stems and the top of the leaves; there is sparse pubescence on the bottom of the leaves. Fruit-bearing plants do not exhibit noticeable anthocyanin pigmentation on the stems, branches, petioles,

or pedicels. The fruits are attached to the pedicel in a pendant manner (typically two fruit per cluster); the calyx is saucer-shaped (flat, does not envelop the fruit base); the calyx margin shape is intermediate between smooth and dentate; the annular constriction at the junction of the calyx and peduncle is absent; and the pedicels are long, curved, and slender. The fruits are non-deciduous, i.e., the pedicel and calyx usually remain on the fruit at harvest. The seed color is yellow, and seed size is typical for a Habanero-type pepper (5.1 g per 1000 seeds).

The most outstanding attribute of the new cultivar is its ability to produce high yields, particularly early in the season. The results of three replicated field studies conducted at Charleston, SC, in 2009 and 2010, for example, showed that the total yield of marketable fruit harvested from ‘CaroTex-312’ equaled or exceeded the yields of total marketable fruit harvested from the ‘TigerPaw-NR’ parent or from the open-pollinated control cultivar Habanero (Table 1). More importantly, average early yield (first harvest yield) was 19.0% of total yield (total of six harvests) for ‘CaroTex-312’, but only 4.7% of total yield for ‘TigerPaw-NR’ and 4.2% of total yield for the open-pollinated control cultivar Habanero. The results of a replicated field study conducted at College Station, TX, in 2010 showed that early yield of marketable fruit (first harvest) of ‘CaroTex-312’ was 102.7% higher than the early yield of its ‘TigerPaw-NR’ parent, 109.1% higher than the early yield of the open-pollinated control cultivar Habanero, and 9.0% higher than the early yield of the F₁ hybrid control cultivar Chichen Itza; total marketable fruit yield (sum of two harvests) of ‘CaroTex-312’ was 166.6% higher than the total yield of ‘TigerPaw-NR’, 118.5% higher than the total yield of ‘Habanero’, and 102.0% higher than the total yield of ‘Chichen Itza’ (Table 2).

A typical lantern-shaped ‘CaroTex-312’ fruit weighs ≈10.12 to 11.78 g (13.26 g in the mulched test conducted at College Station, TX) and is 2.96 to 3.24 cm wide × 4.42 to 4.94 cm long (Table 3). The shape of the pedicel attachment end of the fruit is truncate, the neck at the base of the fruit is absent, and the shape at the blossom end of the fruit is intermediate between pointed and blunt. The cross-section of a typical fruit at the level of the placenta exhibits a slight-to-intermediate



Fig. 1. A typical fruiting plant of the Habanero-type F₁ hybrid pepper cultivar CaroTex-312.

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¹To whom reprint requests should be addressed; e-mail k-crosby@tamu.edu.

Table 1. Days from transplanting to harvest, very early marketable yield (first harvest), early marketable yield (first harvest + second harvest), and total marketable yield (total of six harvests) for the F₁ hybrid cultivar CaroTex-312 and the parental lines UV88-2004 and TigerPaw-NR grown in three separate field trials at Charleston, SC, 2009–10.^z

Trial/pepper accession	Days to harvest (no.)	Marketable fruit yield (g/plant)		
		Very early yield	Early yield	Total yield
Trial I				
CaroTex-312	85 a ^y	259.1 a	402.5 a	932.3 a
UV88-2004	85 a	138.7 ab	214.0 b	609.1 b
TigerPaw-NR	85 a	53.1 b	140.1 b	594.4 b
Trial II				
CaroTex-312	76 a	147.1 a	217.2 a	771.7 a
UV88-2004	76 a	98.2 ab	166.1 ab	534.3 a
TigerPaw-NR	76 a	16.3 b	54.7 b	558.3 a
Habanero ^x	76 a	23.5 b	52.5 b	665.2 a
Trial III				
CaroTex-312	76 a	97.6 a	166.7 a	960.0 a
UV88-2004	76 a	68.6 ab	145.6 a	847.2 a
TigerPaw-NR	76 a	13.2 b	41.8 b	598.9 a
Habanero ^x	76 a	30.6 b	69.3 b	608.6 a

^zThe experimental design of each trial was a randomized complete block with five replications. Single-row plots were used (10 plants per plot for Trial I, four plants per plot for Trial II, and three plants per plot for Trial III). The intra-row spacing between plants was 30 cm; the rows were 102 cm apart. The transplants were started from seed in the greenhouse on 23 Mar. 2009 (Trial I), 17 Feb. 2010 (Trial II), and 8 Mar. 2010 (Trial III); the transplants were set in the field on raised beds on 3 June 2009 (Trial I) and 6 May 2010 (Trials II and III); and fully mature fruits were harvested (six harvests for each trial) from 27 Aug. 2009 to 28 Sept. 2009 (Trial I) and 21 July 2010 to 23 Aug. 2010 (Trials II and III).

^yMean separation within columns by Student-Newman-Keuls multiple range test, $P \leq 0.05$.

^xOpen-pollinated control cultivar (Jordan Seed Company, Woodbury, MN).

Table 2. Fruit size, early marketable yield (first harvest) and total marketable yield (total of two harvests) for the F₁ hybrid cultivar CaroTex-312, the parental lines UV88-2004 and TigerPaw-NR, the open-pollinated control cultivar Habanero, and the F₁ control cultivar Chichen Itza grown in a field study at College Station, TX, 2010.^z

Pepper accession	Days to harvest	Fruit size (g)	Marketable fruit yield (g/plant)	
			Early yield	Total yield
CaroTex-312	78 b ^y	13.26 a	218.5 a	829.1 a
UV88-2004	76 b	12.26 ab	211.2 ab	529.9 b
TigerPaw-NR	83 b	10.16 c	107.8 c	311.0 d
Habanero ^x	92 a	11.78 b	104.5 c	379.5 c
Chichen Itza ^w	82 b	12.15 b	200.5 b	410.5 c

^zCompletely randomized summer trial grown on black plastic mulch with sub-surface irrigation/fertigation. Intra-row spacing between plants was 30 cm and the rows were 102 cm apart. The trial had three replications; 10 plants per accession were harvested.

^yMean separation within columns by Student-Newman-Keuls multiple range test, $P \leq 0.05$.

^xOpen-pollinated control cultivar (Jordan Seed Company, Woodbury, MN).

^wF₁ hybrid control cultivar (Seminis Seeds, Woodland, CA).

Table 3. Comparison of fruit characteristics of the F₁ hybrid cultivar CaroTex-312 and the parental lines UV88-2004 and TigerPaw-NR grown in three separate field studies at Charleston, SC, 2009–10.^z

Trial/pepper accession	Fruit characteristics			
	Width (cm)	Length (cm)	Wall thickness (mm)	Fruit size (g)
Trial I				
CaroTex-312	2.96 a ^y	4.94 a	1.84 a	11.78 a
UV88-2004	2.60 b	5.00 a	1.66 a	10.62 a
TigerPaw-NR	2.94 a	4.60 b	1.92 a	11.38 a
Trial II				
CaroTex-312	3.24 a	4.42 a	2.16 a	10.12 a
UV88-2004	2.70 c	4.64 a	2.04 a	9.18 a
TigerPaw-NR	2.90 b	4.50 a	2.06 a	10.56 a
Habanero ^x	2.88 b	4.90 a	2.10 a	10.09 a
Trial III				
CaroTex-312	3.14 a	4.80 a	2.08 a	10.80 a
UV88-2004	2.60 b	4.20 b	2.00 a	8.30 a
TigerPaw-NR	2.68 b	4.62 a	2.05 a	9.54 a
Habanero ^x	2.82 b	4.72 a	1.98 a	9.52 a

^zFruit samples harvested from replicated field trials conducted at Charleston, SC, 2009 (Trial I) and 2010 (Trials II and III).

^yMean separation within columns and trials by Student-Newman-Keuls multiple range test, $P \leq 0.05$.

^xOpen-pollinated control cultivar (Jordan Seed Company, Woodbury, MN).

corrugated shape. The fruit wall is thin (1.84 to 2.16 mm). The color of immature fruit is green (Munsell color rating: 5.3 GY 4.7/5.8); the color of harvest-stage fruits is a glossy, bright orange (Munsell color rating: 5.9 YR 5.5/8.9) (Fig. 2). The fruits are quite pungent (capsaicin content: 9100 ppm, dry weight basis), and a typical fruit has three locules.

Observations of a number of ‘CaroTex-312’ plantings in Texas and the results of prior research with the parental lines used to develop ‘CaroTex-312’ suggest that the new cultivar has several potentially useful disease resistance attributes. In greenhouse and field screenings at College Station, TX, no differences in TSWV resistance were observed between ‘CaroTex-312’ and the TSWV-resistant UV88-2004 parent. No TSWV-infected plants were found in either the field (30 plants each) or the greenhouse (eight plants each). In the same trials, TSWV infection in susceptible ‘Orange Habanero’ and several breeding lines not carrying the *Tsw* gene ranged from 30% to 80%. In two field evaluations (2009–10) at Uvalde, TX, both ‘CaroTex-312’ and the PepMoV-resistant UV88-2004 parent exhibited resistance to PepMoV. Severe infection by PepMoV was observed in all 20 plants of susceptible checks ‘Orange Habanero’ and ‘TAM Mild Habanero’ in both trials. Additionally, ‘CaroTex-312’ is heterozygous for a dominant gene conditioning resistance to the southern root-knot nematode; the expression of the root-knot nematode resistance trait in ‘CaroTex-312’ is not expected to differ from the level of resistance exhibited by the resistant ‘TigerPaw-NR’ parent.

‘CaroTex-312’ is recommended for trial by fresh market growers throughout the southern United States. The new cultivar produces large, attractive, orange-colored fruit that should appeal to most consumers of Habanero-type peppers. Additionally, the yield attributes of ‘CaroTex-312’, particularly its potential for producing high early yields, should be especially appealing to growers trying to widen their marketing window.

Availability

The USDA has obtained a Plant Variety Protection Certificate (PVPC #200700006) for the ‘TigerPaw-NR’ parent of ‘CaroTex-312’. ‘TigerPaw-NR’ seed can be made available to interested pepper researchers for experimental



Fig. 2. Freshly harvested fruit of CaroTex-312 (left) and the commercial cultivar Habanero (right).

use through the execution of a Material Transfer Agreement. Additionally, 'TigerPaw-NR' is available to license for use as a parental line to produce seed of commercial F₁ hybrid cultivars. The breeding line UV88-2004 was developed by Texas A&M University. It is also available for experimental use through the execution of a Material Transfer Agreement; the line can be licensed for use as a parental line to produce seed of F₁ hybrid cultivars. A seed company will be solicited for exclusive rights

to produce and market commercial seed of 'CaroTex-312'. Small quantities of 'CaroTex-312' seed are available for research purposes from K.M. Crosby, Vegetable and Fruit Improvement Center, Texas A&M University, 1500 Research Parkway, Suite 120, College Station, TX 77845.

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