PA-560, a Southern Root-knot Nematode-resistant, Yellow-fruited, Habanero-type Pepper

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PA-560 is a new Habanero-type pepper (*Capsicum chinense* Jacq.) released 20 Oct. 2009 by the Agricultural Research Service of the U.S. Department of Agriculture (USDA). PA-560 is a yellow-fruited, Habanero-type advanced breeding line that is homozygous for a dominant gene conditioning a high level of resistance to the southern root-knot nematode [*Meloidogyne incognita* (Chitwood) Kofoid and White]. The southern root-knot nematode is a major pest of peppers in the United States, and all Habanero-type cultivars currently popular with commercial growers and home gardeners are susceptible (Fery and Thies, 1997). The release of PA-560 will provide pepper breeders interested in developing yellow-fruited cultivars of Habanero-type peppers access to a near-cultivar quality parental line that is homozygous for the southern root-knot nematode resistance gene.

Origin

In 1995, recurrent backcross breeding procedures were initiated to transfer the dominant southern root-knot nematode resistance gene from a Scotch Bonnet accession into classical Habanero-type backgrounds (Fig. 1). The donor parent was PA-426 and the recurrent parent was PA-350. PA-426 is a southern root-knot nematode-resistant, Scotch Bonnet-type germplasm line that was released by the USDA in 1997 (Fery and Thies, 1997, 1998a, 1998b). PA-350, susceptible to southern root-knot nematodes, is a classical, Habanero-type cultigen obtained from an heirloom collector. In 2002, a total of 63 BC4F3 populations were evaluated in a greenhouse test for reaction to *M. incognita* and in a replicated field test for horticultural characteristics. Although superior, southern root-knot nematode-resistant, orange-fruited BC4F3 populations were identified in these 2002 tests, no resistant, yellow-

fruited BC4F3 populations were found. However, one of the susceptible yellow-fruited BC4F3 populations (02-564) did exhibit superior horticultural characteristics, and a single plant from this population was subsequently crossed with a single plant from one of the resistant, orange-fruited BC4F3 populations (02-531) to initiate a pedigree breeding procedure to develop a southern root-knot nematode-resistant, yellow-fruited, Habanero-type line. PA-560 was derived from a single F3 (BC4F3 × BC4F3) plant grown in 2005. Both of the parental lines used in the last cross are sib lines of the orange-fruited, southern root-knot nematode-resistant cultivar TigerPaw-NR that was released by the USDA in 2006 (Fery and Thies, 2007).

Description

PA-560 has a compact plant habit (height = 83 cm; width = 103 cm) and produces campanulate (a flattened bell or lantern-type shape), yellow-colored fruit (Fig. 2). PA-560 fruit have a more elongate shape than those of 'TigerPaw-NR'. The period from transplanting to first harvest of mature fruit is 77 to 86 d at Charleston, SC (Tables 1 and 2). There are typically three pedicels per axil and the pedicel

position at anthesis is intermediate. Flower petal color is white; the corolla throat markings are yellow, and the stamens have white filaments and purple anthers. At full anthesis, the length of the style is the same or slightly greater than the length of the stamen. The leaves are large, lanceolate-shaped, and have an intermediate green color. The stem pubescence is sparse and the leaves are glabrous. Fruit-bearing plants exhibit extensive anthocyanin pigmentation on the stems, branches, and petioles; there is moderate pigmentation at the base of the pedicels. The seedling hypocotyl exhibits heavy anthocyanin pigmentation. 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 dentate; the annular constriction at the junction of the calyx and pedicel is present; and the pedicels are short, curved, and slender. The fruits are non-deciduous, i.e., the pedicel and calyx usually remain on the fruit at harvest.

The results of two replicated field studies conducted at Charleston, SC, indicate the yield potential of PA-560 is comparable to that of traditional Habanero-type cultigens. In a 2006 field test, no difference in marketable fruit yield could be demonstrated between PA-560 and the recurrent Habanero-type parent PA-350 (PA-560: 17,313 kg·ha⁻¹; PA-350: 17,313 kg·ha⁻¹). In a 2007 field test, no difference in marketable fruit yield could be demonstrated between PA-560 and the commercial cultivar Habanero (PA-560: 6409 kg·ha⁻¹; Habanero: 6929 kg·ha⁻¹).

A typical PA-560 fruit weighs ≈7.6 to 8.0 g. 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 pointed. The cross-section of a typical fruit at the level of the placenta exhibits a slightly corrugated shape; the longitudinal cross-section exhibits a narrow triangular to

Fig. 2. Freshly-harvested fruit of the southern root-knot nematode-resistant, yellow-fruited, Habanero-type pepper breeding line PA-560.

Table 1. Days from transplanting to harvest, fruit size, and marketable fruit yield for the southern root-knot nematode-resistant, yellow-fruited breeding line PA-560 and the southern root-knot nematode susceptible, orange-fruited, Habanero-type recurrent parent PA-350 in a field trial grown at Charleston, SC, 2006.^z

Pepper accession	Days to harvest (no.)	Fruit size (g/fruit)	Marketable fruit yield (kg·ha ⁻¹)
PA-560	77.0 ^y	8.0 a ^x	17,313 a
PA-350	77.0	8.4 a	18,460 a

^zThe experimental design was a randomized complete block with three replications. Single-row plots were used (10 plants per plot, 30 cm between plants, and 102 cm between rows). The trial was established using transplants; the trial was planted on 4 May 2006 and fully mature fruits were harvested from 20 July 2006 to 28 Aug. 2006 (six harvests).

^yFirst harvest for all plots made on 20 July 2006.

^xMean separation within columns by Student-Newman-Keuls multiple range test ($P \leq 0.05$).

trapezoid shape. A typical PA-560 fruit is 3.37 cm wide × 4.43 cm long and has a thin wall (1.43 mm) (Table 3). The color of immature fruit is a glossy, dark green; the color of harvest-stage fruits is a glossy, bright yellow (Munsell color rating: 3.8 Y 6.8/10.5). The fruits are extremely pungent (326,710 Scoville heat units), and a typical fruit has three locules (average number of locules: 3.3).

PA-560 is homozygous for a dominant gene that conditions a high level of resistance to southern root-knot nematodes. It exhibited a high level of resistance to the southern root-knot nematode in a 2006–2007 winter greenhouse test; no galls or egg masses were evident on any of the root systems (Table 4). The resistance exhibited by PA-560 is equal to that exhibited by

Table 2. Days from transplanting to harvest, fruit size, and marketable fruit yield for the southern root-knot nematode-resistant, yellow-fruited, Habanero-type pepper breeding line PA-560 and the southern root-knot nematode-susceptible, orange-fruited cultivar Habanero in a field trial grown at Charleston, SC, 2007.^z

Pepper accession	Days to harvest (no.)	Fruit size (g/fruit)	Marketable fruit yield (kg·ha ⁻¹)
PA-560	86.0 ^y	7.6 a ^x	6409 a
Habanero ^w	86.0	8.3 a	6929 a

^zThe experimental design was a randomized complete block with three replications. Single-row plots were used (10 plants per plot, 30 cm between plants, and 102 cm between rows). The trial was established using transplants; the trial was planted on 24 Apr. 2007 and fully mature fruits were harvested from 19 July 2007 to 27 Aug. 2007 (seven harvests).

^yFirst harvest for all plots made on 19 July 2007.

^xMean separation within columns by Student-Newman-Keuls multiple range test ($P \leq 0.05$).

^wJordan Seed Company, Woodbury, MN.

Table 3. Comparison of fruit characteristics of the southern root-knot nematode-resistant, yellow-fruited, Habanero-type pepper breeding line PA-560 and the southern root-knot nematode-susceptible, orange-fruited cultivar Habanero in a field trial grown at Charleston, SC, 2007.^z

Pepper accession	Fruit characteristic			
	Width (cm)	Length (cm)	Wall thickness (mm)	Locules (no.)
PA-560	2.37 a ^y	4.43 a	1.43 b	3.3 a
Habanero ^x	2.40 a	4.37 a	1.70 a	3.6 a

^zThe experimental design was a randomized complete block with three replications (10 typical fruit were sampled from each plot).

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

^xJordan Seed Company, Woodbury, MN.

the donor of the resistance gene, the Scotch Bonnet-type germplasm line PA-426.

The southern root-knot nematode-resistant PA-560 is recommended for use as a parental line by pepper breeders interested in developing yellow-fruited, southern root-knot nematode-resistant cultivars of Habanero-type peppers. The dominant nature of the gene conditioning the southern root-knot nematode resistance trait would make PA-560 useful as an inbred parent for development of southern root-knot nematode-resistant F1 hybrids.

Availability

Small trial samples of PA-560 breeder's seed are available for distribution to all

Table 4. Average root-gall index and average egg mass index for PA-560, PA-350 (susceptible recurrent parent), and PA-426 (resistant donor parent) grown in soil infested with the southern root-knot nematode, *Meloidogyne incognita* race 3 (Greenhouse Experiment, 2006–2007).^z

Accession	Gall index ^y	Egg mass index ^x
PA-560	1.00 ± 0.00 ^w	1.00 ± 0.00
PA-350	2.85 ± 0.07	2.85 ± 0.07
PA-426	1.00 ± 0.00	1.00 ± 0.00

^zUnreplicated experiment (20 plants per accession; seeds planted on 27 Nov. 2006 and seedlings subsequently transplanted into a steam-pasteurized mixture of soil, sand, and peat; soil surrounding roots of each seedling was infested with 3000 *M. incognita* race 3 eggs on 3 Jan. 2007; and roots of all plants removed from the growth media on 5 Mar. 2007 for evaluation for galling and egg masses).

^yRated on a scale of 1 to 5: 1 = no galls; 2 = light galling, 1% to 25% of root system galled; 3 = moderate galling, 26% to 50% of root system galled; 4 = heavy galling, 51% to 80% of root system galled; and 5 = severe galling, 81% to 100% of root system galled.

^xRated on a scale of 1 to 5: 1 = no egg masses evident, 2 = scattered egg masses covering 1% to 25% of root system, 3 = moderate number of egg masses covering 26% to 50% of root system, 4 = numerous egg masses covering 51% to 80% of root system, and 5 = extremely large number of egg masses covering 81% to 100% of root system.

^w± SE.

interested research personnel. Genetic material of this release will be deposited in the National Plant Germplasm System where it will be available for research purposes, including the development and commercialization of new cultivars. It is requested that appropriate recognition of source be given when this germplasm contributes to research or development of a new breeding line or cultivar.

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