‘Orange Bulldog’, A Virus-resistant Pumpkin for Fall Production in the Southeast

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Additional index words. *Cucurbita maxima*, virus resistance, vegetable breeding, open-pollinated, plant variety protection

Most ornamental pumpkins produced in the United States are *Cucurbita pepo* L., which are highly susceptible to virus and mildew diseases. ‘Orange Bulldog’ is a *C. maxima* Dutch pumpkin developed with greater virus disease (Potyvirus group) resistance and tolerance for powdery mildew [*Podosphaera xanthii* (Castag.) U. Braun and N. Shish. (formerly known as *Sphaerotheca fuliginea*) or *Golovinomyces cichoracearum* (D.C.) Huleta (formerly known as *Erysiphe cichoracearum*)] and downy mildew [*Pseudoperonospora cubensis* (Berk. & M.A. Curtis) Rostovzev]. Germplasm from this species is known to be a source of multiple disease resistance, particularly to virus diseases (Keinath and DuBose, 2000; Paris and Brown, 2005). This variety was specifically developed for fall production in the Southeast as an ornamental pumpkin for fall and Halloween displays. This pumpkin should have a good fit for both roadside pick-your-own operations and wholesale growers for local markets. The fruit is edible and can be prepared like summer squash when immature or can be made into a suitable pumpkin filling when mature.

Received for publication 24 Jan. 2007. Accepted for publication 29 Apr. 2007.

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populations in minimum isolation (plots were isolated by 9.1 m of planted muskmelon). Criteria for selection were for generally round fruit with an open cavity suitable for Halloween carving and capable of standing on the blossom end without support. Bright orange color was also an important criterion for selection. Continued recurrent phenotypic selection occurred until the winter of 2002–2003 at which time selections were grown in the greenhouse and selfed. Seed from these selfs were then used for 2 more years of recurrent phenotypic selection in 2003 and 2004. The final selection was made in 2004 when 13 open-pollinated fruit from two different locations (Attapulgus Research Farm, Attapulgus, GA, and the Vidalia Onion and Vegetable Research Center, Lyons, GA) were bulked as breeder seed and designated NP-04-1768. Foundation seed production, which produced ≈159 kg of seed, was done at the Vidalia Onion and Vegetable Research Center, Lyons, GA, in the spring of 2005.

Description

‘Orange Bulldog’ is a vining plant exhibiting vigorous growth with vines extending 3 to 4.5 m from the crown. Leaves are large reniform to orbiculate in shape without the serrated leaf margin common to *C. pepo* pumpkins. The leaf laminae are attached by long petioles allowing the leaves to be held up to 0.5 m above the ground near the crown. It produces yellow flowers. Fruits are round, mostly oblate to orbiculate, with pronounced furrows. They are bright yellow when immature, turning a light salmon to burnt orange color at maturity (Fig. 1). Fruit have an open

Origin

In 1996, seed of both oblong and flattened fruit of *C. maxima* were collected from natives in remote areas of Brazil by Krewer and interplanted in 1997. Putative hybrids from this planting were then planted in 1998 and became the basis for developing a pumpkin variety suitable for production in the Southeast. Individual fruit from the initial planting were used as the basis for developing

Fig. 1. Examples of ‘Bulldog’ fruit, which show the variability in the fruit as well as the distinctive ground spot that is visible on some.

cavity suitable for carving with a rind ≈ 4 cm in thickness. Immature fruit can be harvested and consumed like summer squash. Mature fruit can be processed for pie fillings. Fruit size ranges from 3 to 7 kg at maturity. The fruit has a pronounced yellow ground spot.

In the summer and fall of 2005, replicated trials were conducted at the Attapulgus Research Farm to evaluate NP-04-1768, which has been named 'Orange Bulldog'. The trials consisted of eight entries in the summer and seven in the fall in randomized complete-block design experiments of four replications. Each experimental unit consisted of 10 plants with 3.7 m between-row and 1.8 m in-row spacing. The summer trial was transplanted with 2-week-old transplants on 19 May 2005 and harvested on 5 and 19 Aug. 2005. The fall trial had a similar arrangement and was transplanted on 18 July 2005 with harvest on 7 Oct. 2005. Cultural practices followed University of Georgia Cooperative Extension Service recommendations (Kelley and Langton, 2001). Both yield and number of fruit were transformed with square root (x) before analysis and the results were back-transformed to their original units to normalize the distributions (StataCorp, 2003). In addition, randomly selected leaf samples from each experimental unit from both trials were collected ≈ 2 weeks before harvest and sent to Agdia Inc. (Elkhart, IN) for virus screening with their cucurbit screen, which tested for 11 specific viruses as well as the Potyvirus group test. Finally, visual observations of overall plant condition were evaluated, which was based on disease incidence primarily incited by downy and powdery mildews. In addition, a visual rating of virus symptoms was also done. Analyses of visual ratings involved transforming the data with square root ($x + 0.5$) to normalize the distribution before analysis with results back-transformed to their original units (StataCorp, 2003). The enzyme-linked immunosorbent assay (ELISA) test data were transformed with square root (x) before analysis and back-transformed to their original units.

'Orange Bulldog' yielded significantly higher than other pumpkins in the summer and fall trials (Tables 1 and 2). In previous trials in 2003 and 2004, advance breeding lines similar to 'Orange Bulldog' had yields similar to commercial pumpkins in summer trials (data not shown) but consistently produced higher yields during fall trials. Low yields in both of these trials with conventional pumpkins (*C. pepo*) was primarily the result of severe viral infections, particularly if the plants were infected early, before flowering, in some cases resulting in little or no yield.

Visual foliar fungal disease (powdery and downy mildew) evaluations showed that 'Orange Bulldog' consistently had less disease than commercial cultivars (Tables 1 and 2). The visual evaluation of virus disease

Table 1. Pumpkin variety trial, Attapulgus Research and Education Center, Summer 2005.^z

Entry ^y	Yield/acre (lbs)	No./acre	Foliar disease screen ^x	Virus screen ^w	Potyvirus enzyme-linked immunosorbent assay (abs)
Orange Bulldog (NP-04-1768)	11,598	1951	2.7	1.0	0.138
Gold Strike	91	22	7.7	1.4	1.284
Longface	46	15	6.2	2.6	0.479
Spooktacular	3285	1,415	5.7	1.0	1.214
Spirit	78	15	4.2	3.9	2.728
Appalachian	312	44	4.0	2.9	2.516
Phantom	14	8	5.4	4.6	2.376
Trickster	404	232	6.9	2.1	0.187
CV	48%	44%	9%	31%	46%
Fisher's protected least significant difference ($P = 0.05$)	410	90	0.4	NS	0.515

^zTrial transplanted 19 May and harvested 5 and 19 Aug.

^yAll entries are *C. pepo* except Orange Bulldog.

^xVisual fungal disease screening: 1 = no visible symptoms; 9 = severe disease symptoms.

^wVirus disease screening: 1 = no visible symptoms; 9 = severe disease symptoms.

Table 2. Pumpkin variety trial, Attapulgus Research and Education Center, Fall 2005.^z

Entry ^y	Yield/acre (lbs)	No./acre	Foliar disease screen ^x	Virus screen ^w	Potyvirus ELISA (abs)	PRSV ELISA (abs)
Orange Bulldog (NP-04 1768)	20,464	4235	1.9	1.2	1.331	0.140
Longface	0	0	4.1	6.7	3.520	0.709
Spooktacular	771	605	4.6	8.5	4.000	1.279
Spirit	1053	303	4.5	6.2	4.000	1.332
Appalachian	4755	726	3.4	3.4	3.579	0.917
Phantom	233	61	5.7	8.2	3.703	1.449
Trickster	166	212	4.7	6.7	3.341	1.376
CV	46%	41%	19%	8%	19%	35%
Fisher's protected least significant difference ($P = 0.05$)	2699	529	0.3	0.1	0.963	0.538

^zTrial transplanted 18 July and harvested 7 Oct.

^yAll entries are *C. pepo* except Orange Bulldog.

^xFungal disease screening: 1 = no visible symptoms, 9 = severe disease symptoms.

^wVirus disease screening: 1 = no visible symptoms, 9 = severe disease symptoms.

ELISA = enzyme-linked immunosorbent assay.

symptoms showed no difference in the disease ratings between the cultivars in the spring trial (Table 1), but the ratings were significantly lower in 'Orange Bulldog' in the fall trial (Table 2). Of the 11 viruses and Potyvirus group screened for by ELISA, only the Potyvirus group screen had any positives in the summer trial. The Potyvirus ELISA absorbance readings were significantly lower for 'Orange Bulldog' compared with the commercial cultivars except for 'Longface' and 'Trickster'. In the fall trial, there were positive results for both the Potyvirus screen and Papaya Ringspot Virus (PRSV) with 'Orange Bulldog' having significantly lower absorbance readings for both the Potyvirus group screen and PRSV compared with the commercial cultivars.

'Orange Bulldog' consistently produces fruit during fall production, whereas commercial pumpkin cultivars often succumb to severe virus infections before fruiting. In addition, the 'Orange Bulldog' vines hold up well and should be particularly advantageous for pick-your-own marketers where vine cover is important, particularly for

"reseeded" with additional fruit for continued sales.

Availability

Small quantities of seed are available from the senior author (GEB) to those willing to sign a nonpropagation agreement with the University of Georgia. Application for plant variety protection is currently underway with the hope that a commercial seed supplier will handle this cultivar.

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